The Exchange Rate and the Current Account

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1. Introduction

Other papers at this Conference (particularly Pitchford and Blundell-Wignall, Fahrer and Heath) examine the factors that determine the exchange rate. This paper explores how the exchange rate impinges on the separate components of the current account in the short run and the part it plays in longer-term balance of payments adjustment. In particular, it examines both the effect of the exchange rate on imports and exports and considers the role of the exchange rate in adjusting the economy to underlying structural changes.

The Australian economy since 1980 is an ideal 'test bed' for this. During this period:

- there was an important change of policy regime (the floating of the exchange rate in December 1983);
- the underlying current account deficit increased markedly compared with earlier periods, suggesting that there were important *structural* changes; and
- there was a wide short-term variation in the current account deficit, which exceeded 6 per cent of gross domestic product (GDP) three times in the decade.

The variety and extent of the experience should provide the opportunity to draw some conclusions about the role of the exchange rate. The distinction between short-term shocks and responses, on the one hand, and the longer-term adjustments to structural changes, on the other, provides a theme that will be important in analysing the variety of experience.[1]

The main forces driving the short-term movements in the current account were terms of trade changes and investment shocks. Large swings in the terms of trade played a central role in the activity cycles during the period and their impact shows clearly in the current account. While these terms of trade swings were large, they were generally reversed and provide evidence that, within a long-term steady, secular decline in the terms of trade, the larger fluctuations are temporary. There

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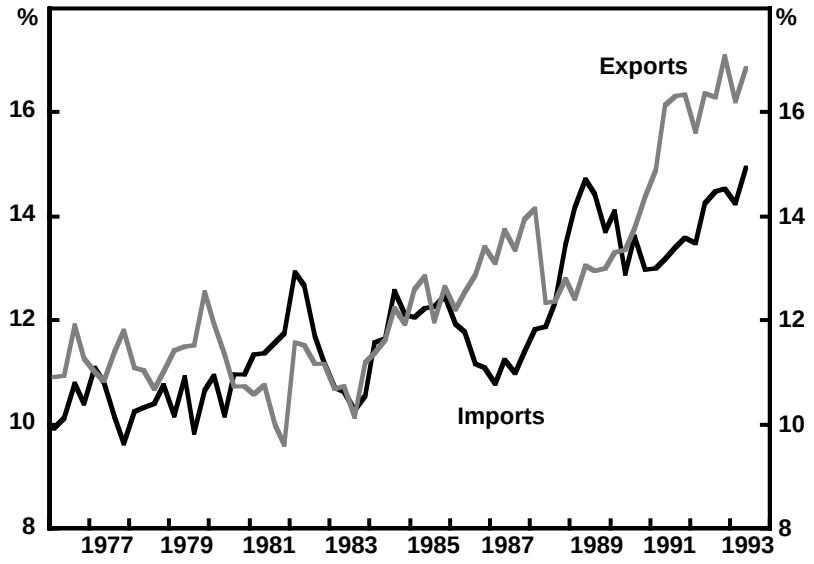
* Reserve Bank of Australia. This paper has benefited from comments and assistance from many colleagues in the Bank, particularly Adrian Blundell-Wignall.

1. For details of balance of payments developments in the 1980s, see Tease (1990).

were two major investment shocks which had a powerful impact on the current account.

Among the structural changes, increasing international integration was central. A high degree of integration of the capital account had been achieved before 1980, but during the 1980s both imports and exports rose significantly as a percentage of GDP (see Figure 1). This is a relatively recent phenomenon for Australia. Among the OECD countries, Australia was almost alone in *not* increasing its degree of international integration significantly in the 1960s and 1970s. In the second half of the 1980s, the picture changed markedly. Effective rates of external protection have been almost halved since 1984. Also, producers have come to recognise the importance and permanence of the change and have begun to adapt their productive capacity to this new world. The link between protection and the earlier failure of international trade to rise was noted by the 1984 Brookings study of the Australian economy (Caves and Krause 1984). As well, there has been significant (although unfinished) microeconomic reform, encompassing the labour market, public enterprises and a wide range of private industries. At the same time, Australia's external environment was changing, with the emergence of a number of rapidly industrialising countries in Asia, providing a new source of import supply and export markets. With the current account averaging nearly 5 per cent of GDP during the 1980s compared with 2 to 3 per cent which was the norm in earlier decades (see Figure 2), there was a build-up of foreign liabilities, which

Figure 1: Imports and Exports of Goods
(per cent of GDP, 1989/90 prices)



rose from around 10 per cent of GDP in the mid-1970s to almost 55 per cent in 1992 (see Figure 3).

Figure 2: Current Account
(per cent of GDP)

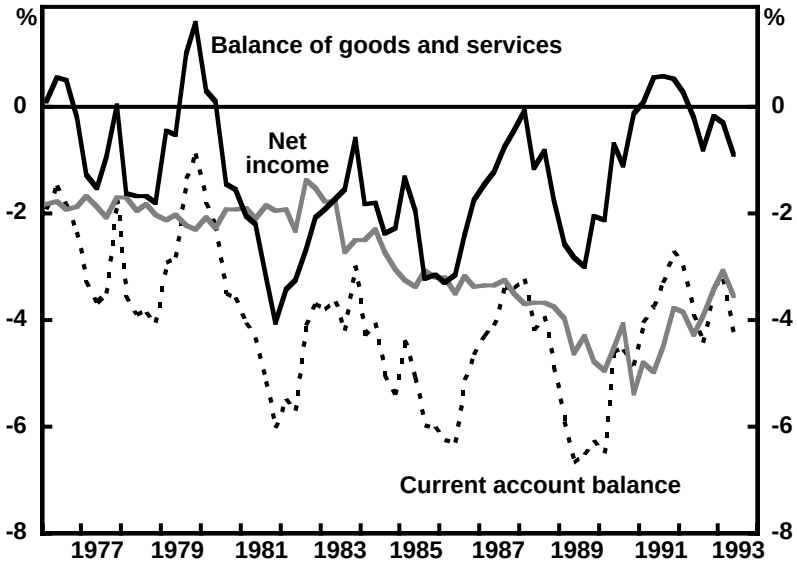
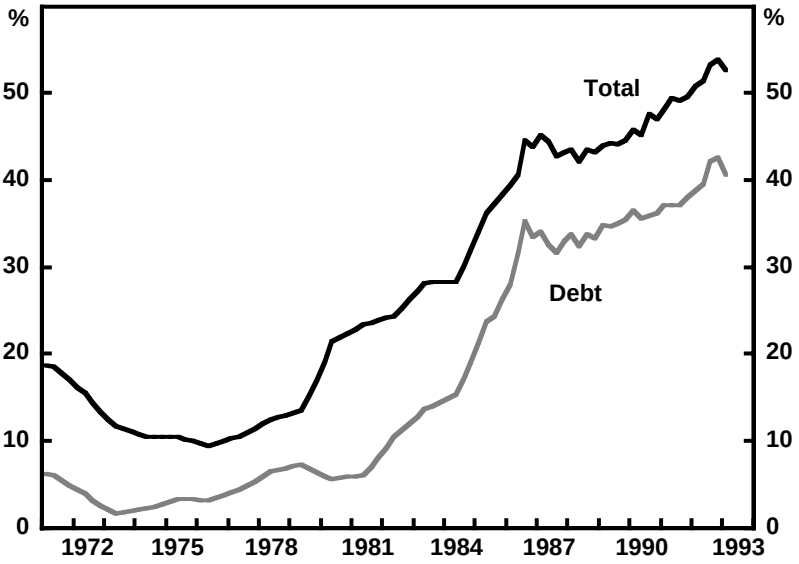


Figure 3: Net Foreign Liabilities
(per cent of GDP)



Accounting identities suggest that the external sector can be examined from three vantage points. Firstly, there is the external balance, focusing on trade in goods and services. Secondly, there is internal balance, highlighting the relationship between the nation's current account balance and its domestic saving-investment balance. Equivalently, this can be seen as the relationship between income (or production) on the one hand and absorption (expenditure) on the other. The third approach focuses on how a surplus or deficit is financed and the accumulation of claims on foreigners - that is, it emphasises intertemporal aspects. Each of these approaches is valid but the first and second approaches may provide more insights in short-run analysis, while the third will be important in the longer term. None of these relationships imply anything about causation. They are all interrelated parts of a system in which the relative importance of domestic and foreign factors can only be evaluated against the real world.

Section 2 explores responses to short-term shocks, while Section 3 describes some of the structural changes Australia experienced. Section 4 provides econometric estimates of imports and manufactured exports. Section 5 uses the findings of the two previous sections to examine the structural adjustment process. Section 6 examines how foreign liabilities (representing the cumulated current account deficits) play a role in the adjustment process, and looks at the debate on the sustainability of the external position.

2. Adjustment to Short-Run Shocks

This section takes as its starting point the sort of model set out in Pitchford's paper at this Conference, and uses the predictions from this model as a guide for comparing actual current account experience since 1980 in response to the two typical shocks that Australia experiences: an investment shock and a terms of trade shock. Of particular interest is the role of the exchange rate in the adjustment to these shocks. Of course, monetary and fiscal policy influenced the current account also, but the main focus of this section is on terms of trade and investment shocks.

2.1 The Framework

The expected response of the current account to the two shocks might be summarised as follows:

- shocks which can be characterised as a rightward movement in the IS curve (e.g. an investment surge) are expected to raise interest rates and the exchange rate, increase the current account deficit and increase domestic output (probably putting pressure on inflation). The role of the current account in these short-term shocks is to provide the opportunity to 'spill' excess demand into the international economy, ameliorating the problem of 'bottle-up' discussed in Blundell-Wignall *et al.* (in this Volume). The exchange rate

change will also shift domestic resources into production of non-tradeables. The more closely the domestic and international goods and services markets are linked, the speedier and more complete is this process of 'spilling' excess demand (and the less inflationary pressure is on the domestic economy); and

- an adverse terms of trade shock reduces income and, at the same time, alters one set of relative prices (between importables and exportables). For Australia, the shock generally takes the form of an export price change. The reaction should depend on whether people view the terms of trade shock as permanent or temporary. If permanent, they should begin the process of adaptation to the fall in income, which will require a lower exchange rate to switch production towards tradeables (to offset the deterioration in the current account) and switch domestic demand towards non-tradeables (so as to maintain domestic balance). If the shock is seen as temporary, consumption smoothing considerations suggest that the current account should move towards deficit by the full extent of the terms of trade shock; corresponding to this change in the external account, savings are temporarily run down to accommodate the loss of income. No change in the exchange rate is needed, as no 'switching' of production or demand is required. In practice, of course, people cannot know whether the shock is permanent or temporary (nor would their adjustment to a permanent shock be instantaneous) and so a mixture of the two responses might be expected.

2.2 Short-Term Shocks in Four Episodes

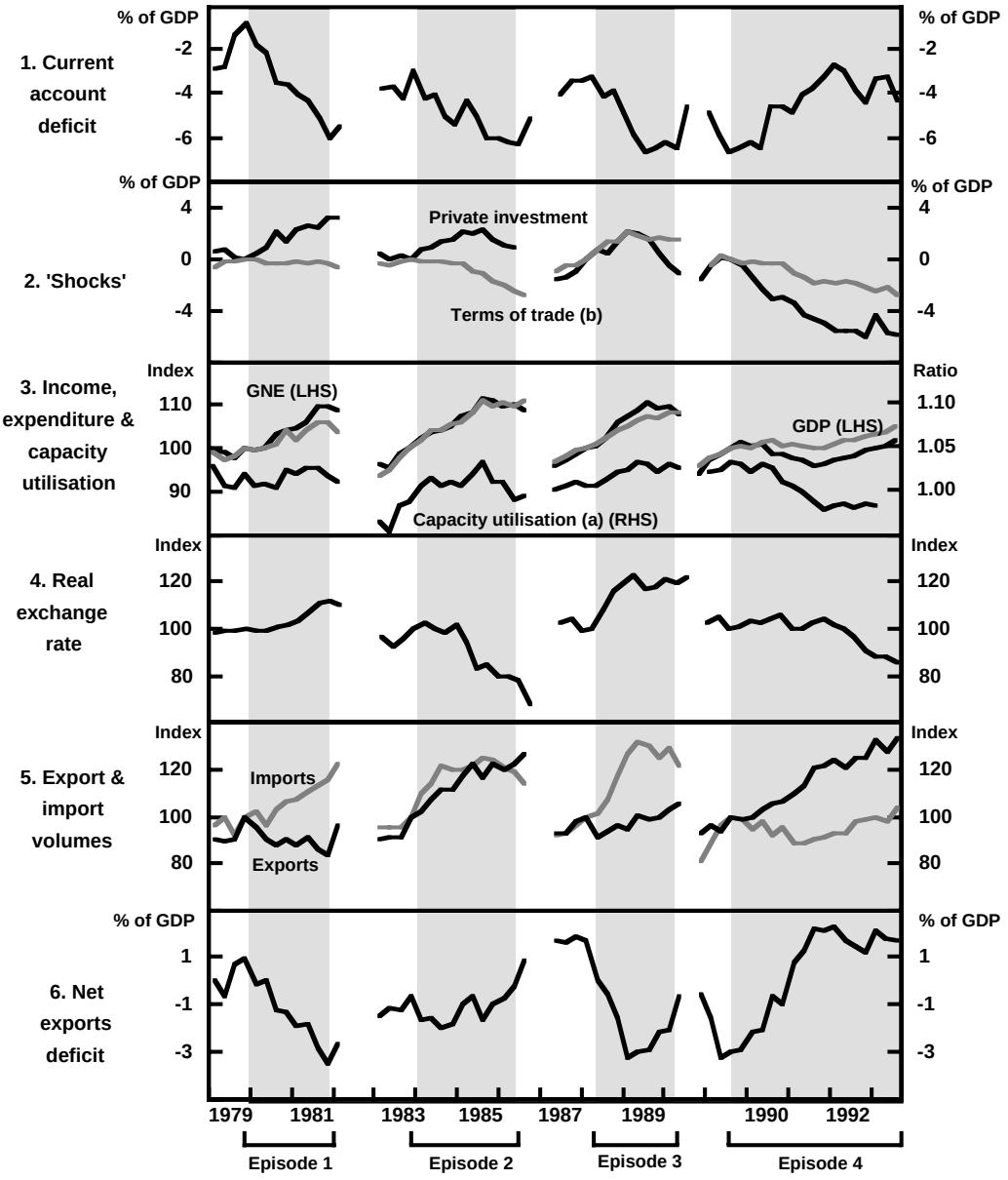
With these predicted responses in mind, this section examines the short-term adjustment process in action, in four episodes over the past 12 years. Does reality fit the model? Three of these episodes are associated with the three peaks in the current account deficit, and the fourth illustrates a period when there were strong forces tending to enlarge the current account deficit (in the form of an adverse movement in the terms of trade), but this was offset by contractionary income pressures. The four episodes provide case studies in the two prevalent types of shocks:

- investment booms - in 1980/81 and 1988/89; and
- adverse terms of trade movements - 1985/86 and 1990/91.

2.2.1 Episode 1: 1980/81

In this period, the current account deficit rose from around 1 per cent of GDP to 6 per cent (see panel 1 of Figure 4). This was driven by a strong rise in investment (panel 2), in turn reflecting the 'minerals boom' - a surge of optimism set off by the second OPEC oil price increase and the prospect of higher commodity prices (a prospect which was not, in fact, realised). This shock was

Figure 4: Four Episodes



Notes: (a) Ratio of real GDP to real GDP trend.
(b) The deviation of the terms of trade adjusted GDP from GDP(I) as a per cent of GDP(I).

equal to nearly 4 per cent of GDP, and so coincides reasonably closely with the expansion in the current account deficit. Changes in net export volumes, driven by imports increases (see panels 5 and 6), correspond closely in size and timing with the investment surge.

This episode provides an example of a fairly pure, investment shock. The exchange rate (and relative price changes) were an important part of the adjustment process, helping to 'spill' the excess domestic demand into the external sector.

2.2.2 Episode 2: 1984 to 1986

The early phase of this period had the same characteristics as an investment shock, but looking at the period as a whole, the terms of trade shock not only dominates, but entirely explains (in a proximate sense) the current account deficit increase - which amounted to 3 per cent of GDP. While the terms of trade decline was an important explanation for the 35 per cent fall in the exchange rate, one element of the terms of trade shock seems to have been delayed in its effect - the income-reducing impact of the terms of trade deterioration. Until 1986, this was offset by strong expansionary pressures coming from a strong world economy, a boost to investment from a change in factor shares in favour of capital and the beginnings of asset price inflation. By early 1986, monetary policy was tight and the income effects of the terms of trade deterioration were beginning to be felt: expenditure growth flattened. Net export volumes rose to offset part of the terms of trade loss, increasing by almost 3 per cent of GDP in 1986.

2.2.3 Episode 3: 1987 to 1989

In this episode, the current account deficit rose from about 3 per cent of GDP to over 6 per cent, reflecting two successive (and related) shocks: a reversal of the terms of trade decline of 1985/86 (which would tend to reduce the current account deficit); and an investment surge (which would tend to increase it).

Initially, expenditure and production expanded in concert, despite a very rapid recovery. As in 1984, there was room for domestic production to meet the expanding demand (see capacity variable in panel 3). This expansion was initiated by a terms of trade improvement equal to 3 per cent of GDP, but this was reinforced by an increase in private investment (amounting to 4 per cent of GDP), driven not only by the enhanced prospects that came with the terms of trade improvement, but by business euphoria associated with rapidly rising asset prices. The increase in the current account deficit roughly corresponded to the rise in investment. Both these shocks should appreciate the exchange rate, and this certainly happened, with a rise in the real trade-weighted index (TWI) of around 20 per cent.

2.2.4 Episode 4: 1990 to 1992

This episode was, to a large extent, the reversal of episode 3. The current account deficit fell by around 2 per cent of GDP, with a terms of trade fall equal

to around 2 per cent of GDP and a reduction in private investment equal to 6 per cent of GDP (offset to some degree by the expansion of the budget deficit equal to 3 per cent of GDP). There was very little exchange rate movement until late 1991, probably reflecting the firm stance of monetary policy. Most of the action was in gross national expenditure (GNE), which fell by around 5 per cent. This can be seen as the dominant force of this episode - a fall in investment and income opening up a sizeable gap between GNE and GDP (see panel 3), with the main adjustment being driven by income elasticities rather than prices.

2.2.5 Observations

There are interesting contrasts between the two terms of trade declines. In 1985/86, the current account deficit expanded by about the same size as the terms of trade shock, while in 1990/91, the current account deficit actually got smaller. Does this contrast correspond with the temporary/permanent dichotomy? The change in the exchange rate does not appear to be consistent with this idea; if 1985/86 had been seen as temporary (and therefore consumption smoothing was the relevant model), the exchange rate would not have needed to change much. However, if the 1990/91 terms of trade deterioration had been seen as permanent, that would have implied a significant exchange rate change, which in practice was slow in coming. This cannot be explained solely by differences of monetary policy stance, as policy was tight in both episodes. The fundamental difference seems to be in the context of the time: there were a myriad of interrelated expansionary forces in 1985 (world growth, an investment boom, a change in the wages-profits share, optimism about fiscal policy and the beginnings of the asset price boom) which contrasts starkly with the gloomy environment of the 1990/91 episode, with its large fall in investment. These expansionary factors offset the income-contracting effect of the terms of trade fall in 1985. But if these forces were so strong, why did the exchange rate fall so far? Part of the answer is that it was reacting to the newly recognised realities of higher foreign debt and the limited benefits of the 1980 mineral boom (see Blundell-Wignall *et al.*, in this Volume).

The second comparison is between episodes 2 and 3 where in both cases, there was a substantial increase in the current account deficit, and a strong rise in both GNE and GDP. The major contrast here is in the behaviour of the exchange rate and therefore relative price movements. It is here, above all, that the importance of relative prices in the adjustment process is clear: in 1986, the depreciation and relative price change was enough to produce a positive change in net export volumes which went quite some distance to offsetting the adverse movement of the terms of trade on the current account, while in 1988/89 the rise in the exchange rate (and associated change in relative prices) was enough to 'spill' much of the income shock into the external sector - thus expanding the current account deficit.

Other generalisations can be made:

- the exchange rate *is* effective and plays an important part in changing net export volumes. In the two investment shocks (1980/81 and 1988/89), the exchange rate was effective in spilling excess domestic demand into the overseas sector and attracting incremental saving to finance real investment;
- terms of trade shocks generally seem to be seen as *permanent* rather than temporary (two characteristics of permanent changes are exchange rate responses and some adjustment of trade *volumes*). This seems curious, given that these large swings in the terms of trade have invariably proved to be only partly sustained, and that the long-term trend in the terms of trade has been quite modest; and
- where spare domestic capacity existed, GNE increases and GDP increases moved more or less in tandem. This suggests that goods and services markets are not perfectly integrated internationally, as domestic productive capacity was the first 'port of call' for meeting increased demand.

3. Structural Issues

Over the course of the 1980s, there have also been longer-term structural changes, which have seen Australian production become much more closely integrated with international markets. Merchandise trade volumes rose sharply as a share of GDP from the mid-1980s, following a period of relative stability in the 1970s (see Figure 1). Clearly, exchange rates and relative prices, by themselves, cannot explain this simultaneous rise in both imports and exports.

This greater integration is not, of course, a phenomenon confined to Australia. Since 1960, international trade has grown roughly twice as fast as average GDP growth in the OECD countries, and this is reflected in the rise in exports as a proportion of GDP in most industrial countries (see Table 1). What is different about Australia is how it has lagged the international trends in integration.

In Australia's case, the most prominent specific policy factor driving this greater integration was the reduction in protection. Figure 5 shows the Industry Commission's calculation of the effective rate of assistance for Australian manufacturing.[2] It captures tariffs, quotas and other assistance measures which distort the relative prices facing manufacturers. On this measure, protection fell sharply in the early 1970s (following the across-the-board cut in tariffs in 1973). Not much more progress was made (in fact, some reversion occurred) until the mid-1980s, and since then, another substantial downward movement has been recorded.

2. The series shown in Figure 5 is a spliced series. See Appendix A for details.

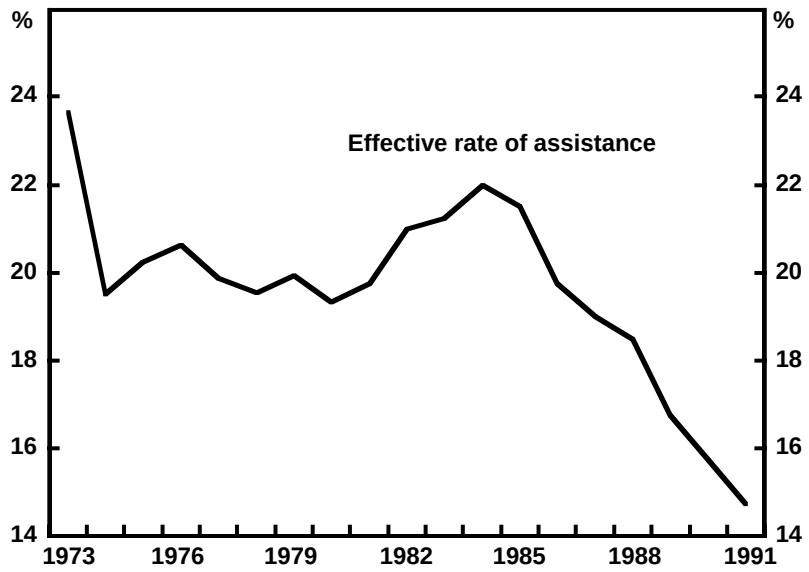
Table 1: Exports of Goods and Services to GDP

(constant prices, per cent)

	1970	1985	1992
Australia	13.9	16.5	22.7
Austria	25.4	40.9	47.3
Canada	21.2	27.0	32.0
France	15.1	23.0	27.1
West Germany	22.5	35.1	44.2
Italy	15.5	20.8	24.3
Japan	8.1	16.2	18.4
Switzerland	28.1	40.7	42.8
United Kingdom	21.5	28.6	30.9
United States	5.6	7.2	11.6

Source: OECD Quarterly National Accounts.

Figure 5: Effective Rate of Assistance



At the simplest level, this reduction in protection would be expected to have two effects - the exchange rate would depreciate in order to offset the tendency for imports to increase; and, as a result of this, exports would increase. So the

reduction in protection might be one of the explanations for the increase in *both* imports and exports. This simple intuition is appropriate in the short run. It may not, however, be the end of the story. In the longer run, if the distortions imposed by tariffs are very large, removing the tariff increases national income and, like other increases in productivity, this would put upward pressure on non-traded goods prices and thus upward pressure on the real exchange rate. The dynamic distortions caused by tariffs may be potentially more important than the static distortions. A second qualification is that tariffs might impose a sufficiently high 'tax' on exports (imported inputs costs are higher than under free trade), that a general reduction in tariffs might actually improve the trade balance and cause a real appreciation (Johnson 1966). Neither of these considerations, however, alters the intuition that a reduction in tariffs would be expected to increase both imports and exports.[3]

The reduction in tariffs is only one example of the significant microeconomic reforms of the past 10 years (and, in these, the tariff reduction would often have been an important catalyst). The changes are often attitudinal and unquantifiable, but are reflected in the new-found emphasis on export orientation and 'world-best practice'.[4] Many of these reforms have no clear direct balance of payments link (see Forsyth (1990)), but have served to make Australia more competitive and outward looking. While they cannot be quantified, they form an important backdrop to the greater international integration. These changes involved:

- a rise in intra-industry trade;
- rapid increases in manufactured exports; and
- a substantial alteration in the direction of trade, particularly in exports.

3.1 Intra-Industry Trade

Historically, much of Australia's trade has been *between* industries - exporting commodities and importing manufactures - rather than within industries. Lowe (1990) showed that in 1987, intra-industry trade accounted for only 12 per cent of total Australian trade, the lowest proportion of any OECD country. In most European countries and North America, for example, intra-industry trade accounts for around 40 to 50 per cent of total trade. The structure of Australia's resource endowment provides one explanation. Intra-industry trade tends to be lower in

3. Clements and Sjaastad (1984) discuss the theory of import protection, emphasising how much of the burden is borne by exporters. They also provide empirical estimates of the cost to exporters of protection. Swan and Zeitsch (1992) show, in the context of the ORANI model, that reductions in tariff protection result in increases in manufactured exports.

4. McKinsey & Company (1993) document the recent emergence of this export culture in many small and medium-sized firms.

goods which are relatively homogeneous - for example, commodities. Australia's large weighting towards these types of exports would, therefore, tend to decrease the amount of intra-industry trade as a proportion of the total.

Trade structure is not, however, the whole story. Lowe shows that even for trade categories in which intra-industry trade is prevalent (in particular, manufactured goods), Australia's intra-industry trade is much lower than the average. An important factor here has undoubtedly been protection of the domestic manufacturing industry in Australia. With reduced protection, intra-industry trade should expand. Indeed, while the share of intra-industry trade in total Australian trade remains very low, it has risen, particularly over the past decade, to levels nearly three times higher than 25 years ago (see Table 2). Individual industries show a more dramatic change. Intra-industry trade in the broad category of beverages and tobacco has risen from about 7.5 per cent in the 1960s and 1970s to almost 40 per cent at the beginning of the 1990s. The Closer Economic Relations Agreement has led to a dramatic expansion of intra-industry trade with New Zealand. Around 45 per cent of Australian trade with New Zealand is now of intra-industry type, compared with about 14 per cent in the 1960s. Furthermore, the growth of manufactured exports over the second half of the 1980s (see Section 3.2 below) has also embodied an increase in intra-industry trade.

Table 2: Australian Intra-Industry Trade
(as a percentage of total trade)

Period average	Total Goods	Manufactures
1965-69	5.1	6.2
1970-79	6.6	9.2
1980-85	8.2	9.8
1986-91	11.4	13.4
1991	13.8	17.4

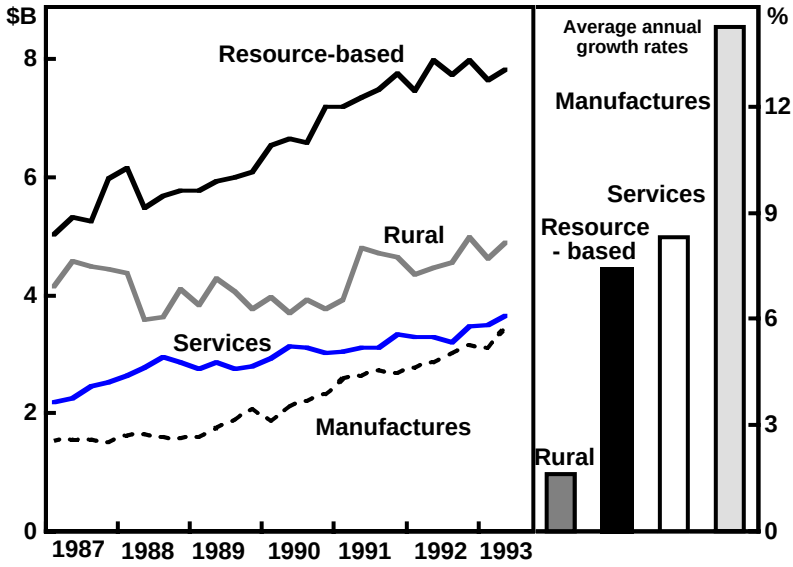
Sources: Lowe (1990) and Australian Bureau of Statistics.

3.2 Manufactured Exports

Figure 6 shows growth rates of the main categories of exports. Manufactured export volumes[5] have grown by almost 15 per cent per annum over the past six years, compared with about 6 per cent over the previous six years (see Figure 6).

5. Throughout the paper, manufactures are defined in a narrow sense to exclude some large, simply-transformed categories such as iron and steel and aluminium. These are classified as resource-based exports.

Figure 6: Composition of Exports
(1989/90 prices)



While this strong growth has been from a low base, it is symptomatic of important structural change occurring in the domestic economy. Some commentators have suggested that the growth reflects temporary rather than structural factors, arguing that the growth:

- is cyclical, reflecting sluggish domestic demand;
- is due to fast growth in a few markets and does not reflect a broader strength; and
- is all in categories which are receiving government assistance.

These explanations play some part in the story: in general, however, previous work has concluded that the growth appears to be too widespread across destinations and sectors to be attributable principally to the above factors.[6] More deep-seated structural forces seem to be at work.

3.3 Direction of Exports

There has been a substantial change in the direction of Australian exports over the past 40 years (see Table 3). In the 1980s, Asia (excluding Japan) became a very important destination for Australian exports, particularly exports of manufactures.

6. Reserve Bank of Australia (1992).

Table 3: Direction of Merchandise Exports
(per cent of total)

	1950s	1970s	1980/81	1991/92
United Kingdom	32.3	5.5	3.7	3.5
Other EEC	21.5	10.4	8.7	9.0
Japan	10.3	30.0	27.3	26.5
Other Asia	9.7	17.1	20.4	32.7
North America	9.7	13.2	13.5	11.0
New Zealand	4.8	5.1	4.8	5.1
Other	11.7	18.7	21.6	12.2
	100.00	100.00	100.00	100.00

Notes: (a) Other Asia - Bangladesh, Brunei, China, Hong Kong, India, Indonesia, Cambodia, Korea, Laos, Macau, Maldives, Burma, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Vietnam.
(b) North America - Canada, United States.
Source: Australian Bureau of Statistics Catalogue No. 5436.0.

The re-orientation away from Europe and towards Asia was initially driven by the formation of the EEC and the strong post-war growth of Japan. More recently, the strong growth in Asian countries other than Japan has presented Australia with further export opportunities. This group now accounts for one-third of Australia's merchandise exports (compared with less than 10 per cent in the 1950s and 20 per cent as recently as 1980/81). Taken together with Japan and New Zealand, our regional trading partners now account for nearly two-thirds of our merchandise exports.

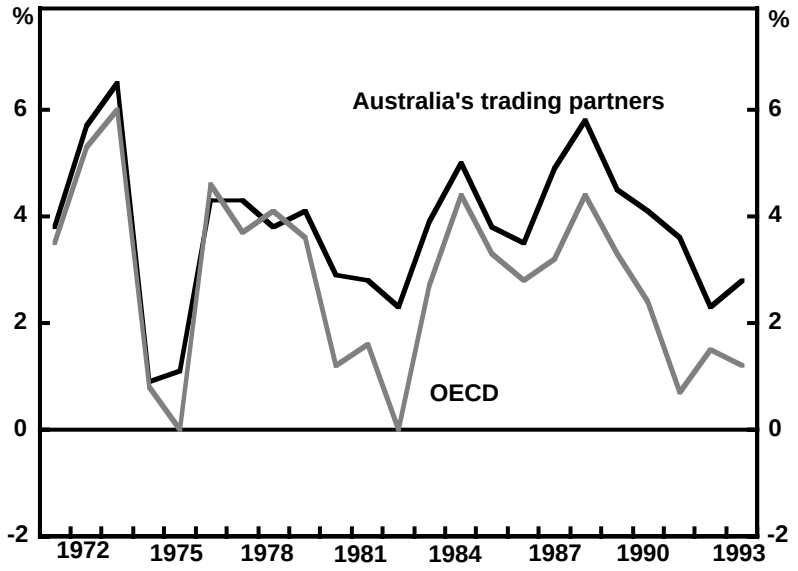
The economic growth of this 'Other Asia' area has been quite fast for the past couple of decades (about 6 per cent per year in the 1970s and 7 per cent in the 1980s), but it was not until the 1980s that the region's *absolute* size became significant. These countries have not only grown fast, but this has been outward-looking growth, with large increases in the proportion of GDP accounted for by international trade (see Table 4). The growing market in these countries can be seen in Figure 7, which compares GDP growth in OECD countries with that in Australia's trading partners, where the fast-growing Asian area has provided a rapidly growing export market. Unlike the earlier expansion in Japanese demand, the more recent expansion in Australian exports to this region has been focused on manufactured goods. Simply keeping pace with the growth of manufactured imports by this region, for example, has resulted in average annual growth in

Table 4: Selected Asian Economies: Exports/GDP
(per cent)

	1965	1990
China	4	18
Indonesia	5	26
Philippines	17	28
Thailand	16	38
Malaysia	42	79
Korea, Rep.	9	32
Singapore	123	190
Hong Kong	71	137

Source: World Bank, *World Development Report 1992.*

Figure 7: Output Growth
(year-ended percentage change)



Australian manufactured exports to Asia of over 20 per cent in the second half of the 1980s.

Table 5 shows growth in Australian manufactured exports to various countries and growth in manufactured imports by those same countries over the second half of the 1980s.

Table 5: Growth in Manufactured Exports

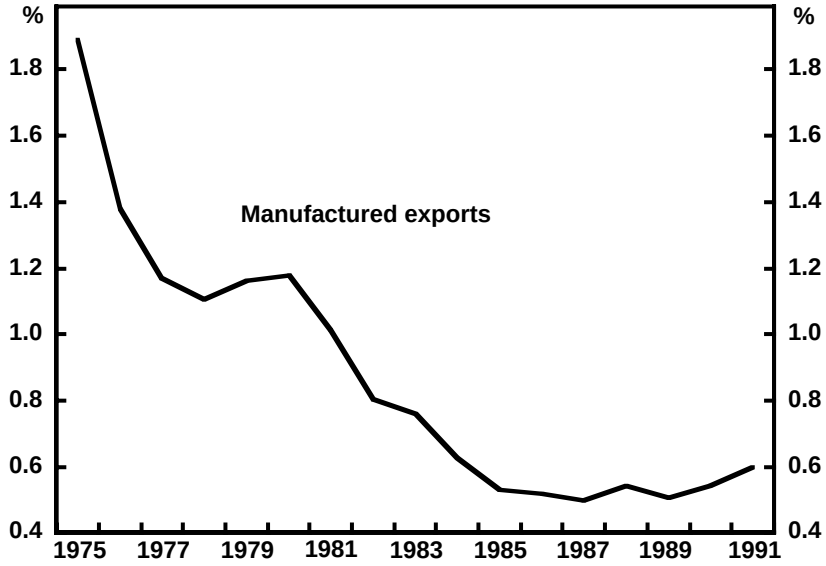
Country/region	Australian manufactured exports	Manufactured imports of these countries	Share of Australian manufactured exports
	(average annual percentage change, 1986-1991)		(per cent, 1991/92)
Singapore	31.0	24.7	6.1
Hong Kong	21.4	24.9	5.7
Indonesia	38.8	17.8	3.6
Korea	40.0	20.5	2.6
Taiwan	28.0	27.9	2.5
Malaysia	29.1	29.8	2.3
Thailand	35.0	34.1	2.2
Philippines	33.6	22.6	1.2
China	-1.8	7.6	1.0
Total Asia (excluding Japan)	**27.6**	**21.4**	**24.6**
Japan	30.2	21.1	7.9
New Zealand	17.7	7.0	18.8
OECD Europe	24.5	14.8	16.3
North America	27.6	6.3	16.0
TOTAL of above	**24.8**	**13.5**	**83.6**

Notes: (a) Due to data limitations, the statistics in this table are in value rather than volume terms.
(b) To account for differences in inflation rates among countries, growth rates are measured in US dollar terms. Details of the calculations are available on request.

Sources: OECD, *Foreign Trade by Commodities.*
Asian Development Bank, *Key Indicators of Developing Asia and Pacific Countries.*
United Nations, *International Trade Yearbook.*
Department of Foreign Affairs and Trade, *Central Statistics Section.*
Council for Economic Planning and Development, Republic of China, *Taiwan Statistical Data Book 1992.*

The data show that although there has been some gain in market share in Asia, there have been even more substantial gains for Australian manufacturers in the more 'traditional' markets of New Zealand, OECD Europe and North America. Furthermore, manufactured exports to Asia grew at about the same rate as exports to the other markets, even though the Asian markets were growing much more quickly. Figure 8 shows that after a long period of declining market share in Asia, Australian manufacturers have managed to hold market share since 1986, and

Figure 8: Australian Manufactured Exports to Asia[(a)]
(share of region's manufactured imports)



Note: (a) As defined in Table 5, but excluding China and Taiwan.

perhaps even increase it slightly. Some of these puzzles will be examined in the empirical work of the next section.

4. Estimating Trade Equations

So far, in looking at the short-term movements and structural changes, the analysis has been descriptive. The next two sections attempt to bring a degree of precision to the analysis, with econometric estimates of imports and exports. The discussion above suggests a number of possible explanators:

- relative prices;
- reductions in tariffs and other assistance; and
- strong growth in Asia.

4.1 Imports

In Section 3, the rise in the ratio of imports to GDP was noted as an example of structural change. High *short-term* income elasticities make some intuitive sense.[7] But in the longer term, elasticities closer to unity might be expected, so the sharp

7. An excess demand shock of the type described in Section 2 equal to, say, 1 per cent of GDP, which entirely 'spilled' into imports would, in an economy with an import ratio of 20 per cent, imply an income elasticity of 5.

rise in the imports/GDP ratio suggests that structural factors are at work. This section explores this through the estimation of an import equation.

A recent study by Wilkinson (1992) is taken as the starting point. This used an error-correction approach to estimation which seems particularly suited to trying to separate short-run and long-run elasticities. The results of this work differed somewhat from those of previous studies.[8] Estimates of the long-run income elasticity were much higher - in a range of 1.85 to 1.94 depending on the definition of imports and the activity variable used. At the same time, the estimates of price elasticities were generally lower than in previous studies: -0.3 to -0.8. Wilkinson's preferred equation succeeded in tracking, out of sample, the large rise in imports in 1988/89 and the subsequent fall.

One surprising characteristic of the Wilkinson equation is that there was no substantial difference between short and long-run income elasticities, even though the estimating technique had the potential to separate these. The relatively high income elasticities estimated make some sense for the short-run response to income shocks, but it is hard to see why the long-term elasticities should be so high. Five possible reasons could be put forward:

- computer imports became such an important component, and grew so quickly, that they need to be explained not only by income and relative price elasticities but also in terms of changing tastes in technology;[9]
- imports comprise capital goods, consumption goods and intermediate inputs (with the last category accounting for about half of endogenous imports). There may be too much diversity in the behavioural relationships underlying the various groups of imports to be able to model them successfully in aggregate;
- other structural changes, particularly on the domestic supply side, have been important and are being confounded with the income elasticities of the demand equation;

8. See Macfarlane (1979) for a survey of price and income elasticities of demand for imports from the 1960s and 1970s. Gordon (1986) reports price elasticities for a few studies in the 1980s.

9. When rebasing the constant price estimates to 1984/85 prices (in 1988), the Australian Bureau of Statistics (ABS) introduced a new method for calculating the volume of computers. They now use a computer price series, developed by the Bureau of Economic Analysis (BEA) in the United States, to deflate the value of computer imports. Due to the rapidly improving quality of computers over time, this price series falls almost continuously and very sharply, and the volume correspondingly rises very sharply. (See McCarthy (1989) for details of this method of calculation.) As a result, estimation of import demand functions which include computers will tend to find much larger elasticities on income and relative price than if computer imports had been excluded. Studies carried out prior to the introduction of this computer price series by the ABS (i.e. all of the studies reported in Macfarlane (1979)) will not be affected by this problem.

- the reduction of protection represents an important structural change which is not captured in the Wilkinson equation, but which might be expected to explain an important part of the increase in imports (and exports) as a per cent of GDP. The regression may be attributing to the income variable some of the influence of tariff reductions; and
- as a result of greater international integration, greater intra-industry trade may explain higher imports *and* exports, for any set of income and prices.

The final three relate to structural *supply-side* changes which are poorly defined in the sort of model estimated here. The final two were discussed in Section 3 as reasons why gross trade flows may be rising in general.

The following sections look briefly at the first two issues. A third section looks at whether reductions in protection help to explain the rise in import volumes. Intra-industry trade was discussed in Section 3 and will not be covered again here.

4.1.1 Excluding computers

Table 6 compares Wilkinson's results with a re-estimation of the same model excluding computers.[10] This gives some idea of the extent to which computer imports have influenced the relevant elasticities. Rebasing the constant price estimates resulted in a much lower growth in endogenous imports[11] and estimating Wilkinson's model using these rebased data and a longer sample, results in a

Table 6: Long-Run Elasticities of Import Demand

	Income	Relative Price
Wilkinson (1992) (1984/85 prices)		
1974:3 to 1989:3	1.94	-0.49
This study (1989/90 prices)		
1974:3 to 1992:4		
including computers	1.70	-0.45
	(33.55)	(-4.43)
excluding computers	1.55	-0.42
	(28.55)	(-3.36)

Notes: t statistics are in brackets. There were no t statistics reported in Wilkinson.

10. The model is estimated over a longer sample than Wilkinson's; September 1974 to December 1992. Furthermore, it is a simpler model. In particular, it excludes the relative price of exports and capacity constraints which, in subsequent work, were found to be insignificant in the long-run equation estimated using the Phillips-Hansen technique.

11. See Australian Bureau of Statistics Catalogue Nos 5227.0 and 5243.0.

significantly lower income elasticity.[12] The effect of excluding computers has been to reduce the income elasticity further, as would have been expected. While much lower, however, the income elasticity is still well above unity.

4.1.2 Disaggregation

Consumption goods might be expected to have a higher price elasticity than, say, investment goods, because there are close domestic substitutes for consumption imports. Producer inputs may be less responsive to changes in relative prices. Figure 9 shows growth of each type of import with a relevant activity variable and relative price. Long-run equations and error-correction models were estimated for each component of imports. Table 7 summarises the long-run elasticities. Details of the estimates are recorded in Appendix A.

Two main conclusions emerge. Firstly, for all three categories of imports, income elasticities are significantly greater than 1 (but below the Wilkinson estimate). Consumption imports appear to have a higher income elasticity than other types of imports. The high aggregate income elasticity, however, does not appear to be the result of behavioural differences in imports; whatever is pushing up the income elasticities is a general factor, affecting all types of imports. Secondly, there are substantial variations in price elasticities. Consumption and capital imports have price elasticities around -0.8, higher than for total imports. The relative price effect on 'other' imports (principally intermediate goods) is

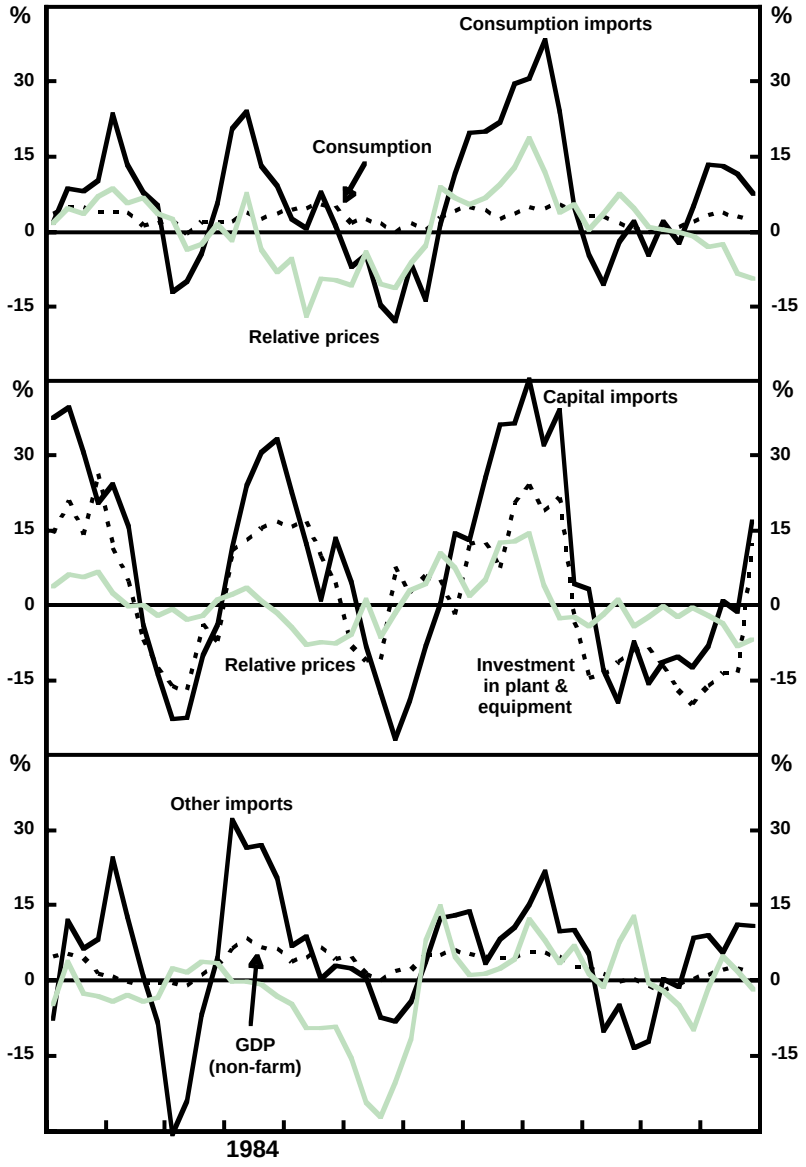
Table 7: Long-Run Elasticities of Import Demand

Component of Imports	Income	Relative Price
Consumption	1.73	-0.70
	(17.76)	(-5.15)
Capital (using GNE)	1.40	-0.76
	(5.48)	(-2.29)
Other	1.48	-0.18
	(12.01)	(-1.53)

Note: t statistics are in brackets.

12. The reason for this difference is not the sample period. When the model was estimated using the rebased data including computers over the same period as Wilkinson (1992) the income and price elasticities were 1.72 and -0.49, respectively.

Figure 9: Imports, Activity and Relative Prices
(year-ended percentage change)



much smaller at -0.2 and is statistically insignificant at the 10 per cent level. This makes some intuitive sense; there may well be limited domestic substitutes for imported inputs and producers may find it easier to pass these costs on.

4.1.3 Tariffs

With falling protection, the price of imports facing consumers will be falling relative to the price of domestic goods and the import penetration ratio will therefore be rising. The price of imports over the docks does not capture this effect so the relative price term in the import equations was adjusted to allow for falling tariffs.[13] The adjustments were made in both the aggregate equation and in the equation for consumption imports, reflecting an *a priori* belief that protection is most prevalent on consumption items.

Table 8 reports the results of this further estimation, comparing it with earlier estimates. Evidence of a tariff effect is very weak; the differences in the estimates are not statistically significant. Nevertheless, it is interesting to note that the income elasticity, in particular, moves in the expected direction; it falls when the tariff adjustment is included.

Table 8: Long-Run Elasticities

	Activity	Relative Price
Endogenous Imports:		
without tariff adjustment	1.55	-0.42
	(28.55)	(-3.36)
with tariff adjustment	1.50	-0.41
	(24.26)	(-3.52)
Consumption Imports:		
without tariff adjustment	1.73	-0.70
	(17.76)	(-5.15)
with tariff adjustment	1.64	-0.68
	(16.11)	(-5.03)

Note: t statistics are in brackets.

The evidence from Table 8 is not particularly compelling. An alternative model was therefore formulated to further test the importance of falling protection in import growth. The dependent variable was defined to be the import penetration ratio (endogenous imports/GDP) - i.e. the coefficient on domestic income was constrained to be unity. Two variables were tried to capture the tariff effect. Firstly, the effective rate of assistance (ERA, as shown in Figure 5) was used as an explanator, together with the relative price series used in the regression reported

13. See Appendix A for a description of this adjustment.

in Table 6 (RP1, it does not incorporate tariffs). The results are reported in Table 9. Secondly, a relative price which incorporates import prices measured at the *retail* level (i.e. including tariffs) was tried (RP2).[14] This variable is available only since December 1984, so the sample period is reduced to 32 observations. The performance of this relative price was then compared with the performance of the relative price term which does not incorporate tariffs.

The first regression indicates a significant relative price elasticity of around -0.7 and an elasticity on ERA of around -1.2, although this variable is not significant at the 10 per cent level. The second and third regressions show the results with the two different relative price variables. These tests should be interpreted cautiously. The sample period for these regressions is very short and the long-run coefficients reported may be biased (Inder 1991). For what it is worth, both relative price variables have significant long-run coefficients. The fourth column presents a simple test of the relative performance of each variable. The results suggest that RP2, the relative price including tariffs, performs better in modelling the import penetration ratio.

Table 9: Tests of the Effect of Tariffs

Endogenous imports/GDP regressed on:		Period of Estimation	Long-run Coefficient	F test (b)
(i)	ERA	74:3 - 92:4	-1.16	
			(-1.13)	
	RP1		-0.65	
			(-2.47)	
(ii)	RP1	84:4 - 92:4	-0.65	F(8,20) = 2.174
			(-4.83)	(0.076)
(iii)	RP2	84:4 - 92:4	-1.06	F(8,20) = 3.978
			(-3.15)	(0.006)

Notes: (a) t statistics are in brackets.
(b) F test of the hypothesis that all variables in the error-correction model could be excluded. The figures in brackets are significance levels.

A lot of weight should not be given to these results. Nevertheless, taken together, the results in Tables 8 and 9 are weak evidence of a role for tariff reductions in explaining the rise in imports. These results will be used in Section 5 in discussing structural change.

14. See Appendix A for details.

4.2 Exports

This section explores trade equations for exports, with the special interest being the role of the exchange rate and relative prices. Relative prices could find their way into export equations in three ways:

- export prices/domestic prices: this 'internal competitiveness' represents the supply-side effect, whereby a rise in export prices may attract resources away from other uses, principally in the non-traded sector;
- Australian export prices/world export prices: this reflects the competitiveness of Australian exports, *vis-à-vis* rival suppliers; and
- export prices/prices in the 'target' market: this captures the competitiveness of Australian exports, *vis-à-vis* alternative sources of supply within the importing country.

It has proven difficult to find clear relative price effects in export equations for Australia (although Goldstein and Khan (1985) report some success for other countries). For the bulk of Australia's exports (commodities), the supply-oriented relative prices are probably the most relevant, as there is no scope for price differentiation in this sort of homogenous good. Given the long lags in supply response, it is perhaps not surprising that this relative price effect is difficult to find.

The focus in this paper will be on manufactures, as this is not only the component of exports which has grown extraordinarily quickly since the mid-1980s, but it may also be more responsive to *demand*-oriented relative prices. Such goods are not homogenous; there is scope for product differentiation and, therefore, price differentials between similar goods on the world market. Furthermore, for a small country such as Australia, the price elasticities of demand for manufactured exports would be expected to be relatively high. With only a small share of world markets, growth in Australia's exports of manufactures should not be constrained by total market growth; a fall in the relative price of Australian manufactures would, therefore, be expected to result in a significant rise in exports of those goods.

4.2.1 Exports of manufactures

This section relates the growth in manufactured exports to a number of variables including relative prices and foreign income. The feature which distinguishes this study from earlier estimates[15] is that it uses cross-section as well as time series data. A panel of annual data on Australian manufactured exports to 21 countries from

15. See, for example, Hargreaves, Harrington and Siriwardana (1993), Menzies and Heenan (1993), and Ryder and Beacher (1990). Coppel, Simes and Horn (1988) report the results from the NIF88 model of the Australian economy.

1976 to 1991 is constructed and used in estimation. There are a number of advantages to using panel data in this situation. Firstly, quarterly data on exports are very volatile. Use of cross-section data allows the time series to be annual without immediately running into sample size problems. Secondly, the Asian countries have grown very quickly over the past decade and have become increasingly important destinations for Australian manufactured exports. Use of cross-section data allows these differential growth rates to be explicitly accounted for, and for any differences in income elasticities across countries to be tested. More generally, use of cross-section data introduces more variation to the data, which may assist in identifying the influence of particular factors. Finally, there are some econometric advantages which are discussed in Appendix B.

A general model of Australian manufactured export volumes is given in the following equation.[16]

$$X_{it} = f_i(Y_{it}, W_t, P_{it}, Z_{it}) \quad (1)$$

where X_{it} is the volume of manufactured exports to country i at time t, Y_{it} is the real level of income in country i, W_t is the price of Australian manufactured exports relative to world manufactured exports, P_{it} is the price of Australian manufactured exports relative to country i's manufactures, and Z_{it} is any other variable that may impact on the penetration of Australian manufactured exports overseas.

Australian manufactured exports to country i are, at the simplest level, a function of the income in country i and the price of Australian manufactured exports relative to the price of competitors. Other factors which may be relevant are:

- 'internal' competitiveness: if supply is not infinitely elastic, some rise in the price of exports relative to goods sold domestically will be needed to induce an increase in the supply of exports. This may be a short-term switch (the same product simply being sold in a different market) or a long-term one (re-allocation of productive resources to production of traded goods rather than non-traded). The expected sign of this variable is ambiguous. A decline in the price of exports relative to other domestic goods may result in a decline in the supply of exports. On the other hand, the decline in the price of exports may reflect higher productivity in this sector and a flow of resources into exports. In this case, lower export prices relative to domestic prices will be associated with a rise in exports;
- Australian domestic demand: a frequently heard explanation for the strong growth in manufactured exports is that producers are exporting simply because they cannot sell their products in the domestic market due to domestic

16. See Appendix B for details of data constructions and sources.

recession. The implication is that penetration rises when domestic demand is weak and falls as domestic demand strengthens; and

- reductions in protection: tariffs and other forms of protection have a damaging effect on Australian exports through resource misallocation and higher input costs. Furthermore, they reduce pressure on domestic producers to innovate and improve efficiency, thus reducing their competitiveness in world markets. Therefore, as protection is reduced, exports would be expected to rise.

The approach was to obtain non-structural estimates of the impact of foreign incomes and relative prices on Australian manufactured exports. Other variables were then added to the basic formulation to see if they add any explanatory power and/or detract from the explanatory power of the basic variables.[17] Initially, two relative price terms were included; the price of Australian manufactures relative to world prices (the world relative price) and the price of Australian manufactures relative to the domestic price of manufactures in the importing country (bilateral relative prices). The bilateral relative price did not add significant explanatory power, so it was dropped from the basic model. The world relative price variable was significant when the bilateral price was included and did not vary much with its exclusion.

The results of the basic model are shown in the second column of Table 10. Here, the income and price elasticities are constrained to be the same between countries of export destination.

The coefficients on world relative prices and foreign GDP were significant and of the expected sign. An increase in the price of Australian manufactured exports relative to world prices is associated with a fall in manufactured exports. Although the significance level cannot be calculated from this formulation, the estimates suggest that the long-run effect of the world relative price on Australian manufactured exports is around -6.4. That is, over the period of estimation, a 1 per cent fall in Australian manufactured export prices relative to world prices is associated with about a 6.5 per cent rise in the volume of manufactured exports.

An increase in foreign GDP is associated with a rise in Australian manufactured exports; the constrained estimates from the basic model suggest a long-run 'elasticity' of 0.8 on foreign GDP, although once again, significance levels cannot be calculated.

The third to sixth columns of Table 10 show the results of including other factors in the basic model, one at a time. Apart from the effective rate of assistance, none of the other factors improved the fit of the model markedly (as measured by the sum of squared residuals (SSR) and the standard error of estimate (SEE)). The

17. See Appendix B for details.

Table 10: Summary of Results

$$\Delta x_{it} = \alpha_i + \beta_0 x_{it-1} + \beta_1 \Delta x_{it-1} + \omega_0 w_{t-1} + \omega_1 \Delta w_t + \omega_2 \Delta w_{t-1} + \eta_0 y_{it-1} + \eta_1 \Delta y_{it} + \eta_2 \Delta y_{it-1} + \xi_0 z_{it-1} + \xi_1 \Delta z_{it-1} + \xi_2 \Delta z_{it-1} + \varepsilon_{it}$$

Model	Basic Model	Domestic Relative Prices	Australian GNE	Capacity Utilisation	Effective Rate of Assistance
Exports	–0.25	–0.24	–0.28	–0.27	–0.31
x_{it-1}	(0.07, 0.00)	(0.08, 0.00)	(0.07, 0.00)	(0.07, 0.00)	(0.07, 0.00)
Δx_{it-1}	0.35	0.40	0.37	0.50	0.28
	(0.18, 0.05)	(0.22, 0.07)	(0.18, 0.04)	(0.22, 0.02)	(0.18, 0.13)
World relative prices	–1.60	–2.20	–1.96	–2.21	–1.54
w_{t-1}	(0.55, 0.00)	(0.61, 0.00)	(0.97, 0.04)	(1.02, 0.03)	(0.58, 0.01)
Δw_t	–1.37	–1.73	–2.00	–3.33	–1.40
	(0.51, 0.01)	(0.57, 0.00)	(1.08, 0.06)	(0.84, 0.00)	(0.60, 0.02)
Δw_{t-1}	0.76	1.29	1.58	1.88	0.60
	(0.47, 0.10)	(0.57, 0.02)	(0.98, 0.11)	(0.74, 0.11)	(0.42, 0.16)
Long-run elasticity	–6.36	–9.05	–7.00	–8.09	–5.00
Joint significance	11.8	13.83	4.34	21.1	8.65
	(0.01)	(0.00)	(0.23)	(0.00)	(0.03)
Importing country GDP	0.20	0.11	0.10	0.01	0.19
y_{it-1}	(0.12, 0.08)	(0.15, 0.47)	(0.13, 0.45)	(0.14, 0.95)	(0.12, 0.10)

Δy_{it}	1.78 (0.94, 0.06)	1.77 (1.01, 0.08)	1.87 (0.97, 0.05)	1.85 (0.91, 0.04)	2.12 (0.96, 0.03)
Δy_{it-1}	0.17 (1.04, 0.87)	1.29 (0.57, 0.02)	0.28 (0.99, 0.78)	0.01 (1.03, 0.99)	0.31 (0.88, 0.72)
Long-run elasticity	0.80	0.45	0.36	0.03	0.61
Joint significance	6.63 (0.08)	4.90 (0.18)	6.57 (0.09)	6.56 (0.09)	8.24 (0.03)
Added variable	—	–0.36 (0.40, 0.37)	0.14 (0.30, 0.65)	0.25 (0.29, 0.40)	–1.07 (0.25, 0.00)
z_{it-1}					
Δz_{it}	—	0.83 (0.74, 0.26)	–0.95 (0.83, 0.25)	0.33 (0.19, 0.09)	–0.35 (0.50, 0.49)
Δz_{it-1}	—	0.15 (0.66, 0.82)	–1.85 (1.26, 0.14)	–0.68 (0.32, 0.03)	1.26 (0.66, 0.06)
Long-run elasticity	—	–1.47	0.49	0.90	–3.46
Joint significance	—	3.41 (0.33)	9.49 (0.02)	20.75 (0.00)	18.62 (0.00)
R^2	0.15	0.11	0.16	0.10	0.27
SSR	31.60	33.20	31.20	33.50	27.20
SEE	0.33	0.34	0.33	0.34	0.31

Notes:
(a) For coefficient estimates, the numbers in parentheses are, firstly, the standard error of the coefficient estimate and, secondly, the significance level.
(b) All standard errors are Newey-West corrected for heteroscedasticity and serial correlation.
(c) Joint tests of significance are Wald tests distributed as χ^2 (3) and figures in parentheses indicate the significance level.

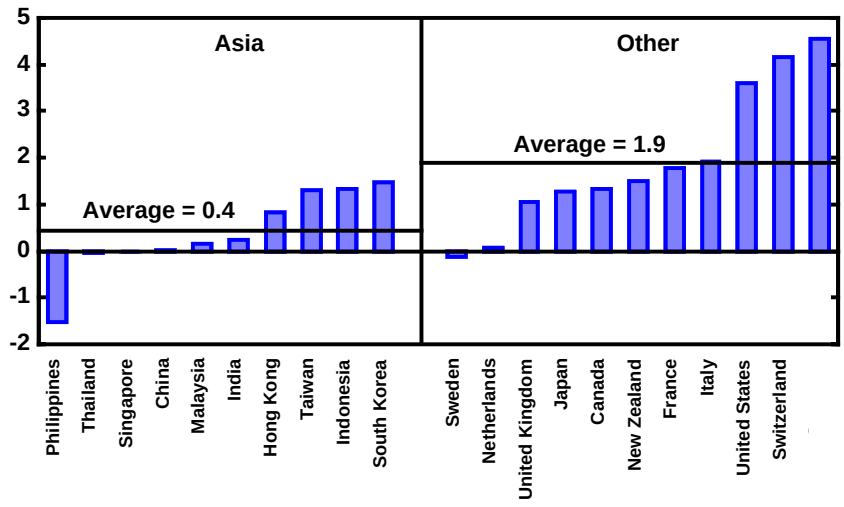
domestic relative price terms were jointly insignificant. Both Australian GNE and domestic capacity utilisation were jointly significant when added to the basic model but improved the fit only marginally. In both cases, there is a negative effect in the short run. The implied long-run effects, however, are positive, probably capturing the relationship between output and exports; over the long run, output and exports will tend to rise together.

The inclusion of the effective rate of assistance in the model improved the fit markedly. The coefficients were jointly significant and the implied long-run 'elasticity' of the expected sign. It also reduced the income and price elasticities. The estimates show that the fall in assistance over the past decade helps to explain the growth of manufactured exports over this period. This is discussed in more detail below.

Importantly, the addition of extra variables did not greatly change the conclusion on relative prices. Even when the effective rate of assistance is included, the implied long-run 'elasticity' on the relative price is still high at 5. On the other hand, the effect of foreign-country GDP on Australian manufactured exports seems more unstable with the addition of further variables.

One advantage of panel data is that it is possible to test the hypothesis that the income elasticities for individual countries are equal. Figure 10 shows the results of estimating the basic model with protection while allowing income elasticities to vary across countries. It shows the implied long-run elasticities for all countries, divided into two groups - Asia and all others.[18] The horizontal lines represent the

Figure 10: Income Elasticities of Australian Manufactured Exports



18. Japan is not included in Asia as it is an industrialised country and a long-standing trading partner of Australia.

average for each group. The difference between the two groups is marked. In general, income elasticities for the Asian countries tend to be much lower than for the other countries included in the estimation. The average income elasticity for the 10 Asian countries is 0.4, compared with an average elasticity of 2 for the other 11 countries. A test of the hypothesis that coefficients on income could be constrained to be equal across countries was conclusively rejected. This result is discussed more fully in Section 5. Once again, this variation on the basic model does not detract from the significance of either the relative price variable or the effective rate of assistance. The implied long-run elasticity on the relative price remains around 5 and that on the rate of assistance around 3.5.

The next section interprets these findings in the context of long-term structural adjustment and the stylised facts outlined in Section 3.

5. Structural Change: What Has Been Achieved?

This section brings together the descriptive material from Section 3 and the econometrics from Section 4 to assess how the process of structural change (as opposed to the cyclical behaviour examined in Section 2) is proceeding. The adaptability of the trade balance is of particular interest: are the changes which were noted in Section 3 simply 'one-off' accidents, or is there a process of adjustment underway which will improve our adaptability and flexibility? In particular, what is the role of the exchange rate and relative prices?

Two factors were at the heart of the adjustment process: the substantial cut in industry protection since 1984; and a real exchange rate that has been, on average, 13 per cent lower since 1986 than it was in the previous decade.

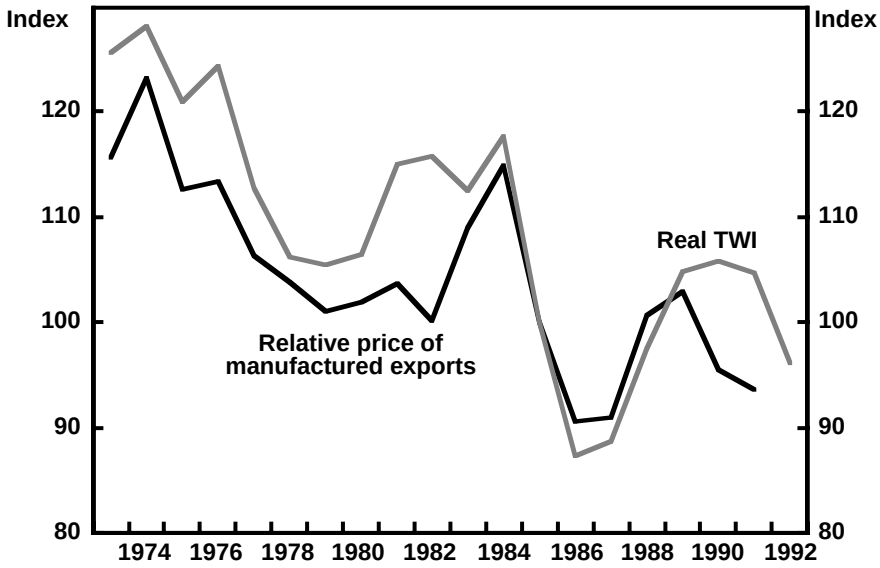
The structural adjustment of the real exchange rate reflected three influences. Firstly, the foreign debt build-up, identified by Blundell-Wignall *et al.* as an influence on the exchange rate (in this Volume). The real exchange rate needed to depreciate in a trend sense so that a more positive trade balance would offset the permanent increase in net income payments to the rest of the world.

Secondly, the exchange rate responded to commodity price movements, smoothing the Australian dollar ($A) prices of commodities. In the mid-1980s, the exchange rate changed to offset cyclical movements in world commodity prices. Also, the secular weakness in commodity prices lowered the exchange rate in the longer term. So the exchange rate has not only reduced fluctuations in the return to exporters, but has probably left a longer-term effect. The story is more complicated for *non-resource* exporters. As the exchange rate buffers the $A prices received by commodity exporters, this imposes a counterpart pattern on the receipts of other exporters. This has resulted in more volatility within the commodity price cycle and some enhancement of international competitiveness of manufactures in the longer term. In practice, Australian exporters of

manufactures seem to have held their export prices in Australian dollars fairly steady in the face of exchange rate fluctuations: Australian manufacturing export prices *relative to their rival foreign suppliers' prices* improve, more or less *pari passu*, when the exchange rate depreciates (see Figure 11). This behaviour is also clear in the work on export price pass-through by Dwyer, Kent and Pease (1993). In the first instance, exporters pass on the benefits of a more favourable exchange rate to their buyers, thus enhancing their international competitiveness. This behaviour means that commodity price fluctuations may provide exporters of manufactures with the opportunity to make their products very competitive in international markets. It also fits with the idea of 'beachheads' (see below), and with the general picture which is emerging - that the events of the mid-1980s were very important in triggering off structural change within the balance of payments.

Thirdly, the exchange rate had to adjust downwards with the opening up of the economy through reductions in effective rates of assistance. While there are dynamic gains for exports, greater openness influences imports even more directly. It is likely that the very large income elasticity identified in the import equations reflects reductions in assistance that could not be captured by the simple adjustments to prices used in the econometric estimation. Tariff reductions, other things being given, would cause the trade balance to deteriorate. For longer-run

Figure 11: Manufactured Export Prices and Real TWI
(1985 = 100)



balance of payments equilibrium, the real exchange rate would have to fall.[19] When these views are placed alongside the estimated relative price elasticities of imports and manufacturing exports, the reason why both of these variables have risen as a share of GDP comes more clearly into perspective. While opening up the economy encouraged both exports and imports, the effect was greater on imports, which explains their rise. The trend fall in the exchange rate had a much greater impact on increases in exports (or at least on the manufacturing component, which contributed one-quarter of export growth over the past six years) than it did on reducing imports.

The impact of reduced protection was most clearly identified, in an econometric sense, on the export side. The average effective rate of assistance from 1986 to 1991 was 15 per cent lower than over the previous 10 years. With an elasticity of -3.5, this accounts for a rise in manufactured exports of a bit over 50 per cent. Therefore, of a total rise in manufactured exports of around 130 per cent over this period, this variable accounts for around 40 per cent. In principle, the effect of tariff reductions on exporters' costs would be expected to be picked up in the relative price term. The explicit tariff variable may, therefore, be picking up the dynamic aspects of opening up the manufacturing sector to competitive pressures. These dynamic supply-side effects (discussed in general terms by Edwards (1989) and Krugman (1989a)) are difficult to identify more precisely than with these crude elasticities, but there is little doubt that such changes are underway. They show clearly in, for example, the rapid rise of intra-industry trade. Over time they will make firms more efficient or will cause resources to move from less efficient to more efficient sectors.

However, 80 percentage points of the 130 per cent rise in manufactured exports is explained by other factors. Improved competitiveness over the past seven years (via a lower real exchange rate) is, according to the econometric estimates, the main reason for the fast growth. With a price elasticity of around 5, this accounts for around half of the 130 per cent increase in export volume growth since 1985/86.

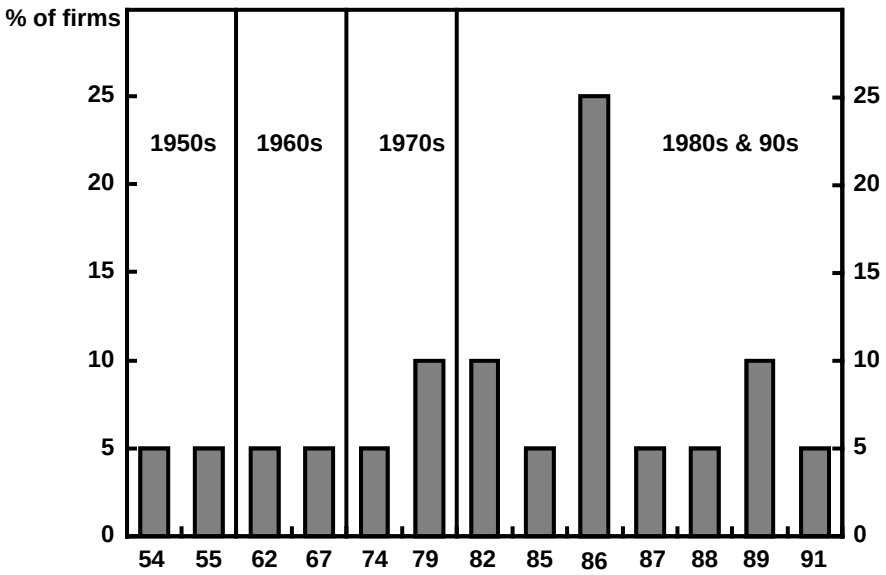
Other evidence also suggests the importance of this sharp change in the exchange rate during the mid-1980s. Menzies and Heenan (1993) presented econometric evidence that there is some threshold relative price change which will trigger firms to enter export markets. Once 'beachheads' are established, the sunk costs of entering foreign markets mean that firms will continue to export, even

19. The longer-run outcome may be more complicated. If the dynamic efficiency gains that come with tariff reductions are significant (which they may well be in the long run), the productivity increases for the tradeable goods sector that come from this will *appreciate* the real exchange rate.

when relative prices move less favourably (as they did in 1988 and 1989, see Figure 11). Furthermore, survey evidence reported in the paper showed that for a relatively large number of firms, exports first became a significant part of sales in 1986 (see Figure 12) and that 60 per cent of firms cited the exchange rate as an important factor in their decision to commence exporting.[20]

The price elasticity is much higher than other studies of Australian manufactured exports have estimated.[21] Although theory would suggest a relatively high elasticity, the actual estimate may be capturing other effects as well. In particular, there seems to have been a change in attitude towards exporting in recent years, particularly to the Asian region. McKinsey & Company (1993, p. 37) attribute this change in export culture to both a 'stick' and a 'carrot'. The 'stick' is 'the relentless internationalisation of the Australian economy and the growing competition that our Asian neighbours are providing in domestic markets'. The 'carrot' is a combination of perceived government support for exporting (both psychological and financial), peer pressure and media attention. If the change in

Figure 12: First Year when Exports Exceeded 10 per cent of Sales



20. For the purposes of the survey, exports were defined as 'significant' when they exceeded 10 per cent of sales. This result is broadly consistent with the results of a study by McKinsey & Company (1993) which was based on a much larger sample.

21. The studies listed in Footnote 15, for example, estimated price elasticities in the range -0.7 to -1.5.

'culture' occurred simultaneously with the sharp change in the exchange rate in the mid-1980s and the fall in tariffs, it may be difficult to separate these effects. This is not to say that the change in culture occurred independently of relative prices: the increased competitiveness may well have been the catalyst for attitudinal changes. Once this started, demonstration effects and other less tangible factors probably played an important role in keeping the process going, even without any further improvements in competitiveness.[22] So the relative price term (with its seemingly high elasticity) may well be capturing a range of interrelated changes that are unique to the estimation period. We would not want to interpret it as a simple price elasticity, with the implication that a small improvement in competitiveness will always bring about a large increase in export volumes.

The income elasticities of these equations, too, will pick up a variety of factors. They incorporate rising import penetration in the importing country, but will also capture compositional effects reflecting the changing mix of the recipient country's imports and the interaction of this with Australia's export supply capabilities. So the interpretation of these elasticities is not straightforward. Nevertheless, some tentative conclusions can be made, in answer to the question: 'How dependent was the growth of Australian manufactured exports on the 'tailwind' from the rapid growth of Asian economies?' Income in the Asian countries has been growing much more quickly than elsewhere, but the income elasticities for these countries are, on average, much lower - often less than unity (see Figure 10). Strong growth in this region has therefore been helpful but, by itself, is not enough to explain the exceptional performance of Australian manufactured exports.

At face value, this suggests that without continual improvements in competitiveness, exports of Australian manufactures to Asia will not keep pace with their growth. One possible reason for this result is the priority given in Asian economies to developing their own manufacturing sectors. This would imply relatively low income elasticities of demand for manufactured imports by those countries. Asian imports of manufactures have, however, grown very strongly over the past two decades: at the same time, Australian exporters have lost market share (see Figure 8).

An alternative possible explanation is related to the *composition* of Australian manufactured exports and the pattern of development of the Asian economies. It may be that these countries were encouraging (with tariffs and other types of assistance) the very industries which Australia, with its history of tariff protection, had encouraged, so their imports were a poor 'fit' with our supply capabilities.

22. One such effect, cited by Menzies and Heenan (1993), is the 'vanguard' effect; exporters entering new markets make it easier for others to follow.

Their imports were, perhaps, concentrated on manufactures which we were ill-equipped to supply. It was only the increased competitiveness in 1985/86 that stopped the slide in market share.

This might suggest that these low income elasticities were a reflection of the estimation period, and that structural change in Australia may raise the relevant elasticities. As protection for Australian manufacturing has declined, resources have moved into different areas and the character of the domestic manufacturing base has changed. McKinsey & Company (1993) highlight the rise of the 'small to medium-sized, high value-added manufacturers', exporting to niche markets in which quality and service are important. As these types of exporters continue to increase in importance, the income elasticity of demand for Australian manufactured exports to Asia is likely to rise.

Table 11 summarises the influence of the various factors discussed above.

Table 11: Growth in Manufactured Exports: 1986-1991

	Elasticity	Change in variable (percentage points)	Contribution to growth (percentage points)
Protection	-3.5	-15	53
Relative prices	-5	-13	65
Income(a)			21
Total			139
Actual growth in manufactured exports			130

Note: (a) Calculated using actual income growth with estimated income elasticities for each country.

6. Conclusion: the Adjustment Process

Concerns about the external sector have been longstanding, with an overlay of 'brooding pessimism'.[23] The concerns were threefold:

- Australia's heavy dependence on commodity exports meant that international fluctuations buffeted the economy. To the extent that exchange rate changes buffered commodity export producers in the face of changing world prices, this delivered increased volatility to non-commodity exporters - notably, manufacturers. With this went a concern that commodity prices were on a long-term secular downward trend, and this would constrain our incomes and our export earnings;

23. As discussed by Corden (1968).

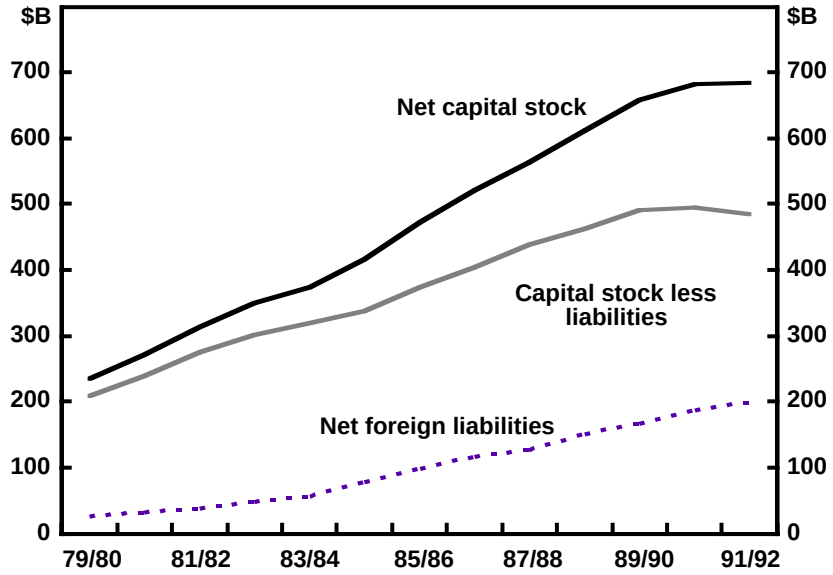
- Australia seemed particularly subject to 'elasticity pessimism' - import income elasticities higher than export elasticities, combined with price elasticities which were small, so that depreciations did little to improve the trade balance. To this was added the apparently adverse 'J curve' effect - valuation effects made the current account look worse (in $A terms) following a depreciation; and
- there was a feeling that dependence on substantial foreign capital inflow made Australia vulnerable.

These concerns and pessimism did not disappear with the floating of the currency. The float and the greatly increased integration with world capital markets did, however, change thinking about the nature of the external constraint. No longer was it seen in terms of excessive current account deficits threatening to exhaust official foreign exchange reserves within a fixed exchange rate framework. There was an increasing recognition that the central issue was the readiness of foreigners to take on Australian assets, and Australians to take on foreign liabilities, and that the focus should be on the *sustainability* of Australia's foreign liabilities. As these liabilities rose (see Figure 13), they became the centre of vigorous debate, some of which spilt over from time to time into the foreign exchange market. Some saw the likelihood of a 'hard landing', along the lines predicted by Marris (1985) for the United States. Others have had the more sanguine view embodied in Stein's law - 'if something cannot go on forever, it will stop' - and its corollary - 'if something cannot go on forever, and everyone knows that it cannot go on forever, it will slow down and stop before it reaches the point beyond which it cannot go on' (Stein 1991, p. 262).

The discussion in Section 5 suggests that adjustment is underway: but is it enough or is the 'brooding pessimism' still justified? As the analytical time horizon lengthens, the considerations of foreign debt build-up and the funding aspects of the external balance become central. The enlarged current account deficit in the 1980s led to an accumulation of foreign debt which, in time, should induce adjustments in the trade balance. Figure 13 shows the relative importance of foreign liabilities, by (notionally) netting these against the capital stock. Part of the adjustment occurs through the influence of income and wealth on spending: in this, issues such as the productivity of investment become important. If the debt allowed an increase in effective productive capacity, the higher domestic income provides the wherewithal to service the debt. If the savings-investment imbalance reflected increased consumption or unproductive investment, the adjustment comes about via a lower national income and decrease in domestic wealth over time. As the savings-investment balance changes, counterpart changes occur in the current account, and the exchange rate is an element in this adjustment.

The structural adjustments examined in the previous three sections not only

Figure 13: Capital Stock and Foreign Liabilities

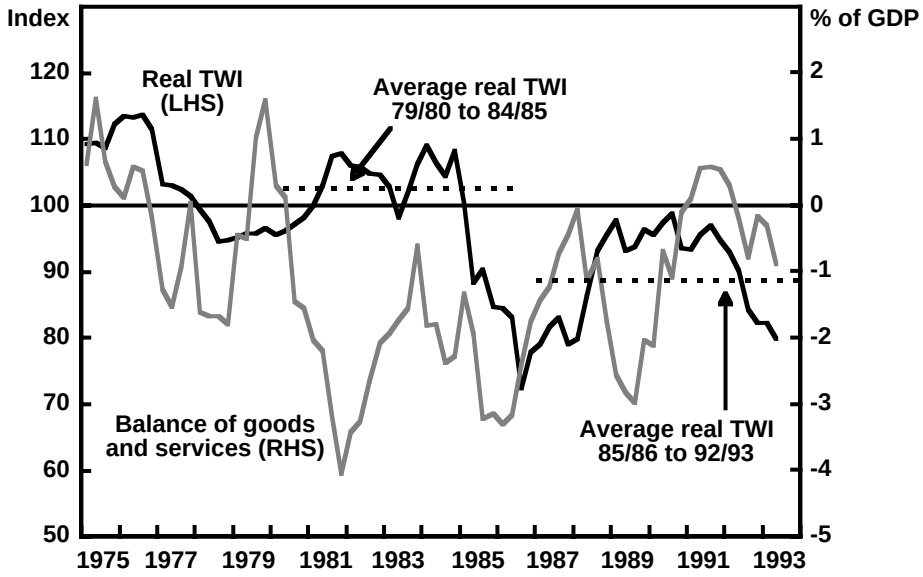


increased exports and imports, but brought an improvement in the overall trade balance. The cyclical behaviour of activity and commodity prices make the underlying improvement difficult to measure with precision, but Figure 14 suggests that the goods and services balance has improved by about 1.5 per cent of GDP over the 1980s. This, if it continues, is consistent with the proposition that Australia's longer-run balance of payments is adjusting according to the requirements of longer-run sustainability.[24] The adjustment in the trade balance has allowed the underlying current account deficit to remain steady in the face of a build-up in foreign income debits. Sustainability - in one sense - is being achieved. With a constant current account deficit, foreign liabilities will asymptotically rise over time towards a fixed ratio of foreign liabilities to GDP.

The central issue, however, is whether this adjustment process is a smooth one, or might involve discontinuities coming from shifts in sentiment. Sustainability is ultimately defined by participants in foreign capital markets and their view may change over time. Those who worry about this see the demand for foreign liabilities as a behavioural relationship that can shift markedly in response to changes of sentiment. The exchange rate elasticity of the demand for foreign liabilities is important also. If there is a widely held, stable view of where the equilibrium exchange rate should be, then a small fall in the exchange rate is

24. See, for example, Whitelaw and Howe (1992).

Figure 14: Balance of Goods and Services and Real TWI



enough to encourage capital inflow. If, on the other hand, the equilibrium rate is not well defined and 'positive feedback' occurs to reinforce any downward shift in sentiment, adjustment can be disruptive. The 'elasticity pessimism' of the trade account is relevant here. If the trade account responded quickly and substantially to changes in the exchange rate, this would smooth the adjustment process. Just as a responsive, well-integrated, outward-looking production sector (characterised by high price elasticities on international trade equations and, often, a high ratio of imports and exports to GDP) allows short-term shocks to 'spill' into the external economy easily and protects the domestic economy from inflationary disruption, close integration facilitates longer-term adjustment.

Appendix A: Estimation of Import Equations

A.1 The General Approach

In Wilkinson (1992), the demand for imports was modelled as the excess demand for importables. The demand for imports is, therefore, shown to be a function of the relative prices of importables, exportables and non-traded goods, real income and production capacity in the Australian economy.

Wilkinson estimates equations for total and endogenous imports, using techniques appropriate for the analysis of non-stationary time series. Firstly, it is established that the series involved are non-stationary, possessing at least one unit root. Secondly, an OLS regression is carried out on the log levels of the variables and the residuals from this equation are tested for stationarity. If the residuals are stationary, the variables are said to be cointegrated and the equation represents a long-run relationship between the variables. Thirdly, a 'short-run' equation is estimated, where the change in the dependent variable is modelled as a function of lagged changes in itself, lagged changes in other explanatory variables and the lagged residual from the long-run equation (which represents the deviation from long-run equilibrium). This approach yields long-run and short-run elasticities for imports.

A.2 Some Simple Models

The general approach described above was used to estimate price and income elasticities for the different categories of imports. Each category of imports was modelled as a function of an activity variable and a relative price. Table A1 shows the explanatory variables used for each equation. The specifications are more simple than Wilkinson's aggregate model in that they exclude the relative price of exports and capacity constraints.

For each type of import, an activity variable was selected which was thought to best reflect the demand factors driving imports. Consumption imports were thought to depend on private consumption. Likewise, capital imports were thought to depend on investment but, as reported below, the results were not satisfactory using this variable. A second model was therefore estimated for capital imports using total domestic spending (GNE) as an explanatory variable. This variable should capture the derived demand nature of investment and capital goods. 'Other' imports are essentially intermediate goods and demand for these will also be a derived demand. Non-farm product is therefore used as an explanator, although there are clearly any number of different variables which could be used instead.

Table A1: Disaggregated Import Equations

Type of Import	Explanatory Variables
Consumption (CM)	• Real private consumption (PC) • Relative price of consumption imports (RPCM). Consumption imports deflator/private consumption deflator
Capital (KM)	*Version 1* • Real investment in plant and equipment (IPE) • Relative price of capital imports (RPKMI). Capital imports deflator/IPE deflator *Version 2* • Real gross national expenditure (GNE) • Relative price of capital imports (RPKMG). Capital imports deflator/GNE deflator
Other (OM)	• Real gross non-farm product (NFP) • Relative price of other imports (RPOM). Other imports deflator/price of home-produced inputs to manufacturing

For consumption and capital imports, the relative price of each particular type of import is defined with reference to the price deflator associated with the relevant activity variable. For other goods, however, the relative price is defined using a price index of home-produced inputs for manufactures.

The sample period for these disaggregated categories is only 12 years. This presents some difficulties in assessing the long-run properties of the series involved and estimating long-run relationships in the manner described above. The results should, therefore, be assessed with this problem in mind.

A.3 Time Series Properties of the Data

Wilkinson (1992) found both total endogenous imports and real GNE to exhibit non-stationary properties over the period September 1974 to September 1989. Table A2 presents Augmented Dickey-Fuller (ADF) tests and Z_t tests for non-stationarity of the additional series used here. The null hypothesis for both tests is non-stationarity, so rejection of the null implies stationarity. All series are in log levels and seasonally adjusted.

The null hypothesis of non-stationarity is accepted for the log level of every series at the 5 per cent level of significance. Non-stationarity of the first differences

Table A2: Unit Root Tests

Variable	Sample		ADF	Z_t
PC	59:3-92:4	level	-2.58	-2.66
		1st difference	-10.53	-10.61
IPE	59:3-92:4	level	-1.80	-2.27
		1st difference	-16.01	-16.03
NFP	59:3-92:4	level	-2.26	-2.47
		1st difference	-12.25	-12.32
CM	79:3-92:4	level	-1.01	-1.11
		1st difference	-6.60	-6.74
KM	79:3-92:4	level	-2.29	-2.52
		1st difference	-3.09	-6.61
OM	79:3-92:4	level	-1.38	-1.36
		1st difference	-6.87	-7.09
RPCM	79:3-92:4	level	-1.56	-1.89
		1st difference	-7.48	-7.71
RPKMI	79:3-92:4	level	-1.82	-2.08
		1st difference	-6.53	-6.66
RPKMG	79:3-92:4	level	-1.61	-1.89
		1st difference	-3.29	-6.62
RPOM	79:3-92:4	level	-1.29	-1.36
		1st difference	-6.47	-6.57

Notes: (a) Tests of the null hypothesis that the series has a unit root.
(b) The ADF tests were constructed to include as many lagged differences as was necessary for the elimination of serial correlation; LM tests for first and first-to-fourth order serial correlation were used for this purpose. The Z_t tests used five lags of the covariance.
(c) All the tests in Table A2 include a constant. The critical values from Fuller (1976) are -3.51 at the 1 per cent level and -2.89 at the 5 per cent level.

is rejected at the 5 per cent level for all series and at the 1 per cent level for most, indicating the presence of one unit root in the levels.

A.4 Estimation

With evidence of non-stationarity, cointegrating relationships between the relevant variables were estimated. The Phillips and Hansen (1990) technique was used to estimate the following equation for each type of import:

$$M_t = \alpha + \beta ACT_t + \gamma RP_t + u_t \qquad \text{(A1)}$$

where M_t is the (log of the) relevant import series at time t; ACT_t is the (log of the) activity variable corresponding to the import category; and RP_t is the (log of the) relevant relative price series.

Table A3 presents the estimates of the coefficients obtained from this procedure. The estimation of the cointegrating relationship for other imports indicated that the relative price term was insignificant at the 5 per cent level so the equation was also estimated without relative prices.

Table A3: Long-Run Elasticities Estimated from Equation A1

Components of Imports	β	γ	ADF	Z_t
Consumption	1.73	-0.70	-2.76	-3.06
	(17.76)	(-5.15)		
Capital (using IPE)	1.41	-0.91	-2.64	-2.60
	(8.38)	(-1.86)		
Capital (using GNE)	1.40	-0.76	-3.56	-3.69
	(5.48)	(-2.29)		
Other	1.48	-0.18	-3.93	-3.82
	(12.01)	(-1.53)		
Other (excluding relative prices)	1.33	—	-3.82	-3.77
	(14.69)			

Notes: (a) t statistics are in brackets.
(b) The null hypothesis for the ADF and Z_t tests is non-stationarity (or non-cointegration). The critical values (from Phillips and Ouliaris (1990)) are -3.77 at the 5 per cent level and -3.45 at the 10 per cent level. For the other imports equation without relative prices, the critical values are -3.37 and -3.66 respectively.

The null hypothesis of non-cointegration is rejected at the 10 per cent level for capital imports when GNE is used as an explanatory variable. For other imports without relative prices, non-cointegration can be rejected at the 5 per cent level; relative prices are, therefore, unnecessary for cointegration. On the other hand, the null hypothesis cannot be rejected for consumption imports or for capital imports when IPE is used as an explanatory variable.

These results are unexpected. Given that total imports have been found to be cointegrated with demand and relative prices, we would expect the individual components to be cointegrated with relevant components of demand. One difficulty might be the relatively short sample period. As a second test of cointegration, the residuals from the Phillips-Hansen estimation (Res) are used

in estimating a model of the form:

$$\Delta M_t = \sum_{i=1}^{l} \alpha_i \Delta M_{t-i} + \sum_{i=0}^{k} \beta_i \Delta ACT_{t-i} + \sum_{i=0}^{m} \gamma_i \Delta RP_{t-i} + \theta \mathrm{Res}_{t-1} + u_t \quad \text{(A2)}$$

If θ, the coefficient on the lagged residual, is significant, this is evidence of cointegration. The error-correction models for each category of imports are presented in Table A4. The approach used was one of general-to-specific modelling. Each equation started with four lagged changes of each variable and was tested down to give a more parsimonious representation.

In the cases of consumption and other imports, θ is significantly different from zero, which is evidence of a cointegrating relationship between imports, activity and relative prices. This is also the case for capital imports when GNE is used as the activity variable. When IPE is used as an explanatory variable for capital imports, however, the results are not as clear-cut.[25] When included in the most general specification of the ECM for capital imports, the coefficient on the residual is insignificantly different from zero. As the model is tested down, however, it gradually becomes significant. The lack of consistency in this reinforces the initial evidence that cointegration between capital imports, IPE and relative prices is tenuous.

The short sample period may also mean that the long-run elasticity estimates reported in Table A3 are biased (see Inder (1991)). One simple check on the estimates is to see if they seem broadly consistent with the results obtained for aggregate imports which were estimated over a longer time period. The average of the income and price elasticities (giving more weight to other imports) are around 1.5 and -0.5, respectively - very similar to the aggregate estimates. This suggests that the long-run elasticities are not too biased.

A second consistency check on the long-run elasticities was carried out by estimating an unrestricted error-correction model (ECM) for each category of imports. The model estimated was of the form:

$$\begin{aligned} \Delta M_t = \mu + \sum_{i=1}^{l} \alpha_i \Delta M_{t-i} + \sum_{i=0}^{k} \beta_i \Delta ACT_{t-i} + \sum_{i=0}^{m} \gamma_i \Delta RP_{t-i} \\ + AM_{t-1} + BACT_{t-1} + CRP_{t-1} + u_t \end{aligned} \quad \text{(A3)}$$

The long-run elasticities are easy to calculate from this formulation. The income elasticity is $-B/A$ and the price elasticity $-C/A$. The standard errors for the long-run coefficients cannot be calculated, so the statistical significance of the

25. These results are not reported here but are available on request.

Table A4: Error-Correction Models

Consumption imports - DCM
Period of estimation: 1980:2 to 1992:4

Variable	*Coefficient*	*Standard error*	*t statistic*
$Residual_{t-1}$	-0.416	0.104	-4.011
DCM_{t-2}	0.276	0.104	2.647
DPC_t	2.464	0.500	4.926
DRP_t	-0.343	0.163	-2.111
R^2		0.508	
Adjusted R^2		0.477	
DW		1.802	
SSR		0.064	
SEE		0.037	

Capital imports - DKM
Period of estimation: 1980:2 to 1992:4

Variable	*Coefficient*	*Standard error*	*t statistic*
$Residual_{t-1}$	-0.338	0.089	-3.78
$DGNE_t$	0.838	0.499	1.680
$DGNE_{t-1}$	0.805	0.448	1.796
$DGNE_{t-2}$	1.749	0.492	3.554
R^2		0.516	
Adjusted R^2		0.485	
DW		2.333	
SSR		0.143	
SEE		0.055	

Other imports - DOM
Period of estimation: 1980:1 to 1992:4

Variable	*Coefficient*	*Standard error*	*t statistic*
$Residual_{t-1}$	-0.761	0.118	-6.446
DOM_{t-1}	0.265	0.113	2.347
$DNFS_t$	0.391	0.097	4.035
R^2		0.471	
Adjusted R^2		0.449	
DW		2.022	
SSR		0.101	
SEE		0.045	

elasticities from this formulation cannot be tested.[26] However, it does give some indication of how robust the point estimates of the long-run elasticities are to different estimation techniques. Table A5 reports the long-run elasticities estimated from equation (A3).

Table A5: Long-Run Elasticities from Unrestricted ECM

Components of Imports	Income	Relative Price
Consumption	1.8	-0.8
Capital (using IPE)	0.4	-3.2
Capital (using GNE)	1.3	-0.6
Other	1.4	—

The estimates of the long-run elasticities derived from equation (A3) are very similar to those obtained from the Phillips-Hansen technique, except for capital imports when IPE is used as the activity variable. In general, modelling capital imports using IPE was not successful - there is limited evidence of a long-run relationship and estimates of long-run elasticities are not robust to estimation technique. Estimates using GNE as an activity variable perform much better on all criteria.

A.5 Incorporating Tariffs

Section 4.1.3 reports the results of adjusting the relative price term for tariffs. The adjusted relative price is defined as:

$$RP_t = \frac{MIPD_t(1 + T_t)}{EIPD_t} \qquad \text{(A4)}$$

where $MIPD_t$ is the implicit price deflator for endogenous imports at time t, $EIPD_t$ is the implicit price deflator for domestic expenditure and T_t is the tariff rate. The relative price of consumption imports is defined analogously, using the *IPD* for consumption imports and the *IPD* for domestic consumption. The tariff is defined as the ratio of customs duty receipts to the total (free-on-board) value of endogenous imports.[27]

26. The Bewley transformation can, in theory, be used to derive valid t statistics for the long-run coefficients.

27. Ostry and Rose (1992) construct a similar measure for testing if tariffs have any macroeconomic effects. This is clearly an imperfect measure: it excludes import quotas and other non-tariff barriers (although it does correspond, in its broad movements, with the measure of effective assistance shown in Figure 5). Furthermore, where tariffs are prohibitive, revenue collection will be negligible.

Section 4.1.3 also reported the results of two other tests for the role of tariffs. The first included the effective rate of assistance as a separate explanatory variable. The second test introduced a new relative price variable (RP2), replacing the free-on-board import price with the imported component of the consumer price index (CPI). Although this variable only captures tariffs on items in the CPI bundle, it does represent a final retail price.

Table 9 in the text reported the elasticities estimated using the Phillips-Hansen technique. In order to test if there is evidence of a cointegrating relationship, the residuals from the three equations were used in an error-correction model. Table A6 reports the coefficients and t statistics on the lagged residuals when the most general model is specified with three lagged changes in all variables.

Table A6: Significance of Lagged Residual in ECM

Model	Coefficient on residual *t-1*	Standard Error	t statistic
i	-0.227	0.082	-2.776
ii	-0.481	0.190	-2.536
iii	-0.854	0.217	-3.929

In each case, the coefficient on the lagged residual is significant at the 5 per cent level, evidence of cointegration.

A.6 Data Sources

Data on Gross National Expenditure (GNE), Private Consumption (PC), Gross Non-Farm Product (GNFP), Investment in Plant and Equipment (IPE), Non-Farm Stocks (NFS) and their deflators are available from the Australian Bureau of Statistics (ABS), *Australian National Accounts*, Catalogue No. 5206.0.

Data on endogenous imports, consumption imports, capital imports, other imports and their deflators are available from the ABS, *Balance of Payments, Australia*, Catalogue No. 5302.0.

Data on the price of home-produced inputs to manufacturing are available from the ABS, *Price Indexes of Materials used in Manufacturing Industries*, Catalogue No. 6411.0.

Data on computer import values and volumes are unpublished and non-seasonally adjusted ABS data. Standard International Trade Classification categories 752 and 75997 are used.

Data on customs duty receipts are available from the Department of Finance, Commonwealth Financial Transactions (monthly).

The effective rate of assistance to manufacturing was derived by splicing shorter-run series published by the Industry Commission (Plunkett, Wilson and Argy 1992).

The imported component of the CPI is available from the ABS, *Consumer Price Index: Effect of Changes in Prices of Imported Items*, Catalogue No. 6444.0.

Appendix B: Econometric Estimates for Manufactured Exports*

B.1 The General Approach

The log-linear specification of (1) in the text can be written as:

$$x_{it} = \alpha_i + \sum_{j=1}^{k} \upsilon_j v_j + \varepsilon_{it} \qquad \text{(B1)}$$

where lower case letters represent logs and the v_j are the k explanatory variables in (B1). A more general specification that allows a long-run equilibrium relationship with short-run dynamics is an autoregressive distributed lag model with two lags:

$$x_{it} = \alpha_i + \delta_1 x_{it-1} + \delta_2 x_{it-2} + \sum_{j=1}^{k} (\upsilon_{j0} v_{jt} + \upsilon_{j1} v_{jt-1} + \upsilon_{j2} v_{jt-2}) + \varepsilon_{it} \qquad \text{(B2)}$$

This can be re-parameterised as an unrestricted error-correction model (UECM):

$$\Delta x_{it} = \alpha_i + \beta_0 x_{it-1} + \beta_1 \Delta x_{it-1} + \sum_{j=1}^{k} (\gamma_{j0} v_{jt-1} + \gamma_{j1} \Delta v_{jt} + \gamma_{j2} \Delta v_{jt-1}) + \varepsilon_{it} \qquad \text{(B3)}$$

where: $\beta_0 = \delta_1 + \delta_2 - 1$
$\beta_1 = -\delta_2$
$\gamma_{j0} = \upsilon_{j0} + \upsilon_{j1} + \upsilon_{j2}$
$\gamma_{j1} = \upsilon_{j0}$
$\gamma_{j2} = -\upsilon_{j2}$

In this form, the long-run elasticities are $-\gamma_{j0} / \beta_0$, etc.

As a first step, a basic UECM specification was estimated; the volume of manufactured exports was modelled as a function of the relative price of Australian manufactured exports and foreign country output. In the context of this basic model, other variables were added to see if they added significant explanatory power.

B.2 Panel Estimation Issues

For the basic model, it was assumed that individual country effects were restricted to the intercept coefficients.

In dealing with the individual country effects, it was decided to use a fixed effects model, rather than a random effects model, as the individual effects are likely to be correlated with the other regressors, especially foreign country

* Denzil Fiebig provided some technical advice regarding the estimation procedure. The authors are responsible for any errors.

output.[28] Further, unlike panel estimations based on cross-sections of persons, the data from this cross-country panel are measurements of populations, rather than of individuals. This also implies that, in this case, the individual effects are less likely to be random in nature.

Estimating dynamic models within a fixed effects framework is problematic. It is well known that the fixed effects estimator is inconsistent when the set of regressors contains lagged dependent variables and the sample is finite in the time dimension.[29] This is because, within each country, each disturbance term is correlated with every observation of the dependent variable. This leads to inconsistent parameter estimates.

This problem can be corrected by instrumental variables (IV) estimation. However, there is a difficulty selecting suitable instruments for x_{it-1}, and Δx_{it-1} since in the probability limit the instrument should be correlated with the lagged dependent variable and uncorrelated with the error terms. Clearly, any lag of manufactured exports to country *i* is an unsuitable choice for an instrument, since all observations within country *i* are correlated with all of the disturbances for that country. $\Delta\Delta x_{it-1}$, was considered as an instrument, but was found not to be well correlated with the level of x_{it-1} or Δx_{it-1} .

It was decided, instead, to use manufactured exports to a third country as an instrument - that is, the instrument for x_{it-1}, was x_{jt-1}, $i \neq j$. Exports can be expected to be correlated across countries because:

- shocks affecting the supply of Australian exports will impact across all countries; and
- the macroeconomic shocks that affect demand for manufactured exports will be correlated across countries, inasmuch as business cycles are correlated internationally.

The variables used as instruments for the lagged dependent variable were constructed in the following way. A correlation matrix was computed for the 21 dependent variable series. For the manufactured export series of each country, the series with the highest correlation was identified. These series were then 'stacked' to form a new variable, the lag and lagged differences of which were used as instruments in the IV estimation.

These instruments can be assumed to be uncorrelated with the disturbance terms, since the use of the fixed-effects model does not imply anything about the correlation of the dependent variable and the disturbance terms across countries.

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28. For a discussion of the relative merits of fixed versus random effects models, see Hsiao (1986, pp. 41-47.)

29. See Hsiao (1986, pp. 73-76) for a proof.

One of the advantages of panel data estimation is that it is no longer necessary to assume the stationarity of the dependent variable and regressors as a condition for the asymptotic normality of the disturbance terms.[30] This is because the effect of the nuisance parameters distorting the disturbances can be made to approach zero by letting $N \longrightarrow \infty$ while keeping T finite.

B.3 The Choice of the Relative Price Measure

The response of manufactured exports to movements in relative prices will depend on the measure used. A fall in the price of Australian manufactured exports relative to the price of manufactures from other sources will generally lead to an increase in demand for Australian exports. For a foreign consumer, the alternatives to Australian manufactures are, firstly, exports from third countries, and secondly, local goods produced by import-competing firms. In the first case, the world price of manufactured exports will be relevant. The 'world' relative price is, therefore, defined as the price of Australian manufactured exports relative to the world price of manufactures. In the second, it is possible that the price of local manufacturing production may exert an independent effect on the volume of Australian manufactured exports. The 'bilateral' relative price is, therefore, defined as the price of Australian manufactures relative to the price of domestically produced manufactures in each country.

The relationship between the price of manufactured exports and supply is less certain. If the price of exports falls relative to the price in the domestic market, manufacturers may find it more profitable to supply the local market and hence reduce exports. If, on the other hand, exporters have some degree of market power, then a fall in the relative price of exports may reflect cost reductions due to increases in productivity specific to exporters. This is likely to be the case if exporters, by being exposed to international competition, achieve faster productivity growth than firms selling only to the domestic market.

B.4 Estimation Procedure and Results

Initially, the basic model was estimated with both world and bilateral relative prices and with two lags of each variable. Income elasticities were constrained to be equal across countries. The results indicated that the world relative price had a significant influence on manufactured exports, whereas an additional effect from bilateral relative prices was not significant. This is consistent with a situation where the prices of import-competing manufactures in other countries are determined by the world price of manufactured exports. Given the lack of significance of bilateral relative prices, this variable was dropped from subsequent estimations.

30. See Goodrich and Caines (1979) for a proof.

It was found that the second lags of all variables were not jointly significant, and the final basic specification was as follows:[31]

$$\Delta x_{it} = \alpha_i + \beta_0 x_{it-1} + \beta_1 \Delta x_{it-1} + \omega_0 w_{t-1} + \omega_1 \Delta w_t + \omega_2 \Delta w_{t-1} + \eta_0 y_{it-1} + \eta_1 \Delta y_{it} + \eta_2 \Delta y_{it-1} + \varepsilon_{it} \quad \text{(B3)}$$

This specification was used as the basis for subsequent tests of the significance of the other variables mentioned above, the results of which were reported in Table 10 in the text.

In order to test the equality of income elasticities across countries, the basic model with the effective rate of assistance was re-estimated, allowing income elasticities to vary. Results for this estimation are reported in Table B1.

Individual estimates for foreign country output terms were mostly insignificant and so are not reported. However, the joint test of the significance of these terms was $\chi^2(63) = 407.8$ and the null hypothesis could be rejected at the 1 per cent significance level. The hypothesis that the coefficients on the various foreign

Table B1: Income Elasticities Varying Across Countries

	Coefficient Estimate	Standard Error	Significance Level
Exports			
x_{it-1}	-0.33	0.11	0.01
Δx_{it-1}	0.28	0.32	0.38
World relative prices			
w_{t-1}	-1.55	0.58	0.01
Δw_t	-1.55	0.68	0.02
Δw_{t-1}	0.52	0.45	0.27
Effective rate of assistance			
z_{t-1}	-1.17	0.32	0.25
Δz_{t-1}	0.12	0.62	0.84
Δz_{t-1}	1.45	0.79	0.07

Notes: $R^2 = 0.37$, SSR = 23.4, SEE = 0.32.

31. The joint test of the significance of all second lags and the bilateral relative price terms was $\chi^2(7) = 7.36$. The null hypothesis that the coefficients on these terms were equal to zero, therefore could not be rejected even at the 20 per cent confidence level.

output terms were equal across countries was also rejected at the 1 per cent significance level.

With regard to the other variables, the long-run elasticities for world relative prices and the effective rate of protection were -4.7 and -3.5, respectively. These results are similar to those obtained from other estimations.

B.5 Error Structure

To test for heteroscedasticity related to the cross-sectional nature of the data, Breusch-Pagan tests were conducted using country dummies as explanatory variables. In all cases, the null hypothesis of no heteroscedasticity was rejected at the 1 per cent level of confidence.

Lagrange multiplier tests for up to fourth order autocorrelation were conducted. In all cases, the null hypothesis of no autocorrelation was rejected at the 1 per cent level of confidence. Varying lag lengths did not appear to markedly affect these results.

Unless corrected for, the presence of heteroscedasticity and autocorrelated errors would lead to inconsistent estimates of the standard errors. Accordingly, Newey-West standard errors have been reported for each estimation.

B.6 Structural Stability

Menzies and Heenan (1993) reported evidence of a structural break in the behaviour of Australian manufactured exports in the late 1980s. To test this with the panel data, Chow tests for a break in the relationship from 1986 onwards were conducted for each model. In all cases, the null hypothesis of stability of the coefficient estimates could not be rejected at the 5 per cent level of significance.

B.7 Data Description and Sources

The panel consists of a balanced sample of 21 countries with annual data from 1977 to 1991. The countries were selected on the basis of their importance as markets for Australian manufactures, as well as data availability. The full list of countries is shown in Table B2.

The definition of manufactures used in this study is Standard International Trade Classification (SITC) Sections 5 to 8, excluding Divisions 67 and 68. This corresponds to the categories 'Transport', 'Machinery' and 'Other Manufactures' as classified in the Australian Bureau of Statistics (ABS) publication *Balance of Payments, Australia*, Catalogue No. 5302.0. Current price estimates of export values at a SITC division level for various countries from 1982 to 1991 were obtained from the Central Statistics Section, Department of Foreign Affairs and

Table B2: Countries included in Estimation

Canada	Italy	South Korea
China	Japan	Sweden
France	Malaysia	Switzerland
Germany	Netherlands	Taiwan
Hong Kong	New Zealand	Thailand
India	Philippines	United Kingdom
Indonesia	Singapore	United States

Trade. Prior to 1982, these series were obtained from OECD Foreign Trade magnetic tapes. Adjustments were made to correct for a break in 1978 due to the change from SITC Revision 1 to SITC Revision 2.

Constant price estimates were calculated at a SITC division level using deflators provided by the ABS. These were then aggregated to obtain the final constant price estimates for manufactured exports to each country.

The world relative price is the ratio of the manufactured exports deflator (balance of payments basis) to the unit value of world manufactured exports. The latter series is obtained from GATT (1992).

Bilateral relative prices are the ratio of the manufactured exports deflator to the price of domestically manufactured goods in each country. The latter series were obtained from the World Bank (1992). Missing observations were replaced using spliced producer or consumer price series obtained from the IMF's *International Financial Statistics.* The exchange rates used were period averages published in the IMF's *International Financial Statistics.*

The domestic relative price is the ratio of the manufactured exports deflator to manufacturing producer prices (excluding petroleum). The latter was obtained from the ABS, *Price Indexes of Articles Produced by Manufacturing Industry, Australia,* Catalogue No. 6412.0.

Foreign country output is (in general) real gross domestic product, obtained from the IMF's *International Financial Statistics.* Data on real Australian GNE were obtained from the ABS, *Australian National Accounts,* Catalogue No. 5206.0.

The measure of capacity utilisation was taken from the results of the ACCI/Westpac Survey of Industrial Trends. The net balance of respondents indicating an increase in capacity utilisation (plus 100 to avoid negative values) was used. The effective rate of assistance to manufacturing was derived by splicing shorter-run series published by the Industry Commission (Plunkett, Wilson and Argy 1992).

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