US-AUSTRALIA TRADE BALANCE AND EXCHANGE RATE DYNAMICS

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ABSTRACT

This paper seeks to explore the dynamics between changes in nominal bilateral exchange rate and nominal trade balance in the US-Australia case. Monthly data are utilized from January, 1995 through June, 2014. The unit root tests find nonstationarity of each variable in level with I(1) behavior. Both variables are cointegrated as unveiled by and tests. The vector error-correction model (VECM) shows unidirectional long-run causal flow from lagged exchange rate changes to the current change in trade balance with interactive short-run feedback effects. The Impulse Response analysis does not reveal any clear patterns. So, the potency of exchange rate policy to influence trade balance remains in doubts for these two countries. **JEL classifications**: F10, F14, F15

INTRODUCTION

The interaction between trade balance and exchange rate is an important topic of international economics. The traditional method of assessing the impact of currency devaluation was to estimate the well-known Marshall-Lerner (ML) Condition. According to this condition, if the sum of import and export demand elasticities add up to more than unity, devaluation or depreciation could improve the trade balance in the long run. The concept of J-curve was introduced by Magee in 1973. This described the phenomenon of initial deterioration in trade balance in the short run and subsequent improvement in the long run resulting in a pattern of movement that resembles the letter J. since 1973, researchers published numerous academic articles for many countries testing the validity of the J-curve. They produced mixed empirical results. A detailed review of literature on this topic is available in Bahmani-Oskooee and Ratha (2004).

Given the implications of the J-curve for the conduct of macroeconomic stabilization polices, its empirical estimation has been a subject of interest. A number of studies have estimated the effect of a change in the real exchange rate on the balance of trade and have confirmed the existence of the J-curve (Artus 1975, Miles 1979, Spitaller 1980, Helkie and Hooper 1987, Krugman and Baldwin 1987, and Marwah and Klein 1996). However, Rose and Yellen (1989), using the data on the U.S. bilateral trade with the G-7 countries as well as the aggregate U.S. trade, did not find any statistically significant evidence for the J-curve. Rose and Yellen's findings are important because theirs is the first time series econometric study that refutes the empirical validity of the J-curve.

The United States is Australia's most important economic partner country. The trade and investment links have been deepening under the Australia-United States Free Trade Agreement (AUSFTA) since January 1, 2005. Historically, Australia has persistently huge trade deficit with the USA as the record shows for 1985-2012. On average, annual total

imports from the USA have been more than double of its annual total exports to USA.

The focus of this study is to reassess the dynamic relationship between changes in bilateral nominal exchange rate and trade balance involving the USA and Australia. The rest of the paper proceeds in the following sequence. Brief review of the related literature, empirical methodology, empirical results and conclusions with some policy implications.

BRIEF REVIEW OF THE RELATED LITERATURE

Numerous studies investigated the relationship between exchange rate and trade balance revolving around the J-curve phenomenon that has been analyzed extensively for a wide variety of countries employing different data sets and econometric techniques. This area of research has met with mixed results. Examples of papers finding support for the J-curve include Marwah and Klein (1996), Bahmani-Oskooee and Alse (1994) and Hacker and Hatemi (2003). Evidence of a weak or 'delayed' J-curve has also been found by several authors such as Rosensweig and Koch (1988), Yusoff (2007) and Bahmani-Oskooee and Bolhasani (2011). Other authors such as Rose and Yellen (1989), Rose (1991), Hsing (2009), Hsing and Savvides (1996), and Mehmet and Mushtag (2010) have not found any evidence of a J-curve in the data.

Using data from 14 countries, Miles (1979) found no evidence for the J-curve effect suggesting that devaluation caused only a readjustment between various accounts of the balance of payments and that it did not improve the trade balance. On the other hand, using a four-country sample, Bahmani-Oskooee (1985) found evidence of a J-curve for Greece, India and Korea, while rejecting the J-curve effect for Thailand. Using a dynamic general equilibrium model, Brissimis and Leventankis (1989) confirmed evidence of the J-curve for Greece. Utilizing new time series econometric methods and a sample of 19 developed and 22 developing countries, Bahmani-Oskooee and Alse (1994) only found evidence of a J-curve effect for four countries (Costa Rica, Ireland, the Netherlands and Turkey). Backus, et al. (1998) found statistically significant evidence for the presence of a J-curve for Japan. Using a similar technique, Demirden and Pastine (1995) found strong evidence of J-curve effects for the USA.

In order to mitigate aggregation bias that could result from aggregate data, some studies have moved to bilateral trade data to investigate the J-curve effect. For instance, Marwah and Klein (1996) used quarterly data for the US and Canada with their major trading partners and found some evidence of the existence of the J-curve. Bahmani-Oskooee and Ratha (2004) examined the US trade balance with industrialized countries and found no specific pattern of a J-curve. Wilson (2001) used VAR methods to examine J-curve effects for three Asian countries (Singapore, Malaysia and South Korea), but found evidence of a J-curve only for South Korea.

Rose (1990) examined the relationship for a sample of developing countries and found no evidence of the J-curve. Bahmani-Oskooee and Ratha (2004) considered 18 major trading partners of the United States (Australia, Austria, Belgium, Canada, Demark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland and U.K.) and were unable to discover any J-curve pattern in the short run, although real depreciation of dollar revealed favorable effects on the U.S. trade balance in most cases.

In contrast, Mahdavi and Sohrabian (1993) found evidence of a delayed J-curve for the USA. Demirden and Pastine (1995) also found evidence of the J-curve for the USA.

Kale (2001) found evidence of the J-curve for Turkey. Narayan (2004) concluded that New Zealand's trade balance exhibited a J-curve pattern following a depreciation of the New Zealand dollar. Kulkarni (1994) found the evidence of the J-curve phenomenon for Egypt and Ghana. In this study, Kulkarni also suggested the possibility of a shifting J-curve phenomenon for these countries over time. In another study, Kulkarni and Bhatia (2002) found the evidence of J-curve in six out of seven different countries (the Philippines, Kenya, Japan, Indonesia, Mexico, China, and Spain) with the exception of China.

The dynamics of consumption smoothing and capital formation of small-open-economies of LDCs give rise to the S-curve in the presence of productivity shocks only (Senhadji, 1998). For these countries, the trade balance determines the net foreign exchange receipts while the terms of trade determine their purchasing power. Additionally, Bahmani-Oskooee (1986b) found evidence of a W-curve for the U.S. current account using quarterly data for 1973-1985. This describes that subsequent to depreciation of the dollar, the current account deteriorated for two quarters and then started improving for five quarters, again deteriorated and finally improved. Rahman and Islam (2006) examined the dynamics of Taka-Dollar exchange rate and Bangladesh trade balance using quarterly data for 1972-2003. They found evidence of J-curve with significant deterioration in the short run and slow improvement in the long run.

Several studies have employed Australian data to examine the J-curve phenomenon. Arndt and Dorrance (1987) adopted a descriptive approach to infer that the Australian trade balance has exhibited J-curve behaviour. However, using a more advanced statistical approach, both Flemingham (1988) and Karunaratne (1988) found no evidence of the J-curve for Australia. Utilizing bilateral trade data and cointegration methodology, Bahmani-Oskooee et al. (2005) find a J-curve effect for only 3 of the 23 Australian trading partners which they examined. Another paper by Bahmani-Oskooee and Wang (2006) examined the J-curve effect using bilateral trade data between Australia and the US for 108 industries. They found evidence of the J-curve only for 35 industries.

EMPIRICAL METHODOLOGY

The standard estimating base model is specified as follows: TB = f(ER)
Where, TB = US-Australia nominal trade balance, and ER = US dollar per Australian dollar (nominal bilateral exchange rate). Monthly data are used from January, 1995 through June, 2014. In terms of years, the sample period may deem relatively inadequate for meaningful cointegration analyses. However, the use of high frequency monthly data may help partially compensate for this deficiency (Zhou, 2001). Due to the application of monthly data, home country and foreign country GDP data are excluded in this paper for consideration since they are available either annually or quarterly. The data are obtained from the direction of Trade and the International Financial Statistics, published by the IMF. Another data source includes the Australian Bureau of Statistics. Finally, the estimating model in linear form in level is expressed as follows:

TB = a + bER + e   (1)

Prior to testing for cointegration, the time series properties of the variables involved are examined. To test for unit root (nonstationarity) in the variables, the modified Dickey-Fuller test, the modified Phillips-Perron test (Elliot et al., 1996; Ng and Perron, 2001) and their counterpart KPSS (Kwiatkowski, Phillips, Schmidt and Shin, 1992) test for no unit root (stationarity) are implemented instead of the standard ADF and PP tests for their

high sensitivity to the selection of lag-lengths. It is important to examine the time series properties of variables since an application of Ordinary Least Squares (OLS) to estimate a model with nonstationary time series data results in the phenomenon of spurious regression (Granger and Newbold, 1974) invaliditating the inferences through the standard t-test and joint F-test (Phillips, 1986). To be cointegrated, nonstationary time series variables must possess the same order of integration, i.e., each variable must become stationary on first-order differencing depicting I (1) behavior.

Second, the cointegration procedure, as developed in Johansen (1988, 1992, and 1995) and Johansen and Juselius (1990), is implemented that allows interactions in the determination of the relevant macroeconomic variables and being independent of the choice of the endogenous variable. It also allows explicit hypothesis testing of parameter estimates and rank restrictions using likelihood ratio tests. The empirical exposition of the Johansen-Juselius methodology is as follows:

$$\Delta V_t = \tau + \Omega V_{(t-1)} + \sum_{(j=1)}^{(k-1)} \Omega_j \Delta V_{(t-j)} + m_t \qquad (2)$$

where, denotes a vector of ER and TB, and. Here, is the speed of adjustment matrix and is the cointegration matrix. Equation (2) is subject to the condition that is less-than-full rank matrix, i.e., r < n. This procedure applies the maximum eigenvalue test and trace test for null hypotheses on r. Both tests have their trade-offs. test is expected to offer a more reliable inference as compared to test (Johansen and Juselius (1990), while test is preferable to test for higher testing power (Ltkepohl, et al., 2001)). However, the Johansen-Juselius test procedure is also not immune to super sensitivity to the selection of lag-lengths. The optimum lag-lengths are determined by the AIC (Akaike Information Criterion), as developed in Akaike (1969).

Third, on the evidence of cointegrating relationship between the variables, there will exist an error-correction representation (Engle and Granger, 1987). The vector error-correction model takes the following form:

$$\Delta TB_t = \beta_1 e_{(t-1)} + \sum_{(i=1)}^{k} \phi_i \Delta TB_{(t-i)} + \sum_{(j=1)}^{k} \delta_j \Delta ER_{(t-j)} + u_t \qquad (3)$$

Equation (3) corresponds to original equation (1). Here, is the error-correction term of equation (3). If is negative and statistically significant in term of the associated t-value, there is evidence of a long-run causal flow to the dependent variable from the relevant explanatory variables. If δ's and ϕ's do not add up to zero, there are short-run interactive feedback relationships in equation (3).

EMPIRICAL RESULTS

To describe the data distribution of each variable, the following standard statistical descriptors are reported:

TABLE 1: DESCRIPTIVE STATISTICS
Sample (January, 1995 – June, 2014)

SERIES	MEAN	MEDIAN	STDEV	SKEWNESS	KURTOSIS	JARAQUE-BERA
TB	-802.414	-799.9014	252.1205	-0.6069	3.4718	14.27407
ER	0.73411	1.3485	0.1357	0.35531	3.7109	14.95362

As observed in Table 1, the distribution of US-Australia trade balance (TB) is slightly skewed to the left and that of exchange rate (US $/AU $) is slightly skewed to the right. The numerics of respective kurtosis and Jarque-Bera statistic suggest near-normal distribution of each variable. Moreover, the simple correlation between these variables is -0.836.

Furthermore, some degree of comovement is observed between bilateral trade balance and exchange rate (Appendix-A).

To examine the non-stationary property of each time series variable, DF-GLS, Ng-Perron, and KPSS tests are implemented. They are presented as follows:

TABLE 2: UNIT ROOT TESTS*
Sample (January, 1995 – June, 2014)

SERIES	LEVEL			FIRST DIFFERENCES		
	DF-GLS	Ng-PERRON	KPSS	DF-GLS	Ng-PERRON	KPSS
TB	-0.2448	-2.2995	0.9902	-11.8476	-10.7772	0.2727
ER	-0.0478	-3.9405	0.8824	-9.6740	-29.1592	0.20722

*The modified Dickley-Fuller (DF-GLS) critical values are -2.653 and -1.954 at 1% and 5% levels of significance, respectively.
The modified Phillips-Perron (Ng-Perron) critical values are -13.00 and -5.70 at 1% and 5% levels of significance, respectively.
The KPSS critical values are 0.70 and 0.347 at 1% and 5% levels of significance, respectively.

In Table 2, DF-GLS and Ng-Perron tests fail to reject the null hypothesis of unit root (non-stationarity) at both 1% and 5% levels of significance. Their counterpart, the KPSS also rejects the null hypothesis of no-unit root (stationarity) at the same levels of significance leading to an identical conclusion. On first-differencing, each variable becomes stationary depicting I(1) behavior, as observed above.

Since both variables are nonstationary in levels with I(1) behavior, the Johansen-Juselius procedure is applied for cointegration between the variables. The and test results are reported as follows:

TABLE 3
TRADING VOLUME EFFECTS
Market-Adjusted Volume Effects Evaluating Trading Volumes of
Days after the Announcement Day (=Day -10), and around First Trading Day (= Day 0), with respect to the Changes of Mean Volume in the Prior Eight Weeks

	Additions		Deletions	
Period	Mean VR	t-Statistic	Mean VR	t-Statistic
Days -9, -8	3.343	1.596*	1.123	1.251
Days -2, 0	6.939	3.314***	3.897	4.338***
Day 0	15.641	7.470***	8.819	9.817***

*denotes rejection of the null hypothesis at the 0.05 level of significance.
** MacKinnon-Haug-Michelis (1999) p-values

Table 3 reveals that both and test results clearly reject the null hypothesis of no cointegration between US-Australia trade balance and exchange rate at 5% level of significance confirming a long-run converging equilibrium relationship between the variables. In light of the above, a bivariate error-correction model (ECM) is estimated. The estimates of ECM (3) are reported as follows:

$$\Delta TB_t = -0.6045\ e_{(t-1)} - 0.1721\ \Delta TB_{(t-1)} - 0.1730\ \Delta TB_{(t-2)} + -6.3143 \Delta ER_{(t-1)}$$
$$\qquad (-5.6731) \qquad (-3.1943) \qquad\qquad (-2.3675) \qquad\qquad (-1.9600)$$
$$\qquad + 11.5052\ \Delta ER_{(t-2)}$$
$$\qquad\qquad (2.3841)$$

$R^2 = 0.40$, $F = 27.39$, $AIC = 12.76$

As observed , the coefficient of the error-correction term has expected negative sign, and it is statistically highly significant in terms of the associated t-value within parenthesis. This confirms long-run causal flow from change in exchange rate towards the current change in trade balance. The numerical coefficients of lagged changes in trade balance and exchange rate with their statistical significance in terms of the associated t-values unveil short-term interactive dynamics between the above variables.

To add further, the Impulse Response analysis that shows how trade balance responds to a given exchange rate shock (Appendix-B) reveals no clear patterns. In fact, figure 2 in this Appendix unveils no improvement in Australia's chronic trade deficit with the USA even if its currency is allowed to depreciate against US dollar. Counter-intuitively, the bilateral trade deficit may even worsen further.

CONCLUSIONS WITH SOME POLICY IMPLICATIONS

Time series monthly data on bilateral nominal exchange rate and nominal trade balance between the USA and Australia are nonstationary in levels depicting I(1) behavior. Both variables are found co-integrated, based on both tests. There are evidences of long-run unidirectional causal flow from exchange rate changes to changes in trade balance with short-run interactive dynamic feedback effects.

The impulse response analysis in figure 3 (Appendix A) shows that a deliberate policy of currency depreciation against US dollar is very unlikely to cure its chronic trade deficit with the USA. So, Australia should pursue other macroeconomic policy measures to improve its persistent trade deficit with the USA in lieu of exchange rate policy as the findings cast doubts on the potency of such policy. Long-run macroeconomic stabilization policies and export promotion through targeted marketing strategies in conjunction with accelerating export facilitation services are likely to be fruitful to reduce Australia's chronic trade deficit with the USA.

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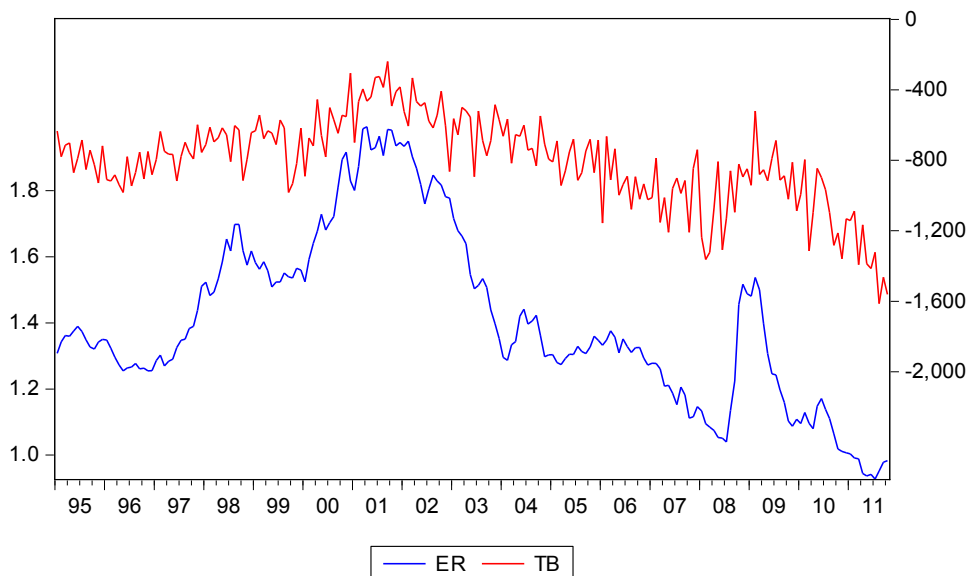Rose, A.K., (1990), "Exchange Rates and the Trade Balance: Some Evidence from

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Appendix-A
Comovement between Bilateral Trade Balance and Exchange Rate
US-AUSTRALIA TRADE BALANCE
TB = Trade balance between US and Australa and ER = US$/AU$

Appendix-B
Impulse Response Analysis
(Response to Cholesky One S.D. Innovations)

Response of TB to TB — Figure 1

Response of TB to ER1 — Figure 2

Response of ER1 to TB — Figure 3

Response of ER1 to ER1 — Figure 4