Exports, Imports and the Trade Balance

Paddy Jilek

Andrew Johnson

Bruce Taplin

This document is based on the research and development work undertaken in recent years in the Modelling Section of the Treasury. It has been released in the interests of evaluating the research results embodied in the model and to encourage public discussion.

The authors are employees of the Australian Treasury. We would like to thank Brett Ryder, Mark Upcher and Annette Beacher for their earlier work that formed a basis for this paper, and Barry Gray for his comments and suggestions on drafts of this paper. Of course any remaining errors and omissions are the responsibility of the authors. The views in this paper are those of the authors and are not necessarily those of the Government or the Treasury.

This document is one of a series presented at the June 1993 Treasury Conference on *The TRYM Model of the Australian Economy*. Papers presented at the Conference also included:

- *An Introduction to the Treasury Macroeconomic (TRYM) Model of the Australian Economy*

  (TRYM paper no. 2)

- *Employment, Investment, Inflation and Productivity: Decisions by the Firm*

  (TRYM paper No. 3)

- *Exports, Imports and the Trade Balance*

  (TRYM paper No. 4)

- *Savings, Dwelling Investment and the Labour Market: Decisions by Households*

  (TRYM paper No. 5)

- *Australia's Trade Linkages with the World*

  (TRYM paper No. 6)

- *The Macroeconomic Effects of Higher Productivity*

  (TRYM paper No. 7)

TABLE OF CONTENTS

1. INTRODUCTION

This paper outlines the approach taken in analysing the external sector of the Australian economy within the framework of the Commonwealth Treasury's macroeconomic TRYM model.

Although there is some discussion of recent trends, the focus is on examining factors that affect the speed, timing and composition of the adjustment of Australia's external sector within the TRYM model framework. The paper is divided into three sections.

The first section examines the export sector, within a simple demand and supply framework, incorporating both the external and the internal competitiveness of Australia's exports. External competitiveness is defined as the price of Australia's goods and services relative to world prices and is a primary determinant of the demand for exports. Internal competitiveness is defined as the incentive for domestic producers to export and is a primary factor determining the supply of exports. Particular attention is also given to the dynamic adjustment of Australia's trade prices to changes in the growth of our major trading partners.

The second section examines the import side of the trade balance. Again, a simple demand and supply framework is utilised with price determined in world markets and volume driven by domestic demand and external (or import) competitiveness. The analysis considers the relative importance of domestic demand and relative prices on import volumes, as well as the timing and magnitude of pass-through of world prices and the exchange rate into import prices.

The final section combines the analysis of the previous two sections to examine the direct impact of a depreciation of Australia's exchange rate on the trade balance. The resultant adjustment is compared with that implied by the J-curve theory.

A summary of the results and directions for future work are outlined in the conclusion.

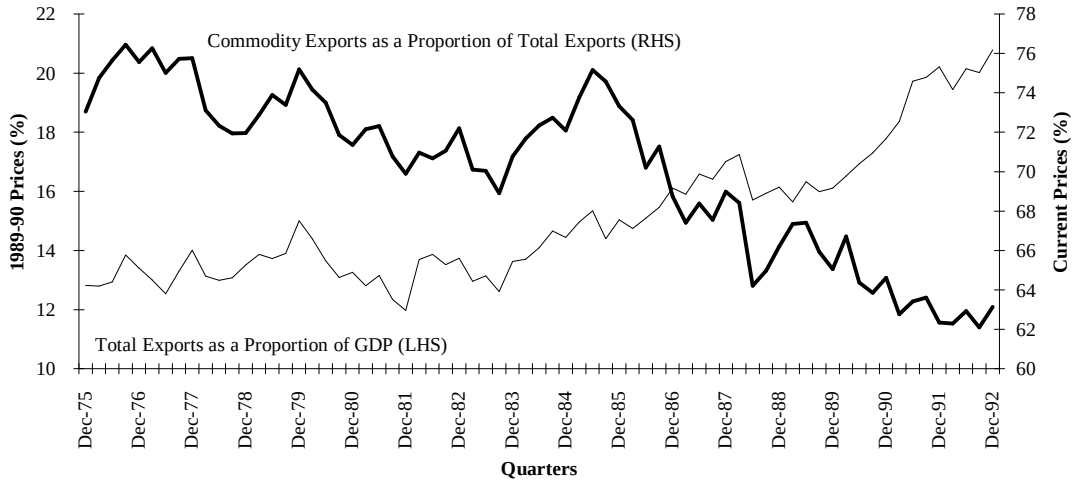
2. EXPORTS OF GOODS AND SERVICES

2.1 Trends in the Export Sector

During the 1970s and early 1980s, exports were about 13 per cent of GDP, but have since increased rapidly to around 20 per cent, driven by increases in the relative importance of the mining, manufacturing and services sectors. Within TRYM, aggregate exports are split into commodity (agricultural and mining) and non-commodity (manufacturing and service) categories. Although components of these can behave differently and respond to different factors, this level of disaggregation is appropriate - particularly given the preference for simplicity.

Commodity exports have declined as a proportion of total exports of goods and services, from about 75 per cent (in value terms) in the early 1970s to around 63 per cent today. Most of the fall in relative importance has occurred since the mid-1980s.

Chart 1: Trends in the Export Sector



It is particularly evident for agricultural exports, which in the past have accounted for up to half of total exports. Since the mid 1980s alone, this proportion has fallen from about 32 per cent to around 22 per cent (in value terms); domestic supply constraints, weakness of world prices and slower population growth in developed countries have all been influences.

In contrast, mining exports have remained strong, contributing around 40 per cent of total exports, despite the shift in developed countries away from resource intensive industries toward services. A primary reason for the continuing strength of the mining sector has been the low costs of production and large improvements in productivity. Furthermore, in contrast to the agricultural sector, supply

in the mining sector has been maintained over the last decade with the introduction of large new projects like the North West Shelf.

Exports of manufactures as a proportion of Australia's total exports have increased rapidly since the mid-1980s from about 11 per cent to 18 per cent. Similarly, there has been strong growth in service exports which now account for around 20 per cent of total exports, or almost as much as the agricultural sector. These movements are consistent with global trends, reflecting the higher demand elasticities in developed countries for manufactured goods and the higher trade barriers facing agricultural products. However, increased price competitiveness, growth of our major trading partners (particularly in Asia), and increased export awareness in the manufacturing and service sectors have also been important determinants of Australia's relative performance.

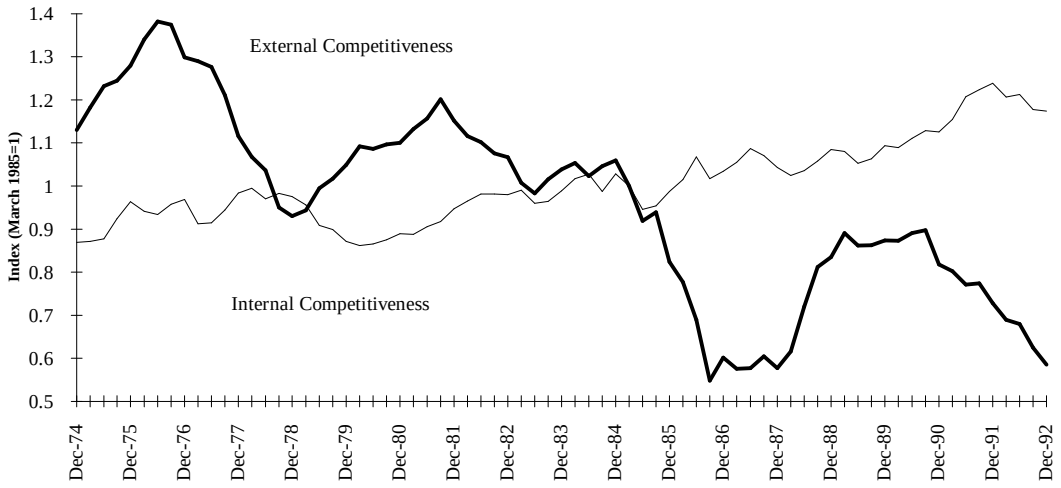
2.2 Major Factors Affecting Export Behaviour in the TRYM model

2.21 Price Competition

At the macroeconomic level, a major factor determining the demand and supply of total exports is price competitiveness, of which there are two relevant concepts. External competitiveness - the price of Australian exports relative to the price of substitutes on world markets - affects the demand for our exports. However, export supply is driven by internal competitiveness, or the ability of the traded goods sector to attract resources from the non-traded goods sector. Domestic (internal) producers move resources into the production of exports on the basis of relative domestic prices of traded and non-traded goods.

These two forms of the real exchange rate have moved quite differently (see Chart 2 below), emphasising the need - as undertaken in the TRYM model - for a clear distinction to be made between demand and supply.

Chart 2: Competitiveness of Exports



Note: a fall in each series implies an increase in competitiveness

It is apparent from Chart 2 that internal competitiveness has been less volatile than external competitiveness, and that the two measures exhibit divergent trends. In particular, current levels of external competitiveness are a significant improvement on the averages of the past 20 years, while until very recently, the internal competitiveness measure has tended to deteriorate.

The behaviour of external and internal competitiveness for commodities is different to that of non-commodities, implying differences in their relative price elasticities of demand and supply.

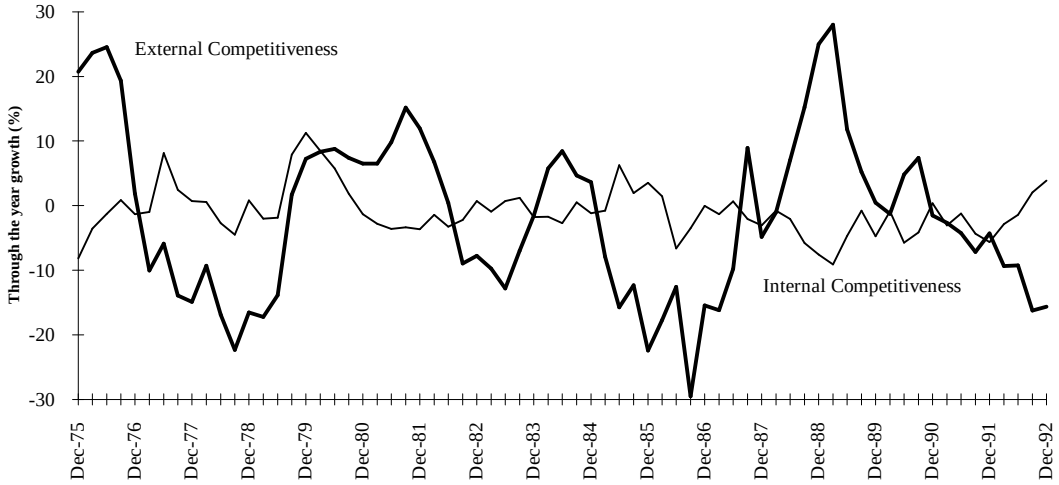
The supply of commodity exports is price inelastic, reflecting limitations on the amount of arable land and known mineral resources. However, demand is very elastic, consistent with the view that, at an aggregate level, Australia is a price taker. An elastic demand curve is also consistent with the homogeneity of the international commodity market[1].

The small country assumption is less applicable when analysing non-commodities. As indicated in Chart 3 below, the internal competitiveness of exports of non-commodities has been much less volatile than external competitiveness*;* changes in the price of non-commodity exports are relatively

[1]At a more disaggregated level, the demand curve for commodities is likely to be less elastic, given that Australian exporters of wool and coal have 'market power'. However, the overall influence of these sectors is diluted when commodity exports are examined at the aggregate level. (In any case, it is not sufficient to assume that demand for wool, for example, would be inelastic because Australia has market power, given that a close substitute for wool could have a substantial impact on its demand elasticity.)

small compared with changes in domestic non-commodity prices. Given that the supply of exports is driven by internal competitiveness, a highly elastic supply curve is implied, with non-commodity export prices primarily determined by the domestic price level. This outcome is consistent with Australian producers of non-commodities exporting a much smaller proportion of their output than commodity producers.

Chart 3: Growth in the Competitiveness of Non-Commodity Exports



Note: A negative growth implies an increase in competitiveness over the previous year.

In contrast, the volatility of the external competitiveness of non-commodity exports suggests a more inelastic demand. The small open economy assumption does not appear to hold for non-commodity exports, probably because output from the manufacturing and services sectors tends to be highly differentiated. In other words, demanders of Australia's non-commodities tend to focus on factors other than relative prices, an explanation that seems plausible in tourism for example, where Australia can offer a unique product.

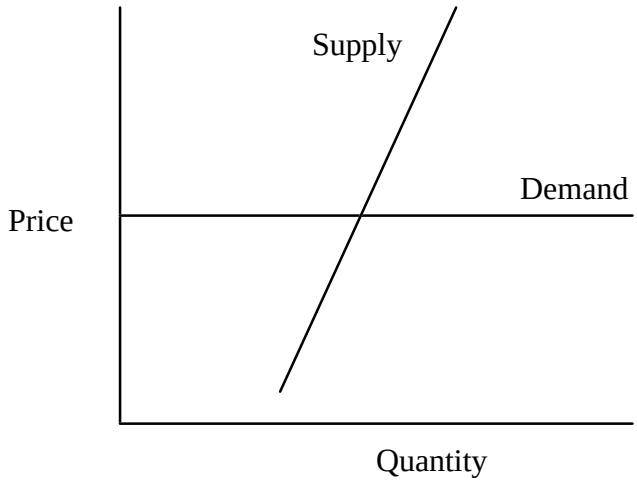
2.22 Simplifying the Analysis

Exports are modelled in the TRYM model using a simplified demand and supply framework. This framework incorporates the two different types of competitiveness and recognises that the demand and supply elasticities for exports of commodities and non-commodities differ substantially. Indeed, the TRYM model framework is simplified greatly by exploiting the following dichotomy.

For commodities, Australia is assumed to be a small open economy with export prices determined by world prices; this assumption implies that the demand curve for Australian commodity exports is infinitely elastic and therefore the volume of commodities exported is supply determined. Demand

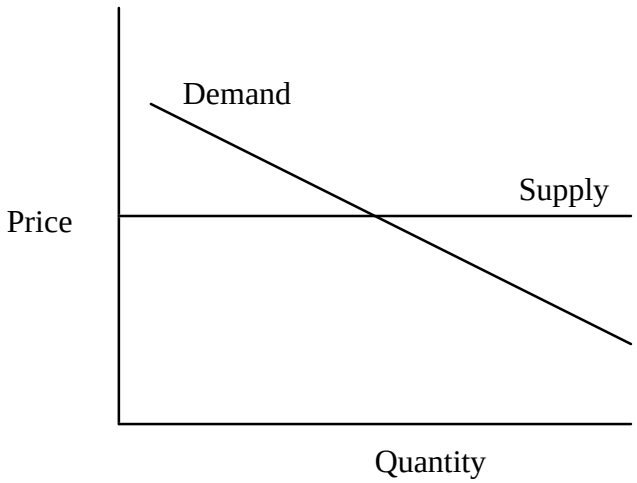
and supply curves are estimated for commodity exports. The former determines the $A export commodity price and the latter determines the quantity of commodities produced.

Commodity Exports



In contrast, domestic producers of non-commodities export only a small proportion of their total output and therefore foreigners can purchase as much of Australia's exports as they wish without affecting the price. This implies that the supply curve for Australian non-commodity exports is infinitely elastic and therefore the volumes of non-commodity exports are demand determined. Only a demand curve is estimated for non-commodity exports. With the supply curve assumed to be perfectly elastic, the supply price of non-commodity exports is determined by the domestic price of non-commodities (which is estimated elsewhere in the model).

Non-commodity Exports



2.23 World Growth

While the relationships between exports and competitiveness are used to establish an analytical framework, special attention is also given to providing a direct link between exports and world growth. World activity influences the demand for both categories of exports; stronger world growth will, other things equal, increase demand for our exports. However, in the TRYM model framework, the transmission mechanisms that relate world activity to exports are different for commodities and non-commodities.

For commodities, world conditions determine export prices because the demand curve for commodity exports determines prices. A fall in world growth leads to a fall in commodity prices and a corresponding fall in Australia's terms of trade.

On the other hand, world conditions are linked to non-commodity export volumes because the demand curve for non-commodity exports determines volumes. A fall in world activity therefore leads to a fall in the volume of non-commodities exported.

These linkages between Australia and the world are explored in more detail in TRYM paper number 6 on *Australia's Trade Linkages with the World.*

World supply is also likely to have an influence on Australia's external sector, particularly in the long run. World growth is an important factor affecting world trade prices and volumes in the short run, but there would be consequent supply responses in the longer term. However, the TRYM model does not (directly) capture these world supply responses.

2.24 Measuring World Activity and Competitiveness in the TRYM model

World growth is expressed in terms of our major trading partners' growth, using a refined world data base, which includes detailed information on Australia's trading partners in Asia. Bilateral export weights, varying over time in accordance with shifts in trading patterns[2], have been applied to quarterly GDP data for our major trading partners to construct a trade weighted 'world growth index' (WGTM)[3].

---

[2]Weights have been smoothed to abstract from one-off influences.

[3]GDP and the price of GDP were chosen as measures of world economic growth and world prices because they were readily available on a consistent basis for most of Australia's major trading partners. Furthermore, Australian exports are assumed to be both intermediate goods in foreign production and final goods in foreign consumption, and GDP encompasses elements of both foreign production and foreign incomes.

The world data base is also used to construct a trade weighted exchange rate (RTWI)[4] and a trade weighted 'world price index' (WPGTM); GDP deflators form the basis for the price index. External competitiveness is measured as the level of foreign prices, adjusted for movements in the exchange rate, compared with domestic export prices. Ideally external competitiveness should account for competition between Australian exporters and foreign producers operating in their domestic markets, and competition between Australian exporters and other foreign producers selling to the same market. The TRYM model measure of external competitiveness does not (directly) capture the third country competition faced by Australia in export markets.

Internal competitiveness is measured by comparing the domestic price Australian producers receive for their exports with the domestic price of non-commodities. An ideal measure would compare the domestic price of exported goods and services with the domestic price of non-traded goods and services. However, practical difficulties in distinguishing traded and non-traded goods, preclude such an approach.

2.3 Estimated Equations for Commodity Exports

Both of the equations estimated for commodity exports are in error correction form, ensuring that there is a clear distinction between the long run relationship and the short to medium term relationships. The equations are estimated jointly.

2.31 Commodity Demand

In the long run, the price of commodity exports (PXC) is assumed to fully adjust to changes in the level of world prices (WPGTM) and the exchange rate (RTWI). In equilibrium, PXC is also a function of a time trend (QTIME), capturing the effects of a trend fall in world commodity prices relative to WPGTM due to various factors, including protectionist trade policies and a shift away from resource intensive industries in developed countries.

The assumption that the demand for exports is perfectly elastic was tested by including the quantity of commodity exports (XC) in the equation for PXC, but the influence of XC was found to be insignificant; in aggregate, Australian commodity exports do not appear to influence world commodity prices. As noted above, analysing commodity exports in aggregate appears to have diluted the effects of those commodities in which Australia has some 'market power'.

---

[4]RTWI differs from the Reserve Bank of Australia's trade weighted index (TWI); RTWI is based on variable export weights rather than the fixed export and import weights used in constructing the TWI.

In equilibrium, the price level of Australia's exports is therefore determined by the following relationship:

log(PXC)= log(WPGTM)-log(RTWI)+C0PXC+C1PXC*QTIME

Among other things, the presence of contractual and delivery lags with commodity exports suggests that this relationship should not hold instantaneously.

In the short run, quarterly changes in the price of exports relative to world prices (Δlog(PXC*RTWI/WPGTM)) are assumed to be a function of the contemporaneous and lagged GDP growth of our major trading partners (Δlog(WGTM)); the relative price of oil (Δlog(WPMPE/WPGTM)); and the real exchange rate calculated using Australia's GDP deflator (Δlog(RTWI*PGTMA/WPGTM)).

Implicitly, it is assumed that it is the growth and not the level of world activity that affects commodity prices. An attempt was made to include a level effect in the long run part of the PXC equation, but this tended to crowd out the short run change effects. In particular, the inclusion of both WGTM and changes in WGTM implies that PXC would fall to a permanently lower level in response to a permanent fall in WGTM. It is likely, however, that the response of PXC to changes in WGTM would be larger in the short run than in the long run, since world supply responses would also eventuate; in response to a permanent fall in the level of world activity, the supply of world commodities is likely to become more elastic in the long run, pushing PXC above its short run level. It is difficult to adequately capture these long run dynamics in an equation which includes the level of world growth and not the level of world supply. Therefore the level of world growth has not been included in the PXC equation.

An increase in the price of oil relative to world prices will generally lead to an increase in Australia's commodity export prices for two reasons. First, the price of Australia's exports of oil will increase, given that Australia is a price taker on international markets. Second, increased demand for commodities which are substitutes for oil, such as coal, may increase the price of those commodities, assuming the overall world demand for energy products remains unchanged[5].

Changes in the exchange rate can be expected to influence commodity export prices in the short run, though the full flow-on will be delayed since a portion of commodity export contracts are denominated in Australian dollars. It is estimated that about 75 per cent of Australia's commodity export contracts are denominated in foreign currencies; based on the assumption that those export

[5]However, the data does not support a long run influence for the relative price of oil.

contracts denominated in Australian dollars are not quickly re-negotiated, the coefficient on the real exchange rate (A2PXC) has been constrained to equal 0.25.

Combining the short run dynamics with the long run equilibrium relationship leads to the error correction equation specified below. The equation has been adjusted to remove any steady state bias from PXC. In particular, the steady state growth rate of the economy (GR), calculated as the sum of the underlying productivity and adult population growth in the economy, is deducted from changes in WGTM. This has no impact on the estimated parameters, but ensures that PXC reaches a steady state equilibrium in a full model simulation of the TRYM model.

$$\begin{aligned}\Delta\log(PXC*RTWI/WPGTM) = {} & A0PXC*[\Delta\log(WGTM)-GR+\Delta\log(WGTM(-1))-GR(-1) \\ & \Delta\log(WGTM(-2))-GR(-2)+\Delta\log(WGTM(-3))-GR(-3)] \\ & +A1PXC*\Delta\log(WPMPE/WPGTM) \\ & +A2PXC*\Delta\log(RTWI*PGTMA/WPGTM) \\ & +A3PXC*[\log(PXC(-1)*RTWI(-1)/WPGTM(-1)) \\ & -C0PXC-C1PXC*QTIME(-1)]\end{aligned}$$

Results: (from joint estimation of commodity demand and supply equations)

Sample: 75(1):92(4)		
R^2=0.62	Standard Error=3.06%	Durbin Watson Stat=1.5
Parameter	Estimate	t-Statistic
A0PXC	0.71	2.44
A1PXC	0.158	5.80
A2PXC	0.25	constrained
A3PXC	-0.063	-2.35
C0PXC	1.41	4.84
C1PXC	-0.051	-4.20

Interpretation of Results

As can be seen from the chart below, this equation tracks history reasonably well. That said, constraining the coefficient A2PXC to equal 0.25 has adversely affected the ability of the equation to explain periods when there were large movements in the nominal exchange rate (the late 1970s and mid 1980s). If A2PXC is freely estimated, the equation tracks history much more closely. However, the equation would then imply that only about 40 per cent of any change in RTWI feeds through into PXC after one quarter. In combination with the long run response, this result also implies that the remainder of the flow through occurs very slowly, even though a large proportion of contracts are written in a foreign currency. Because of these problems the coefficient was constrained at 0.25.

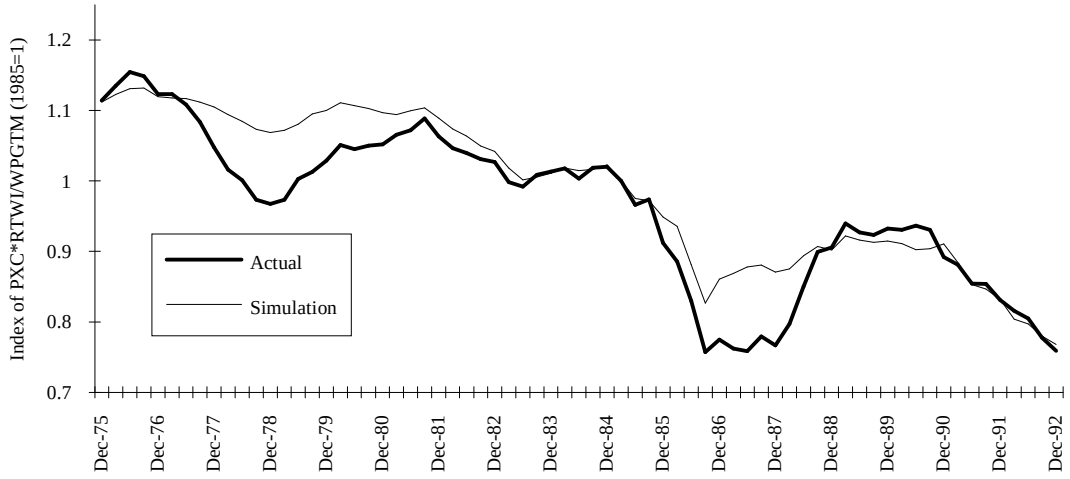
All coefficients are significant and correctly signed. The equation implies that about 6 per cent of any disequilibrium between the actual and desired level of PXC is eliminated per quarter, so that the average lag length is about 4 years. The short run dynamics of the equation imply that:

- a 10 per cent depreciation in the trade weighted index (RTWI) will increase PXC by 7.5 per cent within a quarter, and by 10 per cent in the long run;

- a one per cent permanent fall in the level of growth of our major trading partners will reduce the price of commodity exports by about 3 per cent in the short run, and by nothing in the long run. The adjustment of PXC back to a long run equilibrium is slow, with a mean lag of around 4 years. This is roughly the same pattern of response we would expect if the levels of world demand and world supply were also included in the equation; in the short run, a fall in world demand would lead to a fall in world prices, but in the long run world supply responses would push prices back toward equilibrium levels. That said, the short run price response is a little smaller than was expected. Including the level of world demand in the equation without a measure of world supply results in larger short run changes in PXC in response to a change in world growth, but PXC never adjusts back toward its equilibrium level; and

- a 10 per cent permanent rise in oil prices relative to world prices increases the price of commodity exports by about 16 per cent in the short run, and by nothing in the long run. As noted above, the level of the relative price of oil was found to be insignificant.

Chart 4: Dynamic Simulation of PXC Equation



3.32 Commodity Supply

Australian firms are assumed to maximise their revenue for any given level of inputs by allocating commodity export supply between the domestic and foreign sectors on the basis of relative prices ie. internal competitiveness. Therefore, in the long run, the quantity of commodities exported (XC) is driven by the price of commodity exports (PXC) adjusted for the indirect tax rate on commodity exports (RTXC) relative to the price of domestic non-commodities (PNC).

In equilibrium the supply of commodity exports is also a function of the equilibrium level of supply in the economy (YSTAR)[6] for a given level of the capital stock and employment; the level of commodity exports is a function of the profit maximising level of private business sector output in equilibrium. An increase in YSTAR, due to a structural increase in the underlying productivity of the economy for example, leads to a one-for-one increase in commodity export supply in the long run.

[6]YSTAR is the equilibrium or desired level of private business sector output given the level of the capital stock and employment. This measure is based upon estimated production function parameters within the TRYM model. Further information can be found in *Documentation of the Treasury Macroeconomic (TRYM) Model of the Australian Economy*.

It is also assumed that:

- productivity growth in the commodity producing sector is 3.5 per cent per annum, which is higher than the underlying productivity growth for the rest of the economy (estimated elsewhere in the TRYM model to be 1.1 per cent per annum). This appears to be a plausible assumption given the substantial total factor productivity growth experienced by the mining and agricultural sectors; over the past 15 years labour productivity alone has averaged around 2.5 per cent in the agricultural sector and about 3.8 per cent in the mining sector. This assumption is imposed by setting the coefficient on the time trend (C2XC) equal to 0.035;
- farm stock building (SFM) is part of exportable commodity production; and
- rain affects the supply of commodities and therefore YSTAR (which abstracts from the effects of rain), is adjusted to include rain affected output (QRAIN).

The long run relationship is therefore defined as follows:

```
log(XC+SFM-QRAIN)=log(YSTAR-XC-SFM+QRAIN)+C0XC
                  +C1XC*log(PXC*(1-RTXC)/PNC)+C2XC*QTIME
```

In the short run, the change in commodity export supply is also a function of a lagged dependent variable, giving the error correction equation specified below. As with the equation for PXC, an adjustment has been made to remove any steady state bias - the first line of the equation below.

```
Δlog(XC+SFM-QRAIN)=[GR+C2XC/4]*(1-A2XC)
                  +A1XC*Δlog[(XC(-1)+SFM(-1))-QRAIN(-1)]
                  +A2XC*{log[(XC(-1)+SFM(-1)-QRAIN(-1))
                                  /(YSTAR(-1)-XC(-1)-SFM(-1)+QRAIN(-1))]
                        -C0XC-C1XC*log(PXC(-1)*(1-RTXC(-1))/PNC(-1))
                        -C2XC*QTIME(-1)}
```

Results: (from joint estimation of commodity demand and supply equations)

Sample: 75(1):92(4)		
R^2=0.20	Standard Error=5.5%	Durbin Watson Stat=2.0
Parameter	Estimate	t-Statistic
A1XC	-0.293	-2.59
A2XC	-0.175	-4.04
C0XC	-1.54	-76.23
C1XC	0.52	6.04
C2XC	0.035	constrained

Interpretation of Results

Any disequilibrium between the actual and desired level of supply is removed quickly, at about 17.5 per cent per quarter; the mean lag of adjustment is 1½ years.

The price elasticity of supply is 0.52 (C1XC) in the long run. While this coefficient has the correct sign, it implies that supply is very inelastic, even in the long run.

The assumed growth in productivity (C2XC) is a crucial factor influencing the results of this equation. If C2XC is left unconstrained, the results imply a negatively sloped supply curve. If C2XC is constrained to be larger than 0.035, the estimated price elasticity of supply increases, but some of the t-statistics become insignificant. If C2XC is constrained to be smaller, supply becomes even more inelastic.

These results highlight the difficulties of modelling commodity supply and indicate the need for further work.

2.4 Estimated Equation for Non-Commodity Exports

2.41 Non-Commodity Demand

Demand for non-commodity exports relative to the level of our major trading partners' GDP (XNC/WGTM) is assumed to be driven in the long run by external competitiveness; that is, the

price of exports of non-commodities (PXNC) relative to world prices adjusted for the exchange rate (RTWI/WPGTM). However, the adjustment of the quantities of non-commodities exported to changes in external competitiveness is assumed to be sluggish and therefore a partial adjustment equation has been specified:

```
log(XNC/WGTM) =(1-A0XNC-A1XNC)*log(XNC(-1)/WGTM(-1))
              +A1XNC*log(XNC(-3)/WGTM(-3))
              +A0XNC*[C0XNC-C1XNC*log(PXNC*RTWI/WPGTM)]
```

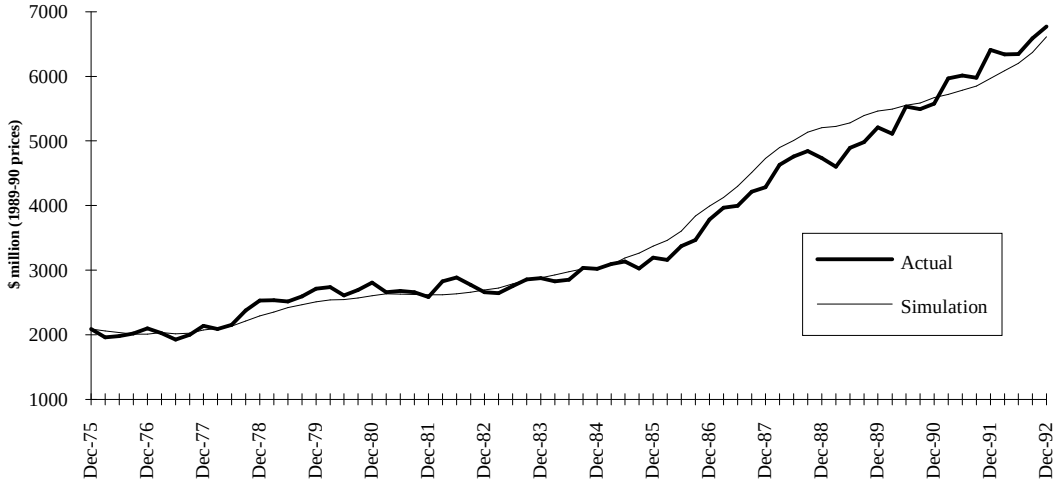
Results

Sample: 75(1):92(4)		
R^2=0.96	Standard Error=3.4%	Durbin Watson Stat=2.0
Parameter	Estimate	t-Statistic
A0XNC	0.081	2.38
A1XNC	0.238	2.79
C0XNC	6.96	5.28
C1XNC	1.74	2.96

Interpretation

The estimated long run elasticity of demand is 1.74; a fall in the real exchange rate (an increase in external competitiveness) of 1 per cent will eventually lead to an increase of 1.74 per cent in the volume of non-commodity exports. However, the adjustment toward the long run equilibrium is fairly slow, taking about 3 years. This slow adjustment probably reflects the effects of product differentiation in the international non-commodity market; it takes time to break into new markets and to capture market share from incumbents.

Chart 5: Dynamic Simulation Of XNC Equation



2.42 Supply of Non-Commodity Exports Identity

A supply curve for non-commodities is not estimated because the supply curve is assumed to be perfectly elastic and therefore the price of non-commodity exports is linked to the domestic price of non-commodities (PNC) using an exogenous ratio (XRPXNC), such that:

PXNC = PNC*XRPXNC

The short run impacts of changes in the exchange rate on PXNC are not directly taken into account, although movement in the exchange rate will affect PNC by impacting on import prices, among other things. It is possible that differences between the level of PXNC and PNC in history could have been due to differing reactions to changes in the exchange rate. This hypothesis is supported by the fact that about 30 per cent of manufacturing export contracts are denominated in foreign currencies; it could be expected, therefore, that a 10 per cent fall in the exchange rate would lead to a 3 per cent increase in manufacturing export prices in the short run. However, XRPXNC is relatively stable in history, even in the mid 1980s when there was a large depreciation in the exchange rate[7]. This suggests that the exchange rate affects PNC and PXNC in a similar way, and supports the approach adopted in modelling PXNC.

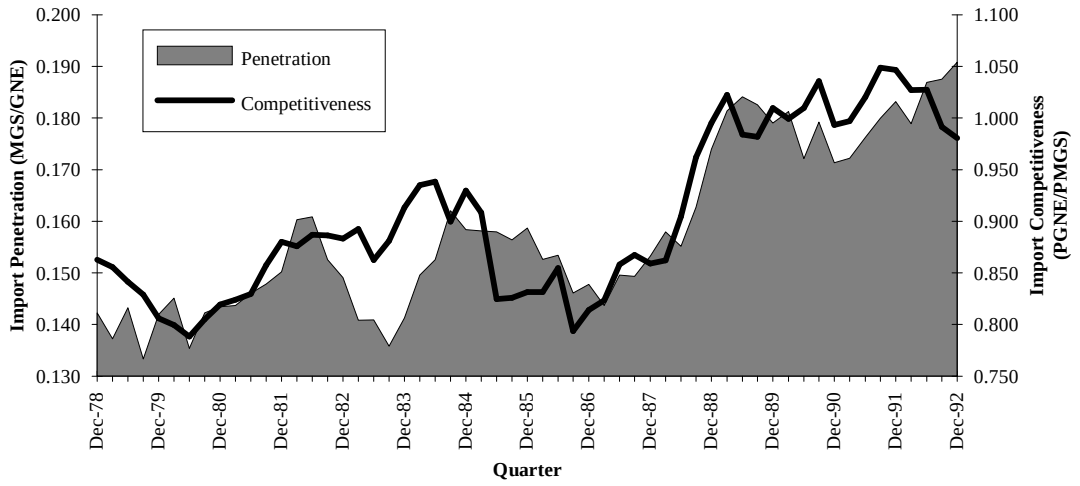
[7]The ratio of PNC to PXNC can be interpreted as the internal competitiveness of non-commodity exports. Through the year growth in this ratio can be seen in chart 2 above.

The estimated equation for PNC is in the Business Sector of the TRYM model and is presented in *The Documentation of the Treasury Macroeconomic (TRYM) Model of the Australian Economy.*

3. IMPORTS OF GOODS AND SERVICES

3.1 Trends in the Imports Sector

Chart 6: Import Penetration and Competitiveness



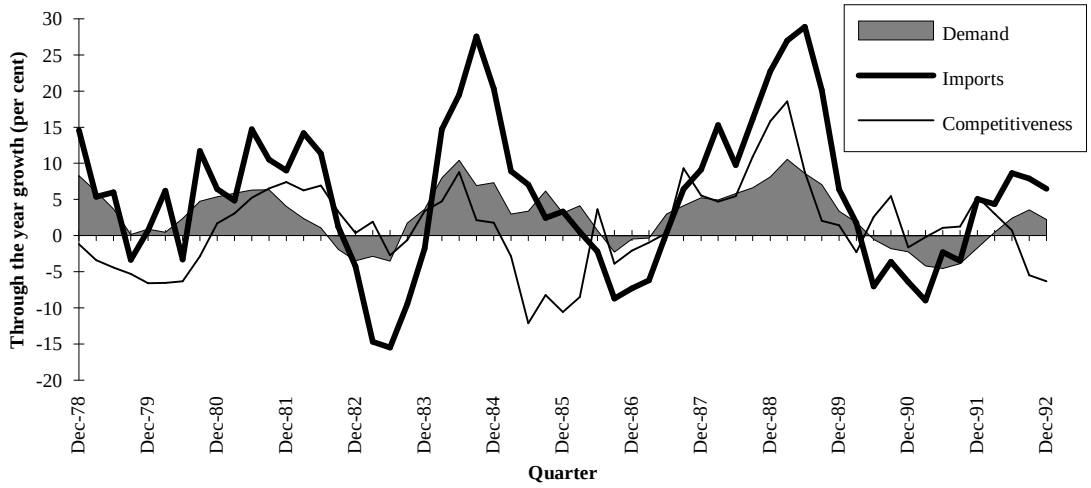
The chart above shows the ratio of imports to demand (MGS/GNE), which is a simple measure of import penetration (the shaded area), and the level of import competitiveness (defined as the ratio of domestic prices to import prices, PGNE/PMGS), a *rise* being a *loss* of competitiveness.

During the 1960s and 1970s, average import penetration was between 13 and 14 per cent of demand. Although cyclical fluctuations were apparent, the underlying level grew relatively slowly over time. In the early 1980s, the level of import penetration appeared to rise and fluctuate around an average level of about 15 per cent of demand. In the late 1980s and early 1990s, import penetration rose again to an average level of around 18 per cent of demand.

The chart suggests a strong long run correlation between the level of import penetration and the level of import competitiveness. Other factors also possibly explain this increase in import penetration, such as a shift towards import intensive expenditure, or a long run income elasticity of imports of greater than one, or a trend of increasing 'internationalisation' of the Australian economy.

A further trend evident in the chart is the deterioration in import competitiveness from late 1986 until fairly recently. Import prices declined relative to domestic prices in the latter half of the 1980s, and this loss of competitiveness is strongly correlated with a rise in import penetration. The fall in import competitiveness appears to reflect a combination of a fall in world oil prices in 1986, a fall in world traded goods prices (especially commodity prices) relative to GDP prices in the mid 1980s, and an appreciation of the exchange rate in the late 1980s.

Chart 7: Imports, Demand and Competitiveness Growth



Another important element in import behaviour apparent from Chart 7 above - showing through the year growth in imports, domestic demand, and import competitiveness (as previously defined) - is that fluctuations in import volumes are more amplified than that of domestic demand. The magnitude of imports growth tends to exceed demand growth in both upturns and downturns. It is also apparent that import competitiveness has played a varying role in different cycles, and should be considered when analysing the short term correlation between import and domestic demand growth.

In the TRYM model, imports of goods and services are examined at an aggregate level. An alternative approach adopted in the past was to disaggregate imports into endogenous goods (total goods imported less 'lumpy items'), exogenous goods, passenger services and shipping and other services. However, as shown in Upcher (1991) it is not clear that this framework yields superior results to examining imports in aggregate. Moreover, the essential elements in import behaviour discussed above can be captured adequately by an aggregate analysis, and this approach is consistent with the overall philosophy of keeping the TRYM model simple.

3.2 Major Factors Affecting Import Behaviour in the TRYM model

The primary factors determining the demand for imports at the macro-economic level are domestic income and the competitiveness of the domestic tradeable goods and services sector. A rise in income will lead to an increase in import demand, and an increase in the price of imports relative to domestic substitutes (an increase in Australia's import competitiveness) will lead to a fall in demand for imports.

The supply curve for imports is horizontal or infinitely price elastic; Australia is assumed to be a small open economy that cannot influence world prices. The price of imports is therefore a function of world prices and the exchange rate, such that an increase in world prices or a depreciation of the exchange rate will lead to an increase in import prices. Allowance is made for the time taken for movements in the exchange rate and world prices to pass through into import prices, and for the differing pass-through of world oil prices and world prices more generally.

In the TRYM model, equations are estimated jointly for import demand and import supply. Under the small open economy assumption, the import demand equation determines the quantity imported, while the supply equation determines the price of those imports (the world price of those goods), and the flow-through from exchange rate and world price movements into import prices.

3.3 Import Demand

A consideration when analysing the demand for imports is whether they should be treated as intermediate or final goods. Analysis of imports in the TRYM model follows the traditional approach, which is to treat imports as a final good. In particular, consumers and firms in Australia are assumed to allocate their purchases between imports, domestic tradeable goods and non-tradeable goods. This suggests that import demand is a function of income and the prices of imports, domestic tradeables and non-tradeables. An alternative approach is to treat imports as an intermediate good, suggesting that they should be included as a factor in the production function, along with other inputs like capital, labour and other intermediate inputs. Import demand would then be derived as a function of income, and the prices of imports, capital, labour and other intermediate inputs.

Whether imports are primarily a final or an intermediate good is not clear. Balance of payments data indicates that other endogenous goods (excludes consumption and capital goods) and fuel imports - a broad proxy for intermediate goods - were around 37 per cent of the value of all imported goods and services in 1991-92. Foreign trade data on imports by broad economic category indicates that food and beverages mainly for industry, industrial supplies, fuels and lubricants, and

parts and accessories for capital goods and transport equipment - another broad proxy for intermediate goods - were around 38 per cent of all imports of goods and services.

3.31 Measuring Income

There are a variety of ways of measuring the domestic income variable used to explain the demand for imports. Horton (1989) estimates import demand equations using both GNE and GDP, and the estimates suggest little to discriminate between either as an explanator of import demand.

In the TRYM model, a National Accounts expenditure aggregate is used, consistent with the analysis of imports as a final good. In addition, an attempt is made to allow for differing import penetration across the different components of domestic demand expenditure. In particular, a weighted average of the expenditure side demand components (DDMGS) has been used to proxy the income variable. The weights, which reflect the incidence of imports from the various types of expenditure, are based on results from the Commonwealth Treasury's micro economic model, PRISMOD[8].

Results from PRISMOD indicate that imports account for 33 per cent of government market demand (GMD), which is equal to government final demand less government expenditure on capital and labour; 29 per cent of business investment (IB), which includes plant and equipment investment and investment in non-dwelling building and construction; 25 per cent of exports of non-commodities (XNC); 20 per cent of the statistical discrepancy (DISA); 17 per cent of private non-rent consumption (CNR); 13 per cent of dwelling investment (IDW); 10 per cent of exports of commodities (XC); and 3 per cent of consumption of rents (CRE).

Another result from PRISMOD suggests that the most import intensive component of expenditure is non-farm stock-building, with imports making a 51 per cent contribution to any expenditure in this area. However, it was felt that increased imports cause increased non-farm stock-building rather than vice versa, and therefore non-farm stock building is excluded when calculating DDMGS. This approach is consistent with the assumption in the TRYM model that *final* demand causes import growth.

DDMGS is defined as:

---

[8]The response of imports after increasing various components of domestic demand was examined using PRISMOD. The marginal propensity to import was subsequently assessed for each component of domestic expenditure.

DDMGS = 0.17*CNR+0.03*CRE+0.29*IB+0.13*IDW+0.25*XNC+0.10*XC+
0.33*GMD+0.20*DISA

Conceptually, DDMGS is a better explanator of import demand than either GNE or GDP as it accounts for the differing import penetration of the various types of expenditure. Furthermore, DDMGS was found to better explain movements in import demand than GNE.

3.32 Measuring Cost Competitiveness

The prices that are relevant in determining import competitiveness and its effect on the demand for imports are the prices of imports, domestic tradeables (domestically produced substitutes) and domestic non-tradeables. Under some simple assumptions[9], an appropriate theoretical measure of import competitiveness commonly used is the price of imports relative to the price of domestic tradeables. Many empirical studies, however, use the price of imports relative to an aggregate expenditure price deflator, such as the GNE deflator (PGNE) or the GDP deflator (PGDP), to measure import competitiveness. PGNE and PGDP implicitly include the price of some non-traded goods and therefore, to make these measures valid, it must be assumed that the elasticity of import demand with respect to traded and non-traded goods is equal[10].

In practice, it is difficult to construct an aggregate price for tradeable goods that excludes the price of non-tradeables. The proxy for the price of domestic tradeables used in the TRYM model is PDDMGS, the implicit price deflator (at factor cost) of our income variable DDMGS. PDDMGS may also be contaminated by the price of domestic non-tradeables. Nevertheless, it is a conceptually superior measure to either PGNE or PGDP because a low or zero weight is placed on the components that have a low or zero tradeable component (for example, the implicit price deflators for consumption of rent, and general government expenditure on labour services and capital services are excluded).

It is also apparent from the data that a combination of DDMGS determining income and PDDMGS determining the relative price provides a superior explanation for movements in import demand than a combination of either PGNE and GNE or PGDP and GDP.

---

[9]Goldstein (1980) demonstrates that assuming homogeneity of degree zero in these three prices and separability in the consumption choice between tradeables and non-tradeables, implies the import function can be written with merely the relative price of imports to domestic tradeables as the price argument. Further, he finds support for these assumptions using his estimated traded and non-traded goods price series.

[10]Goldstein (1980) does not find support for this constraint.

Indirect tax rates are included in the construction of PDDMGS to ensure that PDDMGS is on a factor cost basis, consistent with the Australian Bureau of Statistics measurement of import prices at factor cost. It is assumed that imports and domestic tradeables both incur indirect taxes equally. Measuring PDDMGS at factor cost ensures that there is no net indirect tax 'wedge' between the price of imports and price of domestic substitutes.

PDDMGS is defined as the weighted (weights as in DDMGS) sum of current price expenditure components (suffix 'Z'), adjusted for net indirect taxes (prefix 'RT'), divided by DDMGS.

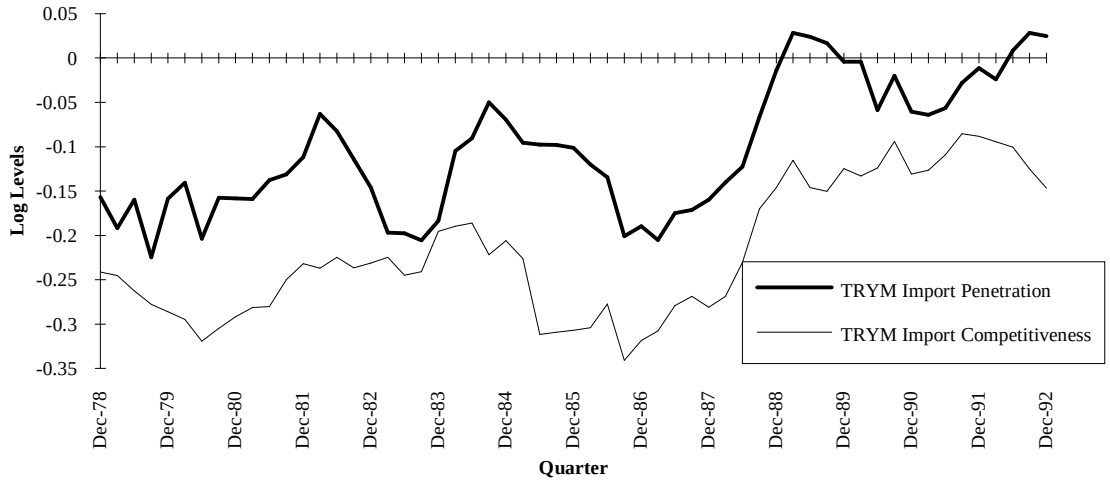
```
PDDMGS =    {0.17*CNRZ*(1-RTCNR) + 0.03*CREZ*(1-RTCRE) + 0.29*IBZ*(1-RTIB)
            +0.13*IDWZ*(1-RTIDW) + 0.25*XNCZ*(1-RTXNC) + 0.10*XCZ*(1-RTXC)
            + 0.33*GMDZ*(1-RTGMD) + 0.20*DISAZ} / DDMGS
```

The relative price term that measures the competitiveness of imports is also adjusted to allow for customs duty (RTMGS), which is an impost on imports but not on domestic tradeables, and will affect the choice between imports and domestic tradeables. Therefore, the relative price of imports is defined as follows:

```
Relative Price of Imports =  PMGS*(1+RTMGS)/PDDMGS
```

3.33 The TRYM Model Measures of Import Penetration and Competitiveness

Chart 8: TRYM Import Penetration and Import Competitiveness



The chart above shows the log levels of import penetration ratio and import competitiveness as defined in the TRYM model. Import penetration is defined as (MGS/DDMGS), and import

competitiveness is defined as the inverse of the relative price of imports (PDDMGS/PMGS/(1+RTMGS)).

The apparent structural increase in import penetration in the early 1980s noted earlier in Chart 6 (based upon a MGS/GNE ratio), is no longer evident when import penetration is based upon the demand measure DDMGS. Allowing for compositional changes between different types of expenditure with differing import intensiveness explains the apparent movement in the simpler measure of import penetration in the early to mid 1980s. Nevertheless, some upward trend in import penetration is still evident in the data. In particular, there is still a large rise in import penetration in the late 1980s.

There appears to be a long term correlation between the level of import penetration and the relative price of imports. In particular, the strong rise in the inverse relative price in the late 1980s is strongly correlated with a large increase in import penetration. Wilkinson (1992) has attributed a large part of this rise to movements in the competitiveness (relative price) of imports.

3.34 Interpretation of Import Penetration Trend

The apparent trend increase in import penetration over the sample period requires some interpretation. Freely estimating an equation over the sample would result in a long run income elasticity greater than one. Conceptually, this result is a problem because it implies that, in the very long run, imports will eventually exceed income. In the interests of sensible long run *simulation* properties, the long run income elasticity has been constrained to equal one, and a time trend has been added to the import demand equation to soak up some of this trend increase in import penetration. This gives the equation the capacity to interpret history and produce forecasts, as well as provide sensible input into policy simulations.

- For forecasting purposes, it is desirable to maintain this characteristic of the data into the immediate future and leave the time trend on; however, in policy simulations, where sensible long run properties are desirable, the time trend can be turned off.

The trend increase in import penetration over the sample may be due to the 'internationalisation' of the Australian economy, or increased exposure to world conditions. This is consistent with an increasing ratio of exports to GDP noted earlier, and with the experience of many other countries, and could reflect increasing specialisation of production and trade between countries. It may also reflect an increase in wealth and affluence resulting in a change of consumer tastes in favour of imported goods.

3.4 Import Supply

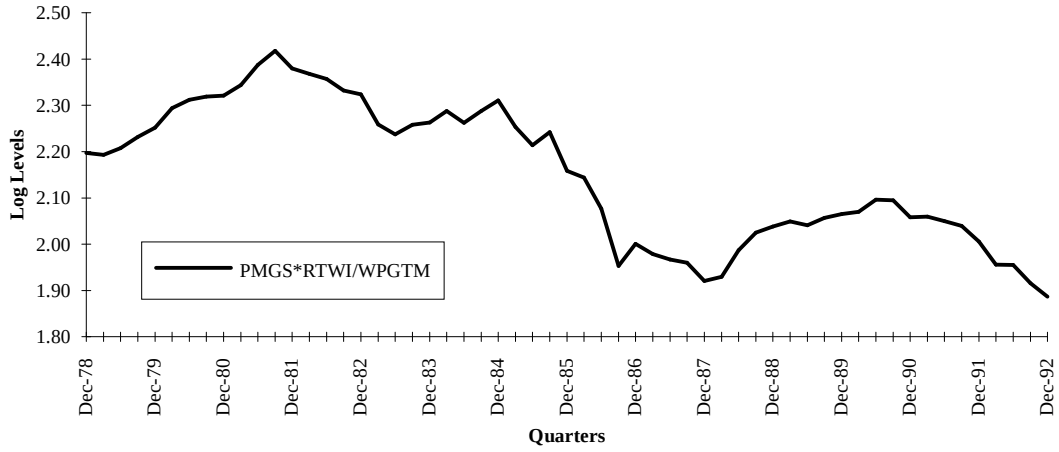
The supply curve is assumed to be infinitely price elastic. In other words, it is assumed that Australia is a small country, whose demand does not affect world prices. The small open economy assumption implies that the Australian price of imports will equal the world price adjusted for the exchange rate. Around three quarters of Australia's imports are non-commodities, and therefore assuming infinitely elastic import supply is consistent with the approach taken in determining non-commodity export supply.

3.41 Measuring World Prices and Exchange Rate

World non-commodity prices are proxied by the world GDP deflator WPGTM as defined in the exports sector. This measure is export weighted and therefore is probably not the best measure of the world price of our imports (reflecting the export weighting and inclusion of non-traded goods prices). Nevertheless, WPGTM was adopted in the interests of keeping the TRYM model simple.

3.42 Measuring Trend and Compositional Influences

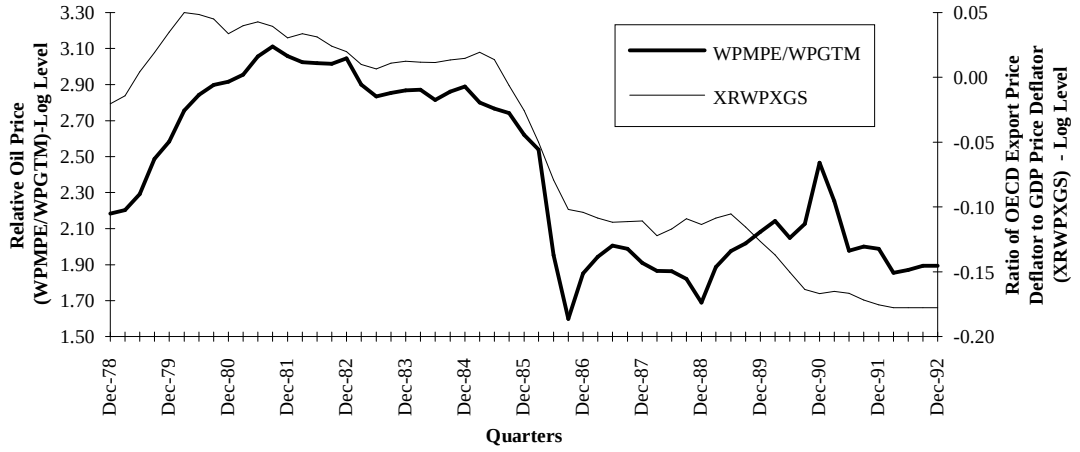
Chart 9: Foreign Currency Price of Australian Imports Relative to World Prices



The above chart shows the price of Australian imports in foreign currency terms relative to the world price (PMGS*RTWI/WPGTM). The small open economy assumption would suggest that this ratio should be constant in the long run, as movements in world prices are fully reflected in Australian import prices (after adjusting for the exchange rate). However, as is apparent from the above chart, this ratio has been declining over the sample; in particular, the ratio fell significantly in the mid 1980s. This secular and/or shift movement appears to reflect the performance of WPGTM as a proxy for the world price of our imports.

The composition of goods and services implicit in WPGTM is almost certainly different to that in PMGS. This becomes a serious problem when a particular good has a significantly different share in import prices from that in world prices, *and* its price is moving in a significantly different way to all other prices. More generally, WPGTM is based on GDP prices and will be less suitable when the price of tradeable goods and services are trending in a different manner to world GDP prices.

Chart 10: World Relative Price of Oil and World Ratio of Export Prices to GDP Prices



Two proxies have been included in the import supply equation to account for these compositional effects. In particular, proxies are included to model world oil prices, and world traded goods prices, relative to world GDP prices. The above chart shows the foreign currency price of Australian oil imports relative to world prices (WPMPE/WPGTM), and the ratio of OECD export implicit price deflators to OECD GDP implicit price deflators (XRWPXGS).

- Oil prices have been moving quite differently to world GDP prices over the sample, and are likely to have a greater direct weight in import prices than in WPGTM. The oil price rises of the early and late 1970s, and oil price decline in the mid 1980s are likely to have a proportionately greater impact upon the price of Australian imports than on world GDP deflators.

- More generally, a shift occurred in the mid 1980s in the relationship between world traded goods prices and GDP deflator prices. The reasons for this shift are unclear.

Both of these proxies appear to have fallen around 1986, and may be useful in explaining the shift in the relationship between WPGTM and PMGS (adjusted for RTWI) at that time.

3.5 Estimated Import Equations

3.51 Import Demand

In the long run, the import penetration ratio (MGS/DDMGS) is assumed to be a function of the relative price of imports (PMGS*(1+RTMGS)/PDDMGS) and a time trend (QTIME). The formulation constrains the long run price elasticity to equal one, while the time trend accounts for the increasing penetration ratio over the sample period.

$$\log(MGS/DDMGS)=C0MGS-C1MGS*\log(PMGS*(1+RTMGS)/PDDMGS)+C2MGS*QTIME$$

It is unlikely that actual import demand instantaneously matches desired import demand, due to informational lags, delivery times and existing contractual obligations. These dynamic considerations have been modelled by estimating an error correction specification.

In the short run, growth in imports ($\Delta\log(MGS)$) is driven by growth in domestic demand ($\Delta\log(DDMGS)$), as well as growth in imports 2 and 3 quarters previously. Also included in the short run dynamics are the growth in the relative price ($\Delta\log(1+RTMGS)/(PDDMGS)$). The coefficient on this variable has been constrained so that imports partially adjust to changes in relative prices. This constraint was necessary because freely estimated results suggested an implausibly fast response of import volumes to relative price changes (over 80 per cent of the long run adjustment occurred in the first quarter).

The preferred error correction equation is as follows (as with exports, the specification has been adjusted to remove steady-state bias):

$$\begin{aligned}\Delta\log(MGS) = {} & [GR + C2MGS*\Delta(QTIME)]*(1-A3MGS-A4MGS) \\ & +A1MGS*[\Delta\log(DDMGS) - GR] \\ & -A5MGS*C1MGS*[\Delta\log(PMGS*(1+RTMGS)/PDDMGS)] \\ & +A3MGS*[\Delta\log(MGS(-2))] \\ & +A4MGS*[\Delta\log(MGS(-3))] \\ & -A5MGS*\{\log(MGS(-1)/DDMGS(-1)) \\ & \qquad -C0MGS \\ & \qquad +C1MGS*\log(PMGS(-1)*(1+RTMGS(-1))/PDDMGS(-1)) \\ & \qquad -C2MGS*QTIME(-1)\}\end{aligned}$$

3.52 Import Supply

In the long run, movements in the exchange rate and world prices flow fully into $A import prices. As discussed above, shifts in this relationship are captured by the relative price of oil (WPMPE/WPGTM), and the ratio of traded goods prices to GDP prices (XRWPXGS).

log(PMGS)=	log(WPGTM)-log(RTWI) +A0PM + A2PM* log (WPMPE/WPGTM) + log(XRWPXGS)

In the short run, exchange rate changes are not fully reflected in import prices. This could be due to a variety of influences including contractual arrangements, the existence of exchange rate hedging, the desire by importers to maintain market share, or uncertainty regarding the fundamental nature or permanence of any exchange rate movement. Similarly, the full impact of world price shocks are not instantaneously reflected in import prices, and oil price movements may not necessarily flow into import prices at the same rate as other world prices.

Early estimation using an error correction model proved unsuccessful, with the error correction term found to be small and insignificant. The movement in import prices was largely explained by the dynamic terms in the ECM, reflecting the strong correlation between *changes* in import prices and *changes* in world prices and the exchange rate. Accordingly, there was little left to be explained by the levels, ie. the long run relationship.

However, it was felt that import supply should capture the long run relationship between import prices, world prices and the exchange rate; these variables should be related in levels and not just in changes. The supply equation is therefore estimated using a partial adjustment specification, imposing a long relationship between the price of imports (PMGS) and world prices adjusted for the exchange rate (WPGTM/RTWI), such that movement in WPGTM or RTWI are fully reflected in PMGS in the long run.

$$\log [PMGS*RTWI/WPGTM] = A1PM* \log [PMGS(-1)*RTWI(-1)/WPGTM(-1)] + (1-A1PM)*[A0PM + A2PM* \log (WPMPE/WPGTM) + \log(XRWPXGS)] + A3PM*\Delta_2 \log (WPMPE/WPGTM)/2 + A4PM*[\Delta \log (RTWI*PDDMGS/WPGTM)]$$

Joint Estimation Results:

Import Demand

Sample: 78(1) to 92(4)		
$R^2 = 0.714$	Standard Error = 2.14%	Durbin Watson = 1.93
Parameter	Estimate	t-Statistic
A1MGS	1.70	8.67
A3MGS	0.247	3.41
A4MGS	0.200	2.59
A5MGS	0.515	6.77
C0MGS	0.0542	2.73
C1MGS	0.622	5.90
C2MGS	0.00571	3.42

Import Supply

Sample: 78(1) to 92(4)		
R^2 = 0.992	Standard Error = 1.33%	Durbin Watson = 1.89
Parameter	Estimate	t-Statistic
A0PM	1.79	22.0
A1PM	0.879	23.9
A2PM	0.167	5.13
A3PM	0.0470	2.54
A4PM	0.529	13.5

Chart 11: Dynamic Simulation of MGS Equation

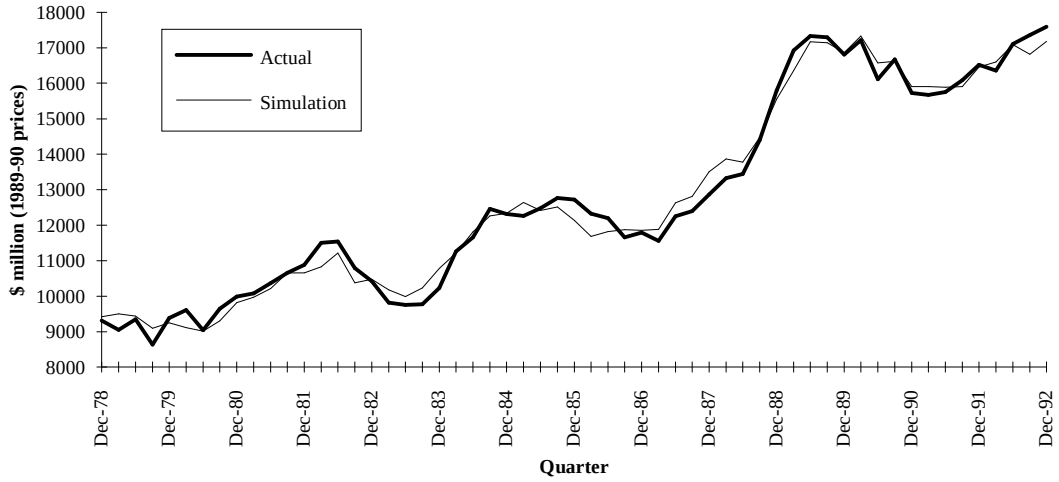
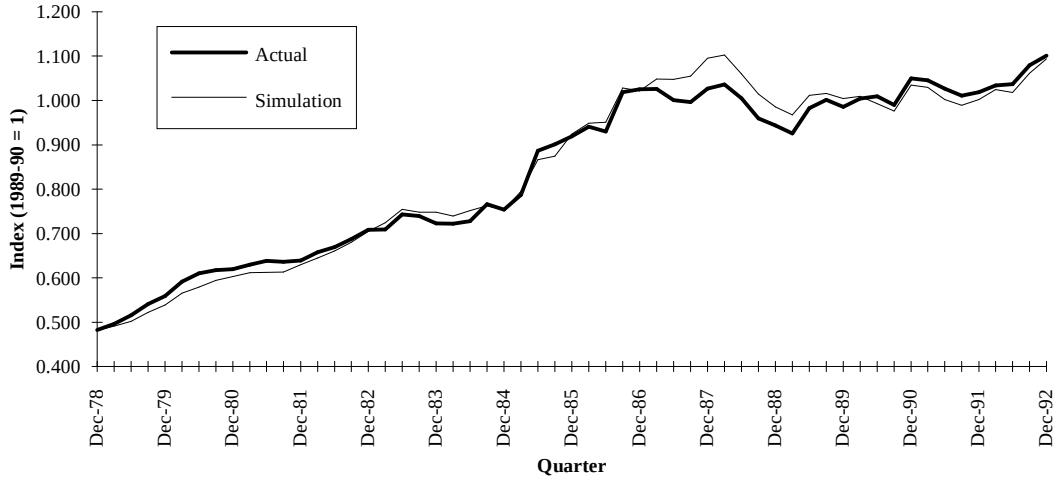


Chart 12: Dynamic Simulation of PMGS Equation



Interpretation of Results

The income elasticity of import demand is constrained to be one in the long run, and is estimated to be around 1.70 in the short run. This is consistent with imports growing faster (slower) than demand as the economy accelerates (slows), and implies that imports grow in line with the overall growth of the economy in the long run. Moreover, this short run impact is broadly consistent with the behaviour of imports in recent cycles. The price elasticity of import demand is estimated to be around -0.62 in the long run, and around -0.32 in the short run. The time trend suggests a secular increase of 0.57 per cent per annum in the import penetration ratio over the sample period. The error correction term is -0.52, suggesting that imports have a mean lag of around 2 quarters in their adjustment to long run equilibrium.

World price and exchange rate movements flow fully into import prices in the long run, but this takes time to eventuate. The exchange rate and world prices have been constrained to flow through at the same rate[11].

- A one per cent increase in the level of all world prices (WPGTM and WPMPE), or one per cent increase in the inverse exchange rate, leads to a 0.47 per cent increase in import prices initially, and an increase of 1 per cent in the long run. This adjustment occurs at a rate of 12 per cent per quarter.

[11]This constraint was supported by the data.

- Exchange rate and world price pass-through is 47 per cent initially, 69 per cent after 1 year, 82 per cent after 2 years and 89 per cent after 3 years.

A one per cent increase in world oil prices *relative* to world prices (WPMPE/WPGTM), will tend to increase import prices by:

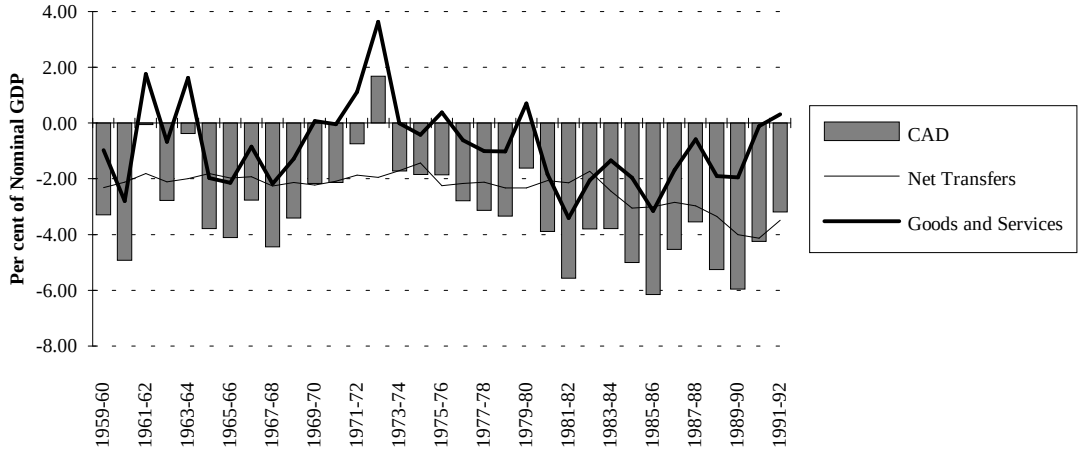
- 0.04 per cent initially, and another 0.04 per cent after one quarter. This result is broadly consistent with *full* pass-through of world oil prices into petroleum imports, which are around 5 per cent of total imports; and

- 0.17 per cent in the long run, consistent with the increase in oil prices increasing the price of other imports that are oil intensive in their production (such as chemicals, port service debits and travel and passenger service debits).

4. TRADE BALANCE AND CURRENT ACCOUNT

4.1 Trends in the Balance on Goods and Services, Net Transfers Overseas and the Current Account

Chart 13: Balance on Goods and Services, Net Transfers Deficit and Current Account Deficit



The above chart shows the balance on goods and services (or net exports in current price terms), the net transfers deficit (net income and unrequited transfer payments), and the current account deficit (CAD) over the last thirty years. A general feature of this chart is that cyclical movements in the CAD appear to be closely linked to movements in the balance on goods and services.

The CAD averaged around 3 per cent and 2 per cent of GDP during the 1960s and 1970s respectively. In the 1980s, however, the CAD increased substantially, averaging around 4 3/4 per cent of GDP. The increase in the CAD in the early 1980s appears to be associated with a deterioration in the balance on goods and services. As the decade passed, the financing of a succession of CADs and depreciation of the exchange rate led to a rapid accumulation of net external liabilities (particularly debt). By the mid to late 1980s the increase in external liabilities (together with a rise in interest rates domestically and overseas), began feeding back into higher net transfer payments overseas (particularly through increased debt servicing).

During the mid to late 1960s, there was a similar succession of large CADs. However, in contrast to the 1980s experience, a reversal with surpluses on the balance of goods and services in the early 1970s (and without any adverse exchange rate valuation effects), prevented a deterioration in the net income deficit and the CAD.

In the TRYM model, the balance on goods and services is a function of export and import volumes equations (determining net exports), and export and import price equations (determining the terms of trade). The remainder of the current account balance (ie. the net transfers deficit), is a product of a set of identities that determine the dynamics between current account financing, net external liability accumulation, and the servicing of these liabilities. These identities are detailed in *Documentation of the Treasury Macroeconomic (TRYM) Model of the Australian* Economy.

5. EFFECT OF A DEPRECIATION UPON THE BALANCE OF TRADE

5.1 Nature of the Shock

This section examines the direct impact of a depreciation of the exchange rate on the trade sector in the TRYM model framework. The purpose of this shock is to demonstrate the responses and lags of various components of the trade sector. The underlying causes of this movement in the exchange rate are ignored, and it is assumed that the economy is initially in equilibrium. Furthermore, no allowance is made for the second round effects on the trade sector from the rest of the economy. The simulation of a world demand shock analysed in the TRYM Paper No. 6 provides a better overall picture of a full model response to changes in the exchange rate. That said, the simulation presented here is sufficient to gauge the reaction of the trade sector alone, and gives an overview of this sector's role in the TRYM model.

The exchange rate is assumed to depreciate by 10 per cent (the inverse exchange rate appreciates by 11.1 per cent), and remains permanently at this lower level. Domestic and world prices are assumed to remain unchanged, and both nominal and real exchange rates depreciate.

The results are presented in the table and charts shown below. They can be can be interpreted as showing the difference between the level (not the growth rate) of each variable if the economy was in equilibrium and the corresponding level of each variable as a result of the shock. The whole economy is initially assumed to be in equilibrium; this analysis abstracts from the impact of any pre-existing disequilibrium in the economy.

IMPACT OF AN EXCHANGE RATE SHOCK ON THE TRADE SECTOR

A ceteris paribus 10 per cent depreciation in the exchange rate.
Deviations from control level.

	Quarters after shock										
	Impact										Long
	0	1	2	3	4	5	6	8	12	16	Run
PRICES											
Inverse RTWI	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
PXC	8.2	8.4	8.6	8.7	8.9	9.0	9.1	9.4	9.8	10.1	11.1
PXNC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PXGS	4.8	4.9	5.0	5.1	5.2	5.2	5.3	5.5	5.7	5.9	6.5
PMGS	5.1	5.8	6.4	7.0	7.5	7.9	8.3	8.9	9.8	10.3	11.1
Terms of Trade	-0.3	-0.9	-1.4	-1.8	-2.2	-2.5	-2.8	-3.2	-3.8	-4.0	-4.2
VOLUMES											
XC	0.0	0.4	0.7	0.9	1.2	1.5	1.7	2.2	2.9	3.4	4.5
XNC	1.5	2.5	3.3	4.1	5.0	5.7	6.4	7.8	10.2	12.1	20.0
XGS	0.6	1.2	1.7	2.2	2.7	3.1	3.6	4.4	5.7	6.8	10.6
MGS	-1.6	-2.5	-3.6	-4.4	-4.8	-5.1	-5.2	-5.3	-5.6	-6.0	-6.3
Net Exports (a)	0.4	0.7	1.0	1.2	1.4	1.6	1.7	1.9	2.2	2.5	3.4
VALUES											
XGSZ	5.4	6.2	6.7	7.4	8.0	8.5	9.1	10.1	11.8	13.1	17.7
MGSZ	3.4	3.1	2.6	2.3	2.3	2.4	2.6	3.1	3.7	3.8	4.1
Balance on Goods and Services (b)	0.4	0.7	0.9	1.1	1.2	1.3	1.4	1.5	1.7	2.0	2.9

(a) Ratio to GDP(A).
(b) Ratio to nominal GDP(A).

Chart 14A: Depreciation in Exchange Rate - Trade Components

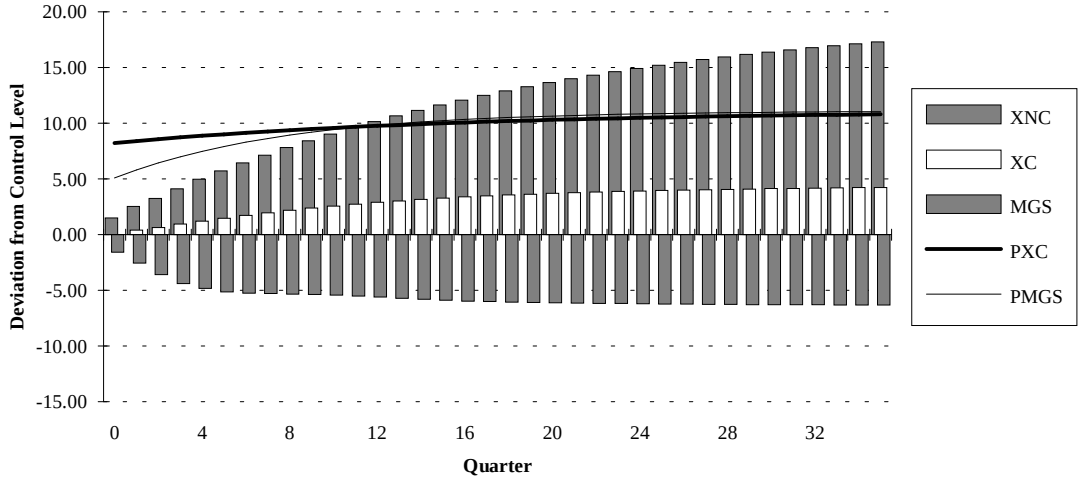
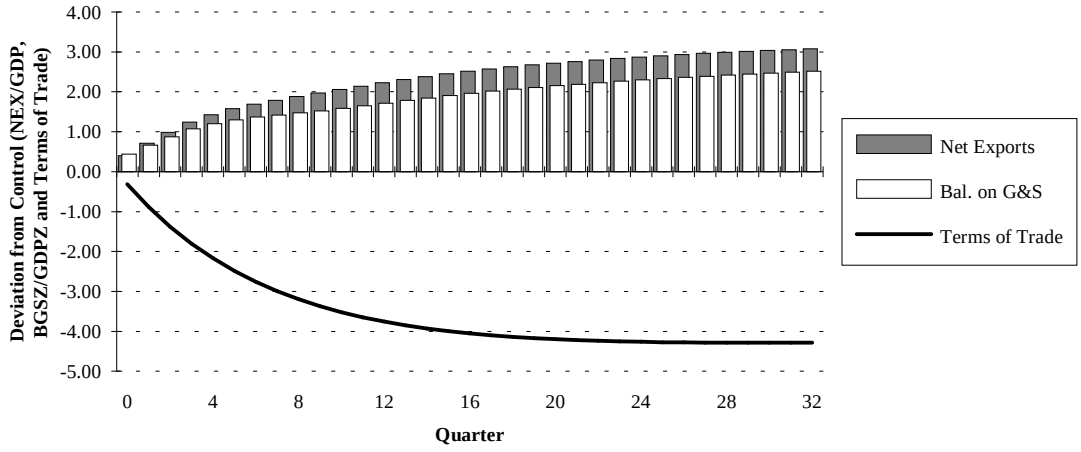


Chart 14B: Exchange Rate Depreciation - Terms of Trade, Net Exports and Balance on Goods and Services



5.2 Summary of Results

A depreciation in the exchange rate increases commodity export and import prices, but does not change non-commodity export prices. The price of commodity exports initially increases more than import prices as *full* exchange rate pass-through into foreign currency denominated commodity export prices (around 75% of commodity exports) offsets partial exchange rate pass-through into import prices (all assumed denominated in foreign currency). Non-commodity prices do not increase because the analysis assumes all other things are equal, and therefore the domestic price of

non-commodities (which determine the export price of non-commodities) is assumed to be unaffected by the depreciation. (In a full model simulation, domestic non-commodity prices would increase and, in turn, this would increase non-commodity export prices.)

The aggregate price of exports increases by less than imports, and the terms of trade falls, stabilising at a lower level after three years; most of the exchange rate pass-through into import and export prices has occurred after three years.

The rise in the commodity exports prices relative to domestic non-commodity prices increases the internal competitiveness of the commodity sector and encourages an increase in the supply of commodity exports. However, the supply response is relatively small, even in the long run, reflecting the price inelasticity of the commodity exports supply curve, and the supply response is also slow to eventuate.

The depreciation of the exchange rate increases the external competitiveness of non-commodities, increasing foreign demand. The demand for non-commodity exports is relatively price elastic and therefore the increase in external competitiveness increases non-commodity exports by a relatively large amount. That said, it takes a long time for the increase in demand to be fully reflected in export volumes.

The rise in the price of imports lowers the quantity of imports demanded. Import volumes are price inelastic, nevertheless, they respond relatively quickly with around half of the adjustment occurring immediately.

The rise in exports and fall in imports provides a boost from net exports (volumes) to the economy. The fall in the terms of trade implies a lesser increase in the balance on goods and services (values), although an increase nonetheless. (A detailed description of the simulation is provided in Appendix A)

5.3 The J-Curve and the Response of the Balance of Goods and Services in the TRYM model

The balance on goods and services jumps initially by 0.4 per cent of nominal GDP, and then rises steadily to be 2.9 per cent of nominal GDP in the long run. In other words, nominal exports increase faster than nominal imports throughout the simulation. This result is somewhat different to that postulated by the J-curve theory.

The J-curve theory refers to an initial deterioration and then an improvement in the balance on goods and services in response to a depreciation in the exchange rate. It is argued that this pattern of response of the balance of goods and services reflects differences between the timing and speed of the response of prices and volumes of both imports and exports. In particular, it is argued that in

the initial period following a depreciation of the exchange rate, import prices will increase by larger amounts and more rapidly than export prices, while import and exports volumes will remain roughly unchanged; there is an initial deterioration in the balance on goods and services. After a period, however, net export volumes respond to the changes in relative prices, with exports volumes increasing and import volumes falling, and the balance on goods and services subsequently improves.

In the model simulation results displayed above, prices move in a way that is consistent with the J-curve hypothesis. The price of imports does grow faster than the price of exports and the terms of trade falls, however the initial gap between import and export prices is not large (although it does grow over time).

- The growth in aggregate export prices is restrained (in a partial analysis) by having unchanged non-commodity prices, however the depreciation flows through very quickly into a large proportion of commodity prices. Import prices do not immediately reflect the depreciation as the pass-through is only about 47 per cent in the first quarter. Therefore, import price rises are only slightly larger than export price rises initially, and are probably not as large as envisaged in the J-curve argument.

While prices in the simulation move in a manner that is qualitatively consistent with the J-curve hypothesis, export and import volumes do not. In particular, volumes react strongly enough in the initial periods following a depreciation to overcome the price effects and prevent a deterioration in the balance on goods and services. Non-commodity export volumes increase by a small amount in the first quarter after the depreciation and import volumes fall (about 25 per cent of the total adjustment in import volumes occurs in the first quarter). Over subsequent periods, commodity export volumes begin to respond, complementing further increases in non-commodity exports and further falls in imports. These factors combine to give a continuous improvement in net export volumes and the balance on goods and services throughout the simulation.

The simulation presented above suffers from a number of important limitations. In particular, it ignores:

- the direct effects that higher import prices have on domestic prices and therefore the price of non-commodity exports;

- the indirect second round effects that an exchange rate depreciation has on wages, interest rates, domestic demand, and government policy;

- the cause of the depreciation. The results are likely to differ, for example, if the depreciation was in response to a change in world demand, world interest rates, or an increase in a risk premium on $A assets, or some combination of these factors; and

- the effect of other shocks that may be influencing the economy. This analysis assumes that the economy is in equilibrium prior to the depreciation in the exchange rate.

The conclusion from all this is that a partial analysis has substantial limitations when attempting to predict outcomes. A more complete analysis of the exchange rate impacts on the trade balance can be gained by examining a full model simulation. Even then, some of the above limitations will still apply.

6. CONCLUSIONS

This paper has outlined the framework used to analyse the trade sector in the TRYM model. It has been shown that factors influencing the demand and supply of both exports and imports can be examined separately, and in a simple and transparent way.

Exports have been analysed by paying particular attention to the differing impacts of internal and external competitiveness on supply and demand respectively. It has also been shown that the growth of Australia's major trading partners can be directly linked to domestic activity via the demand for exports. Future work on the exports sector will involve improving the supply side analysis of both commodity and non-commodity exports. For commodity exports, this could involve attempting to include factors other than relative prices in determining supply. For non-commodity export supply, dynamic linkages between export prices and the exchange rate will be examined. Modelling the supply side more precisely may involve further disaggregation, although disaggregation is not an end in itself.

Imports have been analysed with demand determining the quantity of imports, where demand is driven by domestic activity and import (external) competitiveness. Supply has been assumed to determine import prices in accordance with world prices and the exchange rate. Particular effort has been made to construct measures of domestic demand and domestic prices that reflect the import intensiveness of the various components of expenditure. Future work will focus on constructing a better world price variable that reflects the relative importance of other countries' import trade with Australia, rather than using export trade weights.

Finally, the response of the trade sector in the TRYM model to a change in the exchange rate has been examined. While this analysis relies heavily on all other things being equal, it shows the direction, timing and speed of response of the trade sector to a one-off shock, and emphasises the simplicity and intuitiveness of the TRYM model framework.

7. APPENDIX A

7.1 Description of a Ceteris Paribus Exchange Rate Shock to the Trade Sector

Details of Results

The following dot points provide details of the response of prices and volumes of imports and exports.

Long Run Response of Export and Import Prices and the Terms of Trade

- The price of commodity exports and imports of goods and services rise by 11.1 per cent, consistent with full exchange rate pass-through.
- The price of non-commodity exports remain unchanged, reflecting no change in the domestic price of non-commodities.
- The price of all exports of goods and services rises by 6.5 per cent, consistent with a weighted average of the increases in price of commodities and non-commodities.
- The terms of trade (TOT) falls by 4.2 per cent, consistent with a fall in exports prices and a rise in import prices.

Short to Medium Run Response of Export and Import Prices and the Terms of Trade

- The price of commodity exports rise immediately by 8.2 per cent, reflecting the high proportion of commodity export contracts denominated in foreign currency; it is assumed that exchange rate movements are immediately and fully passed through on those commodity exports denominated in foreign currency, while the remaining $A denominated commodity export prices have a slower adjustment. After one year 80% of the pass-through has occurred, and this increases to 84% and 88% after two and three years respectively.
- The price of imports of goods and services rises immediately by 5.1 per cent (46% of the long run pass-through). As most of Australia's imports are likely to be denominated in foreign currency, this result suggests importers squeeze their profit margins initially, deferring some of the price increase in order to protect their market share. After one year 67% of the pass-through has occurred, and this increases to 80% and 88% after two and three years respectively. (Note these number differ slightly from that in the import sector due to rounding in the table of results.)

- The terms of trade falls initially by 0.3 per cent (7% of the long run adjustment). Total export prices grow more slowly than import prices throughout the shock, resulting in a fall in the terms of trade. After one year, 52% of the adjustment has occurred, this increases to 76% after two years and over 90% of the adjustment has occurred after three years.

Long Run Response of Export and Import Volumes and Net Exports

- The supply of commodity exports is price inelastic and therefore commodity export volumes rise by only 4.5 per cent.

- The demand for non-commodity exports is price elastic and therefore non-commodity export volumes rise by 20 per cent.

- Overall exports of goods and services increase by 10.6 per cent.

- The demand for imports is price inelastic and import volumes fall by 6.3 per cent.

- Net export volumes improve by 3.4 per cent of GDP(A).

Short to Medium Term Response of Export and Import Volumes and Net Exports

- Commodity exports respond slowly to the increase in prices, not increasing at all in the first quarter. After one year 27% of the adjustment has occurred, and this increases to 49% after two years.

- Non-commodity exports initially increase by 1.5 per cent (8% of the long run adjustment). Adjustment to the new long run level is relatively slow. After one year 25% of the adjustment has occurred, and this increases to 39%, 51% and 60% after two, three and four years respectively.

- Imports initially fall by 1.6 per cent (25% of the long run adjustment) and then adjust relatively quickly to new long run levels (in comparison with exports). After one year 76% of the adjustment has occurred, and this increases to 84%, 88% and 94% after two, three and four years respectively.

- Net exports increase initially by 0.4 per cent of GDP(A) (12% of the long run adjustment), then increase fairly slowly to the long run level, reflecting the slow adjustment of commodity exports. After one year, 41% of the adjustment has occurred, and this increases to 55%, 66% and 74% after two, three and four years respectively.

8. REFERENCES

Coppel, J, Simes, R, Horn, P, "The Current Account in the NIF88 Model", Paper presented at The Australian Macro-economy and the NIF88 Model, February 1988, Background Paper No. 13.

CS First Boston Australia Research, "Economic Prospects 1992: Q4", *Economics*, October 1992.

Dywer, J, "The Tradeable Non-Tradeable Dichotomy: A Practical Approach", *Australian Economic Papers*, December 1992, pp 443-459.

Dywer, J, Kent, C, Pease, A, "Exchange Rate Pass-Through: The Different responses of Importers and Exporters", *Research Discussion Paper*, Number 9304, May 1993, Reserve Bank of Australia.

Goldstein, M, Khan, M, Officer, l, "Prices of Tradable and Nontradable Goods in the Demand for Total Imports", The Review of economics and Statistics, 1980.

Horton, T, Wilkinson, J, "An Analysis of the Determinants of Imports", *Research Discussion Paper*, Number 8910, December 1989, Reserve Bank of Australia.

Lipp, L, Bailey, G, "Australian Imports in the 1970s", Paper presented to the *Eleventh Conference of Economists*, August 1982.

Ryder, B, Beacher, A "Modelling Australian Exports", Paper prepared for the Conference *Economic Modelling of Australia*, June 1990.

Treasury (1981), *The NIF-10 Model of the Australian Economy*, AGPS.

Talbot, S, "The Determination of Australian Import Demand", Paper presented to the *Second Conference of Economists*, August 1971.

Wilkinson, J, "Explaining Australia's Imports: 1974-1989", *Economic Record*, June 1992, pp151-164.

Upcher, M, Ryder, B, "The Trade Balance in the TRYM Model", Paper presented to the *Twentieth Conference of Economists*, 1991.