COMPETITIVENESS AND GOVERNMENT EXPENDITURE

Anthony J Makin* and Shyama Ratnasiri
Economics, Griffith Business School,
Parklands Drive
Griffith University
Gold Coast
4222
E-mail: t.makin@griffith.edu.au
E-mail: s.ratnasiri@griffith.edu.au

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* Corresponding author
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Abstract
This paper focuses on an alternative measure of competitiveness based on the prices of non-tradable goods and services relative to tradable goods and services prices. It first presents a straightforward framework for understanding how key macroeconomic variables determine this measure with reference to output and expenditure behaviour in a two sector open economy. It then econometrically examines its most significant determinants with reference to private consumption and investment and government spending in Australia. Econometric results based on quarterly data from 1998 to 2013 suggest government expenditure on non-tradable goods and services was the most significant factor to worsen Australia’s competitiveness in the short run over this interval. This provides an alternative perspective on the role of fiscal policy to those previously advanced in standard international macroeconomic models.

Key words: competitiveness, tradables, non-tradables, government expenditure, Australia

JEL Classification Code: F3, F4

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1. Introduction

Competitiveness has traditionally been thought to convey the capacity of an economy’s producers to compete against foreign producers of goods and services that are substitutes. Approximated by the real exchange rate, competitiveness changes when nominal exchange rates and domestic prices move relative to trading partners. In contrast, productivity gauges how efficiently factor inputs combine to produce goods and services domestically. Both competitiveness and productivity bolster economic growth, although strong competitiveness can compensate for low productivity as a source of economic growth and vice versa.

Many factors influence an economy’s competitiveness. From a macroeconomic perspective these include monetary and fiscal policy settings at home and abroad, as well as economy wide wage growth. Historically, the real exchange rate has most often been examined with reference to monetary policy, price levels, interest rates, purchasing power and interest parity, rather than fiscal variables. However, competitiveness also plays a key role in the classic Mundell (1963) - Fleming (1962) model for analyzing the effectiveness of fiscal and monetary policies in open economies. In this model expansionary monetary policy is effective under floating exchange rates as a stabilization instrument because it improves competitiveness and boosts net exports, whereas fiscal policy is ineffective because worsened competitiveness crowds out net exports.

A broader competitiveness measure devised by the World Economic Forum (WEF) focuses on a number of institutional “pillars” (economic institutions, macroeconomic environment, product and labour market efficiency and technological readiness) that contribute to sustainable economic growth.
Yet Mundell-Fleming genus models implicitly assumes all goods and services are internationally saleable, making no distinction between goods and services that are tradable and those that are non-tradable. Another stream of the international macroeconomics literature based on the tradable-nontradable dichotomy follows the tradition of the so-called dependent economy model, originally proposed by Salter (1959) and Swan (1960). This approach has been adapted by, inter alia, Fischer and Frenkel (1972), Bruno (1976), van Wincoop (1993), Brock (1996), Obstfeldt and Rogoff (1996), Asea and Mendoza (1994), Makin (2013) and Yano and Nugent (1999).

Other studies in this paradigm focus on the international macroeconomic effects of fiscal policy, with a particular emphasis on the government spending-exchange rate linkage, include Dornbusch (1974), and Monacelli and Perotti (2010). Meanwhile, the empirical component of a sizeable literature on the effectiveness of fiscal policy in open economies has predominantly focused on the relationship between budget balances and current account balances (see Abbas et al 2011 for a survey). In contrast, little research has explored the direct relationship between fiscal activity and the real exchange rate, with the exception of Galstyan and Lane (2009) and Kollmann (2010).

In Australia’s case, productivity performance has been central to economic policy debate, yet the macroeconomic role and impact of competitiveness has largely been ignored, despite the real exchange rate being around 30 per cent above its long term average value since the float of the dollar in 1983 during the period following the 2008-09 Global Financial Crisis. This proximately explains why Australia’s tradable sector - manufacturing, tourism and higher education in particular - have struggled to compete internationally. The real exchange rate at
any time also measures nominal exchange rate deviation from equilibrium purchasing power parity (PPP) values and this implies substantial recent overvaluation on this basis.\(^2\)

**Figure 1 - Australia’s Real Exchange Rate 1983 - 2014**

![Real Exchange Rate Chart]


However, as an explanation of exchange rate behavior, PPP falls short in practice due to different weightings in national price indexes, the existence of trade restrictions and transport costs, and the fact that a large proportion of goods and services produced and consumed in the economy are not internationally tradable. This last factor suggests a different competitiveness measure which recognises that economies produce two distinct classes of goods and services, tradables and non-tradables.

The aim of this paper is to advance the literature in this tradition by advancing an alternative competitiveness measure and examining how it is linked to the main forms of aggregate expenditure, with a particular focus on government spending. The theoretical rationale for

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\(^2\) Competitiveness can alternatively be weighted by relative labor costs given their importance for prices.
this measure based on the relative prices of non-tradables to tradables is proposed in the next section. Section 3 then empirically examines the impact of various forms of aggregate spending on competitiveness with reference to Australia’s experience. Section 4 summarises the key findings, highlighting new results for policymakers.

2. An Alternative Competitiveness Measure

This section outlines the key relationships underpinning a straightforward two sector model, later used to examine how expenditure shocks affect competitiveness, alternatively defined.

2.1 Competitiveness and National Output

The economy produces and consumes two distinct classes of goods and services – tradables and nontradables. Gross domestic product is the total quantity of tradable and non-tradable goods and services produced in the economy and can be expressed as

\[ Y = O_T + O_N \]  

(1)

Where \( Y \) is real national output comprised of tradable, \( O_T \), and non-tradable goods and services, \( O_N \).

The foreign currency prices of tradable goods and services are set in world markets, and converted to domestic values via the prevailing exchange rate, such that

\[ P_T = eP_T^* \]  

(2)

Where \( P_T \) is an index of the price of tradables, \( P_T^* \), is an index of the world price of tradables and \( e \) is the nominal effective exchange rate, defined as the price of foreign currency. On the other hand, the price of non-tradables, reflected in the index measure, \( P_N \) is set by domestic demand and supply conditions.
The real exchange rate, $R$, is the ratio of the domestic currency price of non-tradables to tradables, a rise in which signifies a real appreciation, or loss of international competitiveness. Hence,

$$R = \frac{P_N}{eP_T} = \frac{P_N}{P_T}$$

(3)

If nontradables prices are rising faster than tradables prices, competitiveness is worsening, whereas if the prices of tradables are rising faster than those of nontradables, competitiveness is improving.\(^3\) Change in this key relative price thereby alters the pattern of production and expenditure in the tradable and non-tradable sectors of the economy as shown in Figure 2.

**Figure 2 - Competitiveness and the Composition of Output**

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\(^3\) The Balassa-Samuelson (1964) hypothesis is also relevant here. It proposes that real exchange rates should be higher in faster growing economies with relatively more productive tradables sectors than in slower growing economies, although empirical support for this hypothesis is mixed across a range of countries.
If this ratio is rising labour and capital will be drawn away from the tradable sector to the non-tradable sector. Hence a diminishing share of the economy’s output will be exposed to international competition, other things the same, de-internationalising the economy’s production. In other words, this relative price reflects the opportunity cost of shifting resources between the traded and non-traded sectors. As increased demand for non-traded goods raises their relative price, and increases the opportunity cost of using resources in the traded goods sector, a country's competitiveness declines and conversely when the price of non-traded goods falls relative to that for traded goods.

The capital stock is assumed fixed in the short run, such that \( K = K_T + K_N \). Within this time frame the available supply of non-tradable and tradable output for sale is a function of competitiveness, the change in the level of inventories, \( V \), and hours worked by labour, \( H \), in both sectors, such that

\[
O_{T,N} = f(R; V_{T,N}, H_{T,N})
\]

\[
\frac{\partial O_T}{\partial R} < 0, \quad \frac{\partial O_N}{\partial R} > 0, \quad \frac{\partial O_{T,N}}{\partial V_{T,N}} > 0, \quad \frac{\partial O_{T,N}}{\partial H_{T,N}} > 0
\]

2.2 Competitiveness and Aggregate Expenditure

Expenditure by resident entities on tradable and non-tradable output is \( E_T \) and \( E_N \) respectively, and \( TB \) is the trade balance expressed as the difference between domestic spending and national output following Alexander (1952).

\[
Y = O_T + O_N = E_T + E_N + G + TB
\]

Total expenditure is the sum of private consumption and investment expenditure on tradables and non-tradables, \( E(=E_T+E_N) \), plus government spending, \( G \), assumed to be exogenous.
It is assumed that private consumption does not rise proportionately with temporary income variation and so is independent of short run output variation, consistent with the life cycle (Modigliani 1986) and permanent income (Friedman 1957) theories of consumption as well as more recent intertemporal approaches (see Wickens 2011). Hence, private consumption is responsive to changes in the real exchange rate, permanent income, \( \rho \), wealth, \( q \), and the domestic interest rate, \( r \). Private investment is also a function of the real exchange rate, wealth, \( q \), and the domestic interest rate, \( r \).

In reality government spending is overwhelmingly on non-tradable goods and services, such as construction, welfare and public service provision. Hence, an increase in government spending will boost demand for nontradables in the economy, other things the same. Hence, for tradables,

\[
E_T = f(R, r, \rho, q) \tag{6}
\]

\[
\frac{\partial E_T}{\partial R} > 0, \quad \frac{\partial E_T}{\partial r} < 0, \quad \frac{\partial E_T}{\partial \rho} > 0, \quad \frac{\partial E_T}{\partial q} > 0
\]

whereas for nontradables,

\[
E_N = f(R, G, \rho, q) \tag{7}
\]

\[
\frac{\partial E_N}{\partial R} < 0, \quad \frac{\partial E_N}{\partial G} > 0, \quad \frac{\partial E_N}{\partial r} < 0, \quad \frac{\partial E_N}{\partial \rho} > 0, \quad \frac{\partial E_N}{\partial q} > 0
\]

The impact of increased government spending on competitiveness can be illustrated with reference to Figure 3 which depicts output-expenditure equilibria in the non-tradable (left panel) and tradable (right panel) sectors of the economy. Note that the two panels share the vertical real exchange rate axis, so that in the left panel non-tradable output is positively related, and non-tradable expenditure negatively related, to the relative price of non-tradables.

\footnote{Taylor (2009) provides recent evidence of this for Australia and the United States.}
to tradables. In the right panel, the opposite applies, with tradable output negatively related, and tradable expenditure positively related, to $R$.

From initial equilibrium with a balanced trade account, an increase in government spending shifts nontradables demand rightward, raising $\frac{P_N}{P_T}$. As shown in the right panel of the diagram, this worsens competitiveness which contracts tradable production, increases domestic spending on tradables, and widens the trade deficit by stimulating imports.

**Figure 3 - Increased Government Spending and Competitiveness**

While inducing a higher share of non-tradable production, the higher government spending worsens competitiveness by drawing labour and capital resources away from industries competing on world markets to a sector isolated from international trade. This loss of
competitiveness is exacerbated if accompanied by increased labour costs in the non-tradable sector which would shift the supply of nontradables schedule upwards to the left in Figure 3.

3. Empirical Analysis of Australia’s Competitiveness

3.1 Competitiveness: Derivation and Trends

The competitiveness measure was first computed using separate time series for non-tradables to tradables prices published by the Reserve Bank of Australia’s within its official CPI data set. As Figure 4 reveals on this alternative measure Australia’s competitiveness has persistently deteriorated over the past 15 years, sliding by close to 30 per cent between 1998 and 2014.

Figure 4 - Alternative Real Exchange Rate Australia 1998-2014


This reflects a shift of resources to the nontradables sector (including publicly-provided services such as public administration, education, health and welfare) and away from the tradable sector due to domestic demand pressures. The dramatic decline in Australia’s
competitiveness from before the turn of the century reflects the fact that inflation in the nontradables sector, mainly services (including publicly provided services such as public administration, education, health and welfare) has persistently exceeded the rate of growth in the prices of tradable goods and services as evident from Figure 5.

**Figure 5 – Rises in Nontradables versus Tradables Prices, Australia 1998-2014**

Note: These data are presented on an index basis for comparative purposes (June 1999 = 100).

Prices of tradable goods and services are influenced by the value of the exchange rate and have usually grown by less than the Reserve Bank of Australia’s three per cent upper target limit for overall inflation over recent years. Meanwhile, inflation of non-tradables, mainly services not affected by the exchange rate, has tended to exceed 3 per cent.

Over the longer term, a fall in the value of this measure can reflect an underlying trend decline if the goods sector, which is largely tradable, has faster productivity growth than the services sector, which includes many non-tradables. If wages rise similarly across both sectors, non-tradables prices would increase more over the longer term than tradables prices,
other things equal. In recent years, however, this has not been the case for Australia because productivity performance in many non-tradable industries, including construction, financial services and transport services has actually outperformed productivity in the key tradables sectors, mining, agriculture and manufacturing.

3.2 Econometric Approach and Results
In this section we empirically examine the influence of Australian public and private spending on competitiveness \( R_t = P_N / P_T \). First, we specify the relationship between competitiveness, private and public spending as follows.

\[
R_t = f(E_t, G_t)
\]

Here, \( G_t \) refers to Australian public spending in billions of Australian dollars which comprises of public investment and consumption spending. In this study we have calculated Australian public spending \( (G_t) \) in two ways. Our first measure \( (G1_t) \) excludes spending of the public corporations while the second measure \( (G2_t) \) includes this spending. For this reason we have two versions of each model referred respectively as Model I and Model II.

The variable \( E_t \) refers to the Australian private spending which is the sum of private consumption and private investment expenditure. The data were converted into natural logarithms so that the estimated coefficients can be interpreted as elasticities. We used quarterly data from 1998Q3 to 2013Q3 inclusive, yielding 62 observations. The data were obtained from statistical tables of Reserve Bank of Australia and Australian National

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5 Goldstein and Officer (1979) provide earlier estimates of this phenomenon.
6 Parham (2012) provides more detailed estimates.
First, we examine the above relationship using a simple OLS model. The OLS estimation involves the model of the following form:

$$\ln(R_t) = \alpha + \beta_1 \ln(E_t) + \beta_2 \ln(G_t) + \varepsilon_t,$$

(9)

The error term, denoted by $\varepsilon_t$ in the above model is assumed to have the usual properties.

Further to this, the theory presented in the previous section suggests that public investment spending may have different implications on international competitiveness than public consumption spending, a fact, the basic model above (Equation 9) does not explain. We are interested in exploring which of these two is more influential for Australian competitiveness.

To this end, we conducted further estimation of the basic relationship by disaggregating public expenditure into consumption, and investment, with each entering the regression equation as independent variables. Again, these variables are measured in million AU$ and converted into natural logarithms. This model is given below.

$$\ln(R_t) = \alpha + \beta_1 \ln(E_t) + \beta_2 \ln(IG_t) + \beta_3 \ln(CG_t) + \varepsilon_t,$$

(10)

Here, $CG_t$ refers to public consumption spending and $IG_t$ refers to public investment spending while the rest of the variables have the same description as earlier. As mentioned previously, note that we have defined $IG_t$ variable in two ways, one which excludes the investment spending by the public corporations ($IG1_t$) and the other includes this spending ($IG2_t$). We henceforth refer these two versions of the model as Model III and Model IV. The results of this preliminary study are presented in Table 1.
The results reveal that public expenditure has been the most significant factor in appreciation of real exchange rate. When public expenditure is disaggregating into consumption, and investment, the results reveal that public consumption expenditure has been more influential in appreciation of real exchange rate, and hence a loss of competitiveness. In contrast, increased public investment expenditure implies improved competitiveness. The OLS estimates presented below are conceivably inconsistent due to presence of endogeneity in regressors and is inefficient due to presence of serial correlation given the fact that we use time series data in the analysis.

To circumvent these two problems, we used Fully Modified Ordinary Least Squares (FMOLS) regression designed by Phillips and Hansen (1990). Before the FMOLS estimation, we tested the variables for unit roots employing the Augmented Dickey-Fuller (1979) (ADF) test and Phillips-Perron (1988) (PP) tests in levels and differences.

Table 1 OLS Estimation Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 1I</th>
<th>Variable</th>
<th>Model 1I</th>
<th>Model 1V</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\ln E_t$</td>
<td>0.196**</td>
<td>0.304***</td>
<td>$\ln E_t$</td>
<td>-0.230*</td>
<td>-0.186*</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.000)</td>
<td></td>
<td>(0.073)</td>
<td>(0.060)</td>
</tr>
<tr>
<td>$\ln G1_t$</td>
<td>0.376***</td>
<td></td>
<td>$\ln CG_t$</td>
<td>1.105***</td>
<td>1.095***</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td></td>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>$\ln G2_t$</td>
<td></td>
<td>0.242***</td>
<td>$\ln IG1_t$</td>
<td>-0.052*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.006)</td>
<td></td>
<td>(0.093)</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>-6.703</td>
<td>-6.563</td>
<td>$\ln IG2_t$</td>
<td></td>
<td>-0.081***</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td></td>
<td></td>
<td>(0.002)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C</td>
<td>-8.867***</td>
<td>-9.020***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.97</td>
<td>0.96</td>
<td>$R^2$</td>
<td>0.975</td>
<td>0.975</td>
</tr>
</tbody>
</table>

Figures within parenthesis are probability values. *** indicates significant at 1% level, ** indicates significant at 5% level, * indicates significant at 10% level.
For these two tests we use Schwarz Information criterion (Schwarz 1978) and the Newey and West (1987) method respectively to choose optimal lag length. The results are shown in Table 2. The null hypothesis of a unit root is not rejected in levels of the variables however, rejected in the first differenced variables. All first differenced series are therefore stationary with integrated order of one [I(1)]. FMOLS is appropriate in this case as it estimates a single cointegrating relationship with a combination of I(1) variables.

The results of the FMOLS estimation are presented in Table 3 and also suggest the same conclusion that Australian public expenditure has been the most significant factor in appreciation of real exchange rate. In particular, increased public consumption expenditure has been more influential in worsening Australia’s competitiveness.

Table 2 Unit root tests

<table>
<thead>
<tr>
<th>Variable</th>
<th>Augmented-Dicky-Fuller (ADF)</th>
<th>Phillips-Perron (PP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln R t</td>
<td>0.533159</td>
<td>-3.34943</td>
</tr>
<tr>
<td>ln E t</td>
<td>-0.98718</td>
<td>-5.25286</td>
</tr>
<tr>
<td>ln G1 t</td>
<td>-1.59419</td>
<td>-2.47271</td>
</tr>
<tr>
<td>ln G2 t</td>
<td>-1.20742</td>
<td>-8.00079</td>
</tr>
<tr>
<td>ln CG t</td>
<td>-0.81258</td>
<td>-3.97178</td>
</tr>
<tr>
<td>ln IG1 t</td>
<td>-1.28348</td>
<td>-2.90728</td>
</tr>
<tr>
<td>ln IG2 t</td>
<td>-1.08029</td>
<td>-7.02114</td>
</tr>
</tbody>
</table>

Test critical values:

- 1% level: -3.54821
- 5% level: -2.91263
- 10% level: -2.59403
### Table 3 Results of FMOLS estimation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model II</th>
<th>Model III</th>
<th>Model IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \ln E_t )</td>
<td>0.195*</td>
<td>0.291*</td>
<td>-0.439**</td>
<td>-0.274*</td>
</tr>
<tr>
<td></td>
<td>(0.092)</td>
<td>(0.021)</td>
<td>(0.023)</td>
<td>(0.060)</td>
</tr>
<tr>
<td>( \ln G1_t )</td>
<td>0.377***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \ln G2_t )</td>
<td></td>
<td>0.252*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.069)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \ln CG_t )</td>
<td></td>
<td>1.501***</td>
<td>1.296***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td></td>
</tr>
<tr>
<td>( \ln IG1_t )</td>
<td></td>
<td>-0.108*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.022)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \ln IG2_t )</td>
<td></td>
<td></td>
<td></td>
<td>-0.121***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.001)</td>
</tr>
<tr>
<td>C</td>
<td>-6.706</td>
<td>-6.518</td>
<td>-10.11***</td>
<td>-9.73***</td>
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<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>R(^2)</td>
<td>0.97</td>
<td>0.96</td>
<td>0.973</td>
<td>0.976</td>
</tr>
<tr>
<td>Engle-Granger tau-statistic</td>
<td>-2.395</td>
<td>-1.318</td>
<td>-3.66</td>
<td>-4.496</td>
</tr>
<tr>
<td></td>
<td>(0.549)</td>
<td>(0.930)</td>
<td>(0.164)</td>
<td>(0.032)</td>
</tr>
<tr>
<td>Engle-Granger z-statistic</td>
<td>-432.50***</td>
<td>-5.956</td>
<td>-32.46**</td>
<td>107.23</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.843)</td>
<td>(0.016)</td>
<td>(0.99)</td>
</tr>
<tr>
<td>Phillips-Ouliaris tau-statistic</td>
<td>-1.670</td>
<td>-1.387</td>
<td>3.08</td>
<td>-3.389</td>
</tr>
<tr>
<td></td>
<td>(0.854)</td>
<td>(0.919)</td>
<td>(-0.395)</td>
<td>(0.261)</td>
</tr>
<tr>
<td></td>
<td>(0.710)</td>
<td>(0.821)</td>
<td>(0.304)</td>
<td>(0.226)</td>
</tr>
</tbody>
</table>

Figures within parenthesis are probability values. *** indicates significant at 1% level, ** indicates significant at 5% level, * indicates significant at 10% level.

### 3.3 Cointegration Analysis

Having explored the influence of public and private spending on Australia’s competitiveness using our new measure of real exchanges rate, we are interested in assessing the causal
relationship between these variables. For this purpose we use a multivariate Vector Auto Regression (VAR) based causality test. A VAR is preferred over a single equation method as the latter is conceivably not valid if certain explanatory variables do not hold the assumption of exogeneity (Sims, 1980). To explore the aforementioned causal relationships, we proceed with Equation 9 to test for the presence of cointegration relationship employing Johansen’s multivariate maximum likelihood method (Johansen and 1988; Johansen and Juselius 1990).

This method has been favoured over the FMOLS due to its capability in detecting multiple cointegration relationships. The requirement of the Johansen test is that all the variables are integrated of the same order \( I(1) \).

### Table 3a Johanson Cointegration Test Results (Model I)

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Trace Statistic</th>
<th>Critical Value</th>
<th>Max-Eigen Statistic</th>
<th>Critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>5%</td>
<td>1%</td>
<td>5%</td>
</tr>
<tr>
<td>r=0</td>
<td>35.943</td>
<td>35.193</td>
<td>41.195</td>
<td>17.889</td>
</tr>
<tr>
<td>r&lt;=1</td>
<td>18.053</td>
<td>20.262</td>
<td>25.078</td>
<td>12.251</td>
</tr>
<tr>
<td>r&lt;=2</td>
<td>5.802</td>
<td>9.165</td>
<td>12.761</td>
<td>5.802</td>
</tr>
</tbody>
</table>

### Table 3b Johanson Cointegration Test Results (Model II)

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Trace Statistic</th>
<th>Critical Value</th>
<th>Max-Eigen Statistic</th>
<th>Critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>5%</td>
<td>1%</td>
<td>5%</td>
</tr>
<tr>
<td>r=0</td>
<td>39.02220</td>
<td>35.19275</td>
<td>32.26837</td>
<td>19.60563</td>
</tr>
<tr>
<td>r&lt;=1</td>
<td>19.41657</td>
<td>20.26184</td>
<td>17.98038</td>
<td>12.72996</td>
</tr>
</tbody>
</table>
Since the Johansen approach is sensitive to the lag length used in the model, prior to cointegration tests we determine the optimal lag using Akaike information criterion (AIC) (Akaike 1977) where choice of the model is based on minimum AIC value. This criterion indicates optimal lag length is 4, and the autocorrelation LM test provides no evidence of serial correlation in the residuals at 4 lags at 5% significant level. The results of the Johansen tests of Model I and Model II are presented in Tables 3a and 3b respectively.

The trace test indicates a single cointegration relationship at 5% significance level while Maximum-Eigen test indicates no cointegration relationship at 5% significance level for both versions of Equation (9).7 The Johansen test detects relatively weak evidence in relation to the null hypothesis of presence of a long run cointegration relationship between Australia’s real exchange rate, private expenditure and public expenditure. However, we proceed to estimate a restricted version of VAR as Engle and Granger (1987) cautioned that if the two time series are I(1) and provides evidence of integration, a multivariate Vector Auto Regression VAR estimation in first difference will be misleading.

They suggest a restricted version with and error correction term (ECT) entered into a VAR framework to determine the direction of such a causal relationship. Furthermore, the evidence of cointegration relationship among $E_t$, $G_t$ and $R_t$ suggest that there must be a causal relationship, in Granger sense, at least in one direction. For these reasons, we included an Error Correction Term (ECT). The model with ECT and one cointegration relationship is presented below.

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7 MacKinnon-Haug-Michelis (1999) probability values are used in testing the null hypothesis of no cointegration relationship.
\( \Delta R_t = \lambda_R ECT_{t-1} + \sum_{j=1}^{k} \alpha_{1j} \Delta R_{t-j} + \sum_{j=1}^{k} \theta_{1j} \Delta E_{t-j} + \sum_{j=1}^{k} \gamma_{1j} \Delta G_{t-j} + u_t \)  

(11)

\( \Delta E_t = \lambda_E ECT_{t-1} + \sum_{j=1}^{k} \alpha_{2j} \Delta R_{t-j} + \sum_{j=1}^{k} \theta_{2j} \Delta E_{t-j} + \sum_{j=1}^{k} \gamma_{2j} \Delta G_{t-j} + u_t \)  

(12)

\( \Delta G_t = \lambda_G ECT_{t-1} + \sum_{j=1}^{k} \alpha_{3j} \Delta R_{t-j} + \sum_{j=1}^{k} \theta_{3j} \Delta E_{t-j} + \sum_{j=1}^{k} \gamma_{3j} \Delta G_{t-j} + u_t \)  

(13)

Here, \( \Delta \) is the first difference operator, ECT indicates the error correction term, \( R_t, E_t \) and \( G_t \) are competitiveness, private expenditure and public expenditure respectively. The notation \( k \) denotes the maximum lag length, and \( u \) denotes the Gaussian residuals. The coefficient \( \lambda_i, (i = R, E, G) \) is the adjustment coefficient that represents deviation of the dependent variable from its long-run equilibrium. The coefficients associated with the lagged dynamic terms are given by \( \alpha_i, \theta_i \) and \( \gamma_i \) where \( (i = R, E, G) \).

3.4 Short Run vs Long Run Causality

In addition to providing evidence in relation to the direction of the causality among the variables, the ECM distinguishes ‘short-run’ and ‘long-run’ causality. To explore the long-run causality (weak exogeneity of the dependent variable) we test the null hypothesis \( H_0 : \lambda_i = 0 \ (i = R, E, G) \) using a simple \( t \) test. The non-rejection of null implies that dependent variable does not respond to its deviation from long-run equilibrium in the previous period (i.e \( t-1 \)). For example, in Eq 4, non-significant \( t \) statistics for \( \lambda_R \) provide no evidence of an error correction mechanism that drives \( R_t \) back to its long-run equilibrium.

To examine the short-run causal relationships, we test the statistical significance of each of the lagged dynamic terms, in turns, using a Wald Test. For example, the null of \( H_0 : \alpha_{ij} = 0 \)
tests if $\Delta E_t$ in Eq 4 does not Granger cause $\Delta R_t$. Rejection of this null implies that $\Delta E_t$ Granger cause $\Delta R_t$ in short-run. The results are presented in Tables 4a and 4b respectively for Models I and II.

Beginning with long run causal effects, significant $t$-statistics with correct negative sign on the $ECT_{t-1}$ indicates that there is a significant error correction mechanism that triggers Australian competitiveness to restore its long run equilibrium in the event of a shock to the system. More precisely, the results suggest the current measure of Australian real exchange rate adjusts within a quarter in response to its deviation from long-run equilibrium in the previous period.

**Table 4a: Causality Tests Results - Model I**

<table>
<thead>
<tr>
<th></th>
<th>$\Delta \ln R_t$</th>
<th>$\Delta \ln E_t$</th>
<th>$\Delta \ln G1_t$</th>
<th>$ECT_{t-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta \ln R_t$</td>
<td></td>
<td>7.23</td>
<td>1.706</td>
<td>-0.998434**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.124)</td>
<td>(0.789)</td>
<td>[-2.85387]</td>
</tr>
<tr>
<td>$\Delta \ln E_t$</td>
<td>1.2002</td>
<td></td>
<td>4.125</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.8781)</td>
<td></td>
<td>(0.389)</td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln G1_t$</td>
<td>18.85***</td>
<td>7.37</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0008)</td>
<td></td>
<td>(0.117)</td>
<td></td>
</tr>
</tbody>
</table>

Figures within parenthesis are probability values. The figures within square brackets are t statistics)
Table 4b: Causality Tests Results - Model II

<table>
<thead>
<tr>
<th></th>
<th>$\Delta \ln R_t$</th>
<th>$\Delta \ln E_t$</th>
<th>$\Delta \ln G2_t$</th>
<th>$ECT_{t-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta \ln R_t$</td>
<td>6.19</td>
<td>1.96</td>
<td>-1.191033***</td>
<td>[-3.39011]</td>
</tr>
<tr>
<td></td>
<td>(0.185)</td>
<td>(0.7425)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln E_t$</td>
<td>1.965</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.74)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta \ln G2_t$</td>
<td>16.28***</td>
<td>15.10***</td>
<td>3.65</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.004)</td>
<td>(0.45)</td>
<td></td>
</tr>
</tbody>
</table>

Figures within parenthesis are probability values. The figures within square brackets are t statistics.

Turning to short run effects, the results presented in tables 4a and 4b provide strong evidence of change in government expenditure causing changes in our measure of international competitiveness. This conclusion is robust across the two models; suggesting that public expenditure including investments of public corporations Granger causes changes in real exchange rate and hence changes in Australian competitiveness. Furthermore, Model II provides evidence government expenditure including investments of public corporations Granger causes private expenditure in Australia. No bi-directional causality relationships were observed in this analysis.

Conclusion

This paper has contributed to the international macroeconomics literature in two ways. First, in the tradables-nontradables tradition it has examined how domestic expenditure shocks can influence an open economy’s competitiveness, production structure and trade balance. Second, it has applied these principles to examine Australia’s experience, in the process
revealing that government spending in particular has mainly been responsible for a worsening of the economy’s international competitiveness since the late 1990s.

These results are not only relevant to the literature on international competitiveness, but to the expansive literature that has emerged over recent years on the macroeconomic role fiscal policy plays in influencing the broader economy in the short run, with a focus on the size of fiscal multipliers. Much of this literature has abstracted from international economic influences, most notably conventional real exchange rate effects in the Mundell-Fleming tradition, to empirically examine how fiscal policy affects national income.

In contrast, the analysis of this paper affords fiscal policy a direct role in influencing macroeconomic activity via an alternative real exchange rate measure, yielding empirical results for Australia that suggest government expenditure adversely affects competitiveness in the first instance. The corollary is that fiscal consolidation that targets unproductive government consumption expenditure would improve competitiveness and encourage expansion of the tradable sector of the economy.

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References


World Economic Forum *Annual World Competitiveness Reports*, various. Available at http://www.weforum.org/