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Technology, investment and trade: empirical evidence for five Asia–Pacific countries

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Traditional models of international trade flows find that prices explain significant growth in export market shares. In the new international trade theory nonprice factors are seen to be of great importance for the explanation of trade. Following Magnier and Toujas-Bernate (*Weltwirtschaftliches Archiv.*, **130,** 1994), this study introduces nonprice factors, namely gross fixed investment and technology (number of patents accepted), into the export market share equation. Empirical estimation is carried out on five Asia–Pacific countries for the period 1978 to 1993. Results are similar to those of Magnier and Toujas-Bernate (1994) for the OECD, which show that nonprice factors have played an important role in determining export market share during the last decade.

I. INTRODUCTION

Traditional models of international trade use relative prices as the principle determinant of trade flows. Krugman (1989), however, suggests that nonprice factors should be introduced into the modelling framework through the inclusion of supply-side arguments. An important nonprice factor in the new international trade theory is innovation and technology (Magnier and Toujas-Bernate, 1994; Verspagen and Wakelin, 1997). Fagerberg *et al.* (1997) suggest that recent growth in the world economy has been stimulated through trade liberalization and the international diffusion of knowledge and innovation.

Technological spillovers are also important. Glaeser *et al.* (1992) postulate that within-firm innovations increase the productivity of other firms. At the national level, Spencer and Brander (1983) observe that strategic research and development (R&D) rivalry between countries can be crucial in explaining trade volumes. Coe and Helpman (1995) suggest that trade is an important catalyst for R&D spillovers. In particular, they conclude that both domestic, and international R&D, affect domestic country total factor productivity. The production of traded and nontraded goods and services bring about a more effective use of existing resources, and hence raises productivity. Indirect benefits are obtained from imports of goods and services that are developed by trade partners. Landesmann and Pfaffermayr (1997) find that R&D enables a country to reach a better position in its quality spectrum of products offered, which implies a higher export elasticity with respect to income.

Finally, Fagerberg (1988) and Magnier and Toujas-Bernate (1994) argue that export performance depends on a nation's ability to deliver quality products, on time, to the international market place. When a country is very competitive in terms of prices and technology, it may not always be able to meet the demands for its goods due to a capacity constraint. Magnier and Toujas-Bernate (1994) derive a theoretical model of export market share which explicitly accounts for capacity constraints through the inclusion of an aggregate investment variable.

This study empirically examines both price and nonprice determinants of regional export market share for a sample of five Asia–Pacific countries. Following Magnier and Toujas-Bernate (1994), specific emphasis is placed on the role of investment and technology in explaining growth in export market share. The paper is organized as follows. In Section II, a theoretical model of export market shares which incorporates both price and nonprice factors, namely the number of patents granted and gross fixed capital formation, is proposed. Data sources and their transformations are described herein. Section III contains both a description of the estimation method and the results obtained. Section IV presents conclusions.

II. MODEL AND DATA

An empirical model of export market shares (*MSX*) is employed here based on the theoretical work of Magnier and Toujas-Bernate (1994). The model incorporates explanatory variables for export prices (P), investment (INV), and technology (T):

$$MSX_{it} = \alpha_1 + \alpha_2 P_{it} + \alpha_3 INV_{it} + \alpha_4 T_{it} + \Sigma \beta_j T_{it-j} + e_{it} \quad (1)$$

where i indexes five countries, t indexes 16 time periods, $j = 5$ is the number of lags for the technology variable, and e_{it} is a white noise additive error term.

Model estimation is based on five Asia–Pacific countries, Australia, Hong Kong, Japan, New Zealand and South Korea, for the period 1978 to 1993. To allow for the initial lag structure of $j = 5$ for the technology variable the sample is effectively reduced to 55 observations; 5 countries multiplied by 11 time periods (1983 to 1993). Annual data, in 1987 prices, are obtained from the IMF (1984, 1991, 1996), the UN (1981, 1982, 1984, 1987, 1989, 1991, 1994), and the World Bank (1997).

MSX is real exports of country i to the other four countries in the sample, divided by the real exports of the other four countries towards the same region. PC is the export price deflator of the four other competing countries divided by the export price deflator of country i. INV is gross fixed capital formation for country i divided by the average gross fixed capital formation for the four other competing countries. T is the number of patents accepted by the respective patents office in country i divided by the total patents of the four other competing nations (smoothed by a three year moving average). Expenditures on R&D would represent a more appropriate measure on which to compare the technological level of the five countries studied since R&D expenditure more accurately reflects the inputs used for innovative activities (Magnier and Toujas-Bernate, 1994). However, since these expenditures are unavailable for three of the five countries contained in the study, the number of patents accepted is used as a proxy for technology.

III. ESTIMATION RESULTS

Equation 1 is estimated on the pooled data above using Kmenta's (1986) GLS procedure to allow for groupwise heteroscedasticity, cross-sectional correlation and group specific autocorrelation.[1] An optimal one period lag length for technology is based on the significance of the last included lagged term in the estimated equation. Estimation results are presented in Table 1.

All estimated parameters are correctly signed and significant at the 1% level, confirming the results of Magnier and Toujas-Bernate (1994). An increase in all explanatory variables would lead to an increase in regional export market share. All responses are inelastic. The positive sign of lagged technology is sensible due to the time lapse between the offical acceptance of patents and the implementation of the resulting technology into economy production processes.

Table 1. *GLS parameter estimates*

Variables		Estimate	t-ratio
Constant	α_1	0.0723	3.678
Price (PC_{it})	α_2	0.1025	5.789
Investment (INV_{it})	α_3	0.0149	6.062
Technology (T_{it})	α_4	0.0613	4.635
Technology (T_{it-1})	β_1	0.0501	3.897

IV. CONCLUSIONS

The above results are consistent with those of Magnier and Toujas-Bernate (1994) for the OECD. Whilst price competitiveness plays an important role in the explanation of international trade, nonprice factors such as investment and technology are also crucial. Government policies which encourage investment, R&D expenditure, and the widespread diffusion of new technology can enhance export performance (Papaconstantinou, 1997). Whilst, this outcome is encouraging there are two important caveats which must be drawn. First, the proxy used to measure technology, the number of patents accepted, is clearly inadequate. However, given the paucity of these data for the Asia–Pacific region it is reasonable to include patents in the export market share equation. A second caveat concerns the countries included in the sample. Australia, Japan and New Zealand are OECD member nations, and Hong Kong and South Korea are newly industrialised economies. Clearly, the sample contains only OECD members, or 'OECD-like' nations in terms of their level of economic development. The strength of our findings will be increased when the results are shown to hold for a more diverse group of Asia–Pacific countries.

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[1] Diagnostic test statistics, provided by Greene (1997), indicates groupwise heteroscedasticity [$75.76 \sim \chi^2$(4df)], cross-sectional correlation [$28.25 \sim \chi^2$(10df)] and group specific autocorrelation [45.81; 4992.5; 5.45; 30.56; 492.51; $\sim \chi^2$(1df)] are present.

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