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TRADE AND GROWTH: NEW EMPIRICAL EVIDENCE FROM HONG KONG

This study employs the bounds test for the level relationship and conditional Granger causality tests to test the trade-led growth hypothesis for Hong Kong. Results confirm the existence of long term relationship between real income and international trade volume in this country. International trade volume as proxied by exports of goods and services plus imports of goods and services has inelastic but statistically significant coefficient for real income both in the long and short terms. Results reveal that real income of Hong Kong converges to its long term level by 16.1% every year. A final finding of the present study is that conditional Granger causality tests suggest undirectional causation that runs from international trade volume to real income; thus, the trade-led growth hypothesis is confirmed in the case of Hong Kong according to the results of the present study.

JEL Classification: C22; C51; O41; O52.
Keywords: Trade, real income, bounds test, causality, Hong Kong.

1. INTRODUCTION

International tourism and international trade are two major sources of foreign exchange for the countries. Small countries, in particular small islands, have more dependency on tourism and trade than the larger ones since their economies are based on only a few sectors (Katircioglu, 2010). There are various ways through which international trade (including services) expansion can contribute to economic growth (Omotor, 2008). Especially, export-oriented services tend to represent unique characteristics of small islands and therefore provide a basis for a potential comparative advantage (Mehmet and Tahiroglu, 2002). There is a huge amount of studies investigating empirical relationship between international trade and economic growth (especially, trade-led, export-led and import-led growth hypotheses); however, results are still inconclusive (see also Katircioglu, 2010 and Gunduz and Hatemi-J, 2005). There is an unverified question of whether

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international trade (exports and imports) actually stimulates economic growth or whether economic growth contributes to trade growth instead.

Empirical research proves that international trade is crucial for economic growth of many countries (Katircioglu, 2010; Shan and Sun, 1998; Xu, 1996; Jin, 1995; Bahmani-Oskooee and Alse, 1993, Marin, 1992; Chow, 1987). Katircioglu (2010) validates the existence of export-led growth hypothesis in the case of the Turkish Republic of Northern Cyprus while it rejects the validity of import-led growth hypothesis for the same country which has a non-recognized state. Katircioglu (2009b), also carried out a similar research for the south of Cyprus, which is known as the legal holder of the entity of the Republic of Cyprus in the international arena, and found that foreign trade (both exports and imports) in the south of Cyprus is output-driven in the long term period.

Recent theoretical literature provides two main mechanisms through which international trade may affect growth (Katircioglu, 2010). The first is its effect on the rate of innovation. The second is its effect on the adoption rate of technologies from more advanced countries that also increases the economy's rate of total factor productivity growth (Proudman et al., 1998). Many studies employed the concept of causality proposed by Granger (1969) and Sims (1972) to detect the causal relationship between international trade and real income. Some empirical studies in the literature confirmed the trade-led growth (TLG) hypothesis for some countries whereas some others rejected it for some other countries, while, on the other hand, some studies in the growth literature support export-led growth (ELG) hypothesis and while some others investigate import-led growth (ILG) hypothesis (Katircioglu, 2010; Katircioglu, 2009b; Deme 2002). Liu et al. (2009) find that export expansion, import liberalization, FDI inflows and inward mergers and acquisitions are integral elements of the growth process in Asian economies including Hong Kong. On the other hand, Rao and Singh (2009) extend the Solow growth model and find that trade openness has considerable impact on the steady-state growth rates of the Asian countries including Hong Kong.

Given the importance of the issue, the present study employs the latest econometric techniques in order to empirically investigate the possible long term relationship and causal link between international trade (exports of goods and services plus imports of goods and services) and real income in the case of Hong Kong (one of the Asian Tigers together with Taiwan, Singapore, and South Korea), which has an extremely free economy, pursued export-driven model for growth and development over the decades, and experiences a shrinking manufacturing sector characterized by mainly light industries. This study

contributes to the relevant literature by also testing the TLG hypothesis of Hong Kong for the first time (to the best knowledge of the authors), using the bounds test to the level relationship and conditional Granger causality tests under the ARDL (autoregressive distributed lag) approach.

The paper proceeds as follows. Section II defines the data and methodology of the study. Section III provides results and discussions and Section IV concludes.

2. DATA AND METHODOLOGY

Data used in this paper are annual figures covering the period 1960 – 2008 and variables of the study are real gross domestic product (GDP), real trade volume, and real effective exchange rate index (RER). Katircioglu (2010, 2009a, 2009c), Oh (2005), Gunduz and Hatemi-J (2005), and Balaguer and Cantavella-Jorda (2002) suggest real exchange rates to be included in the existence of international tourism in order to deal with potential omitted variable problem. This is also true for international trade and real income relationship since exchange rates are important determinant of foreign trade. Thus, RER was also added to the model of the present study. Data was gathered from World Bank Development Indicators (World Bank, 2010) and Pacific Exchange Rate Service (http://fx.sauder.ubc.ca). Variables are all at 2000 constant USD prices.

The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP)[1] Unit Root Tests are employed to test the integration level and the possible co-integration among the variables (Dickey and Fuller 1981; Phillips and Perron 1988). The PP procedures, which compute a residual variance that is robust to autocorrelation, are applied to test for unit roots as an alternative to the ADF unit root test.

To investigate a long-run relationship between each pair of variables under consideration, the bounds test for the level relationship within ARDL (the autoregressive distributed lag) modelling approach was adopted in this study. This model was developed by Pesaran et al. (2001) and can be applied irrespective of the order of integration of the variables (irrespective of whether regressors are purely I(0), purely I(1) or mutually co-integrated). The ARDL modelling approach involves estimating the following error correction model:

[1] PP approach allows for the presence of unknown forms of autocorrelation with a structural break in the time series and conditional heteroscedasticity in the error term.

$$\Delta \ln Y_t = a_{0_Y} + \sum_{i=1}^{n} b_{i_Y} \Delta \ln Y_{t-i} + \sum_{i=0}^{n} c_{i_Y} \Delta \ln X_{t-i} + \sum_{i=0}^{n} d_{i_Y} \Delta \ln Z_{t-i} + \sigma_{1_Y} \ln Y_{t-1} + \sigma_{2_Y} \ln X_{t-i} + \sigma_{3_Y} \ln Z_{t-1} + \varepsilon_{1t} \quad (1)$$

In equation (1), Δ is the difference operator, Y_t is the log of dependent variable, X_t is the log of independent variable and ε_{1t} is serially independent random error with mean zero and finite covariance matrix.

Again in equation (1), the F-test is used for investigating a level (long-run) relationship. In the case of a level relationship, the F-test indicates which variable should be normalized. In equation (1), when Y is the dependent variable, the null hypothesis of no level relationship is H_0: $\sigma_{1Y} = \sigma_{2Y} = 0$ and the alternative hypothesis of a level relationship is H_1: $\sigma_{1Y} \neq \sigma_{2Y} \neq 0$.

In the case of a level relationship based on the bounds test, the Granger causality tests should be done under conditional error correction model (ECM) that employs the ARDL framework. By doing so, the short-run deviations of series from their long-run equilibrium path are also captured by including an error correction term (see also Narayan and Smyth, 2004). Therefore, Granger causality tests under conditional error correction model can be specified as follows:

$$\Delta \ln Y_t = \alpha_0 + \phi_{11}^{p}(L) \Delta \ln Y_t + \phi_{12}^{q}(L) \Delta \ln X_t + \delta ECT_{t-1} + \mu_{1t} \quad (2)$$

$$\Delta \ln X_t = \alpha_1 + \phi_{21}^{p}(L) \Delta \ln X_t + \phi_{22}^{q}(L) \Delta \ln Y_t + \delta ECT_{t-1} + \mu_{2t} \quad (3)$$

Where

$$\phi_{11}^{p}(L) = \sum_{i=1}^{P_{11}} \phi_{11,i} L^i \quad \phi_{12}^{p}(L) = \sum_{i=0}^{P_{12}} \phi_{12,i} L^i$$

$$\phi_{21}^{q}(L) = \sum_{i=1}^{Q_{21}} \phi_{21,i} L^i \quad \phi_{22}^{q}(L) = \sum_{i=0}^{Q_{22}} \phi_{22,i} L^i$$

In equations (2) and (3), Δ denotes the difference operator and L denotes the lag operator where $(L)\Delta \ln Y_t = \Delta \ln Y_{t-1}$ and $(L)\Delta \ln X_t = \Delta \ln X_{t-1}$. ECT_{t-1} is the lagged error correction term derived from the long-run model. Finally, μ_{1t} and μ_{2t} are serially independent random errors with mean zero and finite covariance matrix. Finally, according to the conditional ECM for causality tests, having statistically significant t ratios for ECT_{t-1} in equations (2) and (3) would be a sufficient condition to have causation from X to Y and from Y to X, respectively, in the long term period.

3. RESULTS AND DISCUSSIONS

Table 1 gives ADF and PP unit root test results for the variables of the study. Real GDP, real trade volume, and RER seem to be non-stationary at their levels but become stationary at their first differences as proved by both ADF and PP tests for unit roots; thus, these variables of the present study are said to be integrated of order one, I(1).

Table 1

ADF and PP Tests for Unit Root

Statistics (levels)	ln y	lag	ln T	lag	ln RER	lag
τ_T (ADF)	-0.81	(3)	-2.22	(9)	-2.16	(1)
τ_μ (ADF)	-2.10	(3)	-0.72	(0)	-1.98	(1)
τ (ADF)	2.12	(3)	10.24	(10)	-0.50	(2)
τ_T (PP)	-1.37	(1)	-1.41	(3)	-1.59	(4)
τ_μ (PP)	-2.07	(0)	-0.70	(3)	-1.52	(4)
τ (PP)	7.13	(4)	9.35	(3)	-0.47	(4)
Statistics (first differences)	Δln y	lag	Δln X	lag	Δln RER	lag
τ_T (ADF)	-3.41***	(2)	-2.52	(6)	-3.41***	(1)
τ_μ (ADF)	-2.75***	(2)	-2.21	(6)	-3.33**	(1)
τ (ADF)	-0.98	(6)	-0.59	(6)	-3.35*	(1)
τ_T (PP)	-5.80*	(2)	-6.38*	(3)	-3.53**	(3)
τ_μ (PP)	-4.80*	(2)	-6.34*	(3)	-3.46**	(3)
τ (PP)	-2.35**	(2)	-2.49**	(4)	-3.48**	(3)

Source: authors' computation

Notes: y represents real gross domestic product; T is the total real trade volume; and RER is real exchange rate. All of the series are at their natural logarithms.

τ_T represents the most general model with a drift and trend; τ_μ is the model with a drift and without trend; τ is the most restricted model without a drift and trend.

Numbers in brackets are lag lengths used in ADF test to remove serial correlation in the residuals. When using PP test, numbers in brackets represent Newey-West bandwith (as determined by Bartlett-Kernel).

*, ** and *** denote rejection of the null hypothesis at the 1%, 5% and 10% levels, respectively.

Tests for unit roots have been carried out in E-VIEWS 6.0.

Long-run equilibrium relationship under the ARDL approach will be now investigated by using the bounds test for level relationships. Critical values

for F statistics for small samples are presented in Table 2 as taken from Narayan (2005) to be used in this study. Table 3 gives results of the bounds test for level relaitonship between real income and its regressors, trade volume and RER, in the case of Hong Kong under three different scenarios as also suggested by Pesaran et al. (2001: 295-296), these are with restricted deterministic trends (F_{IV}), with unrestricted deterministic trends (F_V) and without deterministic trends (F_{III}). Intercepts in these scenarios are all unrestricted[2].

Table 2

Critical Values for ARDL Modeling Approach

	0.10		0.05		0.01	
k = 2	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
F_{IV}	3.77	4.54	4.54	5.42	6.43	7.51
F_V	4.58	5.60	5.55	6.75	7.98	9.41
F_{III}	3.44	4.47	4.27	5.47	6.18	7.87
t_V	-3.13	-3.63	-3.41	-3.95	-3.96	-4.53
t_{III}	-2.57	-3.21	-2.86	-3.53	-3.43	-4.10

Source: Narayan (2005) for F-statistics and Pesaran et. al (2001) for t-ratios.

Notes: k is the number of regressors for dependent variable in ARDL models, F_{IV} represents the F statistic of the model with unrestricted intercept and restricted trend, F_V represents the F statistic of the model with unrestricted intercept and trend, and F_{III} represents the F statistic of the model with unrestricted intercept and no trend.

t_V and t_{III} are the t ratios for testing $\sigma_{1Y} = 0$ in equation (1).

Results in Table 3 suggest that the application of the bounds F-test using the ARDL approach strongly suggest the existence of a level relationship (a long-run relationship) between real income (y) and its regressors, T and RER, since the null hypotheses of H_0: $\sigma_{1Y} = \sigma_{2Y} = 0$ is rejected as F statistics are compared with the critical values in Table 2. On the other hand, the results from the application of the bounds t-test in each ARDL model also allow the imposition of the trend restrictions in the models since they are statistically significant in general as can be seen from Table 3 (see Pesaran et al., 2001: 312).

[2] For detailed information, please refer to Pesaran et al. (2001), pp. 295-296.

Table 3

The Bounds Test for Level Relationship

Variables	With Deterministic Trends			Without Deterministic Trend		Conclusion
	F_{IV}	F_V	t_V	F_{III}	t_{III}	
y = f (Trade, RER)						H_0 rejected
F_y (lny/lnT, lnRER)						
p = 1	12.63[c]	8.05[c]	-4.69[c]	17.07[c]	-4.80[c]	
2	3.73[a]	3.83[b]	-3.19[b]	5.05[c]	-3.25[c]	
3	4.03[b]	4.24[b]	-3.30[b]	5.09[c]	-3.17[b]	
4*	5.15[c]	6.40[c]	-4.04[c]	6.19[c]	-3.78[c]	

Source: authors' computation

Notes: Akaike Information Criterion (AIC) and Schwartz Criteria (SC) were used to select the number of lags required in the co-integration test. p shows lag levels and * denotes optimum lag selection in each model as suggested by both AIC and SC. F_{IV} represents the F statistic of the model with unrestricted intercept and restricted trend, F_V represents the F statistic of the model with unrestricted intercept and trend, and F_{III} represents the F statistic of the model with unrestricted intercept and no trend. t_V and t_{III} are the t ratios for testing $\sigma_{1Y} = 0$ in equation (1). [a] indicates that the statistic lies below the lower bound, [b] that it falls within the lower and upper bounds, and [c] that it lies above the upper bound.

Having level relationships in bounds tests, the ARDL approach can be now adapted to estimate the level equation as also discussed in Pesaran and Shin (1999). The resulted estimates of level relationship for the ARDL specification in the case of real income and trade volume relationship can be given by:

Level Equation in the Long Term Period:

$$\ln Y_t = 0.601\ (\ln T_t) - 0.432\ (\ln RER_t) + 10.693 + \hat{u}_t$$
$$(0.011) \qquad (0.000) \qquad (0.043)$$

where $\hat{u}_t$ is error correction term and standard errors are given in parantheses. Level equation shows that trade volume (0.601) and RER (-0.432) have inelastic but statistically significant elasticity coefficients for real income in the case of Hong Kong.

In the next stage, the conditional ECM regression associated with the above level relationship should be estimated. This is provided in Table 4:

Table 4

The ARDL Error Correction Model

Real Income-Trade Model (2, 1, 0)

Regressor	Coefficient	Standard Error	p-value
$\hat{u}_{t-1}$	-0.161	0.036	0.000
ΔlnY_{t-1}	0.104	0.089	0.249
ΔlnT	0.478	0.055	0.000
$\Delta lnRER$	-0.044	0.052	0.394
Intercept	-0.000	0.008	0.966

Adj. R^2= 0.714, S.E. of Regr. = 0.023,
AIC = -4.536, SBC = -4.339,
F-stat. = 29.738, F-prob. = 0.000,
D-W stat. = 1.842

Source: authors' computation

Note: Numbers in brackets denote p lag structures in the model

Results in Table 4 show that ECT is not so high, but statistically significant and negative; it is -0.161 and shows that real income converge to its long term equilibrium level by 16.1% every year. On the other hand, the short term coefficient of trade volume is statistically significant except while the others including intercept are not. The short term coefficient of trade volume is again inelastic (0.478).

Finally, the direction of causality can be now searched within the conditional Granger causality tests that employ the ARDL mechanism as a long-run context. F-statistics for short-run causations and t statistics of ECTs for long-run causations are given in Table 5 as they are estimated from equations (2) and (3).

Table 5

Results of Conditional Granger Causality Tests

Dependent Variable	F-statistics [probability values]			t-stat [prob]for ECT_{t-1}
	Δlny_t	ΔlnT_t	$\Delta lnRER_t$	
Δlny_t	-	0.376 [0.860]	1.828 [0.142]	-3.388* [0.002]
ΔlnT_t	0.838 [0.534]	-	1.893 [0.129]	-1.425 [0.165]
$\Delta lnRER_t$	0.565 [0.725]	1.726 [0.163]	-	1.747 [0.092]

Source: authors' computation

Note: * denotes the rejection of null hypothesis at the 0.01 level.

Results from Table 5 suggest undirectional causality that runs from trade volume to real income since t statistic for ECT is statistically significant when real income is dependent variable and t ratio of ECT when trade volume is dependent variable is not statistically significant. F-statistics did not reveal any short-term causation of real income, trade volume, and RER. To summarize, results in the present study confirm the validity of trade-led growth hypothesis in the long-term of the Hong Kong economy as concluded from Tables 4 and 5.

4. CONCLUSION

This study empirically tested the validity of a long term equilibrium relationship and direction of causality between international trade and real income in the case of Hong Kong that employed the latest econometric techniques. Results of the bounds test for the level relationship reveal that long-run equilibrium relationship was confirmed between international trade volume (exports plus imports) and real income in Hong Kong under the ARDL approach. International trade volume has positive but inelastic coefficients for real income both in the long and short terms. Error correction model has shown that real income of Hong Kong converges to its long term level by 16.1% every year with the contribution of international trade. The main finding of this study is that trade-led growth hypothesis is confirmed

for Hong Kong since conditional Granger causality tests have confirmed the validity of undirectional causation that runs from international trade volume to real income in Hong Kong. Thus, major findings of the present study have shown that Hong Kong should continue to promote international trade since it is a major source of foreign exchange and stimulates real income growth in the long term period.

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