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Are Imports and Exports of Australia Cointegrated?

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Abstract

Few studies in the literature have investigated the response of Australian external accounts to macroeconomic policies by directly constructing and estimating some reduced form models. In this paper we offer an alternative method of testing the effectiveness of those policies by investigating the long-run convergence between Australian imports and exports. The application of cointegration technique revealed that Australian imports and exports are indeed cointegrated with cointegrating coefficient very close to unity indicating that indeed Australia's macroeconomic policies have been effective in the long-run.

I. Introduction

In recent years some researchers have tried to analyze the performance of Australia's trade balance. On one hand, some like Felmingham and

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1. The J-Curve term is used to describe the short-run response of the trade balance to devaluation. After devaluation, the trade balance may deteriorate for a while and improvement could come after passage of some time. For more on the J-Curve, see Bahmani-Oskooee [1985] and Arndt and Dorrance [1987].

Divisekera [1986] and Felmingham [1988] have tried to detect the J-Curve by relying upon the response of the Australian trade balance to a change in its terms of trade.[1] They have found no J-Curve effect in the short-run and no favorable response in the long-run. Based on these findings, Felmingham [1988, p. 54] concluded that:

> "Australian policy makers have every reason to be pessimistic about low import and export demand elasticities, but there are apparently no quick fixes for the nation's international trade dilemma."

After arguing that the terms of trade cannot be used to infer the effects of devaluation on the trade balance, Bahmani-Oskooee and Pourheydarian [1991] investigated the effects of real effective exchange rate and found empirical results supporting a short-run "delayed J-Curve" and a positive long-run response of the Australia's trade balance to depreciation.

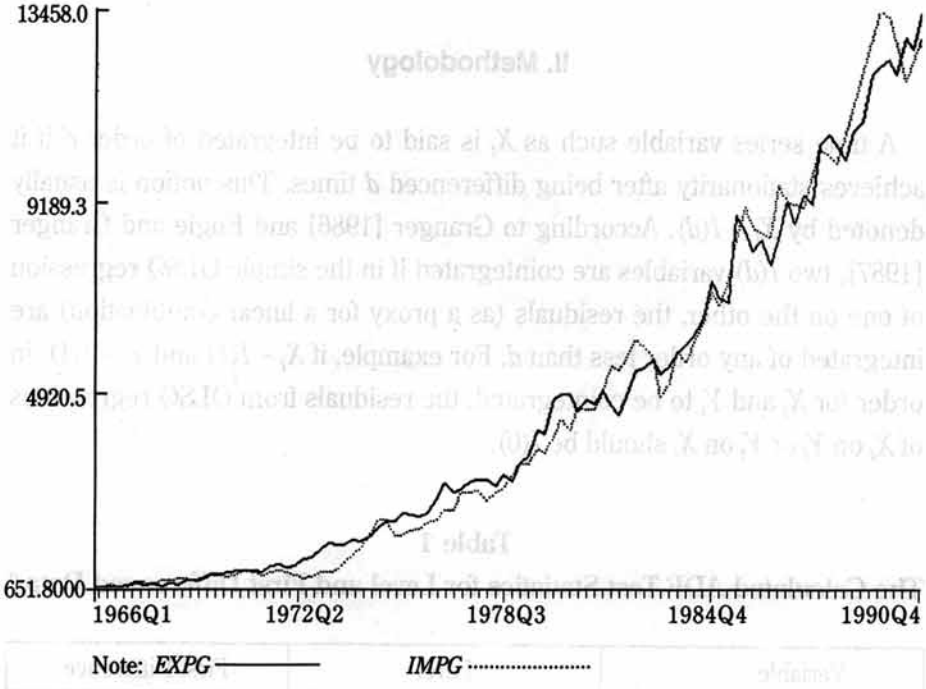
Karunarante [1988] is another author who, in addition to the exchange rate, tried to identify the other macroeconomic determinants (such as measures of fiscal and monetary policies) of the Australia's current account. He concluded that:

> "This suggests the prevalence of serious misalignment of macro policies and the need for their proper assignment in order that the real exchange rate and real interest rates achieve the goal of current account sustainability." (p. 723).

Again, after pointing out the flaws associated with Karunarante's results and conclusion, using Karunarante's macro model and data base Bahmani-Oskooee [1993] showed that all macro economic determinants of Australia's current account do exert significant effects on its trade balance that are in line with the theory.

In this paper we follow an alternative approach to study the behavior of Australia's trade balance and current account. Given the stance of fiscal, monetary, and exchange rate policies implemented by Australian authorities to cope with their internal and external imbalances, our concern is to determine whether the Australia's trade deficit is a short-run phenomenon during which its exports and imports may drift apart and whether they have a tendency to converge toward an equilibrium in the long-run. Convergence toward an equilibrium could be an indication of the fact that trade deficit is sustainable, perhaps by the means of current macro policies one of which is

Figure 1
Plot of Exports of Goods (*EXPG*) and Imports of Goods (*IMPG*) in Millions of A$ over 1966-1990.



the flexible Australian dollar.[2] To get some insight into the behavior of Australia's exports and imports, we plot them in figure 1 for the period of our analysis, *i.e.*, 1966-1990.

From figure 1 it is obvious that although exports and imports drift apart at times, they have a tendency to track each other and converge. However, this needs to be proved scientifically using recent statistical developments in the literature.

The Engle and Granger [1987] cointegration technique is employed to establish the long-run relation between exports and imports. As a matter of fact Granger [1986, p. 213] made a reference to imports and exports for which the cointegration technique could be applied.[3] Section II outlines briefly Engle-Granger technique. Section III presents our empirical findings,

2. For review of Australia's exchange rate policy see Felmingham [1994].
3. For the case of U.S. exports and imports, see Husted [1992].

supporting the notion that there is a long-run equilibrium relation between exports and imports of Australia. Section IV concludes. Data definitions and sources are cited in the appendix.

II. Methodology

A time series variable such as X_t is said to be integrated of order d if it achieves stationarity after being differenced d times. This notion is usually denoted by $X_t \sim I(d)$. According to Granger [1986] and Engle and Granger [1987], two $I(d)$ variables are cointegrated if in the simple OLSQ regression of one on the other, the residuals (as a proxy for a linear combination) are integrated of any order less than d. For example, if $X_t \sim I(1)$ and $Y_t \sim I(1)$, in order for X_t and Y_t to be cointegrated, the residuals from OLSQ regressions of X_t on Y_t or Y_t on X_t should be $I(0)$.

Table 1

The Calculated ADF Test Statistics for Level and First Differenced Data.[a]

Variable	Level	First Difference
Log *EXPG*	–0.54[4][b]	–5.41[4]
Log *IMPG*	–0.44[1]	–6.76[1]
Log *EXPGS*	–0.27[4]	–5.96[3]
Log *IMPGS*	–0.28[4]	–5.26[3]
Log *(EXPG/PX)*	–1.63[2]	–8.91[1]
Log *(IMPG/PM)*	–1.64[1]	–5.75[4]
Log *(EXPG/GNP)*	–3.60[4]	–
Log *(IMPG/GNP)*	–3.10[4]	–
Log *(EXPGS/GNP)*	–3.92[4]	–
Log *(IMPGS/GNP)*	–2.76[4]	–

Notes: a. The critical value of the ADF statistic from the Fuller's [1976, p. 373] table for 100 observations is –2.89 at the usual 5% level and –2.58 at the 10% level of significance.

b. Numbers inside the brackets are the number of lags in the ADF test.

Table 2
The ADF Test Applied for the Residuals of the Cointegration Equations

Dependent Variable	Independent Variable	Constant	Slope	$\bar{R}^2$	ADF [k][a]
Log *EXPG*	log *IMPG*	0.4207	0.9529	0.98	–3.64[2]
		(4.29)[b]	(78.4)		
Log *IMPG*	log *EXPG*	–0.3091	1.0330	0.98	–3.61[2]
		(2.89)	(78.5)		
Log *EXPGS*	Log *IMPGS*	0.0778	0.9508	0.99	–3.53[2]
		(2.68)	(95.2)		
Log *IMPGS*	Log *EXPGS*	–0.0517	1.0404	0.99	–3.54[2]
		(1.67)	(95.2)		
Log*(EXPG/PX)*	Log*(IMPG/PM)*	–3.6275	1.3876	0.77	–3.87[3]
		(5.37)	(18.1)		
Log*(IMPG/PM)*	Log*(EXPG/PX)*	4.0381	0.5558	0.77	–4.46[3]
		(15.2)	(18.1)		

Notes: a. The critical values of ADF statistic for the residuals and for 100 observations at the 5% level is –3.17. This value is from Engle and Yoo [1987, Table 3].
b. Numbers inside the parentheses below coefficients are the absolute value of the t-ratios.

III. Empirical Results

In this section we apply the cointegration technique to Australia's exports and imports using quarterly data over 1966I-1990IV period with a total of 100 observations. Three different concepts of imports and exports are employed. First, we investigate cointegration between nominal exports of goods denoted by *EXPG*, and nominal imports of goods denoted by *IMPG*. Second, we redefine the variables in real terms as *EXPG* deflated by export prices, *PX*, and *IMPG* deflated by import prices, *PM*. Finally, we define the real variables as *EXPG* deflated by nominal *GNP* and *IMPG* deflated by nominal *GNP* too. However, the relation between imports and exports of goods alone may not be relevant to the issue of stabilizing Australia's foreign debt. The interest payment on foreign debt and interest received on

foreign investments are international transactions which are part of the current account but not the trade balance. Thus, as an additional exercise, we carry out the entire analysis for the imports and exports of goods and services denoted by *IMPGS* and *EXPGS* respectively. Note that we can not deflate *IMPGS* and *EXPGS* by *PM* and *PX* due to the fact that *PM* and *PX* are price indexes for merchandise trade flows.

As indicated above we first need to determine the degree of integration of each variable involved. To this end, we rely upon the Augmented Dickey-Fuller (ADF) test.[4] Table 1 reports the results of ADF tests for the level as well as for the first differenced variables.

Comparing the calculated ADF statistic to its critical value reported at the bottom of table 1, we find that except for the variables as a ratio of GNP, all other variables achieve stationarity after being differenced once. Thus, while the first six variables in table 1 are $I(1)$, the last four are $I(0)$. The cointegration technique can only be applied to the $I(1)$ variables.

The next step is to determine the degree of integration of the residuals from the cointegration equations and their inverses that involve only the $I(1)$ series. After estimating cointegration equations by OLSQ, the ADF test was applied to the residuals. Table 2 reports the calculated ADF statistics for the level of the residuals. The critical values are provided by Engle and Yoo [1987, table 3] and are reported at the bottom of table 2.

It is evident from table 2 that all six calculated ADF statistics are smaller than their critical values, indicating that the residuals are on a stationary process, *i.e.*, they are all $I(0)$. Therefore, since the degree of integration of the residuals in any of the six cointegration equations are less than the degree of integration of the variables involved, imports and exports are cointegrated, indicating that there is a long-run equilibrium relation between them. Furthermore, in the first four equations where nominal variables are used, the estimate of slope coefficient is very close to unity. This is an indication that in the long-run one dollar of imports is matched by one dollar of exports and vice versa, resulting in a long-run trade balance as well as a current account balance, though in the short-run exports and imports

4. For how to formulate the ADF test and how to select the number of lags, see Bahmani-Oskooee [1992].

may drift apart, resulting in the short-run imbalances.[5]

What are the policy implications of our finding? First, Husted [1992, p. 164] who examined the U.S. experience and found lack of simple cointegration, interpreted his findings as suggesting that "the nominal U.S. current account is nonstationary, and hence that the United States is violating its intertemporal budget constraint." The implication is that our finding of cointegration for the case of Australia indicates that Australia is not violating its international budget constraint. Second, the results indicate that the short-run imbalances observed from figure 1 are temporary and they are sustainable in the long-run. Third, Australian macroeconomic policies have been effective in bringing imports and exports into an equilibrium in the long-run.

IV. Summary and Conclusion

The purpose of this paper was to infer the behavior of the Australian trade balance and current account. Our concern was to determine whether Australian imports and exports have a tendency to converge toward an equilibrium in the long-run. Using Engle-Granger cointegration technique we were able to show that Australian imports and exports are indeed cointegrated, indicating that there is a long-run equilibrium relation between them. This finding was interpreted as: (1)-Australia not being in violation of its intertemporal budget constraint; (2)-Australian trade deficit is a short-run phenomenon and in the long-run it is sustainable; and (3)-Australia's macroeconomic policies have indeed been effective in making exports and imports converge toward an equilibrium in the long-run.

Appendix

All data are quarterly over the 1966-1990 period and are collected from different issues of International Financial Statistics (IFS) of the Internation-

5. Note that the slope coefficients in the last two equations are not close to unity. This is expected due to the fact that the dependent and independent variables have different units of measurement, *i.e.*, export volume *versus* import volume. The less or more than one slope coefficient is an indication of the fact that one unit of exports is not equivalent to one unit of imports.

al Monetary Fund. They are all seasonally adjusted. If the data for a variable did not come seasonally adjusted, they were adjusted for seasonality using the SAMA command in TSP.

Variables:

EXPG = Exports of goods measured in millions of A$, line 70 of IFS.

IMPG = Imports of goods measured in millions of A$, line 71-d of IFS.

PX = Export price index (1985 =100), line 74 of IFS. Note that we were short by two observations. They were, therefore, estimated through interpolation.

PM = Import price index (1985 = 100), line 75 of IFS. We were short by 4 observations. They were generated through interpolation.

EXPGS = Exports of goods and services in millions of A$, line 90-c of IFS.

IMPGS = Imports of goods and services in millions of A$, line 98-c of IFS.

GNP = Nominal GNP in millions of A$, line 99a.c. of IFS.

PD = domestic price level measured by CPI (1985 = 100), line 64 of IFS.

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