

Is the Export-led Growth Hypothesis Valid for an Export-oriented Economy? Korean Experience

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Abstract

The export-led growth hypothesis has been examined for the Korean economy that heavily depended on international trade. We employed a textbook-style regression model and found that export expansion had an insignificant effect on economic growth. The insignificant growth effect was robust across sample periods and model specifications. We further employed an instrumental variable (IV) for export growth and found that the causal effect was strengthened but not large enough to be statistically significant. Our results thus appear to be at odds with the findings of export-led growth in the existing literature. A separate model was estimated further for growth-driven exports, but the feedback effect of GDP growth on export expansion was also found to be small and insignificant. Perhaps, the discrepancy might be due to fancy time-series techniques used in the literature that may distort causal directions erratically.

Keywords: Export-led growth, instrumental variable, endogeneity bias, reverse causality

JEL Classification: F4, O5, C2

1. Introduction

The ‘export-led growth’ hypothesis in which export expansion has a significant impact on economic growth has been studied extensively in the literature (Bhagwati, 1978; Krueger, 1978). In particular, less developed countries (LDCs) emphasize the expansion of exports that use relatively cheap labor and abundant raw materials. Furthermore, the stock of educated labor force accelerates the growth of exports and improves competitiveness in international markets. In this case, economies may grow as exports rise. On the other hand, ‘growth-driven exports’ suggest that the enhanced international competitiveness, in turn, facilitates exports of domestic products to rise (Lancaster, 1980; Krugman, 1984). More specifically, larger countries spend more money on research and development (R&D) to develop higher technologies domestically, and hence, domestically-produced quality goods will be cheaper and more competitive in international markets. In this case, exports will rise as the size of the economy is enlarged.

The causal relationships between export growth and economic growth that could be in either direction have been empirically investigated in the literature for less developed countries (LDCs) and newly industrialized countries (NICs). Many cross-country studies dominated the findings of export-led growth for LDCs (e.g. Ram, 1985, among others), while the causal effect from export expansion to economic growth was generally difficult to find in time-series analyses (e.g. Jung and Marshall, 1985, among others). For Asian NICs, Jin (1995), provided evidence that the causal effects were bidirectional because of feedback effects from GDP growth to export expansion.

Marin (1992) further investigated the validity of the export-led growth hypothesis for industrialized countries, finding that the disaggregated exports of manufacturing goods had significant causal effects on productivity growth. For a similar set of industrial countries, Sharma et al. (1991), however, found that the causal directions were mixed. Jin and Yu (1996) further examined the causal directions particularly for the U.S. economy, but the causal effect of exports on economic growth was difficult to find. In contrast, Kunst and Marin (1989) and Henriques and Sadorsky (1996) provided evidence to support for growth-driven exports in Austria and Canada, respectively.

As for the Korean context, causal directions were also found mixed and often contradictory. Among 36 related papers published in international journals over the period 1960-1998 (Giles and Williams, 1999), only 13 papers provided

evidence that the export-led growth hypothesis was supported for the Korean economy; 3 papers had an opposite causal direction that was consistent with growth-driven exports; 10 papers found bidirectional causality; and 15 papers came across no causal effects of export expansion on economic growth.^{Note 1} The methodologies used also vary: 11 papers used regression analysis, whereas 25 papers employed Granger causality, cointegration, and other advanced time-series techniques. Especially for Granger causality, 19 papers investigated the causal directions between two variables only: exports and GDP, while 6 other papers employed multivariate causal models that included other factors of production such as capital, labor, investment, and imports. In addition, the key variable, exports, was measured in several different ways. Although total exports are most commonly used in the literature, 7 other papers employed the export/GDP ratio especially for cross-country studies, 3 papers utilized the disaggregated exports of manufacturing goods, and 1 paper used agricultural exports. Most of these studies were time-series analyses for a group of countries that included Korea.

Although many studies in the literature employed a similar set of sample countries, a consensus on export-led growth was difficult to find. First, the measurement of the export variable mattered in the literature. Exports were often measured in aggregate (e.g. Balassa, 1978, among others), while others employed disaggregated export measures such as the exports of manufactured goods (e.g. Marin, 1992, among others), the exports of agricultural products (Arnade and Vasavada, 1995), and non-oil exports (Subasat, 2002). The export share of GDP was also employed as an indicator of trade dependency across countries (e.g. Salvatore, 1983, among others). The findings were sensitive to these export measures.

Second, statistically advanced estimation methods were employed especially in time series, e.g. Granger causality, vector autoregressions (VAR) techniques, cointegration, cointegrated VAR and so forth; but their findings were, in general, half and half, either for export-led growth or no causal directions. A survey of the earlier literature is available in Giles and Williams (1999), and more recent studies have been discussed in Balcilar and Ozdemir (2013). While export-led growth was supported in the earlier literature, bidirectional causality was often discovered in the more recent literature, as were the findings of no causality (e.g. Mahadevan, 2007; Tang, 2013, among others). At this point, we pose a question: Why do the causal directions vary even with the same set of sample countries?

This paper thus aims to select a typical export-oriented economy that heavily depends on exports. To be a nominated economy, quality time-series data should also be available in public. One best fit economy is South Korea (Korea, hereafter), which has been one of the fast growing economies since WWII. In particular, exports were emphasized in the 1960s and 1970s, and the growth of exporting industries has been a national pride in Korea. Shipbuilding industries (Daewoo and Samsung), a steel industry (POSCO), an auto industry (Hyundai) and recently electronics (Samsung) are some examples that ranked atop worldwide. In this regard, we pose another question: Were these industries growing fast with the help of the government's export expansion policies or due to some other factors such as education, health, or new investment in high-tech industries? Although export expansion was emphasized in the past decades in Korea, its contribution to economic growth would be trivial if other factors of production were used more importantly in the process of economic development.

Rather than using fancy estimation techniques that often make it difficult to identify pure independent effects, this paper goes back to an old-fashioned, but standard, textbook-style regression analysis to examine the validity of the export-led growth hypothesis. A simple growth model is specified in Section 2. Model variables are also measured in a standard way. Section 3 discusses basic regression results. Sections 4 and 5 are checking with potential statistical problems: endogeneity bias and reverse causality, respectively. Section 6 concludes with key findings.

2. Model Specification and the Data

Following Bosworth and Collins (2003), our empirical model is based on the Cobb-Douglas production function in which output is a function of total factor productivity, as well as capital and labor inputs:

$$Y = AK^\alpha(LE)^{1-\alpha}. \quad (1)$$

Y is a measure of output, A represents total factor productivity, K stands for physical capital with its share of income α . Labor L is now adjusted for improvements in educational attainment E, and hence LE represents an educated labor force. The quality labor's share of income is assumed to be $1-\alpha$. With this assumption, along with capital share α , the output Y shows the constant returns to scale.

For estimation purposes, we take a logarithm first and then first differences for both sides:^{Note 2}

$$\Delta \ln Y = \Delta \ln A + \alpha \Delta \ln K + (1-\alpha) \Delta \ln LE. \quad (2)$$

With this framework, output growth is decomposed of contributions of total factor productivity, as well as growths of capital and labor inputs. For total factor productivity, a proxy variable is used. If an economy is more open to the world and hence it increases exports and imports with less trade barriers, foreign technologies will be introduced to the domestic economy (Grossman and Helpman, 1991). More specifically, trade openness allows domestic workers to learn

foreign technologies by imitating. R&D spending also develops higher technologies domestically and hence, domestically-produced quality goods will be cheaper and more competitive in international markets. We thus include export expansion as a proxy for such technological enhancements.

For skilled workers, educational attainment E is achieved by the number of years of schooling (Barro, 1991). In this case, secondary education is used as a proxy for the capability of absorbing foreign technologies through international trade. Thus, our empirical model is specified as:

$$d\ln \text{RGDP}_i = \beta_1 + \beta_2 d\ln \text{RK}_i + \beta_3 d\ln \text{LE}_i + \beta_4 d\ln \text{RExp}_i + \varepsilon_i, \quad (3)$$

where $d\ln \text{RGDP}_i$ is the growth rate of real gross domestic product deflated by the price level (2005=100); $d\ln \text{RK}_i$ is the growth rate of real fixed capital formation deflated by the price level (2005=100); $d\ln \text{LE}_i$ is the growth rate of educated labor force that uses secondary school enrollment rates; and $d\ln \text{RExp}_i$ is the growth rate of real exports deflated by the price level (2005=100).^{Note 3}

In this case, residuals ε_i are treated as the estimates of additional total factor productivity, which are best interpreted as further gains in efficiency when more factor inputs are used. Regression models, thus, may include more explanatory variables that determine the efficiency of factor usage: government spending on R&D, government policies on economic openness and property rights, life expectancies, even geographical variables (e.g., Sala-i-Martin, 1997). If all these variables are included, our model clearly suffers from the degrees of freedom problem. Rather than controlling for all possible determinants of economic growth, we merely focus on one important aspect of domestic technology that can be improved through export expansion.

All data, except for quality labor force (LE), are obtained from *International Financial Statistics* (International Monetary Fund, May 2014). The relevant data for labor force (L) and secondary education (E) are taken from *World Development Indicators* (World Bank, May 2014). Because of limited data for quality labor force, the sample period begins from 1981 to 2011, recent three decades. More details are discussed in Appendix.

3. Basic Results

Our regression model examines empirically the export-led growth hypothesis for the Korean economy. Least squares were used for estimation, assuming ε_i to be serially uncorrelated white noise residuals. A rough test for the symptoms of serial correlation and heteroscedasticity problems will be discussed later in this section. Other potential problems such as endogeneity bias and reverse causality will also be discussed in Sections 4 and 5, respectively. Prior to estimation of the model, Table 1 reports the correlation coefficients of explanatory variables to examine a symptom of multicollinearity problems as a rule of thumb. Capital and labor inputs are correlated but not seriously related ($r = 0.46$); capital and exports are negatively correlated but less than that of capital and labor ($r = -0.31$); for labor and exports, a negative correlation appears to be almost nil ($r = -0.03$). Thus, explanatory variables are not seriously collinear to distort the estimation results. Further, parameter estimates in regression models are found not very sensitive when more explanatory variables are included. Distorted signs are no longer observed in regression coefficients. Overall, the potential multicollinearity problem may not be serious in our model specification.

Table 1. Simple Correlation of Explanatory Variables

	dlnRK	dlnLE	dlnRExp
dlnRK	1		
dlnLE	0.46	1	
dlnRExp	-0.31	-0.03	1

Note: See Appendix for variable definitions.

Table 2 reports basic regression results. Model (1) showed that both capital and labor inputs had significant impacts on economic growth. The significant growth effects were robust across model specifications.^{Note 4} Model (2) further included the growth rate of exports, but it is surprising to find that export growth had an insignificant effect on GDP growth. Although it is widely believed that export expansion caused the fast growth of the Korean economy, the export-led growth hypothesis is not supported by the data. The small parameter estimate of exports suggests that, holding capital and labor inputs constant, changes in export growth were, on average, associated insignificantly with economic growth over the period 1981-2011. Thus, our finding implies that the export-led growth hypothesis is not convincing for the Korean economy although it has long been regarded as a typical export-oriented economy after WWII.

Table 2. Basic Results

Dependent variable: dln RGDP							
Independent variables	1981-2011		1961-1991		1961-2012		
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)
Intercept	3.52 (.41)	3.46 (.54)	6.67 (.70)	6.46 (.83)	4.91 (.48)	4.88 (.58)	5.48 (.53)
dln RK	0.28 (.04)**	0.28 (.04)**	0.09 (.04)*	0.09 (.04)*	0.20 (.03)**	0.19 (.03)**	0.13 (.03)**
dln LE	0.44 (.12)**	0.44 (.13)**					
dln RExp		0.006 (.037)		0.016 (.033)		0.002 (.029)	0.025 (.026)
DUM _{GDP}							-8.11 (2.06)**
Adj R ²	0.76	0.75	0.12	0.10	0.37	0.36	0.51
SE	1.73	1.76	2.74	2.77	2.81	2.84	2.50
Obs.	31	31	31	31	52	52	52

Note: See Appendix for variable definitions. The values in parenthesis are standard errors. ** Significant at the 1% level, and * significant at the 5% level.

In order to capture the independent growth effect of export expansion graphically, the GDP growth rates predicted by the growths of capital and labor were subtracted from actual GDP growth. The unexplained portion of GDP growth rates—residuals in model (1)—is then plotted against export growth. Figure 1 shows that the partial association of export growth with the unexplained part of GDP growth is, again, small. The small and negligible association in this plot is consistent with the insignificant growth effect of export expansion found in model (2).

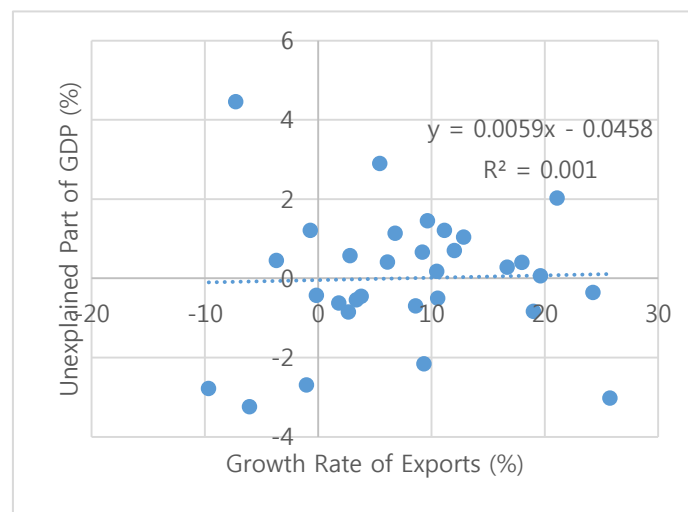


Figure 1. Partial Association of Export Growth with Unexplained Part of GDP Growth

Data sources: The data for nominal exports and nominal GDP were obtained from *International Financial Statistics* (produced by IMF). Both variables were transformed to real values using GDP deflator (2005=100).

The growth effect of exports may differ in earlier decades because export expansion was accentuated more in the 1960s and 1970s in Korea. In order to capture the potential growth effects of exports in earlier decades, model (3) estimated the effect over earlier periods 1961-1991.^{Note 5} Because of the limited data for labor force in the 1960 and 1970s, the growth model included the capital input only. Model (4) further included export growth but its growth effect, again, appeared to be insignificant even for earlier decades. The result appears to be at odds with the findings of Voivodas

(1974), among others, in which export-led growth was supported for the period of 1955-70; but our result is consistent with the findings in Greenaway and Sapsford (1994), among others, in which the growth effect of exports was insignificant for Korea over the period 1964-85.

Similar results were found in models (5) and (6) over the entire sample period 1961-2012. Model (7) included a dummy variable for GDP since the Korean economy severely suffered twice ever in its economic history: one was the year of 1980 right after President Park was assassinated in October 1979, and another was the year of 1998 right after the occurrence of the Korean financial crisis in December 1997. For both years, GDP was experienced negative growth rates. While the effect of this GDP dummy appeared to be negative and significant, the insignificant growth effect of export expansion was found almost intact.

For the soundness of our estimation results, residuals are plotted over time to examine a symptom of serial correlation that often arises in time series. If the serial correlation problem is serious, residuals will show a systematic pattern, i.e. rising or falling consecutively over time. Figure 2 plots residuals over time that was obtained from our landmark regression model (2), but the residuals are approximately randomly scattered around mean zero and no systematic patterns are observed.

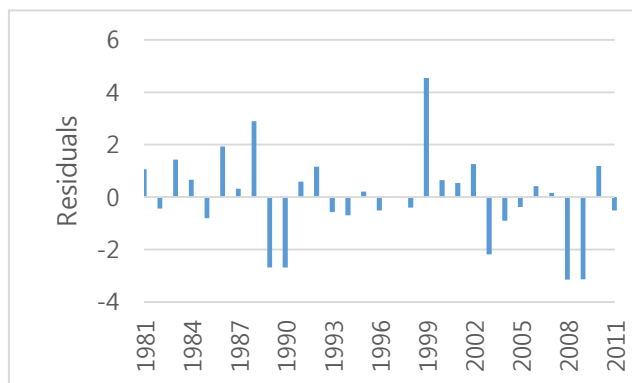
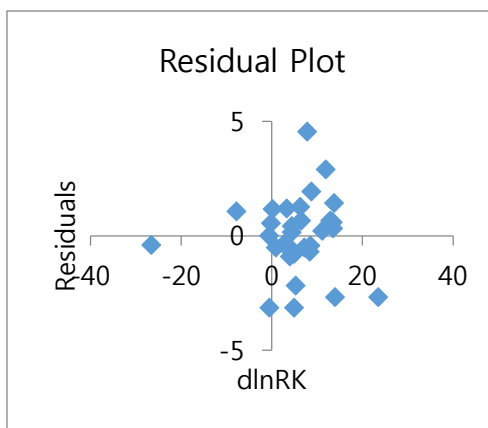


Figure 2. Residuals over Time

Note: Residuals were obtained from Model (2) in Table 2.

Figure 3 further plots residuals against independent variables to check with a potential problem of heteroscedasticity. If the hetero problem is serious, residuals will show a systematic pattern, i.e. getting bigger or smaller depending on the characteristics of explanatory variables. But we found that, for each variable, estimated residuals are around mean zero and few systematic patterns are observed. We thus conclude that OLS assumptions were not seriously violated in our estimation of the models.



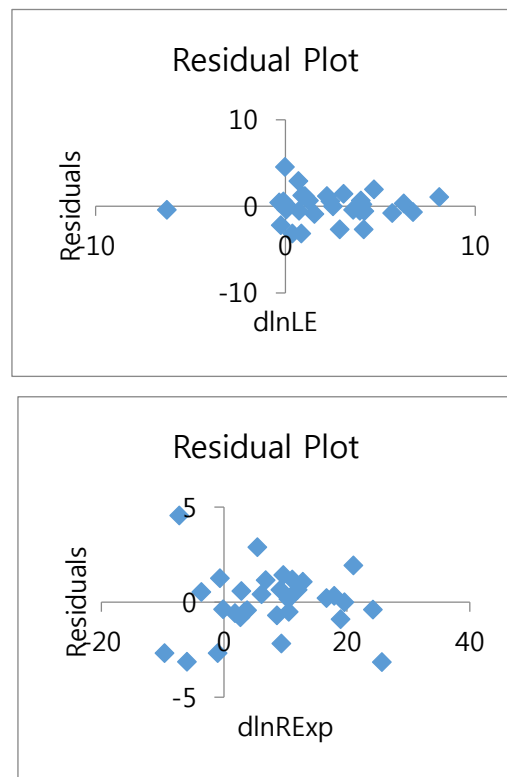


Figure 3. Residuals against Explanatory Variables

Note: Residuals obtained from Model (2) in Table 2 were plotted against each explanatory variable of the model.

4. Endogeneity Bias

The standard regression results were, however, based on the assumption that regressors were uncorrelated with the error term ϵ_i , and hence parameter estimates were presumed to be unbiased and consistent (Pindyck & Rubinfeld, 1998). But in practice, the possibility of biased and inconsistent parameter estimation due to endogenous explanatory variables is not rare. In particular, changes in exports can be affected by changes in real exchange rates, the terms of trade, foreign income levels, and so forth. Therefore, OLS estimates can be biased and inconsistent unless there is no association between export growth and residuals.

To generate exogenous variation of export growth, we select an instrumental variable (IV) that is uncorrelated with the residuals but is strongly related to the exports. One suitable IV is the growth rate of real imports that is not directly related with residuals but highly correlated with the growth rate of real exports.^{Note 6} In particular, Korean exports often rely on the imports of raw materials and intermediate goods from overseas. Because of an excessive increase in imports, the Korean economy suffered trade deficits one third of the sample period 1981-2011. Although the imports of final goods from foreign countries accelerated trade deficits in the early 1980s, the imports of raw materials and intermediate goods were inevitable in Korea due to the lack of natural resources. Thus, exports and imports were close complements in production in Korea.

Accordingly, the growth rate of real exports, $dlnRExp$, is regressed on the growth rate of real imports, $dlnRImp$, to identify the closeness of the two variables. The relevant data are obtained from *International Financial Statistics* (IMF, May 2014). The OLS regression model thus specifies and estimates:

$$dlnRExp = 4.47 + 0.47 dlnRImp \tag{4}$$

(1.84) (.16) **

Adj $R^2 = 0.20$ SE = 8.13 N = 31 obs.

Standard errors are in parenthesis and ** indicates significant at the 1% level. As expected, the growth rate of real exports is significantly affected by the growth rate of real imports. The positive sign of the parameter estimate suggests that the two variables are close complements in production. In contrast, the import growth is found to be weakly correlated ($r = 0.01$) with the residuals in our landmark regression model (2) in Table 2. Hence, the growth rate of real imports can be a proper instrument for export expansion.

Using the predicted export values in Eq (4), the two-stage least squares (2SLS) estimator is computed:

$$\widehat{\text{dlnRGDP}} = 2.96 + 0.26 \text{dlnRK} + 0.41 \text{dlnLE} + 0.11 \text{dlnRExp} - 4.58 \text{DUM}_{\text{GDP}} \quad (5)$$

(.67) (.04)** (.12)** (.09) (2.02)**
 Adj R² = 0.78 SE = 1.64 N = 31 obs.

The model includes both capital and labor, similar to our benchmark model (2) in Table 2.

dlnRExp is the prediction from Eq (4). Unlike capital and labor inputs, the predicted growth rate of real exports has an insignificant effect on economic growth. Again, the causal effect from exports to GDP is not supported by the data. Notice, however, that the causal effect of export expansion, although statistically insignificant, appears to be greater than before—about 20 times higher. One possible interpretation of the results would be that the imports of raw materials and intermediate goods, particularly in Korea, strengthens the growth effect of exports of final goods; but its impact on GDP growth is relatively small and insignificant compared to the growth effects of capital and labor inputs. The results appear to be at odds with the findings of export-led growth in Riezman et al. (1996) and Islam (1998) in which the import variable was additionally included in their multivariate causal models; but the insignificant growth effect of exports found here is, in general, consistent with the findings of no causality in Shan and Sun (1998), among others, especially for Korea.

5. Reverse Causality

Another source of endogeneity bias is reverse causality, in that export expansion depends on the growth of the economy. In other words, exports will rise due to an enlarged size of the domestic economy. If this is the case, causality may run the other way around, from GDP to exports. We address this issue using a structural model for export growth. Export expansion is first regressed on GDP growth. Real exchange rates (RExch) would be a good candidate to be included as a control variable. In particular, if the real exchange rate depreciates, domestically produced goods and services will be cheaper and more competitive in international markets, and thus exports will rise. An increase in foreign income may also be highly related to the growth of exports. If the income level in foreign countries is increased, the overseas demand for domestic products will rise as long as domestically produced goods are attractive in terms of quality and relative prices. The U.S. industrial production index (dlnIP_{USA}) is used here as a macroeconomic indicator of the United States, a Korea’s best trading partner in the past decades.^{Note 7} After controlling these two variables, the effect of GDP growth on export expansion is investigated.

Table 3 provides the results. First of all, model (1) allows the growth rate of real GDP alone to explain export expansion. An increase in GDP will enhance international competitiveness and thus exports of domestic products are expected to rise. However, GDP growth, in fact, had a negative effect on the growth rate of exports. The seemingly inconsistent negative effect, although insignificant, would be due to outliers in our sample. In fact, two extreme values were found in our data set. One was the Korea’s currency crisis in 1997 in which the growth rate of real GDP in the following year dramatically dropped to -7.1%, whereas export growth remained to be very high 24.2%. This was due to the fact that the economic crisis was not anticipated by business firms in the short run, and hence exporting activities that are based on long-term contracts internationally continued to rise.

Table 3. Reverse Causality

Independent variables	Sample period: 1981-2011				
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
Intercept	11.01 (3.26)	3.33 (3.86)	1.96 (10.03)	3.49 (3.57)	-2.25 (9.38)
dln RGDP	-0.52 (.46)	0.49 (.53)	0.48 (.54)	0.21 (.51)	0.15 (.52)
DUM _{exp}		22.84 (7.62)**	22.64 (7.87)**	21.06 (7.09)**	20.14 (7.30)**
RExch			0.01 (.01)		0.01 (.01)
dln IP _{USA}				0.83 (.35)**	0.88 (.36)**
Adj R ²	0.01	0.22	0.19	0.33	0.32
SE	9.07	8.04	8.18	7.43	7.51

Note: See Appendix for variable definitions. The values in parenthesis are standard errors. ** Significant at the 1% level.

Another case was the 2008 global financial crisis. The Korean economy that had been open to international financial markets since the early 1990s could not avoid such external shocks. The real GDP growth rate slowed down immediately in 2008 but the growth rate of real exports was, in fact, rising up to 25.7%, the highest ever. Thus, model (2) includes an export dummy for 1998 and 2008, which reflects the two highest export growths during the crisis years. The effect of the dummy variable thus appears to be positive and significant. But it should be noted that the earlier negative effect of GDP growth in model (1) turns out to be positive after the inclusion of the export dummy in model (2), since the crisis-year dummy used here separates out the negative inclination of the effect due to the two outliers in our sample.

Yet, the effect of GDP growth remained insignificant. The insignificant effect of GDP on export growth might be due to omitted variables, such as real exchange rates and foreign income that may raise exports of domestic products. Model (3) includes real exchange rates but its effect on export growth appears to be small and insignificant. Model (4) includes U.S. industrial production index, which has a positive and significant impact on Korean exports. In contrast, the effect of GDP growth on export expansion remains to be insignificant even at the 10% level. Model (5) further includes both control variables but the insignificant parameter estimate of GDP growth remains almost intact. The results appear to be at odds with growth-driven exports found in Jung and Marshall (1985) especially for Korea. Riezman et al. (1996) also found growth-driven exports for Korea based on bivariate analyses. But the insignificant effects of GDP growth on export expansion found here are, in general, consistent with the findings of no causality in Dodaro (1993), as well as in Islam (1998) that confirms the case of no causality from bivariate causal models. This suggests that the enlarged size of the economy does not guarantee to raise the exports of domestic products in Korea.

6. Conclusion

The export-led growth hypothesis has been examined for Korea. Typically, the Korean economy heavily depended on international trade and its economy was growing fast in the past decades. Using a textbook-style regression model, we found that export expansion had an insignificant effect on economic growth. The insignificant growth effect was robust across model specifications and sample periods.

We further employed an instrumental variable for export growth but the causal effect of export expansion on economic growth was strengthened but appeared to be statistically insignificant. The reinforced growth effect of exports might be due to the effect of accompanying imports of raw materials and intermediate goods that often arises in Korea to enhance the exports of final goods. Although Korea has been well regarded as an export-oriented economy, the growth effect of export expansion is relatively small and insignificant and hence a robust evidence of export-led growth is difficult to find.

The reverse causality from GDP growth to export expansion is also found to be insignificant. The economy size often raises international competitiveness that facilitates exports to rise, but the growth-driven exports were not supported for the Korean economy. Therefore, we can conclude that export expansion had little causal effects on economic growth, and hence its feedback effect on export expansion was also insignificant.

Our results thus appear to be at odds with the findings of export-led growth in the empirical literature. Perhaps, the discrepancy might be due to different estimation methods used in the literature. Unlike our findings that are generally robust across sample periods and model specifications, the existing literature uses Granger causality, VAR techniques, and other sophisticated time-series techniques that are often sensitive to lag lengths and the size of system variables. Inclusion of irrelevant variables reduces efficiency, while exclusion of relevant variables may result in biased and inconsistent estimation. Selection of under or over-optimal lag lengths may also distort causal directions erratically. Endogeneity bias often exists in the literature. All these potential problems might have caused the empirical findings in the literature more difficult to have a consensus on the hypothesis of export-led growth.

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Endnotes

Note 1 Some papers had two different results depending on sample periods, model variables, and estimation techniques used.

Note 2 We presumed that non-stationary series in levels become stationary in first differences. In practice, most macro variables are integrated with one unit root (Nelson and Plosser, 1982).

Note 3 Unlike other studies that used disaggregated trade data such as exports of manufactured goods (e.g., Marin, 1992), we use aggregate exports to figure out the general shape of export-led growth that may support for the Korean economy.

Note 4 Although our empirical model was specified based on the Cobb-Douglas production function, Eq (1), which assumed constant returns to scale, the sum of two parameter estimates appears to be less than one. The seemingly inconsistent result is due to a transformation of our empirical model to the log-differenced form in Eq (3).

Note 5 It would be desirable to include the data for the late 1950s like in Voivodas (1974) but our data source begins from 1960. In fact, the second half of the 1950s were a reconstruction period after the Korean War (1950-1953) and hence exports were nearly inactive. At the time, Korea survived, perhaps, with humanitarian assistance especially from the United States until the 1960s.

Note 6 Real import growth had been used as an additional variable in multivariate Granger-causal models for Korea (Riezman et al., 1996). The imports/GDP ratio was used by Islam (1998) as well. Serletis (1992) also included real imports as an additional variable for Canada. But no papers used the growth rate of imports as an IV.

Note 7 More recently, China is the number one trading partner in Korea, and the USA is the second.

Data Appendix

Definition of Variables:

dln RGDP = log difference of real GDP deflated by GDP deflator (2005=100).

dln RK = log difference of real fixed capital formation deflated by GDP deflator (2005=100).

dln LE = log difference of labor force (L) times secondary education enrollment rates (E), where L = total population

* adult population rate (% of ages over 15) * labor force participation rate (%).

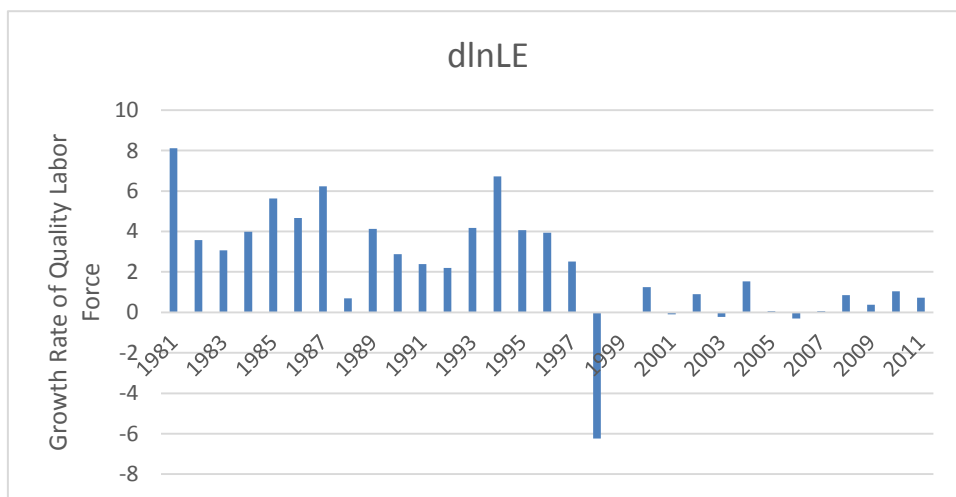
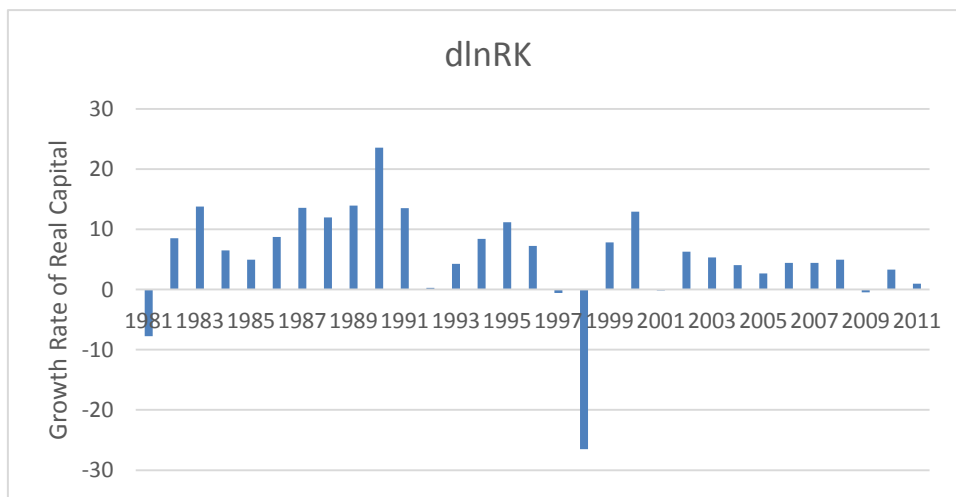
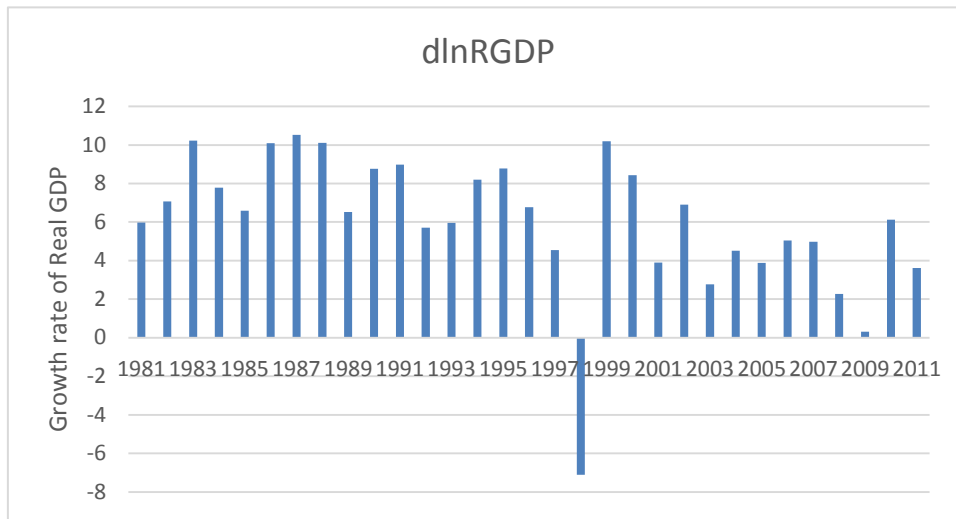
dln RExp = log difference of real exports deflated by GDP deflator (2005=100).

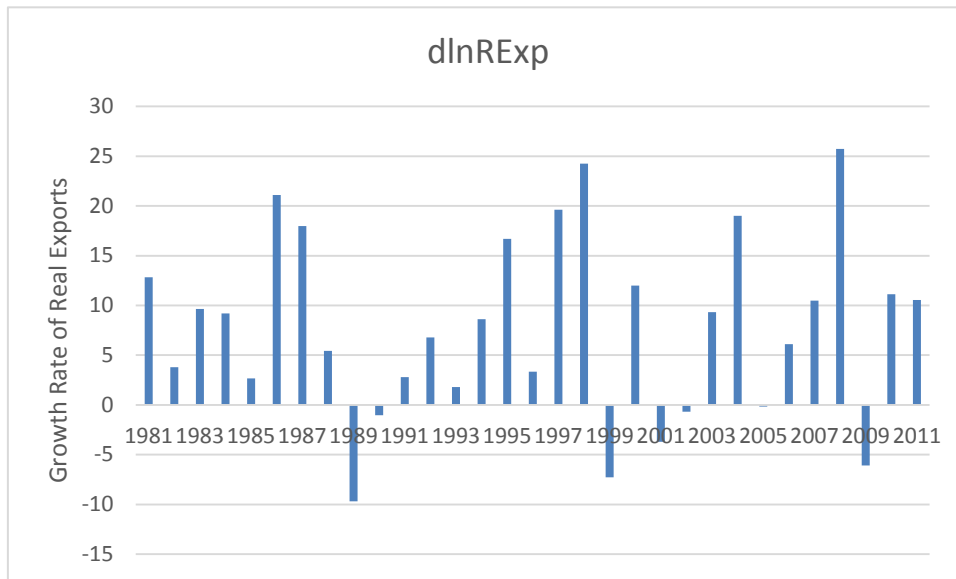
Data Sources:

International Monetary Fund (May 2014), *International Financial Statistics* for GDP, K, Exp

World Bank (May 2014), *World Development Indicators* for L, E

Sample Period: 1981-2011





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