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Does export dependency hurt economic development? Empirical evidence from Singapore

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Abstract

A rapid export growth in East Asia was once identified as a source of the sustainable economic development that the region enjoyed. However, the current global recession has turned exports from an economic virtue to a vice. There is a growing awareness that a heavy reliance on exports has caused a serious economic downturn in the region. The present paper chooses Singapore as a case study to examine the relationship between the origin of the East Asian Miracle (i.e. export dependency) and the economic growth. For this purpose, the study employs a causality test developed by Toda and Yamamoto. The empirical findings indicate that despite a negative long-run relationship between export dependency and economic growth, Singapore's heavy reliance on exports does not seem to have produced negative effects on the nation's economic growth. This is because the increase in export dependency was an effect, and not a cause, of the country's output expansion.

1. Introduction

It is a well-known fact that, until the 1990s, East Asian economies grew faster than those in other regions. This exceptionally rapid economic growth has been dubbed the "East Asian Miracle" (World Bank 1993). During the heyday of the East Asian Miracle, exports from the region were regarded as a crucial "engine" of the economic development. In other words, a country's ability or prospects of attaining economic success depended on whether it was successful in finding its own niche in the global marketplace.

More importantly, an aggressive pursuit of the export-led growth (ELG) has been the key to East Asian economic success. As He *et al*. (2007) observed, the export-led growth model was regarded as the fundamental reason for Asia's economic miracle. For example, Japan's remarkable economic performance in the 1960s was based on the active promotion of export activities by the policy makers. This strategy was successfully emulated in the 1970s by the Asian Newly Industrialising Economies (NIEs), and, in the following decade, by some of the ASEAN countries. The most recent example of export-driven economic growth is China's "open door policy" which has transformed the country into the world manufacturing centre.

However, the global economic crisis that began in 2007 and swept the planet by 2009 has debunked the myth of East Asian Miracle and turned the ELG strategy from being an economic virtue to a vice. There is an increasing awareness that the export-driven economies in East Asia are in fact very vulnerable to external shocks. As a respectable international publication pointed out, "Asia is more reliant on exports than any other region, so it is bound to be hurt by the rich world's worst recession since the 1930s" (*The Economist*, November 28, 2008).

The current global economic slowdown has shown that the ELG strategy can be a double-edged sword and that it has both a positive and a negative side. Just as East Asia's economic development can be driven by economic booms so it can be severely hurt by slowdowns in the US and European economies which are the main export destinations for the region's manufactured goods. It has been observed that "Asia's export-driven economies had benefited more than any other region from America's consumer boom, so its manufacturers were bound to be hit hard by the sudden downward lurch" (*The Economist*, January 31, 2009). The negative side of the ELG strategy or the so-called 'export dependency' is considered the root cause of many economic problems that currently plague Asia. Thus, if the Asian financial crisis of 1998-1999 was mainly caused by the region's dependence on foreign capital, "this time the tigers have been tripped up by their excessive dependence on exports" (*The Economist*, January 31, 2009).

To echo this perception, an article published in the *Financial Times* was eloquently entitled "Stimulating Asia: Those who live by export-led growth can die by it". Its main argument was that though export-led growth strategy had served Asia well in the past, the present export-driven growth that heavily relies on the demands from the United State is unsustainable and vulnerable (*Financial Times*, October 15, 2008).

Despite the recent setbacks, export-oriented industrialization (EOI) strategies adopted by Asian countries continue to inspire developing countries in other regions. However, empirical research studies that examine the relationship between a country's exports and its economic growth have not produced a consistent proof in support of the ELG hypothesis. Furthermore, there is a lack of systematic research on the relationship between export dependency and economic development.

To lessen this gap in research literature, this paper chooses one of the East Asian 'tigers', Singapore, as a case study and examines the relationship between the ELG strategy and economic growth.[1] Singapore is a relatively wealthy Southeast Asian country that has developed into an important *entrepôt* or trans-shipment hub, and is a financial centre in the region. Singapore actively promotes free trade and has signed nine bilateral trade agreements and five multilateral trade agreements, including the ASEAN Free Trade Area (AFTA).[2] As a consequence, Singapore has become one of the most open economies in the world; its openness was more than 200 percent in 2005.[3]

Historically, Singapore's export dependency rate has been very high.[4] In 1967, it was 93 percent. This was followed by a slight decrease to 81 percent in 1970. During the first half of the 1970s, Singapore's export dependency rate kept increasing and became 95 percent in 1975. In 1980, the rate reached 165 percent before it decreased to 129 percent in 1985. However, the downturn trend was reversed in the second half of the 1980s when the export dependency was recorded at 146 percent in 1989. In the first half on the 1990s, Singapore's export dependency kept diminishing and declined to 135 percent in 1994. By 1999, the export dependency rate slightly increased to 138 percent. From 2000 to 2005, Singapore economy was heavily reliant on exports. In 2000, the country's export dependency rate was 148 percent; it increased to 155 percent in 2003, and continued to grow to 184 percent in 2004 before it reached 196 percent in 2005.

Figure 1 and Figure 2 are graphic representations of the key variables, namely, export-dependency and economic development in Singapore, where *LDED* is the natural log of export dependency rate, and *LGDP* is the natural log of real Gross Domestic Product (GDP) in the country. As the figures reveal, Singapore's GDP was increasing quite steadily while the export dependency rate's increase experienced greater fluctuations. The source of data is *International Financial Statistics* (International Monetary Fund 2007).
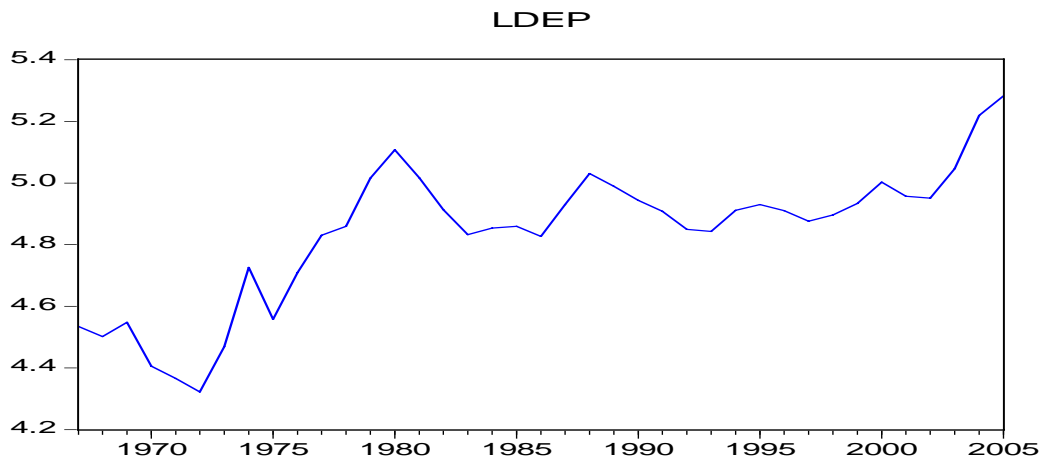
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[1] The World Bank (1993) identified Hong Kong, Indonesia, Japan, Malaysia, Singapore, South Korea, Taiwan, and Thailand as eight East Asian nations with vibrant economic growth.

[2] In 1992, when AFTA agreement was signed, the original member countries were Brunei, Indonesia, Malaysia, the Philippines, Singapore, and Thailand. Later, other four countries joined AFTA, namely, Vietnam (1995), Laos (1997), Myanmar (1997), and Cambodia (1999).

[3] The openness can be measured by the share of imports in the total amount of Gross Domestic Product (GNP). The source of data for openness in Singapore is World Bank (2007).
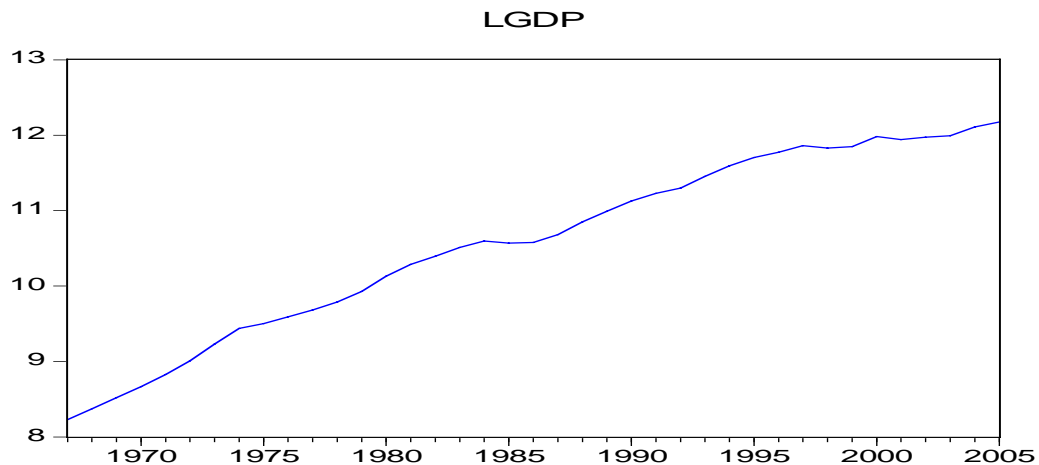
[4] In this paper, export dependency rate is measured by the share of exports in the total amount of Gross Domestic Product (GDP). The source of data for export dependency rate in Singapore is World Bank (2007).

Figure 1: Export dependency in Singapore

LDEP

Source: IMF (2007)

Figure 2: Economic development in Singapore

LGDP

Source: IMF (2007)

The basic question this study addresses is: whether Singapore's remarkably heavy reliance on exports has produced a negative or a positive impact on the economic development? To answer this research question, this paper runs three econometric analyses, namely, (1) unit root test, (2) Johansen cointegration test, and (3) Toda-Yamamoto causality test.

The current study consists of five sections. Following this Introduction, Section 2 briefly reviews some of the available literature on the relationship between exports and economic development. Section 3 discusses research methodology employed in the current inquiry while Section 4 reports and discusses the research findings. Section 5 concludes.

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2. Literature review

Numerous research studies have been done to examine relationship between exports and economic development. However, no consistent proof to support the export-led growth (ELG) hypothesis has been offered. Earlier studies on the topic produced empirical support to the ELG hypothesis (see Michaely 1977, Balassa 1978, Feder 1983, Ram 1985). However, these studies have been criticised because they employed cross-section data which are, methodologically, unable to establish a causal relationship between the variables (Love and Chandra 2005).

In the context of East Asian countries, time series analyses that tested the ELG hypothesis showed mixed results. For example, a study by Ahmad and Harnhirun (1996) tested the ELG hypothesis for five ASEAN countries (i.e., Malaysia, Indonesia, Singapore, Thailand, and the Philippines) over the period 1966-1986. They did not detect a cointegrating relationship between the countries' exports and their economic development. In fact, Ahmad and Harnhirun's empirical findings indicated that economic growth had been causing the expansion of exports, and not *vice versa*. For the Philippines, Amrinto (2006) used parametric and semi-parametric error correction models (ECM) to test the ELG hypothesis over the period 1981-2004. The results of the parametric ECM indicated that there was a unidirectional causality between the Philippines' exports and output in the short-run while the findings from the semi-parametric ECM established a bilateral causality between the two variables.

Piazolo (1996) conducted an empirical analysis to identify the determinants of Indonesia's economic growth over the period 1965-1992. The study incorporated six variables (i.e., exports, government expenditure, population, capital formation, inflation, and foreign investment) into the econometric model, and its results supported the validity of the ELG hypothesis in Indonesia. To test the ELG hypothesis in the context of the Malaysian economy, Keong, Yusop and Liew (2005) used the bounds test method to examine unidirectional causality from exports to growth over the period 1960-2001; however, they did not test unidirectional causality from growth to exports. The study detected a cointegrating relationship between the country's volumes of exports and its economic growth, as well as a short-run causality from exports to economic growth.

Besides the inconsistency in the empirical findings on the validity of the ELG hypothesis, there is a lack of a systematic research on the relationship between a country's export dependency and its economic development. Some development economists believe that export dependency has a negative influence on the economic development. Moreover, as Jaffee (1985:103) pointed out, there are theorists who "consider a reliance on export trade a developmental deadend".

An important question is: why export dependency of a developing country is considered detrimental for its economic development? Partially, the answer may be that export dependency could be equated with a heavy reliance on exports of one or two primary commodities only. This 'primary commodity export dependency' has been identified as a root cause of economic problems that have been plaguing developing countries. Cypher and Dietz (1997) pointed out that in many developing countries primary commodity

exports accounted for a very high percentage of total exports. As a consequence, a shortfall in production and/or a decline in commodity prices can plunge the exporters into economic crisis. This knotty problem is known as the Prebisch-Singer thesis (see Prebisch 1950, Singer 1950). According to the researchers, as a result of a continuous decline in the terms of primary commodity trade, the developing countries are increasingly able to import a fewer amount of manufactured goods for a given amount of primary commodities they export. In other words, primary commodities exporters will have to keep increasing the volume of primary commodities exports in order to import the necessary manufactured goods (Todaro 2000).

For several decades, until the 1980s, the Prebisch-Singer thesis generated a considerable interest among the economists and spurred numerous empirical studies on the topic. However, the findings of these studies were not consistent. Some of the researchers argued that export dependency had a positive effect on economic development (see Ragin and Delacroix 1979, Jaffee 1985) while others reported the contrary results (Weede and Tiefenbach 1981).

In the 1990s, the development economists' interest toward the debate on the benefits and setbacks of export dependency waned. Partially this was due to the indisputable evidence of the economic success of East Asian nations that were promoting economic development through exports of manufactured products rather than of the primary commodities. A further research on export dependency has stalled until very recently. The current global economic crisis has severely hurt most of the highly open economies; this was a reminder to the development economists that any kind of export dependency can put even a most sturdy economy into a quandary. Therefore, this study revisits a somewhat neglected topic of export dependency and chooses a non-primary commodity exporter, such as Singapore, as a case study.

3. Data and method

The present paper uses annual time-series data sets of Singapore's Gross Domestic Product (*GDP*) and export dependency rate (*ED*) for the period 1967-2005. The main source of data is *International Financial Statistics* (International Monetary Fund 2007). All the data were transformed into a log form for the purpose of this analysis. Empirical analysis done in this study consists of the following three steps: (1) the augmented Dickey-Fuller (ADF) unit root test, (2) the Johansen cointegration test, and (3) Toda-Yamamoto causality test.

First of all, an important prerequisite for the existence of a cointegrating relationship between variables (which are *GDP* and *ED* in the present study) is that both variables have to be integrated of order one, or *I(1)*. The augmented Dickey-Fuller (ADF) test in which calculation is based on equation (1) is used to examine the stationarity of the time series data (Dickey and Fuller 1979),

$$\Delta y_t = \mu + \beta t_{t-1} + \delta y_{t-1} + \sum_{i=1}^{n} \gamma_i \Delta y_{t-i} + \varepsilon_t \tag{1}$$

where μ is constant, β, δ and γ are coefficients, n is the number of lag length, and ε_t is an error term. The lag length, n, for the ADF test was chosen by minimizing the Akaike's information criterion (AIC).

Secondly, this study employs Johansen cointegration test which is used to check the long-run movement of the variables (Johansen 1988, Johansen 1991). The Johansen cointegration test is based on a k-dimensional Vector Autoregression (VAR) of order p in the equation (2),

$$Z_t = \mu + A_1 Z_{t-1} + A_2 Z_{t-2} + \dots A_{k+1} Z_{t-p+1} + \varepsilon_t \qquad (2)$$

where Z_t is a $k \times 1$ vector of nonstationary variables, μ is a $k \times 1$ vector of constants, A_t is $k \times k$ matrices of parameters, and ε_t is a $k \times 1$ vector of error terms.

The model could be transformed into an error correction form:

$$\Delta Z_t = \mu + \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \dots \Gamma_{k+1} \Delta Z_{t-p+1} + \pi Z_{t-1} + \varepsilon_t \qquad (3)$$

where π and $\Gamma_1 \dots, \Gamma_{k+1}$ are $k \times k$ matrices of parameters. If the coefficient matrix π has reduced rank, $r < k$, then the matrix can be decomposed into $\pi = \alpha\beta'$. Johansen cointegration test involves testing the rank of π matrix by examining whether the eigenvalues of π are significantly different from zero. There could be three conditions: 1) $r = k$, which means that Z_t is stationary at levels, 2) $r = 0$, which means that Z_t is the first differenced Vector Autoregressive, and 3) $0 < r < k$, which means there exist r linear combinations of Z_t that are stationary or cointegrated.

For example, if the number of cointegrating relations (r) is equal to 1, then the relationship between GDP_t and ED_t could be written as

$$\begin{bmatrix} \Delta GDP_t \\ \Delta ED_t \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix} + \sum_{i=1}^{k-1} \begin{bmatrix} \Gamma_{i,11} \Gamma_{i,12} \\ \Gamma_{i,21} \Gamma_{i,22} \end{bmatrix} \begin{bmatrix} \Delta GDP_{t-i} \\ \Delta ED_{t-i} \end{bmatrix} + \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} \begin{bmatrix} \beta_1 \beta_2 \end{bmatrix} \begin{bmatrix} GDP_{t-1} \\ ED_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \end{bmatrix} \qquad (4)$$

where GDP_t is the natural log of real Gross Domestic Product (GDP) in Singapore in the year t; ED_t is the natural log of export dependency rate in Singapore in the year t. Vector β represent the r linear cointegrating relationship between the variables. The elements of α are known as the adjustment parameters. The current study uses the Trace (Tr) statistic to examine the cointegration relation (Johansen 1988, Johansen and Juselius 1990).

As the third step, this paper uses Granger causality test to analyse the causality between the variables. Granger (1969:428) defined the causal relationship as follows, "We say that Y_t is causing X_t if we are better able to predict X_t using all available information than if the information apart from Y_t had been used".

If VAR are stationary, a standard Granger causality test with the lag length of k could be based on the following equations

$$GDP_t = c_1 + \alpha_1 GDP_{t-1} + .. + \alpha_k GDP_{t-k} + \beta_1 ED_{t-1} + .. + \beta_k ED_{t-k} + \varepsilon_1 \tag{5}$$

$$ED_t = c_2 + \alpha_1 ED_{t-1} + .. + \alpha_k ED_{t-k} + \beta_1 GDP_{t-1} + .. + \beta_k GDP_{t-k} + \varepsilon_2 \tag{6}$$

where c_1 and c_2 are constants; $\alpha_1.......\alpha_k$ and $\beta_1......\beta_k$ are slope coefficients. Granger causality could be examined by using Wald test for the joint hypothesis

$$\beta_1 = \beta_2 = ...\beta_k = 0 \tag{7}$$

The null hypothesis for equation (5) is that *ED* does not Granger-cause *GDP*. On the other hand, the null hypothesis for equation (6) is that *GDP* does not Granger-cause *ED*. The rejection of the null hypothesis could indicate a causal relationship between the two variables.

However, if VAR are not stationary, the standard Granger causality test is not applicable. A modified version of Granger causality test developed by Toda and Yamamoto can be used to test causality in the nonstationary VAR. According to Toda and Yamamoto (1995:227), their method is applicable whether VAR may be stationary, intergrated of arbitrary order or cointegrated of arbitrary order.

Toda and Yamamoto (1995) suggest determining the maximum order of integration d_{max} first and then to over-fit intentionally a level VAR with an additional d_{max} (i.e., $p=k+d_{max}$). In this causality test, *p* is a total number of lags and *k* is an optimal lag length. The researchers proposed to run Wald test on coefficients of first *k* lags only because the coefficients of the last d_{max} lags are regarded as zeros (Toda and Yamamoto 1995:229).[5]

Toda and Yamamoto (1995) further suggest using the ordinary least squares (OLS) to estimate a level VAR. The present paper employs not only OLS but also the seemingly unrelated regression (SUR). As Rambaldi and Doran (1996) showed, the SUR can be used to test causality in a nonstationary VAR.

Four types of causal relationship between export dependency and economic growth are possible:

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[5] The present paper uses a comparatively new econometric analysis (i.e. Toda-Yamamoto causality test) to examine the causal relationship between export dependency and economic development. Toda-Yamamoto causality test is rarely used to examine this topic. More recently, Ang and McKibbin (2007) suggested using a causality test that is able to detect both short-run and long-run causality. The current study also used Ang-McKibbin (2007) method to examine the causal relationship between export dependency and economic development for the purpose of robustness check. Empirical findings from Ang-McKibbin's method indicated that there existed a long-run causality between export dependency and economic development in Singapore. More importantly, there was a bilateral short-run causality from economic development to export dependency, but not vice versa. In other words, the economic development did cause export dependency in short run, but not vice versa. This means that the empirical findings from Ang-McKibbin's method confirm those obtained from the Toda-Yamamoto causality test.

(1) *Independence*: there is no causality between export dependency and economic growth, which could be interpreted as an independent relationship between export dependency and economic development.

(2) *Export-reliance driven growth*: there is a unidirectional causality from export dependency to economic growth, but not *vice versa*, which could be interpreted as a proof that export dependency can promote economic development.

(3) *Growth-driven export reliance*: there is a unidirectional causality from economic growth to exports, but not *vice versa*, which could be interpreted as a proof that economic growth can cause export dependency.

(4) *Two-way causality*: there is a unidirectional causality from exports to economic growth, and *vice versa*, which could be interpreted as a mutually reinforcing bilateral relation between export dependency and economic development.

4. Empirical Results

In the first stage of the empirical analysis, the ADF unit root tests were employed to test stationarity of the time series data sets. Empirical results from the ADF test are shown in Table I. As reported in the table, the obtained results indicate that both variables -- *GDP* and *ED* -- have unit roots in levels. Both time series become stationary in the first difference. In other words, *GDP* and *ED* are integrated of order one, *I(1)*.

Table I: ADF Unit Root Test

	Level		**First Difference**	
	Constant Without trend	Constant with trend	Constant without trend	Constant with trend
GDP	-2.528(1)	-1.490(1)	-3.381(0)*	-4.230(0)**
ED	-1.210(1)	-2.214(1)	-4.229(1)**	-4.171(1)**

Notes: Figures in parentheses indicate number of lag structures
** indicates significance at 1% level
 * indicates significance at 5% level

In the second stage of this study, Johansen cointegration test was used to test the long run movement of the variables. As Engle and Granger (1987) pointed out, only variables with the same order of integration could be tested for cointegration. Therefore, in the present research, both variables could be examined for cointegration.

The Akaike Information Criterion (AIC) was used to determine the optimal lag length selection while the maximum lag length was set at three. Table II shows that the optimal lag length for the VAR is two (2), which minimises the AIC.[6]

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[6] Sewa (1978) has argued that the Akaike Information Criterion can choose models with a higher order than the true model. However, Sewa has pointed out that this bias could be negligible when the selected lag length is less than (N/10), where N equals number of observations.

Table II: Optimal Lag Length Selection
(Maximum Lag Length=3)

Lag Length	AIC
0	1.918
1	-4.769
2	-4.865*
3	-4.787

AIC denotes the Akaike Information Criterion
*indicates optimal lag length selected by the AIC

Results of the Johansen cointegration tests are reported in Table III. The Trace test indicates one cointegrating equation or the cointegrating rank equal to 1. This means that there exists a long-run relationship between the two variables (i.e., *GDP* and *ED*), which shows that these variables are cointegrated.

Table III: Johansen Cointegration Test (Trace)

Eigenvalue	Trace statistic	5 percent critical value	Probability	Number of cointegrating equations
0.344	21.11	20.26	0.038	None*
0.151	5.92	9.16	0.196	At most 1

The result corresponds to VAR with two lags[7]
* indicates significance at 5% level

In other words, although the variables are non-stationary in levels, in the long run, they closely move with each other. A long-run cointegration when the variables are normalised by cointegrating coefficients could be expressed as

GDP = -6.872 ED +50.82

This cointegrating vector equation indicates that there exists a negative long-run relationship between the *GDP* and *ED*. Based on the long-run relationship between export dependency and economic growth, this paper proceeded to analyse the causal direction of the two variables. For this purpose we employ Toda-Yamamoto causality test. As the unit root tests indicated, the maximal order to integration d_{max} can be set at one.

The 'Export-reliance driven growth' hypothesis was tested using Toda-Yamamoto causality test which is based on equation (5) with one additional lag. The results of the Wald statistics and t-statistics are reported in Table IV. The Wald statistics indicate that there was no unilateral causality from export dependency to economic growth in

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[7] A model specification for the Johansen cointegration test is that there is an intercept in the Cointegrating Equation (CE) but no intercept in the Vector Autoregression (VAR) model.

Singapore. This means that export dependency did not cause the country's economic growth.

Table IV: Export-Reliance Growth Hypothesis: Dependent Variable: Δ*GDP*

Ordinary Least Squares (OLS) estimation		
Variable	Degree of Freedom	Wald Test Statistics
Δ*ED*	2	0.252
Seemingly Unrelated Regression (SUR) estimation		
Variable	Degree of Freedom	Wald Test Statistics
Δ*ED*	2	0.313

The result corresponds to VAR with three lags

Next, the results of Toda-Yamamoto causality test, which is based on equation (6) with one additional lag, for the 'Growth-driven export reliance' hypothesis are reported in Table V. The Wald statistics detected a unilateral causality from economic growth to export dependency. This means that economic growth caused export dependency in Singapore.

Table V: Growth Driven Export-Reliance Hypothesis: Dependent Variable: Δ*ED*

Ordinary Least Squares (OLS) estimation		
Variable	Degree of Freedom	Wald Test Statistics
Δ*GDP*	2	5.201*
Seemingly Unrelated Regression (SUR) estimation		
Variable	Degree of Freedom	Wald Test Statistics
Δ*GDP*	2	6.457**

The result corresponds to VAR with three lags
** indicates significance at 5% level
* indicates significance at 10% level

In a nutshell, empirical findings from the Johansen cointegration test show that there was a negative long-run relationship between export dependency and economic growth in Singapore. On the other hand, the results obtained from Toda-Yamamoto causality test show that there existed a unidirectional causality from Singapore's economic growth to the export dependency, but not *vice versa*.

In other words, despite a negative long-run relationship between export dependency and economic growth, Singapore's heavy reliance on exports does not seem to have produced a negative effect on the country's economic growth. This is because an increase in export dependency was an effect, and not a cause, of the country's output expansion.

5. Conclusion

A rapid export growth in East Asian economies was once identified as a cause and a source of a sustainable economic growth in the region. However, the current global

recession has urged a closer scrutiny of this assumption. As a result, export activities have come to be seen as an economic vice rather than a virtue. There has been a growing awareness that an excessive export dependency has brought on a serious economic downturn in the region. Prompted by the past perceptions and the present reality this paper chose Singapore as a case study on the relationship between export dependency and economic growth.

The Johansen cointegration test showed that there existed a negative long-run relationship between export dependency and economic growth in Singapore. On the other hand, Toda-Yamamoto causality test indicated a unilateral causality from economic growth to export dependency. This means that, despite the negative long-run relationship between export dependency and economic growth, Singapore's heavy reliance on exports does not seem to have produced a negative effect on the nation's economic development. This may be because the increase of export dependency was an effect, not a cause, of the country's output expansion. Future studies may want to explore negative effects of the export-led growth strategy on economic development in various countries. A panel data analysis can be used for this purpose. There could be other variables that may influence the relationship between export dependency and economic development. For example, the level of financial development could be a third variable that may affect economic development and the degree of the diversification of the economy. Future research studies may consider incorporating level of financial development or other important macroeconomic variables into the model.[8]

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[8] For a more detailed discussion on financial development and its importance for the economy, see Ang and McKibbin (2007).

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