Labuan Bulletin
OF INTERNATIONAL BUSINESS & FINANCE
Volume 7, 2009 ISSN 1675-7262

TERMS OF TRADE AND TRADE BALANCE IN KOREA, HONG KONG AND SINGAPORE[1]

Hock Tsen Wong[2]

School of Business and Economics, Universiti Malaysia Sabah,

Abstract

This study examines the impact of terms of trade on trade balance in Korea, Hong Kong, and Singapore. Generally, the results of the cointegration tests show that there is a long-run relationship between terms of trade and trade balance. More specifically, an increase in terms of trade will lead to a decrease in trade balance. For Hong Kong, trade balance is found to Granger cause terms of trade and there is bilateral Granger causality between terms of trade volatility and trade balance. Terms of trade has some predictive power on trade balance.

JEL Classifications: F32; F10; F41
Keywords: Terms-of-trade; Trade balance; Cointegration; Causality; Variance decomposition

1. Introduction

The Harberger-Laursen-Metzler (HLM) effect (Harberger, 1950; Laursen and Metzler, 1950) states that an increase in terms of trade will lead to an increase in trade balance. This can be explained by an increase in terms of trade, which will lead to a change in value of exports more than a change in value of imports and thus trade balance will increase. There are many

[1]A version of this paper has been published in the proceedings of Applied International Business Conference 2008, 6-8 November 2008, Grand Dorsett Labuan Hotel, Malaysia, 662-671 (ISBN 978-983-41460).
[2] Corresponding author: Locked Bag No. 2073, 88999 Kota Kinabalu, Sabah, Malaysia. E-mail address: htwong@ums.edu.my

empirical studies on the impact of terms of trade on trade balance (Hoque, 1995; Dibooglu, 2000; Otto, 2003; Wong, 2006). However, the empirical results are mixed. An increase in terms of trade could lead to an increase or a decrease in trade balance. Otto (2003), amongst others, shows that there is the HLM effect. However, trade balance is reduced when the terms of trade shock become more persistence. Conversely, Bouakez and Kano (2008) find that a change in terms of trade does not affect current account in a significant way. Generally, terms of trade is found to have little impact on current account and the impact of terms of trade volatility on current account is argued to be an important channel.

The relationship between terms of trade and trade balance is argued to depend on the duration of the terms of trade shock (Ostry and Reinhart, 1992). Sachs (1981) argues that an increase in permanent terms of trade, which will lead to an increase in income and consumption at about the same level and thus no change in saving and trade balance. Conversely, an increase in temporary terms of trade will lead to an increase in income but consumption will increase less because of intertemporal consumption smoothing. This will lead to an increase in saving and trade balance. Okiti (2003) shows that the impact of terms of trade on trade balance is argued to depend on the response of consumption, which depends on consumption preferences. The response of consumption pattern to the temporary terms of trade shock could be definitive and sometime ambiguous. Conversely, the response of consumption pattern to the permanent terms of trade shock could be ambiguous. On the whole, the response of saving and trade balance depends on consumption patterns in an economy and therefore ambiguous, particularly a change in permanent terms of trade because there is enough time for a change in consumption pattern. In summary, the HLM effect is ambiguous and it is an empirical matter (Okiti, 2003: 16).

This study examines the impact of terms of trade on trade balance in Korea, Hong Kong, and Singapore. These economies are open economies. The openness to international trade, namely exports plus imports to Gross Domestic Product (GDP) of these economies are more than hundred, except Korea (Table 1). International trade is important to these economies and thus knowing the impact of terms of trade on trade balance of these economies is important. Change of terms of trade could have a significant impact on trade balance. Thus an effective trade policy can be implemented to minimise the impact of terms of trade on trade balance. Furthermore, the impact of terms of trade on trade balance is said to be relatively significant for an open economy than for a close economy. This study also examines Granger causality between terms of trade and trade balance, and between terms of trade volatility and trade balance.

The rest of this article is structured as follows. Section 2 provides a literature review of terms of trade and trade balance. Section 3 explains the methodology and data in this study. Section 4 discusses the empirical results. Section 5 gives some concluding remarks.

2. Literature review

Harberger (1950) and Laursen and Metzler (1950) show an increase in terms of trade would lead to an increase in trade balance and vice versa. This analysis is based on the Keynesian consumption function. An improvement in terms of trade raises national income of an economy, that is, domestic output measured in terms of importable or in terms of the true consumption bundle increased. However with a short-run marginal propensity to consume less then unity, there is a less than proportional increase in consumption spending. As a result, the level of private saving is increased. If other things remain constant, this would lead to an improvement in trade balance of an economy (Otto, 2003: 157).

The relationship between terms of trade and trade balance is also discussed in an intertemporal optimising framework with certainty or uncertainty. One finding of the relationship between terms of trade and trade balance in an intertemporal optimising framework with certainty is that the contemporaneous response of trade balance to terms of trade shock depends on the persistence of the shock. The shock that produces transitory changes in terms of trade would lead to the HLM effect. Nonetheless, as the effect of the shock becomes more persistent the HLM effect is reduced. In the standard two-period model of a small open economy, permanent changes in terms of trade have no effect on trade balance (Sachs, 1981; Otto, 2003: 157).

Eicher, Schubert, and Turnovsky (2007: 2-3) develop a theoretical model to show that the impact of terms of trade on current account depends on the credit status of an economy. If an economy is a debtor, a decrease in terms of trade will lead to a decrease in economic growth and thus a decline in debt that causes an increase in current account, which is contradict to the HLM effect. If an economy is a creditor, a decrease in terms of trade will lead to an increase in economic growth and thus a decline in the holdings of foreign assets that causes a decrease in current account, which leads to the HLM effect. Huang and Meng (2007) develop a dynamic small open economy model with imperfect world capital market assumption to examine the impact of permanent terms of trade on current account. The imperfect world capital market assumption implies an economy faces a downward-sloping bond curve or equivalently, an upward-sloping debt curve. The model, amongst others, shows that an unanticipated decrease in permanent terms of trade will lead to an increase in aggregate demand. This will lead to a decrease in current account and thus the HLM effect will happen.

Bouakez and Kano (2008) examine the HLM effect in an intertemporal model for three small open economies, namely Australia, Canada, and the United Kingdom. The results show that a change in terms of trade does not affect current account in a significant way. On the whole, terms of trade is found to have little impact on current account in these economies. It is mentioned in the paper the importance of considering the impact of terms of trade uncertainty on current account, which could be an important channel, particularly in countries whose terms of trade are volatile. Guillo (2001) use a two-country and two sector over lapping generation model and shows that trade balance and relative price of exports are always related when exports are labour intensive regardless of the elasticity of intertemporal substitution in consumption.

Kouassi *et al*. (1999) examine the relationship between current account balance and terms of trade within a context of vector error correction model for Cote-d'Ivoire over the period from 1960 to 1995. They include current account balance, terms of trade, domestic income, foreign income, and foreign interest in the vector error correction model. The results show that there is a long-run relationship between terms of trade and current account balance. Moreover, current account balance is found to Granger cause terms of trade and not vice versa. Finally, dynamic simulations indicate that a significant portion of fluctuations in terms of trade is explained by current account balance.

Otto (2003) employs a structural vector autoregressive model to examine the HLM effect for a number of small open developing and developed economies. The sample period is typically from 1960 to 1997. The variables included in the structural vector autoregressive model are trade balance, terms of trade, and real output. On the whole, the results show that there is the HLM effect. For the vast majority of 55 small open economies examined, an immediate effect of a positive shock to terms of trade is an increase in trade balance. This finding is similar across both developing and small OECD economies. However, trade balance is reduced when terms of trade shocks become more persistence. The variance decompositions for trade balance indicate that on average terms of trade shocks are marginally more important in explaining fluctuations in trade balance of developing economies than developed economies.

Wong (2006) examines the relationship between trade balance and terms of trade in Malaysia for the period from 1965 to 2002 and a sub-sample period of 1965-1996. The study uses commodity terms of trade and income terms of trade. The results show that there is a long-run relationship between trade balance and commodity terms of trade. However, there is no long-run relationship between trade balance and income terms of trade. Commodity terms of trade and income terms of trade are found respectively to Granger cause trade balance and not vice versa. Thus a change in terms of trade will have an impact on trade balance in Malaysia. In the long run, the impact of terms of trade on trade balance is depending on the measure of terms of trade. However, the study examines only the case of Malaysia.

3. Methodology and data

A simple version of the trade balance equation can be derived from the following export and import demand equations, respectively is specified as:

$$X_t = \mathrm{f}(P_{x,t}) \tag{1}$$

$$M_t = \mathrm{f}(P_{m,t}) \tag{2}$$

where X_t is exports, $P_{x,t}$ is export price, M_t is imports, and $P_{m,t}$ is import price. Trade balance (TB_t) is defined as:

$$TB_t = X_t - M_t \tag{3}$$

Alternatively, trade balance can be defined as the natural logarithm of the ratio of equations (1) and (2) as:

$$log\ TB_t = \mathrm{f}(\log \frac{P_{x,t}}{P_{m,t}}) \tag{4}$$

where log is the natural logarithm. The empirical model of trade balance to be estimated in this study is specified as:

$$\log TB_t = \beta_{10} + \beta_{11} \log TOT_t + u_{1,t} \tag{5}$$

where $u_{1,t}$ is a disturbance term. The coefficient of terms of trade could be positive or negative (Eicher, Schubert, and Turnovsky, 2007; Huang and Meng, 2007; Bouakez and Kano, 2008).

In this study, terms of trade volatility is estimated by an Autoregressive Conditional Heteroscedasticity (ARCH) model. More specifically, the ARCH model proposed by Engle (1982) is estimated as follows:

$$h_t = \mu_1 + \sum_{i=1}^{q} \alpha_i u_{t-i}^2 \tag{6}$$

where μ_1 is a drift parameter and u^2_t is the squared disturbance obtained from the conditional variance equation. The drift parameter, μ_1 is assumed to be greater than zero ($\mu_1 > 0$) whilst the coefficients, α_i ($i = 1, \ldots , q$) are assumed to be greater than or equal to zero ($\alpha_i \geq 0$, $i = 1, \ldots , q$), since u_t is a random variable and the square of u_t can not be negative. For $\mu_1 > 0$ and $\alpha_i \geq 0$ ($i = 1, \ldots , q$), the h_t is positive. For sum of the coefficients, $\sum_{i=1}^{q} \alpha_i$ is less than or equal to one or all the roots of $1 - \sum_{i=1}^{q} \alpha_i$, that is, $1 - \alpha_1 z - \ldots - \alpha_q z^q = 0$ lie outside the unit cycle, the model is to be stable. The unconditional variance of u_t (σ^2) is given by $\sigma^2 = \frac{\mu_1}{1 - \sum_{i=1}^{q} \alpha_i}$.

The volatility from which ARCH models, that is ARCH(1) or Generalised ARCH (GARCH(1,1)) to be selected is the one having higher explanatory power of the regression, that is, produces the highest R^2 by estimating the following equation:[3]

$$\log u_t^2 = \beta_{20} + \beta_{21} \log h_t + w_{1,t} \tag{7}$$

where u^2_t is the squared disturbance of the mean equation, h_t is the conditional variance that is estimated by an ARCH model, and $w_{1,t}$ is a disturbance term.[4]

The Dickey and Fuller (1979) (DF) and Phillips and Perron (1988) (PP) unit root test statistics are used to examine the stationarity of the series. According to cointegration methodology, series that are integrated of the same order may cointegrate together. The cointegrated series may drift apart from each other in the short run but the distance between them

[3]The selection criterion based on higher explanatory power of the regression for which ARCH model to be selected is proposed by Pagan and Schwert (1990).
[4]The results of ARCH(1) of Korea, Hong Kong, and Singapore are reported in Table 2.

tends to be constant or to be stationary in the long run. More formally, a vector of series ($n \times 1$), y_t is said to be cointegrated if each of the series is integrated of the same order, an existing non-zero cointegrating vector ($n \times 1$), α' such that the linear combination of these series, $\alpha' y_t$ are stationary. Alternatively, it is said to be integrated of zero (Hamilton, 1994). In the context of multivariate, cointegration might exist even though some of the series are not integrated of the same order.[5]

The Pesaran, Shin, and Smith (2001) (PSS) bounds testing approach and the Johansen (1988) (J) cointegration method are used to examine the long-run relationship between terms of trade and trade balance. The bounds testing approach does not impose restrictive assumption that all the independent variables are to be integrated of the same order. In other words, independent variable could be I(0) or I(1). More specifically, the bounds testing approach is conducted in the following way. The unrestricted error correction model is specified as:

$$\Delta \log TB_t = \beta_{30} + \beta_{31} D_t + \sum_{i=1}^{p} \beta_{32i} \Delta \log TOT_{t-i} + \sum_{i=1}^{p} \beta_{33i} \Delta \log TB_{t-i}$$
$$\beta_{34} \log TB_{t-1} + \beta_{35} \log TOT_{t-1} + u_{3,t} \qquad (8)$$

where Δ is the first difference operator, D_t is the dummy variable to capture the influence of the Asian financial crisis, 1997-1998, and $u_{3,t}$ is a disturbance term. The Wald or F-statistic is computed to test the null hypothesis, H_0: $\beta_{34} = \beta_{35} = 0$ against the alternative hypothesis, H_a: $\beta_{34} \neq \beta_{35} \neq 0$. The critical bounds values can be obtained from Pesaran, Shin, and Smith (2001). If the Wald or F-statistic falls outside the upper bound, the null hypothesis of no cointegration is rejected. In other words, log TB_t and log TOT_t are said to be cointegrated. However, no conclusive inference could be made for the Wald or F-statistic falls inside the critical bounds, unless the order of integration of the independent variables is known. If the Wald or F-statistic falls below the lower bound, the null hypothesis of no cointegration cannot be rejected.

[5]See Charemza and Deadman (1999: 126-127) for the possibility of variables that are integrated of different orders to be cointegrated.

The Hansen (1992) (H) parameter stability tests are used to examine the stability of the long-run relationship between terms of trade and trade balance. When series are cointegrated, the Granger causality test is implemented as follows:[6]

$$\Delta \log TB_t = \beta_{40} + \sum_{i=1}^{p} \beta_{41i} \Delta \log TOT_{t-i} + \sum_{i=1}^{p} \beta_{42i} \Delta \log TB_{t-i} + \beta_{43} EC_{1,t-1} + u_{4,t} \tag{9}$$

$$\Delta \log TOT_t = \beta_{50} + \sum_{i=1}^{p} \beta_{51i} \Delta \log TOT_{t-i} + \sum_{i=1}^{p} \beta_{52i} \Delta \log TB_{t-i} + \beta_{53} EC_{2,t-1} + u_{5,t} \tag{10}$$

where $EC_{i,t-1}$ (i = 1, 2) is an error correction term and $u_{i,t}$ (i = 4, 5) is a disturbance term. For the joint test of lag variables of $\Delta \log TOT_t$ in equation (9) is significantly different from zero, it implies that terms of trade Granger causes trade balance. For the joint test of lag variables of $\Delta \log TB_t$ in equation (10) is significantly different from zero, it implies that trade balance Granger causes terms of trade. When series are not cointegrated, the Granger causality test is implemented by estimating equation (9) and (10) but without the error correction terms. The testing procedure is the same as when series are cointegrated. The impact of terms of trade volatility ($VTOT_t$) on trade balance is examined by replacing terms of trade with terms of trade volatility in equations (9) and (10).

The generalised forecast error variance decomposition and generalised impulse response function (Koop, Pesaran, and Potter, 1996; Pesaran and Shin, 1998) are used to examine the relationship of variables in a system. The generalised forecast error variance decomposition identifies the proportion of forecast error variance in one variable caused by the innovations in other variables in a system. Thus the relative importance of a set of variables that affect a variance of another variable is identified. The generalised impulse response function traces the dynamic responses of a variable to innovations in other variables in a system. The generalised forecast error variance decomposition and generalised impulse response function (Koop, Pesaran, and Potter, 1996; Pesaran and Shin, 1998) solve the orthogonalised problem of the forecast error variance decomposition and impulse response function of Sims (1980). The problem is that the

[6]This study examines Granger causality. In the Granger (1969) sense of a variable *X* causes another variable *Y* if the current value of *Y* can better be predicted by using the past values of *X*. Causality can also be examined using the PSS bounds testing approach as suggested by one reviewer of the bulletin. However, it could be a future direction of this study.

latter approaches are sensitive to the order of the variables in which they enter the vector autoregressive (VAR) system.

Trade balance (TB_t) is defined as (X_t / M_t), where X_t is exports and M_t is imports. Terms of trade (TOT_t) is defined as ($P_{x,t}$ / $P_{m,t}$) $\times$ 100, where $P_{x,t}$ is the exports price index (2000 = 100) and $P_{m,t}$ is the imports price index (2000 = 100). The data were obtained from *International Financial Statistics*, International Monetary Fund (IFS, IMF). The sample period is from 1979, quarter I to 2006, quarter III.[7] Figure 1 shows that terms of trade and trade balance tended to move in the same direction. The scatter plots of terms of trade and trade balance are given in Figure 2. Generally, there is no clear pattern between terms of trade and trade balance, except that for Singapore, the relationship between terms of trade and trade balance is seem to be negative.

4. Empirical results and discussions

The results of the DF and PP unit root test statistics are reported in Table 3. The lag length used to estimate the DF unit root test statistics is based on Schwarz Bayesian criterion (SBC). The lag length used to compute the PP unit root test statistics is based on Newey-West Bandwidth, with the maximum lag length is set to eight. Generally, the DF and PP unit root test statistics show that all series are non-stationary in level but becoming stationary after taking the first difference, except terms of trade volatility and trade balance of Hong Kong. However, for trade balance of Hong Kong it could be considered as a borderline case. Thus there is no long-run relationship between terms of trade volatility and trade balance (Hamilton, 1994).

The results of the PSS bounds testing approach are reported in Table 4. The choice of the lag used in the estimation of the test statistic is based on the SBC. On the whole, all the F-statistics fall outside the upper bound and statistically significant at the 5 percent level, except Korea. Thus evidence of cointegration among terms of trade and trade balance is not rejected and there is a long-run equilibrium between terms of trade and trade balance. The results of the J cointegration method are reported in Table 5. The λ_{Max} and λ_{Trace} test statistics are computed with restricted intercepts and no trends. The lag length of the vector autoregressive, which is used to

[7]In an early version of this study, the sample periods of Korea, Hong Kong, and Singapore are from 1963, quarter I to 1996, quarter IV, from 1973, quarter I to 2006, quarter III, and from 1979, quarter I to 2006, quarter III, respectively. One reviewer of the bulletin proposes to use the same sample period for the purpose of ‘comparison’.

compute the λ_{Max} and λ_{Trace} test statistics, is based on SBC. Generally, the λ_{Max} and λ_{Trace} test statistics show terms of trade and trade balance are cointegrated. On the whole, there is a long run relationship between terms of trade and trade balance.

The results of the cointegrating vector normalised by trade balance are reported in Table 6. Terms of trade and trade balance are found to be negatively cointegrated. The likelihood ratio test statistic, which tests the coefficient of terms of trade is zero is not rejected, except Singapore. The results of the H parameter stability tests, namely the supF, meanF, and Lc statistics are reported in Table 7. The supF is analogous to the recursive Chow test, and the meanF, and Lc statistics are tests for cointegration against the alternative of the parameter vector following a random walk (Hansen, 1992). All the tests statistics are not rejected, except Lc of Korea. Generally, this implies that there is stable long-run relationship between terms of trade and trade balance.

The results of the Granger causality test are reported in Table 8. The lag length used to compute the Granger causality test statistic is based on SBC. On the whole, there is no Granger causality between terms of trade and trade balance, except trade balance of Hong Kong is found to Granger cause its terms of trade. For Hong Kong also, there is Granger causality between terms of trade volatility and trade balance. However, terms of trade is found to have Granger cause trade balance in the long run as the error correction terms are found to be significant.

The generalised forecast error variance decomposition identifies the proportion of forecast error variance in one variable caused by the innovations in other variables in a system. Therefore the relative importance of a set of variables that affects a variance of another variable is identified. The results of the generalised forecast error variance decomposition are reported in Table 9.[8] The results of the generalised forecast error variance decomposition, which are reported, are based on the 1-5, 10, 15, and 20 horizon periods. The results show that the most important contributor to the forecast error variance of trade balance is itself. Terms of trade or terms of trade volatility contributes a small portion of the forecast error variance of trade balance. For Korea, terms of trade accounts for about 10 percent of the forecast error variance of trade balance. For Hong Kong and Singapore, terms of trade accounts for less than 10 percent of the forecast error variance of trade balance, respectively. For Korea and Singapore, terms of trade volatility accounts for less 1 percent of the forecast error variance of trade balance. For Hong

[8]All variables are in the first difference of the natural logarithm.

Kong, terms of trade volatility accounts about 3 to 12 percent of the forecast error variance of trade balance.

The generalised impulse response function traces the dynamic responses of a variable to innovations in other variables in a system. The results of the generalised impulse response function are shown in Figure 3.[9] The results of the generalised impulse response function are plotted over the 20 horizon periods or equivalent to five year periods. For Korea, the responses of trade balance to one standard error shock in terms of trade are positive and negative over about the 0-3 horizon periods and then die out. It seems to have a J-curve phenomenon. For Hong Kong, the responses of trade balance to one standard error shock in terms of trade are positive and negative over the whole horizon periods. For Singapore, the responses of trade balance to one standard error shock in terms of trade are fluctuated around zero over the 0-8 horizon periods and then die out.

Generally, the results of the cointegration tests show that there is a long-run relationship between terms of trade and trade balance. Hoque (1995) and Kouassi *et al.* (1998, 1999), amongst others also find that current account balance and terms of trade are cointegrated. The results of the normalised cointegrating vector show that an increase in terms of trade will lead to a decrease in trade balance in the long run, which implies that there is no HLM effect. This finding is consistent with the postulation of Obsfeld (1982) that an increase in terms of trade will lead to a decrease in trade balance in the long run. Otto (2003) also reports that an immediate effect of a positive shock to terms of trade is an increase in trade balance, but the effect reduces when terms of trade shock becomes more persistence. One possible explanation is that the sum of elasticities of exports price and import price is less than one.

Generally, there is no Granger causality between terms of trade and trade balance in the short run, except Hong Kong. However, terms of trade is found to have Granger cause trade balance in the long run. The finding that trade balance Granger causes terms of trade and not vice versa is contradict with the finding of Kouassi *et al.* (1999). In the short run, change of terms of trade is quickly translated in trade balance and thus pass information of terms of trade have no explanation power on current trade balance. One explanation is that these economies are relatively or very open to international trade. Moreover, the results of the generalised forecast error variance decomposition show that terms of trade contributes little to the forecast error variance of trade balance. The

[9] All variables are in the first difference of the natural logarithm.

results of the generalised impulse response function show that there is no systematic impact of terms of trade on trade balance. Bouakez and Kano (2008) report that terms of trade has little impact on current account and terms of trade volatility is argued have a significant impact on current account. The impact of terms of trade on trade balance when trade balance is measured as the difference between exports and imports is generally larger than when trade balance is measured as a ratio to GDP. Generally, this study finds some evidence that there is relationship between terms of trade and trade balance. More specifically, a change in terms of trade could have an affect on trade balance. Thus changes of demand and supply in the world markets could have an impact on trade balance of an economy. However, the impact of terms of trade on trade balance could be different across economies.

5. Concluding remarks

This study has examined the impact of terms of trade on trade balance. Moreover, this study has examined Granger causality between terms of trade and trade balance, and Granger causality between terms of trade volatility to trade balance. Generally, the DF and PP unit root test statistics show that all series are non-stationary in level but becoming stationary after taking the first difference, except terms of trade volatility. Generally, the results of the PSS bounds testing approach and the J cointegration method show that terms of trade and trade balance are cointegrated. In other words, there is a long-run relationship between terms of trade and trade balance. Moreover, in the long run, an increase in terms of trade will lead to a decrease in trade balance. Generally, the results of the H parameter stability tests show that relationship between terms of trade and trade balance is stable, except Lc of Korea. Generally, there is no Granger causality between terms of trade and trade balance in the short run. However, terms of trade is found to have Granger cause trade balance in the long run. On the whole, this study finds that there is relationship between terms of trade and trade balance. Terms of trade has some predictive power on trade balance.

Acknowledgements

The author would like to thank the reviewers of the bulletin for their comments on an earlier version of this article. All remaining errors are the author's.

References

Bouakez, H. and Kano, T. (2008) Terms of trade and current account fluctuations: the Harberger–Laursen–Metzler effect revisited. *Journal of Macroeconomics*, 30(1), 260-281.

Charemza, W.W. and Deadman, D.F. (1999) *New directions in econometric practice: General to specific modelling, cointegration and vector autoregression*. 2nd Edition, Cheltenham, United Kingdom: Edward Elgar.

Dibooglu, S. (2000) Aggregation supply, domestic absorption, and terms of trade: A structural decomposition of the U.S. trade balance. *The International Trade Journal*, 14(2), 147-168.

Dickey, D.A. and Fuller, W.A. (1979) Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, 74, 427-431.

Eicher, T.S., Schubert, S.F. and Turnovsky, S.J. (2007) Dynamic effects of terms of trade shocks: The impact on debt and growth. *Journal of International Money and Finance*, 1-21.

Engle, R.F. (1982) Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. *Econometrica*, 50, 987-1007.

Granger, C.W.J. (1969) Investigating causal relations by econometric models and cross spectral models. *Econometrica*, 37(3), 424-438.

Guillo, M.D. (2001) The trade balance and the terms of trade in a two-country two-sector OLG economy. *Spanish Economic Review*, 3, 71-80.

Hamilton, J.D. (1994) *Time series analysis*, Princeton, New Jersey: Princeton University Press.

Hansen, B.E. (1992) Tests for parameter instability in regressions with I(1) processes. *Journal of Business and Economics Statistics*, 20(1), 45-59.

Harberger, A.C. (1950) Currency depreciation, income and the balance of trade. *Journal of Political Economy*, 58, 47-60.

Hoque, A. (1995) Co-integration relationship between terms of trade and current account deficit: The Australian evidence. *Applied Economics Letters*, 2, 130-133.

Huang, K.X.D. and Meng, Q. (2007) The Harberger-Laursen-Metzler effect under capital market imperfections. *Journal of International Money and Finance*, 26, 1001-1015.

Jarque, C.M. and Bera, A.K. (1980). Efficient tests for normality, homoscedasticity and serial independence of regression residuals. *Economics Letters*, 6, 255-259.

Johansen, S. (1988) Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, 12, 231-254.

Koop, G., Pesaran, M.H. and Potter,S.M. (1996) Impulse response analysis in nonlinear multivariate models. *Journalof Econometrics*, 74, 119-147.

Kouassi, E., Decaluwe, B., Kapombe, C.M. and Colyer, D. (1998) Is it real? The long-run relation between terms of trade and current account deficits: The Ivory evidence. *Applied Economics Letters*, 5, 437-440.

Kouassi, E., Decaluwe, B., Kapombe, C.M. and Colyer, D. (1999) Temporal causality and the dynamic interactions between terms of trade and current account deficits in co-integrated VAR processes: Further evidence from Ivorian time series. *Applied Economics*, 31, 89-96.

Laursen, S. and Metzler, L.A. (1950) Flexible exchange rates and the theory of employment. *Review of Economics and Statistics*, 32, 281-299.

MacKinnon, J.G. (1996) Numerical distribution functions for unit root and cointegration tests. *Journal of Applied Econometrics*, 11, 1601-1618.

Obstfeld, M. (1982) Aggregate spending and the terms of trade: Is there a Laursen-Metzler effect? Quarterly Journal of Economics 97, 251-270.

Okiti, O.O. (2003) Temporary and permanent terms of trade shocks: A literature survey. *School of Economic Studies, University of Manchester Working paper*.

Ostry, J.D. and Reiniart, C.M. (1992) Private saving and terms of trade shocks: Evidence from developing countries. *International Monetary Fund Staff Papers*, 39, 495-517.

Otto, G. (2003) Terms of trade shocks and the balance of trade: There is a Harberger-Laursen-Metzler effect. *Journal of International Money and Finance*, 22, 155-184.

Pagan, A.R. and Schwert, G.W. (1990) Alternative models for conditional stock volatility. *Journal of Econometrics*, 45, 267-290.

Pesaran, H. and Shin, Y. (1998) Generalised impulseresponse analysis in linear multivariate models. *Economics Letters*, 58,17-29.

Pesaran, M. H., Shin, Y. and Smith, R.J. (2001) Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16, 289-326.

Phillips, P.C.B. and Perron, P. (1988) Testing for a unit root in time series regression. *Biometrika*, 75, 335-346.

Sachs, J.D. (1981) The current account and macroeconomic adjustment in the 1970s. *Brookings Papers on Economic Activity*, 1, 201-268.

Wong, H.T. (2006) Is there a long-run relationship between trade balance and terms of trade? The case of Malaysia. *Applied Economics Letters*, 13, 307-311.

Table 1
Openness to International Trade

Year	Korea	Hong Kong	Singapore
1971-1980	53.6	136.2	267.4
1981-1990	62.2	181.4	303.4
1991-2000	53.9	232.0	278.1
2001	60.5	234.8	277.5
2002	57.5	249.1	272.8
2003	61.3	287.5	293.4
2004	70.3	319.8	346.1
2005	69.3	331.4	368.2

Note: Openness to international trade is measured by exports plus imports of goods divided by GDP.

Table 2
The Result of the ARCH(1) Model for Terms of Trade

The mean equation:

$$\log TOT_t = \mu_0 + \sum_{i=0}^{k} \phi_i \log TOT_{t-i} + u_t$$

The conditional variance (h_t) equation:

$$\text{ARCH: } h_t = \mu_1 + \sum_{i=1}^{q} \alpha_i u_{t-i}^2$$

	Korea	**Hong Kong**	**Singapore**
μ_0	-0.0623	0.3151	-0.0533
	(-0.5902)	(1.6895)*	(-1.3080)
ϕ_1	1.0119	0.9313	1.0107
	(45.5705)***	(22.9819)***	(117.6234)***
μ_1	0.0012	0.00004	0.00009
	(7.1218)***	(7.7100)***	(3.9370)***
α_1	-0.0692	0.6110	0.5461
	(-0.9236)	(3.0937)***	(2.7001)***
Diagnostic tests for the normalised disturbance:			
Skewness	-0.1112	-0.2267	0.2059
Kurtosis	3.6255	5.3897	4.2701
Q(8)	6.0902	12.9535*	6.9975
Q(12)	12.1930	16.9662	12.6684
JB	2.0017	26.8701***	8.0970**
ARCH(8)	1.1592	5.6198***	0.3410
ARCH(12)	0.9837	5.0312***	0.8082
R^2	0.3005	0.3412	0.2949

Notes: log is the natural logarithm. TOT_t is terms of trade. The normalised disturbance is computed as the disturbance of the mean equation (u_t) divided by the conditional variance (h_t) or $\frac{u_t}{h_t}$. Q(.) is the Ljung-Box Q statistic, which the order of lagged used to compute the statistic is given in bracket. JB is the Jarque and Bera (1980) normality test statistic. ARCH(.) is the F-statistic for testing the autoregressive conditional heteroscedasticity, which the order of lagged used to compute the statistic is given in bracket. Values in parentheses under the coefficients are the t-statistic. *** (**,*) denotes significance at the 1% (5%, 10%) level.

Table 3
The Results of the Dickey and Fuller (1979) (DF) and Phillips and Perron (1988) (PP) Unit Root Test Statistics

	DF	PP
Korea		
log TB_t	-2.9910(0)	-2.7454(3)
Δ log TB_t	-12.3339***(0)	-15.0569***(2)
log TOT_t	0.6623(0)	-1.9243(5)
Δ log TOT_t	-9.9954***(0)	-11.6621***(5)
$VTOT_t$	-10.6462***(0)	-10.9774***(4)
Δ $VTOT_t$	-14.4611***(1)	-36.0277***(8)
Hong Kong		
log TB_t	-3.2703**(8)	-4.4490***(4)
Δ log TB_t	-3.6711***(7)	-13.0370***(8)
log TOT_t	-2.9763(0)	-3.1919**(4)
Δ log TOT_t	-10.2147***(0)	-10.215***(1)
$VTOT_t$	-1.9343(6)	-8.8888***(8)
Δ $VTOT_t$	-7.3751***(5)	-28.3540***(8)
Singapore		
log TB_t	-0.9080(1)	-1.0208(2)
Δ log TB_t	-15.0718***(1)	-15.6944***(1)
log TOT_t	-0.2799(0)	0.8721(6)
Δ log TOT_t	-11.8899***(0)	-10.9207***(6)
$VTOT_t$	-8.6226***(0)	-8.8330***(5)
Δ $VTOT_t$	-8.7337***(3)	-27.7866***(5)

Notes: The DF or PP t-statistic is estimated based on the model including an intercept. Values in parentheses are the lag length used in the estimation of the DF or PP unit root test statistic. Critical values can be obtained from MacKinnon (1996). *** (**) denotes significance at the 1% (5%) level.

Table 4
The Results of the Pesaran, Shin, and Smith (2001) (PSS) Bounds Testing Approach for Cointegration

	F-statistic
Korea	0.8341
Hong Kong	5.8156**
Singapore	4.6458**

Notes: The critical values for bounds testing approach are from Pesaran, Shin, and Smith (2001). The critical values for unrestrictive intercept and no trend case with two regressors at the 5% level are 3.79 for lower critical bound, I(0) and 4.85 for upper critical bound, I(1). ** denotes significance at the 5% level.

Table 5
The Results of the Johansen (1988) (J) Likelihood Ratio Test Statistics

	λ_{Max} **Test Statistic**		λ_{Trace} **Test Statistic**	
H_0:	r=0	r<= 1	r=0	r<= 1
H_a:	r=1	r= 2	r≥1	r≥2
Korea	21.03**	0.36	21.39**	0.36
Hong Kong	12.22	7.00	19.23**	7.00
Singapore	29.89**	0.82	30.71**	0.82
c.v.	14.88	8.07	17.86	8.07

Notes: For Korea and Singapore, VAR = 1 is used in the estimation. For Hong Kong, VAR = 6 is used in the estimation. ** denotes significance at the 95% level.

Table 6
The Results of the Normalised Cointegrating Vector

Korea	$\log TB_t = -\ 0.2386 \log TOT_t$
	(2.2008)
Hong Kong	$\log TB_t = -\ 0.1947 \log TOT_t$
	(0.0112)
Singapore	$\log TB_t = -\ 0.9160 \log TOT_t$
	(24.5636)***

Notes: For Korea and Singapore, VAR = 1 is used in the estimation. For Hong Kong, VAR = 6 is used in the estimation. Values in the parentheses are the likelihood ratio test statistic to test terms of trade is zero. *** denotes significance at the 1% level.

Table 7
The Results of Hansen (1992) (H) Parameter Stability Tests

	SupF	L_C	MeanF
Korea	0.4576	5.6912**	9.9242
Hong Kong	0.2299	1.2818	3.0083
Singapore	0.1644	2.0053	6.3888

Notes: The H parameter stability tests are estimated by including a constant in the regression equation. ** denotes significance at the 5% level.

Table 8
The Results of the Granger Causality Test

	EC_{t-1}	$\Delta \log TOT \rightarrow \Delta \log TB$
Korea	-3.5032***	1.7993
Hong Kong	-1.8173*	8.8024
Singapore	-2.7414***	5.6100
	EC_{t-1}	$\Delta \log TB \rightarrow \Delta \log TOT$
Korea	1.3229	1.6147
Hong Kong	0.4718	21.1415***
Singapore	-0.9985	0.8109
		$VTOT \rightarrow \Delta \log TB$
Korea		0.2490
Hong Kong		18.1165**
Singapore		0.0119
		$\Delta \log TB \rightarrow VTOT$
Korea		0.9410
Hong Kong		61.9412***
Singapore		0.3118

Notes: The arrow "→" denotes no Granger causality. *VTOT* denotes terms of trade volatility. *** (**,*) denotes significance at the 1% (5%, 10%) level.

Table 9
The Generalised Forecast Error Variance Decomposition

Panel A

	Korea		**Hong Kong**		**Singapore**	
Horison	$\Delta \log TB_t$	$\Delta \log TOT_t$	$\Delta \log TB_t$	$\Delta \log TOT_t$	$\Delta \log TB_t$	$\Delta \log TOT_t$
0	1.0000	0.0988	1.0000	0.0201	1.0000	0.0150
1	0.9780	0.1037	0.9952	0.0250	0.9831	0.0229
2	0.9775	0.1040	0.9870	0.0395	0.9748	0.0318
3	0.9775	0.1040	0.9468	0.0802	0.9698	0.0357
4	0.9775	0.1040	0.9500	0.0700	0.9571	0.0499
5	0.9775	0.1040	0.9488	0.0725	0.9571	0.0499
10	0.9775	0.1040	0.9470	0.0706	0.9560	0.0510
15	0.9775	0.1040	0.9465	0.0691	0.9560	0.0510
20	0.9775	0.1040	0.9469	0.0683	0.9560	0.0511

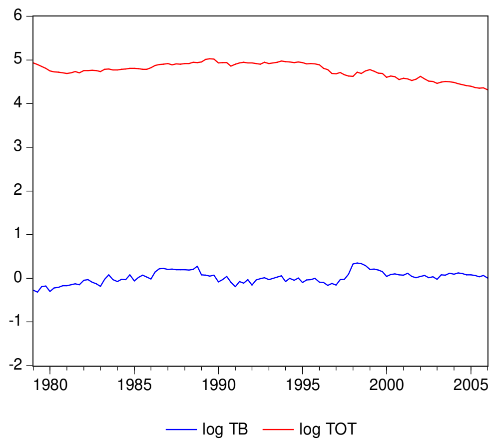
Panel B

	Korea		**Hong Kong**		**Singapore**	
Horison	$\Delta \log TB_t$	$VTOT_t$	$\Delta \log TB_t$	$VTOT_t$	$\Delta \log TB_t$	$VTOT_t$
0	1.0000	0.0009	1.0000	0.0311	1.0000	0.0000
1	0.9976	0.0040	1.0000	0.0307	0.9999	0.0001
2	0.9973	0.0044	0.9999	0.0313	0.9999	0.0001
3	0.9973	0.0044	0.9997	0.0320	0.9999	0.0001
4	0.9973	0.0044	0.9991	0.0299	0.9999	0.0001
5	0.9973	0.0044	0.9964	0.0358	0.9999	0.0001
10	0.9973	0.0044	0.8995	0.1249	0.9999	0.0001
15	0.9973	0.0044	0.8953	0.1253	0.9999	0.0001
20	0.9973	0.0044	0.8945	0.1207	0.9999	0.0001

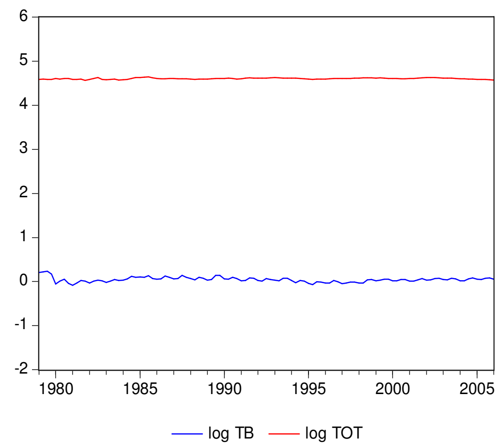
Notes: For panel A, VAR = 1, VAR = 5, and VAR = 4 are used in the estimations for Korea, Hong Kong, and Singapore, respectively. For panel B, VAR = 1, VAR = 8, and VAR = 1 are used in the estimations for Korea, Hong Kong, and Singapore, respectively.

Figure 1
The Plots of the Natural Logarithms of Terms of Trade and Trade Balance

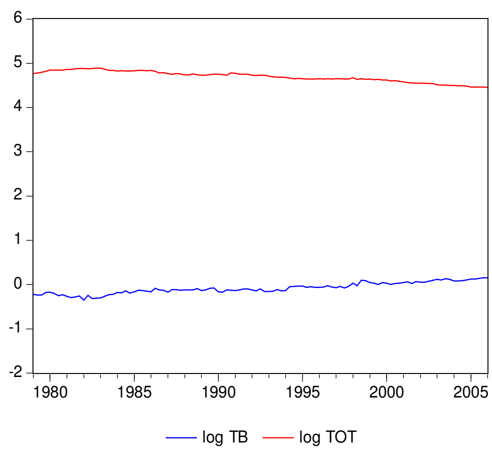
Korea



Hong Kong

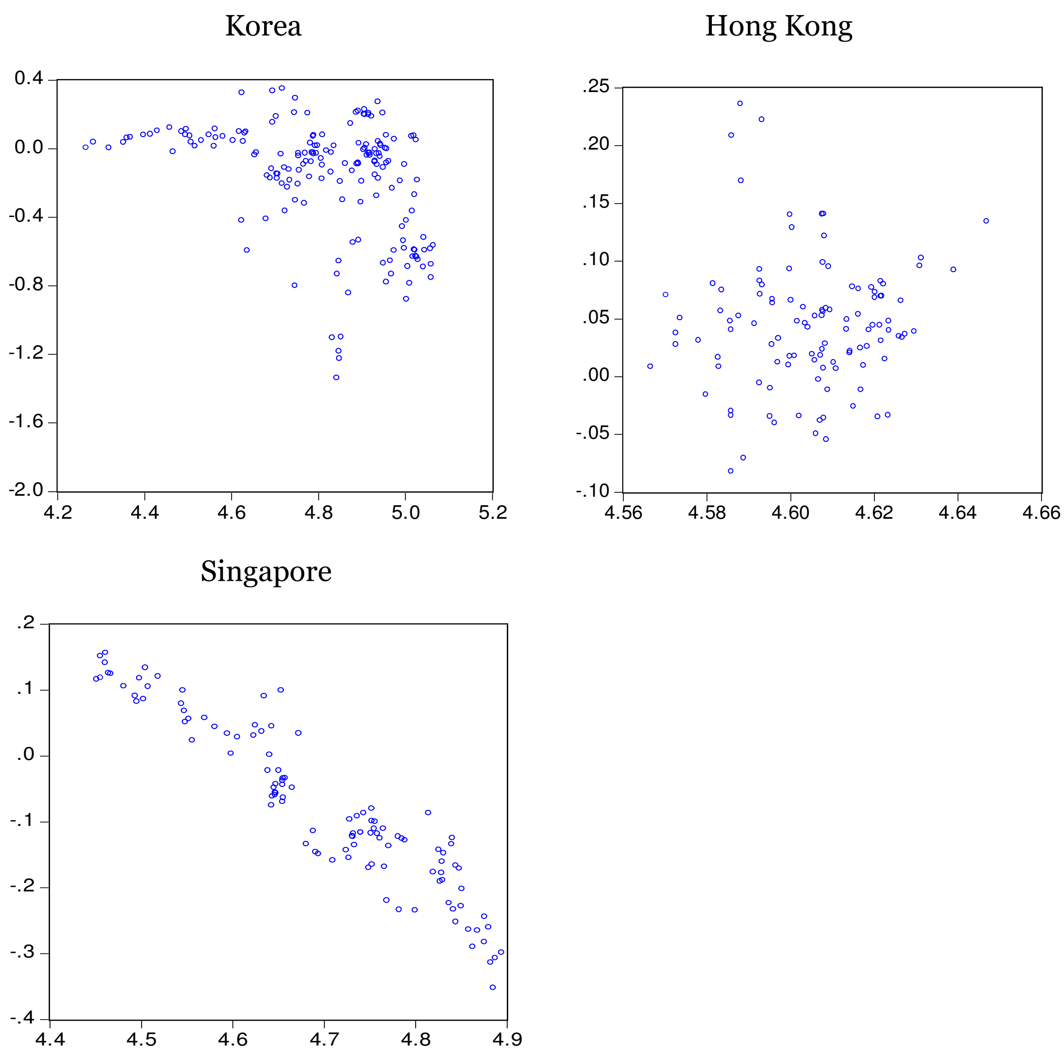


Singapore



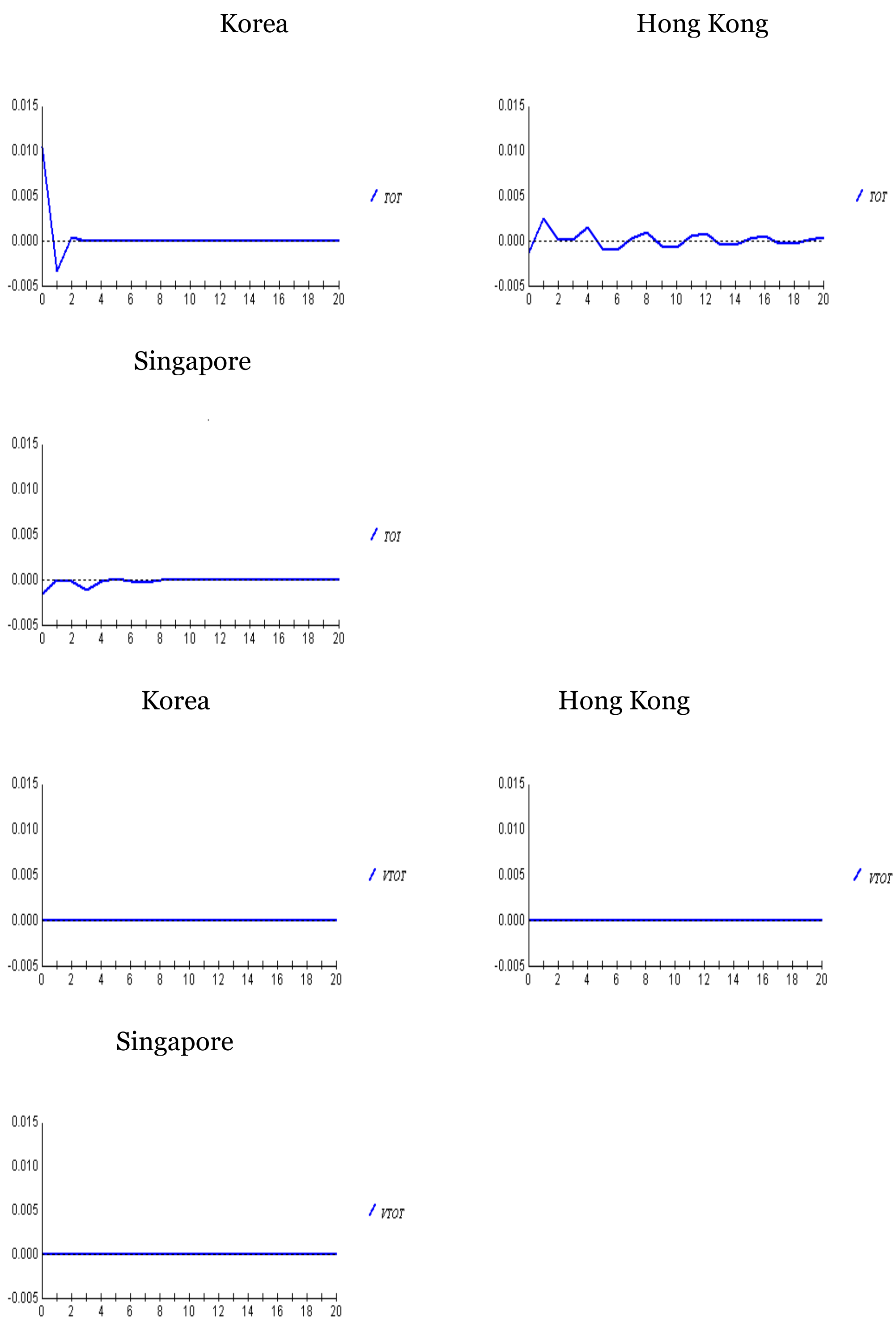
Source: IFS, IMF.

Figure 2
The Scatter Plots of the Natural Logarithms of Terms of Trade (log TOT_t) and Trade Balance (log TB_t)



Note: The vertical axis indicates log TB_t and the horizontal axis indicates log TOT_t.

Figure 3
Plots of the Generalised Impulse Response Functions to One Standard Error Shock in the Equation for the First Difference of the Natural Logarithm of Trade Balance (Δ log TB_t)



Note: TOT = Δ log TOT_t and $VTOT$ = $VTOT_t$.