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The Role of Price and Non-price Factors in Predicting Australia's Trade Performance

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Abstract

This paper investigates the role of price and non-price factors in predicting Australia's trade performance. Results broadly suggest that Australia's trade performance is largely explained by the non-price factors namely, R&D, reliability of domestic supply, aggregate world demand and FDI flows in long-run. Price factors such as, relative price of Australian exports and domestic prices are also important predictors of trade competitiveness. The policy implications of these findings are that there are dividends in terms of improved trade performance by encouraging R&D expenditure, attracting FDI, improving domestic supply and implementing appropriate policies to improve price-competitiveness.

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The Role of Price and Non-price Factors in Predicting Australia's Trade Performance

I. Introduction

Australia's deteriorating trade performance has attracted an intense debate among policy makers in recent year. It is argued that its poor trade performance is largely due to the lack of 'non-price competitiveness of exports', resulting mainly from insufficient innovation.[1] While higher product and process innovation appear to be crucial for superior trade performance[2], empirical evidence in support of this view is not yet available for Australia. The available studies from European countries do suggest that non-price factors are an important predictor of trade flows, although their findings have little relevance to Australia given the small size of its domestic market.[3] Despite this, no study has been carried out to investigate the role of non-price factors in predicting Australia's trade performance. The investigation of this issue is particularly important in the context of increased emphasis placed on the role of technology in making the Australian economy competitive as global competition in a wide range of products intensifies. If non-price factors are influential predictors of international competitiveness then our results will have significant policy implications in improving Australia's trade performance. It is in this context, that this paper aims to investigate the role of price and non-price factors in predicting Australia's trade performance. We do this using panel data for 34 manufacturing commodity groups at

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1 Compared to other advanced countries, Australia invests a small fraction of GDP on R&D. For instance, in 2002 Australia spent 1.64% of GDP on R&D as against 2.65% by USA and 3.12% by Japan (OECD, 2007).

2 See, for example, Fagerberg (1988), Greenhalgh (1990) and Anderton (1999).

3 Literature is too many to cite. See Anderton (1999) and references cited therein.

the two digit level of industry classification from March quarter 1988 to June quarter 2005.

Following this brief introduction, Section II specifies the model of international competitiveness, while data and econometric procedures are discussed in Section III. The econometric model is estimated in Section IV and results are discussed. The paper concludes with policy remarks in Section V.

II. Modelling Trade Performance

(a) Innovation and Trade Performance: Is There a Link?

Traditionally, prices and incomes were seen as major predictors of trade flows and international competitiveness. Only relatively recently, economists have demonstrated how 'non-price factors' (such as innovation and product quality which is the direct outcome of R&D) play an important role in determining international competitiveness.[4] Consequently, in recent studies of international competitiveness both price and non-price factors have attracted researchers' attention.[5] Buxton et. al, (1991) have argued that firms that innovate new products are able to maintain superior trade performance because innovation can lead to a 'technological gap between firms', giving a competitive advantage to the innovating over non-innovating firms through superior quality. Although innovative firms have a competitive advantage only for a short period of time because firms in other countries imitate their

[4] This literature is now growing rapidly and is too large to cite. However, discussions about the role of non-price factors in determining trade flows can be found in Owen and Wren-Lewis (1993), Greenhalgh (1990), Greenhalgh et al. (1994), Anderton (1999) and Salim and Bloch (2009).

[5] Magnier and Toujas-Bernate (1994) argue that models that include both factors perform better in predicting trade flows.

products[6], they earn large profits by being the first to market. Thus, firms have a strong incentive to innovate new products in order to be ahead of its competitors. For this to happen, a high level of R&D is crucial as demonstrated by Anderton (1999) who argues that R&D enables firms to produce state-of-the-art products and to move up the quality ladder relative to their competitors. Theoretically, this has been demonstrated in the 'technology gap and product cycle model of trade' and also in new trade and endogenous growth theories (see, Krugman, 1983 and 1989, and Grossman and Helpman, 1991 and 1995).

Recently, Anderton (1999) has convincingly demonstrated how different levels of innovation can explain the differences in trade performance between nations. Fagerberg (1988) has argued that it is technological competitiveness that predicts a large proportion of differences in international competitiveness and growth rather than cost-competitiveness. The countries which offer a limited range of poor quality products face high (low) income elasticity of demand for imports (exports) and experience continuous suppression of aggregate demand through monetary and fiscal measures in order to avoid the payment crisis (Thirwall, 1986). This suggests that by improving the quality and range of products, a country's import demand curve (export supply curve) can be pushed inward (outward). Krugman (1983 and 1989) has forcefully argued that the observed higher income elasticities for the exports of high growth countries reflect the greater variety of goods produced by these nations as a result of continuous innovation—an outcome of a high level of R&D. The underlying

6 In international trade theory this phenomenon is known as 'product life cycle' theory where it is argued that when a new product is innovated, innovative firms enjoy monopoly profit until it becomes standardised and reaches its maturity. After this point, product is produced using standard technology in developing countries and innovative firms lose its competitiveness in this particular product group.

idea is that the greater the investment in R&D the greater the variety of products (Owen and Wren-Lewis, 1993 and Anderton, 1999).[7]

While some firms do conduct R&D to remain competitive, a large number of firms these days acquire new technologies and production processes through foreign direct investment (FDI). In a globally integrated production network FDI is increasingly seen as a means of obtaining advanced technologies and production processes (Veeramani, 2009 and Iyer et. al, 2009). In fact, because of the high cost associated with conducing R&D in-house, firms tend to prefer FDI, which is particularly true in the case of small firms.[8] It is increasingly evident that openness, by increasing competition and improving access to new technologies, helps improve international competitiveness. It has been demonstrated that industries that are more competitive are the industries that are more open to global competition (Oczkowski and Sharma, 2005), leading us to believe that openness improves trade performance and competitiveness.

(b) The Model

Based on the above discussion we developed the following model for each commodity group (*i)* in log-log form (superscript *i* is omitted for clarity). The expected signs of the coefficients are given below the equation in parentheses.

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7 Ioannidis and Schreyer (1997) provide classification of industries into high- and low-technology intensive based on the R&D intensity data. Accordingly chemicals, non-electrical machinery, professional and scientific goods, and office and data processing machinery, electrical machinery, and transport equipment are classified as high-technology-intensive industries; whereas food, textile, wood products, paper products, non-metallic goods, basic metals, and metal products are classified as low-technology intensive industries (see Appendix I for the classification of industries included in this study).

8 Since most Australian industries are small to medium in size by international standards, they do not tend to invest much on R&D, instead they rely largely on FDI as a means of acquiring advanced technology to compete in both domestic and export markets. This is evidenced by massive inflows of FDI to Australia in recent years (Sharma and Bandara, 2010).

$$LRXM_t = \alpha_1 + \alpha_2\, LRPX_t + \alpha_3\, LRPD_t + \alpha_4\, LADW_t + \alpha_5\, LADA_t + \alpha_6\, LRAD_t + \alpha_7\, LFDI_t$$

(-) (-) (+) (-) (+) (+)

$$+\ \alpha_8 LRAS_t + \alpha_9\, LERA_t + u_t \qquad \text{(Eq.1)}$$

(+) (-)

where:

L = logarithm.

α_1 = constant term.

α_2 to α_9 = coefficients of the independent variables.

u = error term.

t = time period.

RXM = Ratio of Australian exports to Australian imports at the two-digit SITC commodity group (*i*).

RPX = Price of Australian exports relative to world price for commodity (*i*).

RPD = Price of Australian domestic goods relative to price of imported goods for commodity *i*.

ADW = World aggregate demand (proxy by the US final expenditure).

ADA = Australian aggregate demand (proxy by Australia's total final expenditure).

RAD = Australian R&D expenditure relative to that of the rest of the world (US) in commodity *i*.

FDI = Foreign direct investment in industry *i* in Australia.

RAS = Reliability of Australian supply relative to that of the rest of the world, defined as Australian labour productivity relative to that of the US.

ERA = Degree of openness in industry *i* in Australia (proxy by effective rate of assistance, ERA).

Appendix II presents definition of variables and data sources.

III. Data and Economic Procedures

(a) The Data

This study deploys the panel data estimation procedure. Our panel includes time series data for thirty-four (34) manufacturing commodity groups at the two-digit SITC level (sub-group 51 to 89, excluding 68) for the period March quarter 1988 to June quarter 2005. The selection of the period is guided by the availability of data in consistent format. In the absence of readily available disaggregated data, a considerable amount of time was devoted to develop the database in order to be able to estimate the model econometrically. For example, in the absence of published trade and price data at the disaggregated level we were forced to deploy the Australian Bureau of Statistics (ABS) Statistical Consulting Services, while others were obtained through several sources such as ABS catalogues, IMF database, Reserve Bank of Australia (RBA) database and OCED online database and publications.

Capturing precisely the effects of technological advancement and innovation on trade performance is always problematic because of the lack of disaggregated data. To overcome this problem, researchers have frequently used the R&D expenditures and patents data (Hughes, 1986). Following Hughes (1986) we use R&D expenditures as a proxy for technological advancement and innovation.[9] R&D data for the rest of the

9 We are aware that there are several problems in using R&D data and they may not accurately capture the nature of technological advancement and innovation for the following reasons (Hughes, 1986). First, they are input measure, which do not tell us how much has been actually translated into product and process innovation. In other words, not all R&D is commercially successful. Second, since, the effects of R&D are cumulative; ideally a stock measure should be applied. However, because of the measurement problem (such as

world was obtained from OECD online database. Australia's aggregate demand data is proxy by total final expenditure and obtained from the national accounts, while the US final expenditure is used as a proxy for the world aggregate demand (obtained from IFS online database). Degree of openness is proxy by the effective rate of assistance (ERA) and this was obtained from the Industry Commission (IC). The ideal measure of the reliability of supply is the inverse of industrial action. However, industrial action data (e.g. labour days lost due to industrial action) were not available for a long period of time, which forced us to use the Australia's labour productivity relative to that of the US as a proxy, obtained from the Reserve Bank of Australia (RBA) Bulletin database.

(b) Estimation Procedures

This study employs the dynamic modelling approach which incorporates short-run effects as well as lagged and long-run effects. The long-run effects are derived using estimated short-run and lagged coefficients as well the coefficient for the lagged dependent variable.[10] Assuming partial adjustment of the dependent variable to changes in independent variables over time, an empirical dynamic model for equation 1 is specified below in log-log form:

$$\begin{aligned} LRXM_t = {} & \alpha_0 + \alpha_1 LRPX_t + \alpha_2 LRPD_t + \alpha_3 LADW_t + \alpha_4 LADA_t + \alpha_5 LRAD_t + \alpha_6 LFDI_t \\ & + \alpha_7 LRAS_t + \alpha_8 LERA_t + \alpha_9 LRPX_{t-4} + \alpha_{10} LRPD_{t-4} + \alpha_{11} LADW_{t-4} \\ & + \alpha_{12} LADA_{t-4} + \alpha_{13} LRAD_{t-4} + \alpha_{14} LFDI_{t-4} + \alpha_{15} LRAS_{t-4} + \alpha_{16} LERA_{t-4} \\ & + \alpha_{17} LRXM_{t-4} + \varepsilon \qquad \text{(Eq.2)} \end{aligned}$$

depreciation) the stock data are not reliable. Despite these limitations, our results will provide useful insights about the role of innovation in explaining trade performance.

10 The precise way of deriving the long-run effects include adding short-run and lagged effects, which is then divided by (1-lagged dependent variable). For details of the dynamic modelling approach, see Baltagi (2005) and Gujarati (2003).

The above equation (eq.2) is estimated using the fixed effect model (FEM) as it is the appropriate modelling tool when time series are larger than cross-sections (see Baltagi, 2005 and Gujarati, 2003).[11] Estimating the FEM by OLS will result in coefficients with poor statistical significance. Hence, the estimated generalized least squares (EGLS; cross-section seemingly unrelated regression or SUR) can achieve asymptotically efficient estimates (see Baltagi, 2005 for details of the procedure).We estimated the panel regression employing this procedure and using *Eviews* econometrics software package.

Note that both short-run effects (variables in current values) and lagged effects (variables lagged four-period since data are quarterly) are incorporated in the regression model.

IV. Results and Discussion

The estimated results are presented in Table 1. The regression estimation performed generally satisfactorily in overall terms, as shown by the value of R^2, adjusted R^2 and F-statistics. Jarque-Bera test shows that there is residual normality. Note that the panel FEM (SUR) regression automatically corrects for contemporaneous serial correlation and cross-section heteroscadasticity.

** INSERT TABLE 1 ABOUT HERE**

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[11] Note that we have 70 time series and 34 cross-sectional observations.

Price and income effects

As expected we find a strong statistical evidence to suggest that a higher relative price of exports ($LRPX_t$) retards Australia's trade performance regardless of the nature of transition (ie. short-, intermediate- and long-term). Our finding—which is similar to Greenhalgh (1990) and Anderton (1999)—tend to suggest that any measures to lower the relative price of Australian exports (through appropriate reforms) would lead to better trade performance.

Contrary to expectations, our results tend to indicate that an increase in domestic price relative to import prices ($LRPD_t$) leads to superior trade performance in both short- and long-run, but not in intermediate period. This unexpected results (for short- and long-run) about the link between domestic price relative to import prices appear to be associated with the nature of Australian exports which are increasingly dominated by high quality goods and they tend to be somewhat insulated from price competition due to the greater degree of product differentiation (Wilkinson, 1992).

Turning to the effects of world's aggregate demand on Australia's trade performance, our findings—as expected—tend to suggest that a higher world's aggregate demand ($LADW_t$) improves Australia's trade performance in short-, intermediate- and long-term. Recent down turn in world's aggregate demand (caused by the banking sector crisis of 2008) and its impact on Australia's lacklustre trade performance further reiterate the relevance of our findings. With regard to the link between Australia's aggregate demand ($LADA_t$) and its trade performance, our results suggest that a higher domestic demand retards trade performance regardless of the nature of transition (ie, short-, intermediate- and long-term), although this relationship is not statistically significant in short-run. This tend to indicate that monetary and fiscal measures to curtail aggregate domestic demand—when the economy is growing rapidly—would be useful to improve Australia's trade performance .

Non-price effects—the effects of R&D and FDI

Our findings broadly support the view that a higher R&D—which is a proxy for innovation and product quality—improves trade performance.[12] This is similar to previous Australian studies on the link between R&D expenditure and trade performance by Engelbrecht (1998) and Salim and Bloch (2009). Although the relationship between R&D and trade performance is statistically insignificant in short-run, it has a positive sign, suggesting that a higher level of R&D leads to better trade performance. Note that our results about the link between R&D and trade competitiveness is in contrast to Halkos and Tzeremes (2008) who observed that R&D intensity had no positive effect on trade performance in a cross-country study of 16 OECD countries.

Turning to the effect of FDI on Australia's trade performance, we found that foreign direct investment contributes to superior trade performance in intermediate- and long-run, which seems to occur through access to superior know-how, well established marketing networks and improved work practices. Note that contrary to expectations the coefficient of FDI has a negative sign in short-run, suggesting that the participation of foreign firms retards trade performance, although the relationship is not statistically significant. This unexpected result for short-run appears to be due to

[12] Our cross-sectional results—which are not appended to this paper due to space constraint—tend to suggest that R&D is important even for industries such as, leather and leather manufacturing. While this finding is somehow surprising, given the nature of leather goods—which are income elastic—firms tend to undertake R&D to develop new products to remain competitive.

the fact that foreign firms take some time to enjoy economies of scale to be internationally competitive.

Other non-price effects—reliability of supply and industry protection

Other non-price factors namely, reliability of supply and openness also appear to be important determinants of trade competitiveness. As expected, we find that reliability of domestic supply relative to that of the rest of the world ($LRAS_t$) improves Australia's trade performance regardless of the nature of transition (ie, short-, intermediate- and long-run). This suggests that measures to address supply-side constraints would help improve trade competitiveness. The effect of openness ($LERA_t$) on trade performance is mixed. In contrast to expectations, we find that protection of domestic market, not the openness, leads to better trade outcomes in short- and long-term.[13] This is probably because protection permits firms to enjoy scale economies and encourages them to invest in activities that make firms internationally competitive in the long-run as argued by Rodrik (1988). Our findings about the link between openness and trade competitiveness is in contrast to Sakakibara and Porter (2001) who—in a study of Japanese manufacturing—found that protection of domestic market, by limiting competitive pressure, work against international competitiveness. In a study of South Africa's trade competitiveness Edwards and Lawrence (2008) also found that protection retards trade performance.

[13] However, we find that in intermediate term protection of domestic market retards trade performance as expected and this relationship is statistically significant.

V. Conclusion

This paper contributes to the ongoing debate about the role of price and non-price factors in predicting Australia's trade performance, using the dynamic panel data technique. The investigation of Australian experience is particularly useful in the context of an intense debate about the role of non-price factors in making Australian trade sector competitive. Our results broadly suggest that inter-industry variations in trade performance are largely explained by the non-price factors namely, R&D, reliability of domestic supply, aggregate world demand and FDI flows in long-run. Measures to promote R&D, attract FDI, and remove domestic and international barriers would help improve Australia's trade competitiveness. Price factors such as, relative price of Australian exports and domestic prices are also important predictors of trade competitiveness, but not across all sectors.

The policy implications of these findings are that there are dividends in terms of improved trade performance by encouraging R&D expenditure, attracting FDI, improving domestic supply and implementing appropriate policies to improve price-competitiveness.

TABLE 1: Determinants of Australia's Trade Performance: Results of the Short-run, Lagged effects and Long-run effects

Dependent Variable: $LRXM_t$

Independent Variable	Coefficient	t-Ratio
$LRPX_t$	-0.864	-9.143***
$LRPD_t$	1.302	6.500***
$LADW_t$	2.432	4.523***
$LADA_t$	-0.158	-0.772
$LRAD_t$	0.069	1.403
$LFDI_t$	-0.160	-0.805
$LRAS_t$	0.902	1.792*
$LERA_t$	0.454	5.061***
$LRPX_{t-4}$	-1.031	-9.050***
$LRPD_{t-4}$	-0.718	-3.436***
$LADW_{t-4}$	2.016	3.283***
$LADA_{t-4}$	-0.857	-4.561***
$LRAD_{t-3}$	0.153	3.353***
$LFDI_{t-4}$	0.907	5.132***
$LRAS_{t-4}$	2.769	4.939***
$LERA_{t-4}$	-0.309	-3.690***
$LRXM_{t-4}$	0.615	41.516***
Constant	7.619	2.585***
Long-run Effects		
LRPX	-4.921	
LRPD	1.517	
LADW	11.501	
LADA	-2.636	
LRAD	0.576	

LFDI	1.940
LRAS	9.535
LERA	0.376

*Note: Short-run and intermediate (lagged) effe*cts are estimated using Panel EGLS (cross-section SUR) Procedure with Cross-section Weights. *E-views software* does not estimate the long-run effects and hence they are derived by adding short-run and lagged effects which is then divided by (1-lagged dependent variable).
***Significant at the 1 per cent level; *Significant at the 10 per cent level.
Weighted Statistics: R^2 = 0.977; Adjusted R^2 = 0.976; F = 1830.820 (prob: 0.00);
D.W. = 1.549; Jarque-Bera Normality: 2.983 (prob: 0.22);
Total Panel (balanced) observations used in estimation = 2244.
Note that at the diagnostic test stage we had to reduce lag to a three period for R&D variable.

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Appendix I: Industry Classification

High-technology intensity (High degree of product differentiation)	Low-technology intensity (Low degree of product differentiation
Organic Chemicals	Articles of Apparel and Clothing
Inorganic chemical	Textile, Yarn, Fabrics
Dying, Tanning and Colouring	Footwear
Medical and Pharmaceutical Products	Cork and Wood Manufacturing
Essential Oils	Rubber Manufacturing
Fertilisers (Excluding Crude)	Leather & Leather Manufacturing
Plastic in Non-primary Forms	Plastic in primary Forms
Chemical Materials etc.	Non-metalic Minerals
Power Generating Machinery	Iron and Steel
Machinery Specialised	Manufactures of Metals
Metal Working Machinery	Prefabricated Buildings, Structures
General Industrial Machinery	Furniture, Parts there of
Office Machines	Travel goods, Hand Bags
Telecommunications Equipment	Paper, Paperboard etc
Electrical Machinery, Appliances	
Road Vehicles	
Transport Equipment	
Professional, Scientific and Medical Instruments	
Photographic Apparatus	

Note: Compiled by the authors based on Ioannidis and Schreyer (1997).

Appendix II: Definition of variables and data sources

LRXM: Log ratio of export volume to import volume in 1989-90 prices. Source: Unpublished data produced by the ABS.

LRPX: Log ratio of price of Australian export relative to world price. Data source: (i) Australian data: unpublished data produced by the ABS. (ii) World data: *International Financial Statistics*, International Monetary Fund, online database, 2006. The world data was in US$ converted into real terms using GDP deflator for Australia before taking the ratio. http://imfstatistics.org/imf/ImfBrowser.aspx

LRPD: Log ratio of price of Australian domestic good relative to price of imported good. Data source: unpublished data produced by the ABS. (ii) World data: *International Financial Statistics*, International Monetary Fund, online database, 2006. The world data was in US$ converted into real terms using GDP deflator for Australia before taking the ratio. (matched by type of commodity). http://imfstatistics.org/imf/ImfBrowser.aspx

LADW: Log of world aggregate demand proxy by the US total final consumption expenditure. The US consumption data was in US$ which was converted into real terms using GDP deflator for Australia. Data source: *International Financial Statistics*, International Monetary Fund online database, 2006 http://imfstatistics.org/imf/ImfBrowser.aspx

LADA: Log of Australia's aggregate demand, proxy by total final consumption expenditure. Data source: ABS, *Australian National Account: National Income, Expenditure and products*, Catalogue No. 5206.0 (Table 2)

LRAD: Log ratio of Australian R&D relative to the rest of the world (proxy by the US R&D). Data source: OECD, Analytical Business Enterprise Research and Development database (various issues). R&D data for the US was in US$ which is converted into real terms using GDP deflator for Australia before taking the ratio.
http://www.oecd.org/document/17/0,2340,en_2825_497105_1822033_1_1_1_1,00.html

LFDI: Log foreign direct investment. In the absence of time series data for each two digit manufacturing industry, we were forced to use total FDI data (quarterly). Data source: ABS, *Balance of Payments and International Investment Position, Australia*, Levels of Foreign Investment in Australia-Quarterly (Table 27). Catalogue No. 5302.0.

LRAS: Log reliability of Australia's supply relative to that of the rest of the world (US). This is proxy using Australia's labour's productivity relative to the US labour productivity. Data source: *DXdata, EconData*. RBA Bulletin Database, Australia.

LERA: Log effective rate of assistance in Australian manufacturing industries. Data source: *Trade and Assistance Review, 2003-2004*, Productivity Commission Annual Report Series, Productivity Commission, Melbourne (also available on http://www.pc.gov.au/research/annrpt/tar0304/index.html).