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IMPLICATIONS OF WORLD ENERGY PRICE INCREASES ON THE RURAL AND OTHER SECTORS OF THE AUSTRALIAN ECONOMY

by

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initial impact effects on its balance of trade of the world price increases. Where they are unfavourable (as in column (I)) we could expect, for example, additional stimulation of export industries associated with the need to cover a reduced ability to attract capital inflow. In column (II), on the other hand, an increased ability to attract capital inflow would further reduce non-coal exports.

Finally, there are serious difficulties in handling substitution possibilities between energy sources. In the present version of ORANI, oil and coal are treated as non-substitutes. If this is (as we have argued on page 4) an acceptable assumption for the period of our study (5 years), then column (I) of Table 1 is readily interpretable. The question arises, however, as to the relevance of column (II) where the price of coal follows the price of oil. On page 4, we mentioned substitution possibilities as a justification for assuming a close relationship between coal and oil prices. But if this is the case, we should allow for substitution possibilities in the domestic economy. We have been unable to attempt such an allowance in the simulations reported above.

balance is achieved via an increase in domestic relative to world prices. Hence the export oriented agricultural and mining sectors (with the exception of the coal export industry) suffer at the expense of the domestically oriented sectors.

Finally, we note various qualifications which should be kept in mind in interpreting the results presented in this paper. First, the current input-output data base underlying our ORANI model simulations refers to the 1968/69 economy.[1] The 1978/79 economy is considerably more energy rich than was the case in 1968/69. In particular, the reliance on imported crude oil has fallen while the coal export industry has expanded substantially (as has the energy intensive aluminium export industry). Hence we would expect the results in column (I) of Table 1 to be overstated and the results in column (II) to be understated. Thus if our simulations were repeated using a 1978/79 I-O table in the model's data base, we would expect that under the initial shock of higher oil prices, the agricultural sector for example would expand by less than 0.14 per cent while under the initial shock of higher oil and coal prices the agricultural sector would contract by more than 1.54 per cent.

Second, the assumption of a constant balance of trade (assumption (c)) may be inadequate in the present context. Increasing world energy prices may change the relative attractiveness of countries as places for capital inflow. The results in both column (I) and (II) of Table 1 would be accentuated if Australia's long-term capital inflow depends on the

1. The 1968/69 I-O table is the latest table currently available in completed form. A preliminary version of the 1974/75 I-O table has recently become available. It is to be hoped that the completed version of this table will soon be released.

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4. CONCLUSION

In the August 1978 budget, the price of domestically produced crude oil was raised to the import parity level existing at that time. Since the budget's domestic oil price adjustment, domestic crude oil prices have been increased at six monthly intervals to reflect increases in the world price of crude oil.

Our analysis indicates that the short term implications for the agricultural and other sectors, of the initial jump to import parity pricing, differ considerably from the longer term implications for these sectors of continued increases in world oil prices. Raising domestic oil prices to a fixed import parity level generates domestic cost increases - especially via wage indexation - thus imposing a cost-price squeeze on the traded goods sector. Agricultural exports and export related industries are among the principal losers. The longer term consequences of higher world crude oil and other energy prices for the sectoral composition of the economy are however quite different. Our results suggest that increases in world crude oil prices, provided they do not impinge directly on the price of coal, will lead to an expansion in the outputs of the export oriented agricultural and mining sectors at the expense of the more domestically oriented manufacturing and service sectors. The price adjustment mechanism is via the balance of trade. A reduction in the domestic price level relative to world prices must occur in order to generate sufficient foreign exchange to pay for the higher priced oil imports.

However because the Australian economy is a net exporter of energy, increases in crude oil and coal prices of the same magnitude will lead initially to a net increase in foreign exchange earnings. External

prices.[1] This is detrimental to export oriented industries (other than coal) who face a domestic cost-world price squeeze. Thus the agricultural and food processing sectors contract and the mining sector as a whole expands (because of the higher world price for coal). The manufacturing sector contracts because of increased pressures from imports and slightly reduced domestic absorption. The slight expansion in the services sector reflects increased activity in transport industries engaged in moving coal to the ports.

The increase in the level of real wages at the given level of employment together with the reduced aggregate absorption indicates that labour's share of national income has increased. The industrial composition of the economy in column (II) is heavily biased against both land and capital intensive industries. Thus returns to land in each of the land using agricultural industries fall as do returns to capital in the economy as a whole. (The slight fall in aggregate absorption and hence national income can be attributed to a reduction in the intensity with which the economy uses its land and capital endowments).

1. The model's consumer price index increases by 1.15 per cent compared with a simple average increase in all world commodity prices of 0.5 per cent.

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1. INTRODUCTION

In its August 1978 budget, the Australian Government, for longer term resource allocation reasons, announced a policy of import parity pricing for domestically produced crude oil. Before this decision was taken, the major part of domestic oil production had been priced at import parity levels set before the large increases in world oil prices of the mid and late 1970's. Hence up until the budget decision, Australian consumers of oil products were reasonably well insulated from the direct effects of the world price hikes imposed by the OPEC producing cartel, because of our relatively large degree of self sufficiency in oil[1] and the maintenance of comparatively stable (and low) prices for domestically produced oil.

In addition, the Government announced that henceforth it would adjust domestic crude oil prices at periodic (currently six monthly) intervals to reflect changes in the world price. Thus since the budget decision the Australian economy has become fully exposed to the effects of future price fixing arrangements in the world oil market.

Our brief in this paper is to analyse the effects of higher oil prices on the agricultural and other sectors of the Australian economy. It is convenient to separate these effects into two parts;

1. The proportion of Australia's crude oil requirements met from domestic production climbed rapidly from the mid-1960's to a current level of around 70 per cent.

(i) those attributable to the 1978 budget decision to increase domestic prices to world parity,

and

(ii) those attributable to likely continued increases in the world price of oil relative to the world prices of other internationally traded goods, assuming that the domestic price is maintained at world parity.

In a previous paper (Vincent, Dixon, Parmenter and Sams (1979)) we investigated in detail the short term effects on industrial and workforce composition of the August 1978 budget decision to raise domestic prices to import parity, i.e., part (i) above. We concluded that the short-run adjustment problems facing the Australian economy were not trivial, especially if the commodity price increases engendered by the crude oil price increase were allowed to flow through into money wages. Our analysis showed that the effects of (i) are borne unevenly by different sectors of the economy. In particular, since it increases the domestic price level relative to foreign prices, the short-run costs of (i) are borne most heavily by exporting and import competing industries. Because of international competition, these trading sectors find it difficult to pass on cost increases.[1] Assuming constant real wages and constant real domestic absorption, we projected the

1. Such cost increases result from the direct effects of higher priced inputs of oil products and the indirect effects via increased prices for oil intensive inputs and higher labour costs if some degree of wage indexation is assumed. The size of the direct effect of higher oil prices on domestic production costs for a particular industry will depend on the share of oil products in that industry's total costs. For most industries in the economy, these shares are small, generally less than one per cent in 1968/69 (see ABS (1977)). (The output of the oil products industry in 1968/69 represented about 2 per cent of GNP in that year.) The primary industries are amongst the most intensive in their direct use of oil products with shares of oil in total costs ranging from 2 to 5 per cent.

The adjustment mechanism underlying the column (I) results is analogous to (although of opposite sign to) that advanced by Gregory (1976) and Dixon, Parmenter and Sutton (1978) in their analyses of the effects of the 1960's mining boom on the sectoral composition of the economy. The initial effect of the higher foreign currency cost of oil imports is to move the balance of trade towards deficit. In order to eliminate the deficit (as required by the balance of trade constraint) without a reduction in domestic employment, domestic prices must fall relative to world prices.[1]

It is interesting to note that the degree of dependence on energy inputs is only of very minor significance in determining output performance. Although the comparatively energy intensive agricultural sector must pay higher prices for fuel and fuel based products, these specific cost increases are more than offset by the reduction in the general price level relative to overseas that occurs via the balance of trade.

The results in column (II) indicate, however, that the sectoral consequences of an initial increase in world oil and coal prices are quite different, being of the same general pattern as those obtained in the 'mining boom' analyses referred to earlier. The column (II) results reflect the fact that while Australia is a net importer of oil it is also a net exporter of energy (oil, coal, energy based exports, energy based imports). Higher world prices for coal in particular generate foreign exchange earnings in excess of those required to meet the higher oil import bill. Hence the balance of trade initially moves towards surplus. External balance is achieved via an increase in the domestic price level relative to overseas

1. The model's index of consumer prices increases by 0.07 per cent compared with a simple average increase in foreign commodity prices of 0.28 per cent.

across the board reductions in non-oil imports.[1] The sectoral composition of national output is shifted in favour of export oriented sectors (agriculture, mining[2] and food processing) and away from the domestic oriented manufacturing[3] and services sectors. The adverse movement in the terms of trade caused by the rise in the oil import bill reduces the productivity of the domestic economy leading to a corresponding fall in the real wage.

TABLE 1 : MEDIUM TERM IMPACT OF WORLD ENERGY PRICE INCREASES

Variable Projected	Column I : initial 2 per cent increase in crude oil price, with prices cumulated for 5 years	Column II : initial 2 per cent increase in crude oil and coal prices, with prices cumulated for 5 years
Real wage	-0.27	0.15
Aggregate real absorption	-0.18	-0.09
Aggregate real exports	0.71	1.45
Aggregate real imports	0.65	1.33
Rural employment	0.32	-2.24
Industry Sector Outputs		
Agriculture	0.14	-1.54
Mining	0.48	6.30
Processed Foods	0.07	-1.04
Other Manufacturing	-0.04	-0.71
Services	-0.14	0.07

1. Results for imports by commodity are available on request. These results show that the quantity of oil imports also falls because of a reduced demand for the refined product and a fixed domestic output of crude oil.
2. Agricultural export industries are less responsive to domestic cost-world price changes than are mining industries because of the existence of the fixed factor land in agriculture.
3. Gains to the manufacturing sector from reduced import competition are more than offset by reduced activity in the domestic economy.

short-run (1-2 year) effects of (i)[1] to result in contractions in the outputs of export oriented agricultural industries of about 0.9 to 1.8 per cent[2] and contractions in the real incomes of such industries of from 6 to 8 per cent. These output and income effects were projected, however, to be considerably smaller if it were assumed that none of the commodity price rises engendered by the increase in the price of oil are passed on to money wages.

In the remainder of the paper we concentrate on part (ii) above. The essence of the situation in (ii) is not so much a change in domestic relative to world prices as a general change in the world prices of oil and other energy intensive commodities relative to the world prices of other traded commodities. In contrast to the short term focus of our analysis in part (i) we consider it more appropriate to take a longer term view when analysing the effects of increases in world oil prices. The analysis presented later is designed to establish the medium term (say five years hence) implications for Australia of changes in world commodity prices initiated by annual increases in the world price of oil, assuming that the current policy of adjusting domestic oil prices to world parity levels will be maintained. We do not pretend in this paper to be able to forecast with any accuracy future developments in world oil prices.[3] Nevertheless, in view of the recent performance of the OPEC cartel, it seems reasonable to

1. We considered that as a consequence of the budget decision, the ex-refinery price of oil products would be increased by about 40 per cent.
2. This compares with a projected average output contraction across all industries in the economy of about 0.5 per cent.
3. A number of alternative scenarios on the future price of oil have been developed for the IMPACT Project. These include constant, increasing and decreasing real prices! See Freebairn (1978).

expect, at least over the medium term,[1] periodic increases in the real price of oil. Our analysis, as well as assuming such increases, recognizes that increases in oil prices will have implications for the world prices of other commodities, especially those that may substitute closely with oil, such as coal, and those, such as aluminium, that are intensive in their use of energy inputs.[2] In Section 2 we describe a procedure for calculating the effects of projected increases in world energy prices on the world prices of non-energy commodities. Section 3 discusses our analytical approach, the model simulation and the results. Conclusions are presented in Section 4.

1. It seems unlikely that OPEC could sustain rises in the relative price of oil for an indefinite period. Already a move towards substitute fuels has taken place and major research on new energy sources is under way. Although more moderate members of OPEC, such as Saudi Arabia, appear to recognize that continued oil price increases are not necessarily in the interests of the oil producing nations, this is not yet the collective view of the cartel.

2. Increases in world oil prices may also have wider implications for general world trading conditions. For example, of particular concern to Australian agriculture is the extent to which overseas market access for 'sensitive' commodities such as beef will be affected by the reduction in foreign exchange likely to confront energy poor Australian beef importing countries such as Japan and Korea. Our analysis does not take into account any change in overseas market access that might be attributed to higher world oil prices.

(I) price vector A cumulated for five years : i.e., the vector of percentage changes in world commodity prices between the base year and year five resulting from an annual 2 per cent increase in the world price of crude oil assuming no direct increase in the price of coal;

and

(II) price vector B cumulated for five years : i.e., the vector of percentage changes in world commodity prices between the base year and year five resulting from an annual 2 per cent increase in both crude oil and coal prices.

Results

A summary of results is presented in Table 1. In order to conserve space, outputs from the 113 industries in the model have been aggregated to five broadly defined sectors. Following the interpretation suggested earlier, the figure in the first row, first column of Table 1 indicates that in the fifth year, the real wage would be 0.27 per cent lower than it otherwise would have been had the world price of crude oil not been increased.

The results in column (I) reflect the fact that Australia is a net importer of oil. In order to meet the higher oil import bill without running a balance of payments deficit the economy is forced to divert resources from domestic absorption to the international account. Thus real domestic absorption falls by 0.17 per cent, aggregate exports rise by 0.70 per cent and the increase in the import bill (0.59 per cent) is moderated by

Alternatively, if the economy is a net exporter of energy, any increase in export earnings must be spent. This assumption simply reflects that over the longer term the external account must be balanced. This is achieved by the endogenous adjustment of domestic absorption.

(d) Balanced changes in real domestic absorption. We assume that endogenous changes in domestic absorption are allocated amongst its components (aggregate consumption, investment and government expenditure) according to their initial (base year) shares.

(e) Fixed domestic crude oil output. We assume that domestic oil producers are unable to expand their production in response to higher world oil prices. This assumption about the medium term supply constraints to domestic oil production accords with commonly expressed views of oil industry commentators.

(f) Fixed industrial production technology. The present version of ORANI does not allow industries to substitute between alternative forms of energy or between energy and other intermediate inputs.

Given these assumptions, the effects on the economy's industrial structure and various macroeconomic variables are projected for the following two exogenous shocks:

2. THE EFFECTS OF WORLD ENERGY PRICE INCREASES ON THE WORLD PRICES OF OTHER TRADED COMMODITIES

Before proceeding with the model simulation, we first need to establish the impact of an initial increase in the price of 'energy' commodities such as crude oil and/or coal on the world prices of 'non-energy' commodities. We imagine that the 'average' world industrial production technology can be depicted by a matrix of conventional input-output (I-O) coefficients within the static Leontief I-O framework. This allows us to make use of the associated price model to trace the direct and indirect effects of higher priced energy commodities on the prices of non-energy commodities.

Thus we write

$$P' = P'A1 + P_E'A2 + P'\hat{KR} + W\ell \,, \qquad (1)$$

where the notation is as follows :

P' : 1 x n vector of world commodity prices excluding energy commodities,

P_E' : 1 x m vector of world prices of energy commodities,

A1 : n x n matrix of 'average world' intermediate input coefficients. A1 has typical element $a1_{ij}$ representing the amount of non-energy commodity i required to produce a unit of output of non-energy industry j ,

A2 : m x n matrix of 'average world' I-O coefficients, whose typical element $a2_{ij}$ represents the input of energy commodity i required to produce a unit of output of non-energy industry j ,

K : $n \times n$ matrix of capital requirements coefficients, with typical element k_{ij} representing the quantity of non-energy good i required in the capital stock necessary to support the production of one unit of output from non-energy industry j,

$\hat{R}$: $n \times n$ diagonal matrix of industry specific gross rates of return to capital,

W' : $1 \times q$ vector of wage costs of each of q occupations,

ℓ : $q \times n$ matrix of labour requirements coefficients. A typical element ℓ_{ij} represents the quantity of labour from occupation i required to produce a unit of output in industry j.

The interpretation of equation (1) is as follows: the world price of a unit of a non-energy commodity is composed of the intermediate input unit costs of non-energy commodities ($P'A1$) and energy commodities ($P_E'A2$), the unit cost of capital ($P'\hat{K}\hat{R}$) and the unit cost of labour ($W'\ell$).

Our strategy is to solve (1) for P' assuming changes in P_E' and assuming a fixed $W'\ell$. That is, we interpret P' as representing the vector of non-energy commodity prices that would follow from a given initial increase in world energy prices relative to the world cost of labour.[1] To solve (1) we require an I-O coefficients matrix of energy and non-energy sectors that can be taken as representative in some sense of 'average' world

1. In our calculations the term $W'\ell$ includes small amounts of other costs (such as taxes) in addition to labour costs.

Assumptions Underlying the Simulations

Our focus is on a typical year five years hence. We use the model to provide a picture of how the Australian economy, if exposed to increases in world energy prices and other commodity price increases that ensue from increased energy prices, would differ in year five compared to its state in year five if no changes in world prices had occurred. Our results are produced under the following set of assumptions:

(a) Fixed rates of return by industry and endogenous capital stocks. As discussed above, we believe the long run setting is more appropriate for examining the structural consequences of future world oil price changes than the short run focus we adopted in our earlier study (which examined the consequences of raising domestic oil prices to world parity).

(b) Fixed occupational wage relativities and employment held constant at the level of year zero. Since we wish to examine the effects of higher energy prices on the Australian economy independently of short-run business cycle phenomena, we abstract from changes in aggregate employment. Occupational wage relativities are assumed fixed to reflect institutional rigidities in the labour market and the given level of employment is achieved by the endogenous adjustment of the average real wage level.

(c) Constant balance of trade. We assume that the economy must meet its higher import bill for crude oil without being able to run a balance of payments deficit.

of higher oil prices on the economy, ORANI computations in recent years have been used to analyse the effects on industries, occupations and regions of tariff, exchange rate and real wage changes, the exploitation of mineral resources, subsidies to ailing industries, the move towards equal pay for women and the adoption of Keynesian demand stimulation policies.[1]

A further element of flexibility is given by the ability of the ORANI model to be used in alternative time frames. Most simulations produced to date have employed a conventional short run specification in which industry specific capital stocks are held fixed and rates of return on capital are endogenous. The alternative long run specification, which we employ here, allows for capital mobility between industries. Capital stocks in each industry adjust to levels at which they earn historically observed rates of return. The model is then used to provide a picture or snapshot of the economy in a single year, the underlying assumption being that the snapshot year is far enough into the future such that changes in relative rates of return induced by the initial disturbances, in this case higher world oil and related commodity prices, are eliminated by capital mobility between industries.

1. Papers describing these model applications are available from the IMPACT Project. A catalogue of titles available may be obtained by writing to the IMPACT Project Information Officer, Industries Assistance Commission, P.O. Box 80, Belconnen, ACT. 2617.

production technology.[1] In practice such a matrix does not exist. In the present exercise we assume that Australian production technology as contained in IMPACT's 1971/72 I-O table of the economy[2] can be taken as representative of world production technology.[3]

We use (1) to generate two non-energy commodity price vectors. In producing the first vector (vector A) the energy price vector $P_E^{\prime}$ contains only one element, crude oil, whose price is increased by 2 per cent. The price of the other primary energy commodity, coal, is assumed not to increase directly as a result of increasing the price of crude oil. In producing the second vector (vector B), $P_E^{\prime}$ contains <u>both</u> crude oil and coal with the price of each increased by 2 per cent. The assumption in vector A is that the price of coal is entirely supply determined. Thus the longer term price of coal is taken to reflect the cost of coal mining operations rather than demand conditions. In contrast, in vector B it is assumed that attempts to substitute coal for oil as oil becomes relatively more expensive will in turn lead to higher coal prices. The most likely world energy price scenario

1. Additional (though less important) data requirements are a capital coefficients matrix (K) and a vector of industry specific rates of return to capital (R) which are in some sense representative of 'world' capital creation technology and which are internally consistent with the I-O coefficients matrix (A). We have obtained these data elements from IMPACT's SNAPSHOT model for 1971/72. (See Harrower and Vincent (1978)).

2. This table is an updated version of the ABS 1968/69 I-O table (See Lawson (1979)). The table recognizes 109 industries. Three of these may be regarded as energy supplying industries - industry 12 (coal and crude petroleum), industry 81 (electricity) and industry 82 (gas). We have separated the coal and crude petroleum components of industry 12. Electricity and gas are not primary energy sources, being manufactured largely from other energy sources such as coal. Hence electricity and gas are elements of $P^{\prime}$. Increases in the price of electricity and gas and hence the prices of the outputs of industries intensive in their use of electricity and gas will follow indirectly via the increased cost of primary energy such as coal used to manufacture electricity and gas.

3. The implications of this assumption are probably quite reasonable. Energy intensive domestic sectors such as agriculture and some mineral processing industries (e.g., aluminium) are prominent in world trade. Thus Australian production technology in such industries is likely to be close to 'average' world production technology.

probably lies somewhere between these two price vectors.[1]

The world price vectors for non-energy commodities are available from the authors. Because direct energy inputs for most industries represent only a small proportion (less than one per cent) of total costs, the total (direct plus indirect) price impact of an initial 2 per cent increase in primary energy prices is minimal for most non-energy commodities. The simple annual average of all non-energy price increases is 0.04 per cent in price vector A and 0.06 per cent in price vector B.[2] The largest increase of from 1.1 to 1.2 per cent per year is for oil and coal products. Crude oil constitutes about 50 per cent of the total costs of this industry. Price increases for agricultural commodities average about 0.04 per cent per year in price vector A and about 0.05 per cent per year in price vector B.

1. The evidence suggests that there are immense reserves of coal. However, it is unclear what the implications will be for coal extraction costs should massive substitution of coal for oil occur. Over the time horizon of this study it is consistent to envisage both a horizontal world supply curve for coal and steady increases in world oil prices. The installation of sufficient coal-oil conversion capacity is likely to take a least five years. On the other hand, Freebairn (1978) provides some evidence of a correlation between oil and coal prices.

2. Thus our world price scenarios imply annual increases in the real price of energy of about 1.96 and 1.94 per cent respectively for the five year period. We believe increases of this order of magnitude to be within the plausible range given the recent behaviour of OPEC and the comments made in footnote 1 on page 4.

3. ANALYTICAL PROCEDURE AND RESULTS

Our projections are derived from the ORANI model of the Australian economy. ORANI is a large multisectoral model of industrial and workforce composition, based on a 115 x 113 commodity by industry input-output matrix and a labour force disaggregated into nine occupations. The theoretical structure emphasises price responsiveness and substitution. The model's main behavioural postulates are that producers minimise the costs of producing their outputs (subject to appropriately specified production functions) and that consumers maximise their utility subject to an aggregate consumption constraint. Competitive pricing behaviour is imposed via zero pure profit constraints.

A complete description of the theoretical structure and data base of the basic model is given in Dixon, Parmenter, Ryland and Sutton (1977). In the current and previously cited simulation involving the effects of oil price increases, we have employed a more recent version of the model (referred to as ORANI 78). This version differs from the earlier version mainly in the specification of the agricultural sector. Rather than rely on the I-O treatment of agriculture which defines agricultural industries as product groups, ORANI 78 incorporates a 10 x 8 commodity by industry agricultural sector which recognizes both the multiproduct features of agricultural industries and regional differences in agricultural industry production technologies.[1]

The ORANI model is extremely flexible from a policy user's viewpoint. This flexibility is reflected in the user's ability to make almost any (logically valid) classification of the variables in the model into endogenous and exogenous sets. As well as being used to study the effects

1. See Dixon, Parmenter, Powell and Vincent (1979) for a detailed description of the treatment of agricultural commodities and industries in ORANI 78.