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Medium-run Consequences for Australia of an APEC Free-Trade Area: CGE Analyses using the *GTAP* and *MONASH* Models

by

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ABSTRACT

The inauguration of APEC in October 1994 raises the prospect of large reductions to impediments to trade within the Asia-Pacific region. The global trade analysis model GTAP (see Hertel [6]) is a research tool well suited to the analysis of such developments. Recent work with GTAP by Young and Huff explores the consequences for ten regions of the development of APEC in the post-NAFTA era.

The present paper amplifies this GTAP work (by using a 37 rather than a 3 commodity disaggregation) and focuses it on Australia (by treating Australia as a separate region). The consequences for Australia of the development of APEC are explored in detail by feeding results from GTAP into a highly disaggregated (115 commodity) national model of Australia, MONASH. The latter is regularly used as the basis for medium and long range forecasts of the Australian economy (Adams, Dixon and McDonald [1]).

APEC is good news for Australia, causing a 3 per cent improvement in its terms of trade, and allowing real expenditure to increase by about one half of one per cent at a fixed setting of the trade balance and with fixed total endowments of capital and labour. However some industries producing internationally traded goods run into major structural pressures: the black coal industry reduces output by almost 14 per cent relative to base case, while non-ferrous metals, some food products, and some suppliers to the textiles sector experience falls in output of about half this magnitude.

Keywords: trade liberalization, Australia, APEC, general equilibrium, models, GTAP, MONASH.

J.E.L classification numbers: C68,F02,F14.

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1. Introduction

Meeting in Bogor, Indonesia, in October 1994, the heads of government of seventeen Pacific Rim countries committed themselves to establish by 1996 a program and timetable for the removal of impediments to trade within the region. Including the United States, Canada, Japan, parts of South and most of South-East Asia, APEC is a grouping accounting for about one half of the world's current economic activity. The membership of China and the rapidly growing 'tigers' of Asia means that the grouping — if it survives — will encompass more than half of the world's economic activity early in the new millennium. For countries such as Australia and New Zealand that are effectively shut out of opportunities for increasing their traditional exports to Europe, APEC looms large as the way of the future.

Recently Australia has become alarmed about a potential loss of momentum with the APEC initiative, to the point where, despite its recent strong commitment to virtually universal free trade, the government is prepared to consider membership of an APEC instituted as a preferential trading zone with external trade barriers.[1] It is such a scenario that underlies the computer simulations reported in this paper: trade barriers are eliminated among the members of APEC, but no change in tariffs on imports from other countries into APEC countries occurs.

The two models used in this paper, *GTAP*[2] and *MONASH*[3] are large applied general equilibrium models. 'Large' here means that many tens of thousands of equations are solved simultaneously in each case. These models focus respectively on global trading relations and on the detailed sectoral, occupational, and regional dimensions of the Australian economy.

Applied general equilibrium models are designed specifically to work out how the relative prices of various inputs and outputs change under some shock, and the consequences of these changes on the input and output mixes of one or more economies.

The version of *GTAP* used here distinguishes the eleven regions shown in Table 1, and the thirty-seven commodities listed in Table 2. Aggregation to about this level is

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1 *The Australian*, March 1st 1995, pp.1&2.

2 GTAP is documented in Hertel [6]. See especially Hertel and Tsigas [7].

3 Monash is the successor to the *ORANI* model — see Dixon, Parmenter, Sutton and Vincent [3]. A listing of the Monash model in the TABLO language is available in [2]. TABLO is the algebraic language used by the Gempack software suite used to solve many large economic models, including Monash. For a brief introduction to Gempack, see Harrison and Pearson [4]; comprehensive documentation is available in Harrison and Pearson [5].

Table 1
Regional Entities recognized in GTAP (as used in this paper)

Identifier	Countries in region
1. NAM	*North America* — United States, Canada & Mexico
2. JPN	Japan
3. AUS	Australia
4. NZL	New Zealand
5. CHN_HKG	China and Hong Kong
6. SKOR	South Korea
7. TWN	Taiwan
8. MYS_SGP	Malaysia and Singapore
9. THA_PHL	Thailand and the Philippines
10. IDN	Indonesia
11. ROW	The rest of the world

necessary to make computation feasible on a powerful personal computer.[4] APEC encompasses the first ten regions in Table 1.

In the *GTAP* simulation, all tariffs (and tariff equivalents of other trade barriers) on APEC-sourced imports are removed by each APEC country.[5] This matches one of the three simulations reported (but at a much higher level of commodity aggregation) by Young and Huff [8].

The shocks imposed on the model start from a situation in which the NAFTA trade liberalization has already taken place. We have used Young and Huff's method (but at the level of detail shown in Tables 1 and 2) to produce a post-NAFTA data base and to calculate the sizes of the shocks to tariff rates required to simulate the formation of APEC.

This *GTAP* simulation produces projections of changes in the production, bilateral (source- and destination-specific) trade, and relative prices of the thirty-seven commodities shown in Table 2.

Our modelling strategy, in which we use the *GTAP* results to drive the *MONASH* model, requires us to summarize these changes as exogenous movements in the import supply and export demand schedules confronting Australia. Because Australia is modelled as being too small to influence the foreign-currency price of its imports, changes in the supplies of imports to Australia can be shown as percentage deviations in the foreign-currency prices of commodities. This is done in the unshaded rows of Table 2.

4 The computations reported in this paper were made using a 486 personal computer with 48 mbytes of RAM, ample hard-disk space and a clock speed of 66 mHz, running under DOS 6.2.

5 We do this using *GTAP*'s standard closure, except that the foreign currency prices of Australia's imports and exports are exogenized. This allows us to use a *tops-down* approach to the joint solution of *GTAP* and *MONASH*, a necessity given that we do not have a fully developed interface between *GTAP* and *MONASH* which would allow the two models to be solved as a single, very large, model. *GTAP* endogenizes shifts in the supplies of imports to, and the demand for exports from, Australia; these shifts are used as inputs to the *MONASH* model. Results in *GTAP* for real GDP and other welfare indicators in the 10 non-Australian regions of Table 1 are not sensitive to this change of closure.

Table 2
Commodities in GTAP and Projected Changes in Australia's Trading Conditions due to APEC[a]

Identifier	Price change or DEMAND SHIFT (%)	Commodity
1 pdr	0.09	paddy rice
2 wht	14.0	*WHEAT*
3 gro	15.5	*GRAINS*
4 ngc	0.1	*NON-GRAIN CROPS*
5 wol	7.1	*WOOL*
6 olp	3.5	*OTHER LIVESTOCK*
7 for	-1.3	forestry
8 fsh	29.7	*FISHERIES*
9 col	1.7	*COAL*
10 oil	2.0	oil
11 gas	3.3	gas
12 omn	24.5	*OTHER MINERALS*
13 pcr	2.1	processed rice
14 met	47.9	*MEAT PRODUCTS*
15 mil	1.6	milk products
16 ofp	-4.21	*OTHER FOOD PRODUCTS*
17 b_t	-1.9	beverages and tobacco
18 tex	-4.9	textiles [b]
19 wap	-4.4	wearing apparels
20 lea	-1.5	leather, etc.
21 lum	0.5	lumber
22 ppp	-1.0	pulp, paper, etc.
23 p_c	-0.0	petroleum and coal
24 crp	-1.1	chemicals rubbers and plastics
25 nmm	-0.3	non-metallic minerals
26 i_s	0.6	primary ferrous metals
27 nfm	11.4	*NON-FERROUS METALS*
28 fmp	0.2	fabricated metal products
29 tm	0.1	transport industries
30 ome	-0.9	machinery and equipment
31 omf	-0.6	other manufacturing
32 egw	-2.3	electricity, water and gas
33 cns	2.9	construction
34 t_t	0.2	trade and transport
35 osp	-0.9	other services (private)
36 osg	-0.9	other services (govt)
37 dwe	1.4	ownership of dwellings

[a] In this table, the shifts in demand for Australia's traditional exports are shown in shaded rows. For all other commodities, the value shown in the second column is the change in the import price.

[b] Australia's traditional exports include wool tops and some other items assigned to this category.

The shaded rows of Table 2 show *GTAP*'s projections of the percentage outward shifts in the demand schedules for Australia's traditional exports that come about because of the formation of APEC.

Apart from Australia's traditional exports, there are changes in demand for all other exports from Australia. Excepting tourism, which is treated by *MONASH* as a special case, the average change in these non-traditional exports as projected by *GTAP* is 30.8 per cent; the projected increase in demand for Australian tourism services is 2.8 per cent. The net upshot of the changed trading environment is an improvement in Australia's terms of trade of 3.13 per cent (of which, more later).

The remainder of this paper is structured as follows. In Section 2 we briefly discuss the impact of instituting free-trade within APEC on real GDP and welfare in the ten APEC regions. We preface our discussion of these (mainly) *GTAP* simulations with some guidance as to the time frame in which they are to be construed.

Then, in Section 3, the detailed results for Australia from the *MONASH* model are presented and discussed. In the fourth and final section we offer concluding remarks and a perspective for further research.

2. IMPACT ON APEC MEMBERS

2.1 Preliminaries — time frame for the simulations

In the simulations presented here, the overall size of the capital stock in each of the 11 regions is treated as being unaffected by the APEC trade liberalization, as is the size of the workforce in each economy; hence changes in overall output in each country come about because of more efficient use of capital and labour, rather than as changes in the amounts of them. This shows up as increases in the sizes of some, and declines in the sizes of other, industries within each economy. Thus the time frame is one which is long enough to allow a good deal of reorganization within national economies, but not long enough for the relative sizes of national economies to have diverged from base case. Whilst we cannot be very definite about how this translates into calendar time, a period of about 5 to 7 years seems appropriate.

2.2 Reprise of Young and Huff's results; effect of aggregation level

We reproduce Young and Huff's results for the terms of trade, real GDP and a household utility index in Table 3. These *GTAP* simulations were implemented in a version of the model that distinguished just three commodity groups: food & agriculture, resources & manufacturing, and services. As well, Young and Huff treated Australia and New Zealand as one regional entity. In the same Table we show also our own *GTAP* results at the 37-commodity level of disaggregation and with Australia and New Zealand treated as separate regions.[6] In the case of Australia, the reported results are from the *MONASH* simulations.[7]

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6 There is a third difference between the two sets of results: closure. Young and Huff work in *GTAP's* standard closure; as explained above in footnote 5, we have modified this closure slightly to enable us to interface *GTAP* and *MONASH* on a tops-down basis. We did, however, recompute our results using the standard closure. Other than for Australia, the values of the variables reported in Table 3 were not sensitive to this change.

7 The closure of *GTAP* used to generate the appropriate shocks for *MONASH* is not suitable for computing the effects on Australia's terms of trade, GDP or welfare. In particular, the foreign-currency demand price of Australia's imports has been exogenized, as has been the position of the demand curves for her exports.

Table 3

Impact on Terms of Trade, GDP and Welfare of the Formation of APEC as a Preferential Trading Zone[a]

Region	Terms of trade (per cent)		Change in real GDP (per cent)		Change in household utility index	
	Young & Huff	*this paper*	*Young & Huff*	*this paper*	*Young & Huff*	*this paper*
	(1)	(2)	(3)	(4)	(5)	(6)
1 North America	–1.03	–2.08	–0.05	–0.01	–0.11	–0.11
2 Japan	4.08	4.65	0.02	0.15	2.29	1.82
3 Australia	–0.84	*3.13*	–0.01	*0.051*	–0.07	*not available*
4 New Zealand		2.14		0.10		2.75
5 China/Hong Kong	0.96	–0.36	0.02	0.06	1.28	1.88
6 South Korea	–2.01	–1.57	1.22	0.90	3.16	5.66
7 Taiwan	0.81	1.22	–0.33	–0.06	2.40	2.82
8 Malaysia/ Singapore	1.17	1.38	0.08	0.42	2.42	3.97
9 Thailand /Philippines	–6.29	–6.13	0.11	0.01	–3.05	–1.11
10 Indonesia	–1.05	1.87	0.06	0.25	–0.17	2.11
11 The rest of the world	–1.17	–0.97	0.00	0.01	–0.34	–0.14

[a] All results except those for Australia are from the GTAP model. The Australian results are from MONASH (driven by GTAP). The Young and Huff results are from Young and Huff [8].

Does the level of commodity aggregation affect our perception of the consequences of the formation of APEC? Table 3 clearly demonstrates that the answer is 'yes'. However, we should not overstate the case. Qualitatively the signs of the changes in real GDP are robust in the sense that, with the exception of Australia and New Zealand, the direction of the effect on GDP does not depend on which level of aggregation is chosen. All other regions except North America are projected to experience rises in real GDP under either aggregation, while North America records a very small negative change under both aggregations.

In the case of estimates of changes in the terms of trade, there are three sign reversals — New Zealand, China/Hong Kong and Indonesia; the scatter plot across the ten regions given as Figure 1, however, shows that there is little or no systematic difference between the three- and the thirty-seven-commodity aggregation level. Nevertheless, the differences between aggregations in estimated terms-of-trade changes can be substantial, as New Zealand, Australia[8], and Indonesia demonstrate.

The striking feature of Figure 1 is the large gain in terms of trade experienced by Japan and the large fall experienced by Thailand/Philippines. (Our discussion from this point is based on the results for the 37-commodity aggregation.) The price index for tradeables produced in Japan rises by 4.2 per cent, while the index of prices paid for tradeables used in Japan falls by 0.4 per cent, yielding a terms of trade gain of about 4.2 – – 0.4 = 4.6 per cent. In the case of Thailand/Philippines, the

8 Our methodology implies that the figures for Australia in columns (1) and (2) are not strictly comparable. However, when we compute a *GTAP* result for Australia in column (2) using *GTAP's* standard closure, we obtain a terms of trade improvement of 4.13 per cent.

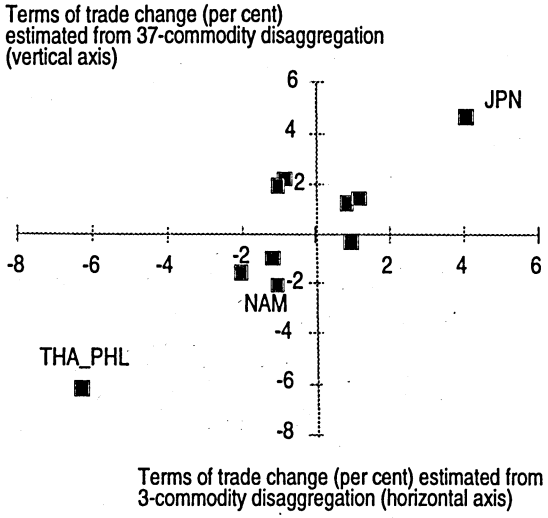

Figure 1: Scatter plot of estimates of changes in the terms of trade due to instituting APEC as a preferential trading zone. Australia is excluded from the above because the results for the 3- and 37-commodity aggregations are not comparable.

corresponding indices change by –6.0 and +0.1, leading to a fall in the terms of trade of about 6.1 per cent.

To a first approximation, these changes can be related to the shares in a country's total exports of commodities with prices that are stimulated by the formation of APEC, and to the shares in a country's import bill of commodities whose prices decline. A strong improvement in the terms of trade would be registered by countries producing export commodities that gain strongly in price and importing commodities with prices that decline sharply.

2.3 Pattern of commodity price changes

A broad picture of the relative price changes brought about by the formation of APEC is given in Figure 2.[9] The five top 'winners' (in the left-hand ladder) are fisheries, forestry, primary ferrous metals, wool and construction; the five 'losers' at the bottom of the right-hand ladder of Figure 2 are milk products, meat products, wearing apparels, textiles and other food products.

3. IMPLICATIONS FOR AUSTRALIA

3.1 Welfare implications of Australia's improved terms of trade

According to our simulations, the formation of APEC is good news for Australia. The welfare implications, however, are understated by the response of real GDP. In

9 The picture is 'broad' because it only shows the *average* price changes of commodities pooled over all source regions. In *GTAP* the prices of any given commodity vary between supplying regions.

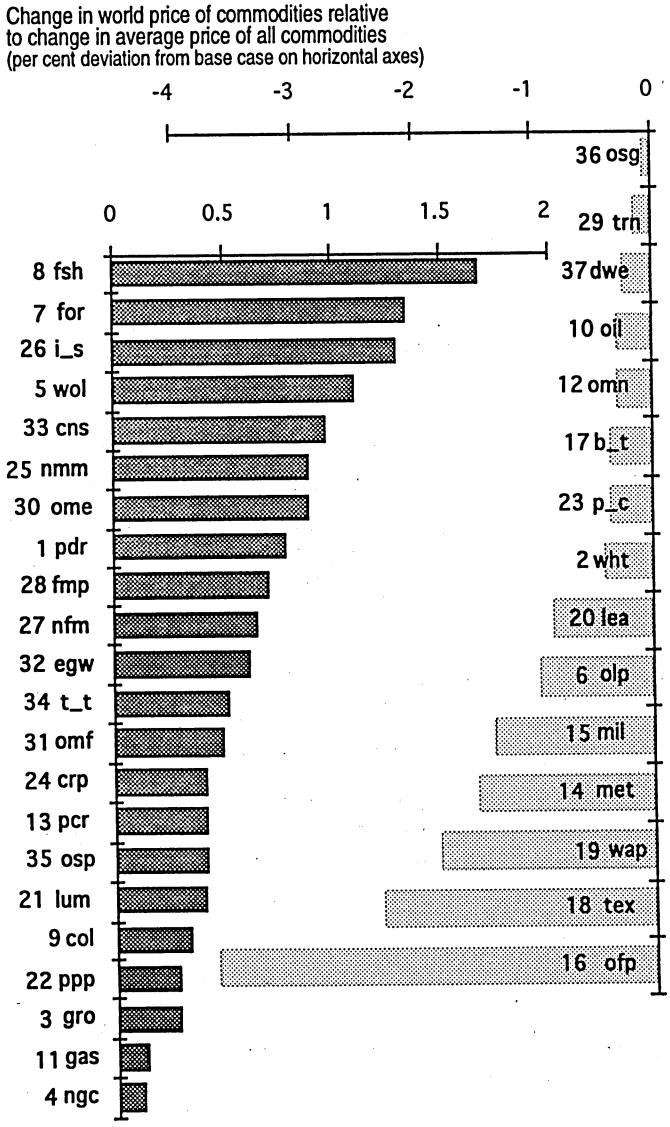

Figure 2: Percentage deviations from control in world average price of traded commodities expressed as a deviation from the percentage deviation from control in the average price of all traded commodities. For a key to the commodities, see Table 2. The prices of the commodities in the ladder at left deviate from control by more than the mean for all prices; those in the ladder at right, by less.

Table 4
Medium-term Impact of APEC: Macroeconomic and Trade Indicators for Australia

Mnemonic	Variable	Percentage deviation from base case
1. xi3	Consumer price index (numeraire)	0
2. toft	Terms of trade	3.13
3. gdpreal	Real GDP from expenditure side	0.05
4. gner	Real GNE	0.54
5. cr	Real household consumption	0.54
6. ir	Aggregate real investment expenditure	0.54
7. othreal	real "other" demands *[⇔ real gov't spending]*	0.54
8. expvalf	Foreign currency value of exports	1.26
9. impvalf	Foreign currency value of imports	1.14
10. expvol	Export volume index	-1.06
11. impvol	Import volume index	1.91
12. xi4	Exports price index	-0.16
13. xim	Imports price index	-3.19
14. feq_ntrad	Quantity shifter — demand for non-traditional exports	30.76
15. ntradexpvalf	Foreign currency value of non-traditional exports	18.06
16. ntradexpvol	Non-traditional exports volume	15.08
17. xi4trad	Traditional exports foreign currency price index	2.19
18. tradexpvalf	Foreign currency value of traditional exports	-4.67
19. tradexpvol	Traditional exports volume	-6.71
20. gx4_abare_mi	Total mining exports	-6.41
21. gx4_abare_ru	Total rural exports	-3.81
22. realdev	Real devaluation index	-3.67
23. real_wage_c	Real wage rate as seen by employees	0.73
24. real_wage_e	Real wage rate as seen by employers	0.23
25. xi2	Aggregate investment price index	-0.45
26. xi4ntrad	Non-traditional exports foreign-currency price index	2.59
27. xi5	"Other" demands price index	0.33
28. xigdp	GDP price index (expenditure side)	0.50
29. ximp0	Duty-paid imports price index	-3.21

the closure of *MONASH* used here,[10] real spending (GNE) is a better measure of welfare.

To see why, we note that the fixity of aggregate capital and labour assumed in our simulations necessarily implies that Australia's quantum of output scarcely varies from control (GDP stands +0.05 per cent above its base-case value — see Table 3). The improved terms of trade, however, mean that a given physical quantity of Australia's exports buys more real imports; consequently some or all of consumption, investment, and/or government expenditure, increase in real terms.

[10] Australia's balance of trade deficit (as a proportion of GDP) is kept at its base-case value in our simulations with *MONASH*.

The increase in Australian real GNE attributed to the formation of APEC is 0.54 per cent. Since relative to the base case this is a gain in perpetuity, it represents a very substantial rise in the economy's spending power.

In the version of *MONASH* used here, we have arbitrarily spread this increase in real spending power evenly across personal consumption, investment, and government outlays. Thus in Table 4, the percentage deviations from base case in each of these components of spending are equal. Also shown in Table 4 are several other macroeconomic indicators of interest.

3.2 Structural pressures on industries

The price indexes shown in Table 4 are all expressed relative to the Australian CPI (which is the numeraire). The real devaluation index shows a *fall* of 3.67 per cent (row 22); thus the Australian dollar experiences a real *appreciation* of this proportion. The rise in labour costs recorded in row 24 contributes to this loss in competitiveness. The terms-of-trade improvement hence has some *Dutch disease* effects on Australia's industry structure. The crowding out of manufacturing industries, however, is significantly buffered by their participation in non-traditional exports, which experience a boost in demand of 31 per cent (row 14 — a shock to *MONASH* computed in *GTAP*). This is larger than the stimuli experienced by traditional exporters other than Meat Products (see Table 2). In fact, in the post-APEC solution of the model, non-traditional exports are 15 per cent above base case (row 16), whereas traditional exports actually decline overall by 6.7 per cent (row 19). Mining and rural exports decline respectively by 6.4 and 3.8 per cent (rows 20 and 21).

Projected changes in activity levels by Australian industries are shown in Figure 3. Because in pre-APEC times Scientific and Photographic Equipment exports a relatively large share (one-third) of its output, its participation in the export boom of non-traditional exports leads to this industry topping the list of expanding industries in Figure 3; it also benefits from increased expenditure at home. Meat Products (a traditional rural export) goes against the average for rural export industries, experiencing a healthy increase in output of 2.5 per cent. Black Coal, which receives only a weak export demand stimulus from APEC (row 9 of Table 2), experiences a bad dose of Dutch disease, as does Seafood and Other Food Products, which starts behind par because it actually faces falling export demand (row 16 of Table 2).

The rise in output of the Meat Products industry (and in the outputs of some of its suppliers — e.g., the Northern Beef industry) reflects the strength of the stimulus to the demand for Australian exports of Meat Products: at 48 per cent (Table 2), this is the largest demand stimulus placed on any Australian export industry by the APEC trade liberalization.

3.3 Tracing the shift in overseas demand for Australian meat exports

We can trace the sources of the increased demand for Australian exports in *GTAP*; Meat Products is discussed by way of example.

In terms of *GTAP*'s data base, the formation of APEC causes the demand for Australian meat products (at their initial price level) to expand by 959.2 m. real 1992 US dollars. All of Australia's APEC partners contribute to this stimulus — see Figure 4 — however, the big increases in demand come from Japan (39% of the total), North America (38%) and South Korea (19%), while the demand by non-APEC countries actually falls by 19.4 m real US dollars.

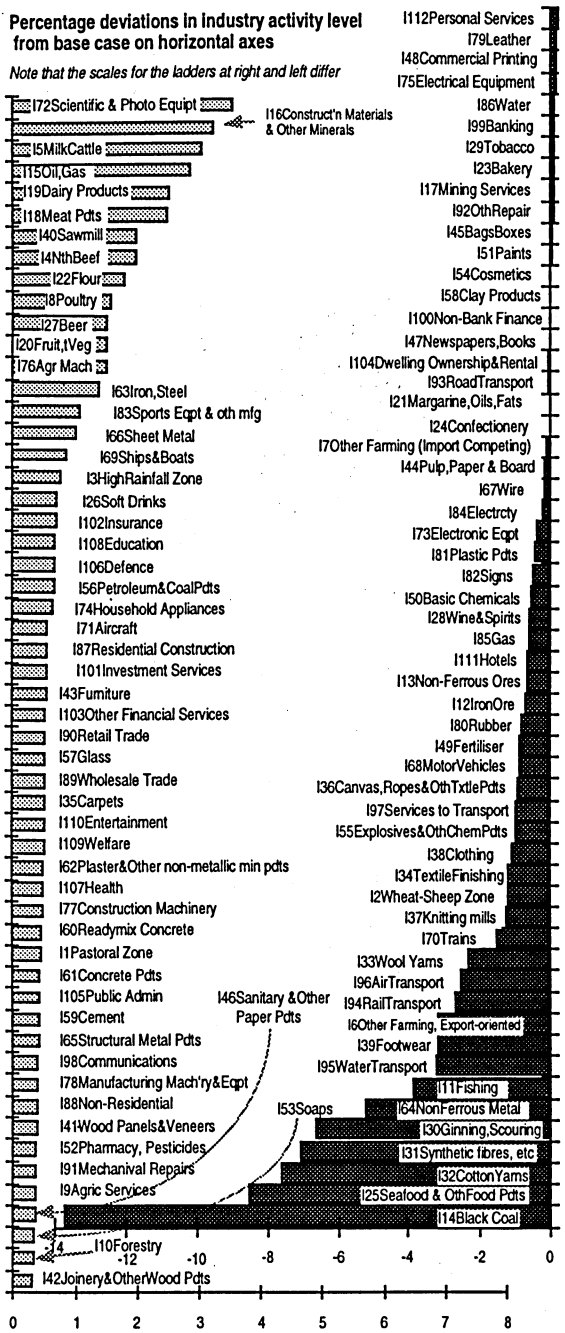

Figure 3: Effects of APEC on Australian industries' activity levels

If Australian Meat Products had not become more price-competitive relative to alternative sources of supply, the increase in demand would only have been $ US 608.0 m. In the cases of both Japan and North America, the increased demand for Australian meat is about 50% due to the expanded sizes of these foreign markets, and about 50% due to Australia's improved price competitiveness allowing her to increase market share in these countries. In South Korea, by contrast, the increased demand for Australian meat is due almost entirely to the expanded overall size of that market.

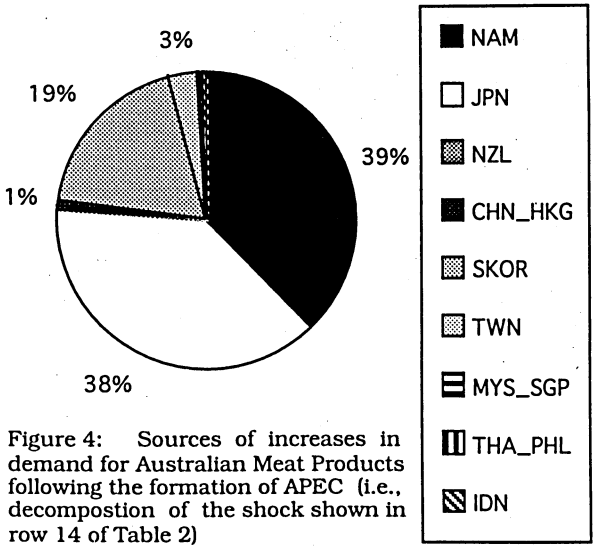

Figure 4: Sources of increases in demand for Australian Meat Products following the formation of APEC (i.e., decompostion of the shock shown in row 14 of Table 2)

4. CONCLUDING REMARKS

The major challenge in policy analyses based on big models is explaining the results. In a longer paper we would have to face this issue squarely; why is it that the interaction of demands and supplies for the many products recognized in *GTAP* and *MONASH* lead to the changes in relative prices and in trading conditions that we have reported? Whilst quality control in computing and the reliability of the GEMPACK software virtually guarantee that we do indeed have valid solutions for the very large models that we have used, it remains a major challenge to unravel the pieces in a way which is illuminating without being prohibitively voluminous.

So far as we know, this is the first use of the *GTAP* global model in conjunction with a detailed national model. Some aspects of the methodology require further research: in particular, the validity of the tops-down approach needs to be investigated in the light of any potential feedbacks on the global trading environment from the region modelled in detail (Australia in our case). However, the initial results are promising.

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