# The Stability of Export-led Growth Hypothesis: Evidence from Asia's Four Little Dragons

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# THE STABILITY OF EXPORT-LED GROWTH HYPOTHESIS: EVIDENCE FROM ASIA'S FOUR LITTLE DRAGONS

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## ABSTRACT

The objective of this study is to re-investigate the export-led growth hypothesis for Asia's Four Little Dragons using cointegration and rolling causality analyses. Employing both bivariate (exports and GDP) and trivariate (exports, GDP and exchange rate) models, the study finds that exports and GDP are cointegrated for all the four economies, implying that there is a long run relationship between the variables. However, the MWALD causality test results differ between the bivariate and trivariate models. The export-led growth hypothesis is valid only for the case of Hong Kong and Singapore in the bivariate model but valid for all four economies in the trivariate model. Furthermore, the rolling regression-based MWALD test shows that export-led growth in each of the four economies is not stable over their respective period of analysis.

## 1.    INTRODUCTION

For decades, economies that relied on exports to drive their economies have achieved considerable success in accelerating their economic growth. In Asia, several countries have taken this route to generate impressive economic growth since the sixties. These countries include Korea, Taiwan, Hong Kong, Singapore, Malaysia, Thailand and more recently, China and India. The success of these export-oriented economies has also resulted in a plethora of empirical studies that examine the role of exports in generating economic growth. Thus, examining the export-led growth hypothesis is hardly a new area of research in the international trade and development literature. The World Bank (1987) did a comprehensive study on trade strategies and reported some evidence supporting the idea that export-

promotion strategy is the best option for Less Developing Countries (LDCs) attempting to industrialise and transform into more developed economies.

However, economies which are overly dependent on exports for growth are very vulnerable when there is a global slowdown. Thus, the financial crisis in 2008-2009 in the major developed countries had a devastating impact on export-dependent economies. During this period, most of the affected economies including the Four Little Dragons (that is, Hong Kong, Korea, Singapore and Taiwan) have adopted easy monetary and fiscal policies to stimulate domestic demand to generate growth. Although the strategy of domestic demand-led growth has been advocated in recent times (Palley, 2002), and has empirical support, it should not replace an export-led growth strategy entirely (Lai, 2004). If a long run relationship between exports and economic activity exists, export-orientation is still one of the best strategies to adopt to ensure growth. Nevertheless, in view of the deep recession suffered by these export-dependent economies during this period, questions began to arise whether export-led growth strategies remain viable.

The economies of the Four Little Dragons are of interest because these countries have achieved remarkable economic growth driven by exports (Giles and Williams, 2000a). Despite their relative small size in terms of population, they are all ranked in the top 20 export economies in the world in 2008, with Korea ranked at the 11th position, Hong Kong at 12th, Taiwan at 16th and Singapore at 17th. However, the empirical studies on the export-led growth hypothesis for these four economies have so far produced mixed and inconclusive results.[1] There are some empirical studies that lend support to the export-led growth hypothesis for these economies (for example, Bahmani-Oskooee and Alse, 1993; Xu, 1996, 1998; Tang, 2006). On the other hand, there are studies that reject the export-led growth hypothesis. For example, Jung and Marshall (1985) failed to uncover any causality evidence to support the presence of the export-led growth hypothesis in the case of Taiwan and Korea. There are yet other studies which find that the causality evidence between export and economic growth for the Little Dragons tends to be neutral (Darrat, 1986). In contrast, the results from the study by Shan and Sun (1998) on the export-led growth hypothesis for the economies of the Four Little Dragons are mixed. This led them to conclude that the hypothesis is not valid in these economies.

From the above literature, it is evident that there is a divergence between theory and empirical findings. International trade and development theory suggests that exporting is a prominent source for economic growth; however, empirical studies do not provide clear evidence to support the export-led growth hypothesis. Xu (1996) noted that the contradictory findings of studies on the export-led growth hypothesis might be attributed to the arbitrariness in the choice of the order for lags in the various causality tests. In addition, Giles and Williams (2000a; 2000b) summarised that apart from the choice of the lag order, the inconclusive causality results may also be attributed to the estimation techniques and data spans employed (Gordon and Skayi-Bekoe, 1997). Recently, Tang (2008) incorporated the recursive regression procedure into the Granger causality tests and found that the results of the causality tests vary over time.[2] This suggests that the contradictory causality results observed for the four economies may be due to unstable causal relationships over the analysis period. It is thus interesting to show empirically whether this is true.

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[1] Interested readers could refer to the empirical survey conducted by Giles and Williams (2000a) for a more detailed discussion.

[2] The recursive regression-based Granger causality test is a time-varying regression procedure by first running the Granger causality test with $T$ observations. One observation is then added to the dataset (i.e. $T+1$) and the Granger causality test is repeated with $T+1$ observations. This process is repeated until the entire dataset is used to perform the Granger causality tests.

The objective of this study is therefore to re-examine the export-led growth hypothesis for Asia's Four Little Dragons emphasising the stability of the causal relationship between exports and GDP by incorporating the rolling regression approach into the Modified Wald (MWALD) causality test (Toda and Yamamoto, 1995) within the augmented vector autoregression (VAR) framework. To the best of our knowledge, thus far, there are no studies that demonstrate the stability of the export-economic growth relationship. The stability of the relationship is of interest because the effectiveness of macroeconomic policies which encourage exports to generate growth is impaired when the export-economic growth relationship is unstable. Moreover, the findings of this study can help to answer partially the empirical question of why the causality evidence for export-led growth hypothesis is mixed thus far for the economies of the Little Dragons.

The remainder of this study is organised as follows. In Section 2, we briefly discuss the data and econometric techniques used in this study. Section 3 reports the empirical results while the conclusion and policy recommendations of this study are reported in Section 4.

## 2. MODELS, DATA AND ECONOMETRIC TECHNIQUES

### 2.1 Models and data source

In this study, after taking into consideration data availability and also for comparison purpose, we employ both the bivariate and trivariate models which are specified as follows: [3]

$$\text{Bivariate Model: } \ln Y_t = \beta_1 + \beta_2 \ln EX_t + \mu_{1t} \tag{1}$$

$$\text{Trivariate Model: } \ln Y_t = \beta_1 + \beta_2 \ln EX_t + \beta_3 \ln ER_t + \mu_{2t} \tag{2}$$

where $Y_t$ is real GDP, $EX_t$ is real exports and $ER_t$ is the real exchange rate. The variables are expressed in logarithm form. The residuals $(\mu_{1t}, \mu_{2t})$ are assumed to be normally distributed and white noise.

This study uses quarterly data of real exports, real gross domestic product (GDP), real Industrial Production Index (IPI), GDP deflator (Base year: 2000), real exchange rate, and Consumer Price Index, CPI (Base year: 2000). These data are obtained from the *International Financial Statistics* (IFS) and Republic of China National Statistics.[4] The GDP deflator is used to derive real GDP for Hong Kong, Korea and Taiwan. For Singapore, the IPI is used as a proxy for GDP since quarterly GDP data are not available for earlier years. The study period differs from one country to another, depending on data availability. For Hong Kong, the analysis period covered is from 1973:Q1 to 2007:Q2; Korea from 1960:Q1 to 2007:Q2; Singapore from 1966:Q1 to 2007:Q2; and Taiwan from 1961:Q1 to 2007:Q2.

### 2.2 Johansen cointegration test

This study uses the Johansen multivariate cointegration approach to investigate the presence of a long run relationship between exports, GDP and exchange rate. According to Gonzalo (1994), the Johansen cointegration procedure performs better than other

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[3] Although capital and labour are important in determining GDP, the variables are excluded from this study because of the unavailability of quarterly data. We are aware that there are various interpolation techniques available to construct quarterly data from annual data; however using raw data collected from the relevant database has less measurement errors than interpolated series (Tang, 2004; Tang and Lean, 2007).

[4] http://eng.stat.gov.tw/mp.asp?mp=5

cointegration tests even when the error distribution is non-normal and the lag structure in the error-correction model (ECM) is incorrectly specified. In order to use the Johansen cointegration approach, the following vector error-correction model (VECM) is estimated:

$$\Delta Z_t = \Phi D_t + \Pi Z_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta Z_{t-i} + \mu_t \tag{3}$$

where $\Delta$ is the first difference operator, $Z_t$ is a vector of endogenous variables $\left(\ln Y_t, \ln EX_t, \ln ER_t\right)$ while $D_t$ is the deterministic vector (constant and trend, etc) and $\Phi$ is a matrix of parameters for $D_t$. The matrix $\Pi$ contains information about the long run relationship between the $Z_t$ variables in the vector. If all the variables in $Z_t$ are integrated of order one, the cointegrating rank, $r$, is given by the rank of $\Pi = \alpha \beta'$ where $\alpha$ is the matrix of parameters denoting the speed of convergence to the long run equilibrium and $\beta$ is the matrix of parameters of the cointegrating vector. To ascertain the number of cointegrating rank, we employ the likelihood ratio (LR) test statistic, namely the trace test $LR\left(\lambda_{\text{trace}}\right) = -T \sum_{i=r+1}^{k} \ln\left(1 - \lambda_i\right)$. The $\lambda_i$'s are the eigenvalues $\left(\lambda_1 \geq \lambda_2 \ldots \geq \lambda_k\right)$ for the Johansen test and $T$ is the number of observations. The null hypothesis of '$r$' cointegrating equations is rejected if the computed $LR\left(\lambda_{\text{trace}}\right)$ statistic is greater than the critical values tabulated in Osterwald and Lenum (1992).

### 2.3 MWALD causality test

We employ the MWALD causality test developed by Toda and Yamamoto (1995) to investigate the export-led growth hypothesis using the augmented-VAR system. Zapata and Rambadi (1997) noted that both the likelihood ratio and the Wald tests are very sensitive to the specification of the short run dynamics in error-correction models (ECMs), even in large samples. Furthermore, they stated that given the performance of the tests in larger samples, the MWALD test is more appealing because of its simplicity. To use the MWALD test, we have to decide the optimal lag order and also the maximal order of integration $\left(d_{\max}\right)$ to be specified into the augmented-VAR system. To implement the MWALD test, we estimate the following augmented-VAR systems, where equation (4) is for the bivariate model while equation (5) is for the trivariate model.

$$\begin{bmatrix} \ln Y_t \\ \ln EX_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} + \begin{bmatrix} A_{11,1} & A_{12,1} \\ A_{21,1} & A_{22,1} \end{bmatrix} \times \begin{bmatrix} \ln Y_{t-1} \\ \ln EX_{t-1} \end{bmatrix} + \cdots + \begin{bmatrix} A_{11,k} & A_{12,k} \\ A_{21,k} & A_{22,k} \end{bmatrix} \times \begin{bmatrix} \ln Y_{t-k} \\ \ln EX_{t-k} \end{bmatrix}$$

$$+ \begin{bmatrix} A_{11,p} & A_{12,p} \\ A_{21,p} & A_{22,p} \end{bmatrix} \times \begin{bmatrix} \ln Y_{t-p} \\ \ln ER_{t-p} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \tag{4}$$

$$
\begin{bmatrix} \ln Y_t \\ \ln EX_t \\ \ln ER_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{bmatrix} + \begin{bmatrix} A_{11,1} & A_{12,1} & A_{13,1} \\ A_{21,1} & A_{22,1} & A_{23,1} \\ A_{31,1} & A_{32,1} & A_{33,1} \end{bmatrix} \times \begin{bmatrix} \ln Y_{t-1} \\ \ln EX_{t-1} \\ \ln ER_{t-1} \end{bmatrix} + \cdots + \begin{bmatrix} A_{11,k} & A_{12,k} & A_{13,k} \\ A_{21,k} & A_{22,k} & A_{23,k} \\ A_{31,k} & A_{32,k} & A_{33,k} \end{bmatrix}
$$

$$
\times \begin{bmatrix} \ln Y_{t-k} \\ \ln EX_{t-k} \\ \ln ER_{t-k} \end{bmatrix} + \begin{bmatrix} A_{11,p} & A_{12,p} & A_{13,p} \\ A_{21,p} & A_{22,p} & A_{23,p} \\ A_{31,p} & A_{32,p} & A_{33,p} \end{bmatrix} \times \begin{bmatrix} \ln Y_{t-p} \\ \ln EX_{t-p} \\ \ln ER_{t-p} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix} \tag{5}
$$

where $Y_t$ is real GDP[5], $EX_t$ is real exports and $ER_t$ is real exchange rate. The optimal number of lags, $k$ is determined by the Akaike Information Criterion (AIC) and the order of lag $p$ is actually $(k + d_{\max})$. We used $d_{\max} = 1$ as it performs better than any other order of $d_{\max}$ (Dolado and Lütkepohl, 1996). The residuals $(\varepsilon_{1t}, \varepsilon_{2t}, \varepsilon_{3t})$ are assumed to be spherically distributed and white noise. When the null hypothesis "exports do not Granger cause GDP" is not rejected at the conventional significance level, it implies that the export-led growth hypothesis is not valid. However, it must be pointed out here that the extra lag, that is, $d_{\max}$ in equations (4) and (5) is unrestricted as its inclusion is to ensure that the asymptotic $\chi^2$-distribution critical values can be used when the causality test is conducted with the non-stationary variables (Toda and Yamamoto, 1995).

### 2.4 Rolling regression-based causality technique

The rolling regression-based MWALD causality test procedure can be described as follows. Initially, the MWALD causality test is estimated for the beginning subsample of $T$ observations, that is, with a rolling window of size $T$. Then the first observation is removed from the beginning subsample and a new observation is added to the end of the estimation sample period. The relationship is subsequently re-estimated. For example, if we set the rolling window at 10 years, that is, $T = 40$ observations, the first MWALD causality test statistic was obtained by using a subsample period from 1960:Q1 to 1969:Q4 (i.e. $T = 40$ observations). Then the second test statistic was obtained by using data from 1961:Q2 to 1970:Q1. This rolling regression procedure continues until the last observation is employed to examine for the causal relationship. Finally, the generated $\chi^2$-statistics are normalised by the 10 per cent critical values. If the normalised statistic is above one then the null hypothesis is rejected. In other words, if the export-led growth hypothesis is valid, then a large number of significant MWALD tests should be observed when the sample rolls forward.

## 3. EMPIRICAL RESULTS

In this section, we present the empirical results for the stationarity tests, the Johansen cointegration test, and the modified MWALD causality test.

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[5] For Singapore, we used the real Industrial Production Index (IPI) as a proxy to GDP owing to the unavailability of quarterly data on GDP for the period under study.

*3.1    Stationarity and cointegration test results*

In order to avoid the spurious regression problem, the stationarity of the variables must first be determined (Granger and Newbold, 1974; Phillips, 1986). This study employed both the Augmented Dickey-Fuller (ADF) and the Kwaitkowski et al. (KPSS, 1992) stationarity tests to determine the order of integration for each time series. Based on the evidence of Monte Carlo analysis, Amano and van Norden (1992) and Schlitzer (1995) noted that by using the combination of ADF and KPSS tests, the possibility of incorrect conclusions on stationarity will be minimised.

Both the ADF and KPSS tests from Table 1 reveal that the variables are integrated of order one, *I*(1). The results corroborate with the findings of Nelson and Plosser (1982) that most of the macroeconomic variables are non-stationary at the level, but are stationary at first difference. With evidence of the same order of integration for all variables, we then proceed with the Johansen cointegration test to determine whether there is a long run equilibrium relationship among the variables under investigation.

Table 1: The ADF and KPSS stationarity tests

| Economies | ADF | | | KPSS | | |
|---|---|---|---|---|---|---|
| | $\ln EX_t$ | $\ln Y_t$ | $\ln ER_t$ | $\ln EX_t$ | $\ln Y_t$ | $\ln ER_t$ |
| Hong Kong | –2.05 (8) | –2.04 (7) | –2.15 (8) | 0.24 (4)*** | 0.63 (4)*** | 0.30 (4)*** |
| Korea | –2.12 (7) | –0.96 (5) | –2.66 (4) | 0.82 (4)*** | 0.63 (4)*** | 0.46 (4)*** |
| Singapore | –2.38 (0) | –0.94 (9) | –2.85 (4) | 0.52 (4)*** | 0.14 (4)** | 0.23 (4)*** |
| Taiwan | –2.97 (7) | –0.16 (8) | –0.96 (12) | 0.84 (4)*** | 0.83 (4)*** | 0.62 (4)*** |
| Economies | $\Delta \ln EX_t$ | $\Delta \ln Y_t$ | $\Delta \ln ER_t$ | $\Delta \ln EX_t$ | $\Delta \ln Y_t$ | $\Delta \ln ER_t$ |
| Hong Kong | –4.28 (7)*** | –7.36 (6)*** | –3.90 (4)** | 0.04 (4) | 0.03 (4) | 0.13 (4) |
| Korea | –5.66 (7)*** | –6.05 (5)*** | –3.67 (12)** | 0.09 (4) | 0.01 (4) | 0.07 (4) |
| Singapore | –5.42 (3)*** | –4.43 (8)*** | –4.45 (3)*** | 0.04 (4) | 0.07 (4) | 0.05 (4) |
| Taiwan | –5.93 (7)*** | –4.77 (7)*** | –3.92 (12)** | 0.05 (4) | 0.04 (4) | 0.10 (4) |

Note: The asterisks *** and ** denote statistical significance at the 1 and 5 per cent levels, respectively. The optimal bandwidth for the KPSS test is determined by Schwert's (1989) formula, $\ell_4 = \text{int}\left\{4\left(T/100\right)^{1/4}\right\}$. The critical values for the ADF test are obtained from MacKinnon (1996) while the asymptotic critical values for the KPSS test are obtained from Kwaitkowski et al. (1992).

To implement the Johansen cointegration test, we have to decide the optimal lag structure for the VECM system. According to Enders (2004) the maximum lag structure for quarterly data should range from 1 to 12 quarters. In our study, we used the AIC statistics to choose the appropriate lag structure for the VECM system. The estimated cointegration tests for the bivariate and trivariate models together with the optimal lag structures are reported in Table 2.

For the bivariate model, our empirical results indicate that the computed $LR\left(\lambda_{\text{trace}}\right)$ statistics reject the null hypothesis of no cointegration of exports and GDP at the 5 per cent significance level for Hong Kong, Korea and Singapore only. For the trivariate model,

however the $LR(\lambda_{\text{trace}})$ statistics improve significantly by affirming that exports, GDP and exchange rate for the four economies are cointegrated at the 5 per cent significance level. These results concur with Al-Yousif (1999) assertion that export-growth studies with a bivariate framework may be biased due to the omission of variables phenomenon. Hence, the inclusion of exchange rate, a relevant variable, was probably the cause of the improvement of the cointegration results in particular for the case of Taiwan.

Table 2: Johansen cointegration test

| Economies | Optimal Lag Order | Bivariate Model: $(\ln Y_t, \ln EX_t)$ | | |
| --- | --- | --- | --- | --- |
| | | Likelihood ratio test - $LR(\lambda_{\text{trace}})$ | | |
| | | $H_0 : r = 0$ | $H_0 : r \leq 1$ | |
| Hong Kong | 9 | 32.696*** | 5.791 | |
| Korea | 8 | 37.066*** | 5.884 | |
| Singapore | 10 | 22.381** | 4.728 | |
| Taiwan | 12 | 18.924 | 2.412 | |

| Economies | Lag order | Trivariate Model: $(\ln Y_t, \ln EX_t, \ln ER_t)$ | | |
| --- | --- | --- | --- | --- |
| | | Likelihood ratio test - $LR(\lambda_{\text{trace}})$ | | |
| | | $H_0 : r = 0$ | $H_0 : r \leq 1$ | $H_0 : r \leq 2$ |
| Hong Kong | 8 | 50.681*** | 13.672 | 5.728 |
| Korea | 8 | 47.443*** | 14.948 | 5.952 |
| Singapore | 7 | 37.252** | 14.041 | 4.073 |
| Taiwan | 8 | 56.890*** | 25.592*** | 5.030 |

Note: The asterisks *** and ** denote statistical significance at the 1 and 5 per cent levels, respectively. The critical values obtained from Osterwald-Lenum (1992) are used to test for cointegration.

### 3.2    MWALD causality test result

According to the Granger Representation Theorem, if the variables are cointegrated, there must be at least uni-directional causality between the variables. We next proceed to estimate the augmented-VAR system to verify the causal relationship between exports and GDP for the economies within the bivariate and trivariate models. Table 3 reports the causality test results by using the Toda-Yamamoto procedure. We begin our causality analysis with the bivariate model. The MWALD test statistics indicate that at the 5 per cent level of significance, the null hypothesis that exports do not Granger-cause GDP is rejected for Hong Kong and Singapore but it is not rejected for Korea and Taiwan. This suggests that the export-led growth hypothesis is only valid for Hong Kong and Singapore. There are two plausible explanations for this result. First, these two economies have extremely high export-GDP ratios, with Hong Kong's ratio at 165 per cent in 2007 and Singapore's ratio at 138 per cent in 2006. In contrast, the export-GDP ratios for Korea and Taiwan are only at 38 per cent and 64 per cent, respectively. Both Hong Kong and Singapore have relatively lower

populations and smaller domestic markets and thus have to depend heavily on international trade to generate economic growth. Second, the omission of relevant variable(s) may also be the cause for contradictory results. In the trivariate model, where exchange rate is included as an additional variable, the null hypothesis is rejected for all the four economies. Thus, exports Granger-cause GDP for the four economies. Table 3 also presents the results of testing the null hypothesis that GDP does not Granger-cause exports. Regardless of whether the bivariate or trivariate model is used, the causality results strongly indicate that GDP Granger-causes exports. As stated earlier, the existence of cointegration implies that there is at least uni-directional causality. Our cointegration and causality results thus support this contention.

Table 3: Modified Wald (MWALD) causality tests

| Economies | Null Hypothesis: Exports do not Granger-cause GDP | | | |
| | Bivariate Model | | Trivariate Model | |
| | Lag ($k$) | MWALD statistics | Lag ($k$) | MWALD statistics |
| --- | --- | --- | --- | --- |
| Hong Kong | 9 | 18.033** | 11 | 23.407** |
| Korea | 8 | 11.834 | 8 | 15.066* |
| Singapore | 10 | 18.666** | 6 | 12.130** |
| Taiwan | 8 | 10.131 | 4 | 7.998* |

| Economies | Null Hypothesis: GDP does not Granger-cause Exports | | | |
| | Bivariate Model | | Trivariate Model | |
| | Lag ($k$) | MWALD statistics | Lag ($k$) | MWALD statistics |
| --- | --- | --- | --- | --- |
| Hong Kong | 9 | 21.902*** | 11 | 28.820*** |
| Korea | 8 | 45.986*** | 8 | 45.054*** |
| Singapore | 10 | 40.038*** | 6 | 38.904*** |
| Taiwan | 8 | 17.815** | 4 | 14.597*** |

Note: The asterisks ***, ** and * denote statistical significance at the 1, 5 and 10 per cent levels, respectively. The optimal lag order ($k$) is determined by AIC.

It is noteworthy to point out here that many studies on export-led growth, after testing for cointegration and causality, would usually conclude whether the export-led growth hypothesis is valid or otherwise. These studies have produced mixed and inconclusive results, which may be due to the instability of the causal relationship over time. Tang (2008, 2010) noted that the causal relationship may be unstable owing to frequent changes in the global economic and political environments. The causality test using the entire sample period may not be able to reflect such changes. It is an inaccurate measure for export-led growth since it is possible that a causal relationship exists in certain periods but does not exist in other periods. In order to investigate whether the causal relationship is stable, we incorporate the rolling regression procedure into the MWALD causality test. To apply the rolling regression, we have to pre-specify the size of the rolling window. To the best of our knowledge, there is no formal statistical procedure to determine the optimal window size.

In earlier work, the setting of the window size seemed to be arbitrary (Thoma, 1994; Ibrahim and Aziz, 2003; Tang, 2010; Tang and Chua, 2012). In this study, we set three rolling window sizes – 50, 60 and 70 observations.[6] For interpretation, the MWALD statistics are normalised by the 10 per cent critical values. If the normalised MWALD statistic is above the cut-off line 1.00, then the null hypothesis of "export does not Granger-cause GDP" is rejected. In other words, if the export-led growth hypothesis is valid, then we should observe a large number of normalised MWALD statistics greater than unity when the sample rolls forward.

Figure 1 shows the normalised MWALD statistics for (a) bivariate model and (b) trivariate model. Overall, the graphs in Figure 1 show that the MWALD test statistics for each economy fluctuate widely over the period of analysis regardless of the model and window size employed. These results demonstrate the evidence of instability of the export-led growth for the four economies. As we have pointed out, previous empirical studies on export-led growth have produced mixed results. Our findings of the unstable causal relationship between exports and GDP may partially explain why inconclusive results are obtained.

As the MWALD test statistics obtained for the bivariate and trivariate models are similar, we use the results from the bivariate model for interpretation. The results for Hong Kong's case indicate that there is a wide fluctuation of the normalised MWALD statistics in particular for the period 1994 to 2002. The MWALD test statistics are above the cut-off value of 1.00 after 2004 only. The MWALD statistics for Korea support the existence of the export-led growth hypothesis from 1972 to 1989 and from 1998 onwards. For the case of Singapore, the export-led growth hypothesis is only valid prior to 1990 as the MWALD test statistics fluctuate above the cut-off value of 1.00. Similarly, the export-led hypothesis is supported in Taiwan for the period 1985 to 1995 only.

Korea is one of the countries affected by the Asian financial crisis in 1997. The Korean won depreciated by more than 30 per cent during the period, resulting in a significant increase in export competitiveness. This helped boost its export volume and subsequently generated growth. Thus, it is not surprising that the export-led hypothesis is supported after 1998 in Korea. Although the Hong Kong dollar is pegged to the US dollar, it came under speculative attack during the 1997-98 financial crisis due to its high inflation rate. The monetary authorities intervened heavily to maintain the peg. The resultant volatility of the stock and monetary markets impacted on the export sector and this probably accounted for the instability of the export-led growth hypothesis since 1998. For Taiwan, the rejection of the export-led hypothesis after 1994 may be due to the fact that after China opened up its economy for trade and investments after 1978, hundreds of Taiwanese companies moved their manufacturing plants to China especially since the late eighties. As a result, the majority of Taiwanese manufactured exports, particularly labour-intensive goods, now originated from their manufacturing plants in China. A plausible reason for the hypothesis to be valid only prior to 1990 for the case of Singapore is that its export-GDP ratio was in decline throughout the nineties, although it picked up again from around year 2000. Moreover, the export-oriented manufacturing is not the only sector generating growth in Singapore. The financial services sector is just as important in driving the economy.

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[6] Timmermman (2008) noted that short rolling window will be preferred to capture the predictability patterns which may be missed in the long rolling window.
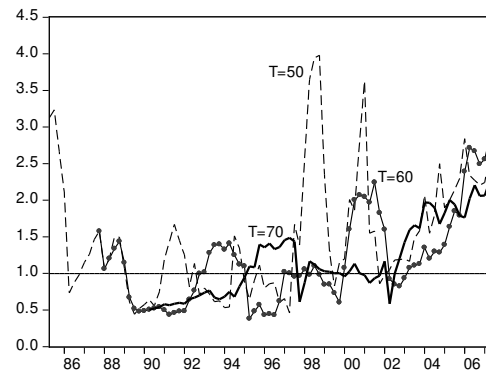
Figure 1: *The results of rolling MWALD causality tests*
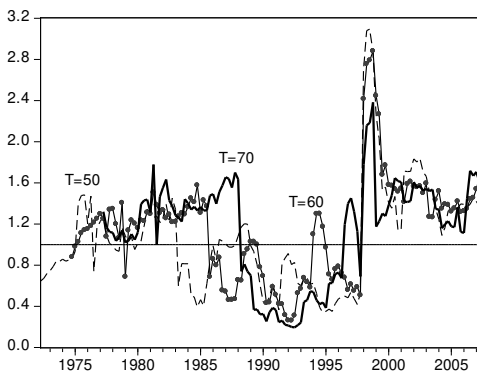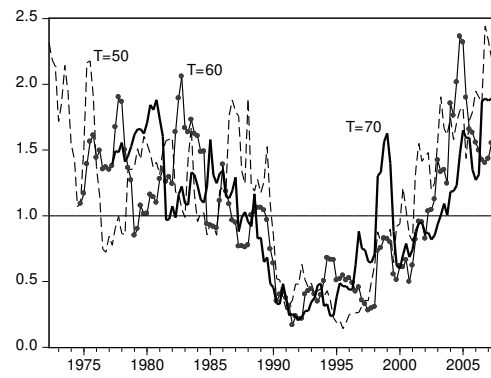
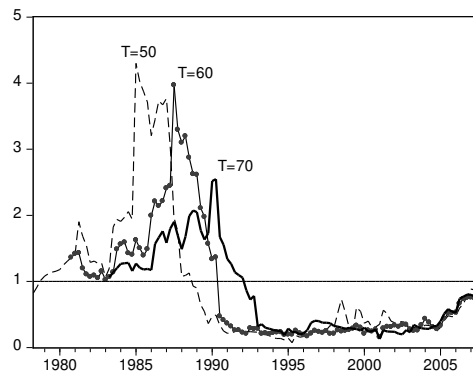| (a) Bivariate Model: | (b) Trivariate Model: |
|---|---|
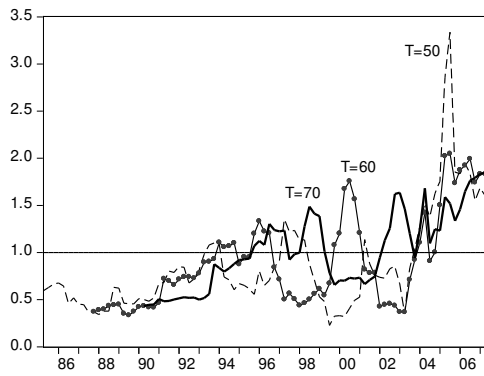


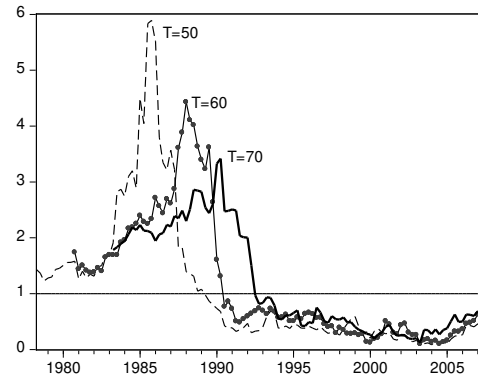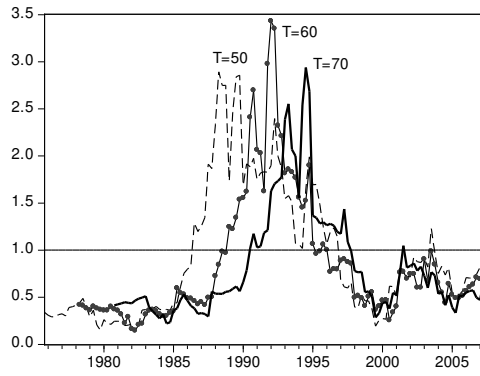Hong Kong



Hong Kong
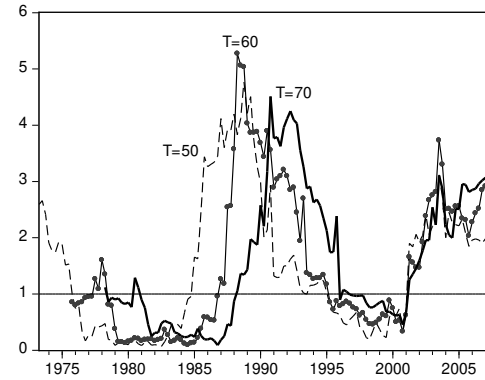


Korea



Korea



Singapore



Singapore

10

Taiwan



Taiwan

Note: The above figures use the 10 per cent normalised rolling causality test for the null hypothesis of exports do not Granger-cause GDP.

## 4. CONCLUSION AND POLICY RECOMMENDATIONS

Using the Johansen cointegration and MWALD causality tests, this study has empirically re-investigated the export-led growth hypothesis for Asia's Four Little Dragons' economies using both the bivariate and trivariate models. Additionally, we also examine the stability of the causal relationship between exports and GDP by using the rolling regression-based MWALD causality approach. The Johansen cointegration test shows that exports, GDP and exchange rate are cointegrated in all four economies regardless of which model is employed. This implies that exports and GDP are moving together in the long run relationship, although deviations from the steady state may occur in the short run.

The results of the MWALD causality test for the export-led growth are mixed when the bivariate model is used. Specifically, there is bilateral causality between exports and GDP for Hong Kong and Singapore, while there is only unilateral causality running from GDP to exports for Korea and Taiwan. On the other hand, when the trivariate model is used, bilateral causality exists for all four economies. It indicates that the bivariate model may be mis-specified. Another important finding of the study is that the export-led growth hypothesis for the four economies is unstable. The MWALD test statistics are subject to wide fluctuations indicating contradictory causality inferences over time. Given these results and considering that the outlook for the export markets remains weak, it is perhaps timely now for the four economies to re-assess their growth strategies which are overly dependent on exports to developed countries. However, these four economies cannot completely discard their export-oriented policies given that their domestic markets are relatively small. New policy strategies aimed at diversifying export markets through regional integration should be implemented immediately. This would reduce their export dependence on traditional markets of developed economies. Despite the relative small size of the domestic markets in these four economies, the contribution of domestic demand to growth should not be overlooked. Thus, as a balancing policy, the decision makers should implement appropriate fiscal and monetary strategies to increase the role of domestic demand and private investment to generate growth.

11

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