# IMPACT OF DEMOGRAPHIC CHANGE ON INDUSTRY STRUCTURE IN AUSTRALIA

A joint study by the Australian Bureau of Statistics, the Department of Employment and Industrial Relations, the Department of Environment, Housing and Community Development, the Department of Industry and Commerce and the Industries Assistance Commission

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## REGIONAL DEVELOPMENTS IN THE ORANI MODEL

by

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## 1. INTRODUCTION

At last year's conference we presented our first attempt to regionalize to the state level results from the ORANI model, (see Dixon, Parmenter and Sutton (1978)). Since then, ORANI has been modified, especially with respect to its treatment of agriculture. We refer to the modified model as ORANI 78 to distinguish it from the original model which is now known as ORANI 77. Some of the advances in ORANI 78 over ORANI 77 are, we hope, of interest to regional economists. Unlike ORANI 77, ORANI 78 recognizes regional variations in production technology across agricultural industries.

Before we describe some of the distinctive features of ORANI 78 and their relevance for regional analysis, it might be useful if we briefly describe ORANI 77.[1] ORANI 77 is a 109 sector input-output based model of the Australian economy. In standard applications it distinguishes 9 categories of labour. The theoretical structure emphasizes price responsiveness and substitution. Computing difficulties associated with size and non-linearities are avoided by using the linearization technique introduced by Johansen (1960). Applications of ORANI 77 have included analyses of the effects on industry outputs, rates of return, employment by industry and occupation, exports, imports, the balance of trade and many other variables of

(i) changes in the exchange rate,

(ii) changes in levels of protection against imports,

(iii) changes in world trade conditions,

(iv) the mining boom,

(v) changes in wage relativities between male and female workers,

(vi) changes in the overall level of real wages, and

(vii) changes in aggregate household expenditure, aggregate investment expenditure and aggregate government expenditure.

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1. ORANI 77 is fully documented in Dixon, Parmenter, Ryland and Sutton (1977).

To each of these applications it was possible to append an ORANI regional computation. The theory and data base for these regional computations are described in the paper, already cited, by Dixon, et al. (1978). Our regionalizing method, based on the earlier work of Leontief et al. (1965), has the following three properties

(i) it involves a minimum use of regional data,

(ii) it is sequential to the economy-wide ORANI computations, and

(iii) it is consistent with the economy-wide ORANI results.

The input of regional data was minimized by two assumptions. First, the use of interregional commodity flow data was obviated by assuming that industries can be categorized as either "local" (i.e., industries producing commodities which can be sold only in the region of their production) or "national" (i.e., industries producing commodities for which the regional pattern of production is independent of the regional pattern of demand). Most service industries and those producing perishable commodities were classified as "local." Examples of "national" industries are those producing automobiles, capital equipment, clothing and other non-perishable and easily transported commodities. Second, we assumed that economy-wide input-output coefficients for inputs of "local" commodities were valid at the regional level, thus avoiding the need for information on region specific technology. The sequential property of the regional computations means that there is no feedback from the regional level to the economy-wide level. First we run the ORANI model to generate economy-wide results. Then the regional computation disaggregates these results to the state level. The disaggregation is consistent with the initial economy-wide computation in the sense that a reaggregation of the state-level results reproduces the initial economy-wide results.

Our regional computations capture two aspects of the differential impact across the states of economy-wide disturbances. First, they reflect variations in industrial composition. For example, in Dixon et al. (1978), we argued that general increases in tariffs are likely to reduce economic activity in Queensland and Western Australia because of the comparatively heavy concentration of those states on exporting industries. On the other hand, Victoria, the home of much of Australia's import competing industry, was projected to benefit from tariff increases. The second ingredient in our regional computations is the local multiplier effects. Stimulation of the automobile industry, for example, will have a greater effect on employment and income in South Australia than in Queensland. This in turn will stimulate "local" industries (service industries and producers of perishables) in South Australia relative to those in Queensland.

Although multiplier effects and variations in industrial composition are clearly important in tracing out the regional implications of economy-wide disturbances, they are certainly not the only factors. In our presentation at last year's conference, we emphasized the limitations imposed on our regional results by their failure (a) to reflect variations in regional technologies and (b) to incorporate data on interregional commodity flows. Our new model, ORANI 78, goes some distance towards overcoming limitation (a). Limitation (b), however, remains as before.

## 2. RECTANGULAR MODELS AND REGIONAL TECHNOLOGIES[2]

ORANI 77 is a square model. Each industry produces only one commodity and each commodity is produced by only one industry. In ORANI 78 we have a rectangular specification. Some products are producible by more than one industry and some multiproduct industries are recognized. However, the first generalization (i.e., the allowance for several industries to produce the same product) is the important one from the point of view of introducing variations across regions in production technologies. With a rectangular specification it becomes possible to have two industries producing steel, one industry called NSW-steel and another called SA-steel.

Assume that SA-steel has a more capital intensive technology than NSW-steel. Now assume that we wish to use our economy-wide model to simulate the impact of a general increase in real wages. Our projections will indicate that output, employment, etc., in the NSW-steel industry are reduced to a greater extent than in the SA-steel industry. When we append our regional disaggregation computation to our economy-wide results, we will capture the indirect regional implications of the different performances of the two steel industries. For example, assume that 90 per cent of the production of NSW-steel is located in the state of New South Wales. (The rest might be located in Queensland, say.) Assume that 95 per cent of SA-steel is located in South Australia. Then, the poor performance of the NSW-steel industry compared with that of the SA-steel industry will induce a relatively poor performance in "local" industries in New South Wales compared with those in South Australia.

In the currently operational version of ORANI 78, the introduction of regional industries has been confined to agriculture. Because of the climatic and biological factors, there are marked differences across Australia in the technologies employed to produce agricultural commodities.

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2. The principal idea in this section, that of defining regional industries, may also be found in Hoffman and Kent (1976). See also Dixon and Parmenter (1979).

## 3. THE AGRICULTURAL SECTOR IN ORANI 78

Table 1 shows the agricultural commodities and industries included in the operational version of ORANI 78. Note that industries 1 - 4 are explicitly regional. The first three are those designated by the Bureau of Agricultural Economics (BAE) (1973) in their sheep industry survey. The table also shows the base period shares of each of the agricultural commodities in the total value of output in each of the agricultural industries : industries 1 -3 and 5 each produce more than one commodity. Vincent, Dixon and Powell (1978) describes the estimation of the transformation elasticities, i.e., the parameters reflecting the technical possibilities within industries for switching between products in response to changes in product prices. Here, however, we give some descriptive material on the industries, emphasizing the regional differences in production technologies and commodity mixes.

### Commodities

The content of commodity rows 1 - 4, 6 - 7 and 10 in Table 1 is self evident. Row 5 (other grains) consists mainly of oats, rice, sorghum and maize. Row 8 (other farming export (OFE)) contains sugar and fruits. Row 9 (other farming import competing (OFM)) contains the import competing commodity tobacco and the essentially non-traded commodities vegetables, hay and flowers. In the I-O tables constructed by the ABS, the OFE and OFM commodities are treated as a single commodity (other farming). In ORANI simulations, the existence of strongly export oriented and import competing commodities within an industry is particularly unsatisfactory. For example, in terms of the information supplied to it, the model might seek (quite rationally) to replace any tobacco imports by directing sugar away from being exported. As a first step we have separated the original commodity into export and non export commodities. Further disaggregation into more homogeneous commodities may be undertaken at a later data.

### Industries

The Pastoral Zone industry occupies the largest area of the three BAE cereals-grazing zones. It includes all of the arid and most of the semi-arid parts of Australia which support a sheep population. Apart from some fringe areas, cropping is not feasible in this zone because of the inadequate and unreliable rainfall. Livestock are generally grazed extensively on natural vegetation. Hence stocking rates are low and property areas extremely large. Unlike the other zones, sheep are grazed in the Pastoral Zone almost entirely for their wool. Although a substantial amount of income is obtained from the sale of 'cast for age' sheep, such income accrues essentially as a by-product of wool production.

TABLE 1

COMMODITY SHARES IN THE OUTPUTS OF INDUSTRIES (1968/69)

| Commodities \ Industries | Pastoral Zone | Wheat-sheep Zone | High Rainfall Zone | Northern Beef | Milk Cattle and Pigs | Other Farming Export | Other Farming Import Competing | Poultry |
|---|---|---|---|---|---|---|---|---|
| Wool | 0.618 | 0.251 | 0.463 | | | | | |
| Sheep | 0.127 | 0.088 | 0.131 | | | | | |
| Wheat | 0.096 | 0.443 | 0.032 | | | | | |
| Barley | 0.001 | 0.033 | 0.012 | | | | | |
| Other Grains | 0.005 | 0.046 | 0.023 | | | | | |
| Meat Cattle | 0.137 | 0.088 | 0.229 | 1.000 | 0.234 | | | |
| Milk Cattle & Pigs | - | 0.030 | 0.055 | | 0.766 | | | |
| Other Farming Export | - | 0.010 | 0.055 | | | 1.000 | | |
| Other Farming Import Competing | 0.016 | 0.011 | | | | | 1.000 | |
| Poultry | - | | | | | | | 1.000 |

Source : Derived from Bureau of Agricultural Economics (1973).

The Wheat-Sheep Zone is the largest of the three zones in terms of sheep numbers and sheep properties, accounting for nearly one half the national sheep flock and well over half the number of sheep properties in Australia. Rainfall is generally sufficient for crop production, and nearly all dryland cropping of cereals is carried out in this zone. As well as forming the basis for the Australian sheep and wheat industries, the zone has become an increasingly important source of cattle output in recent years. Climate, topography and soil type are such that opportunities for diversification into various cropping and livestock activities are large. The zone thus forms a classic example of a multiproduct agricultural region.

The High Rainfall Zone consists entirely of land within 200 miles of the coast and is located predominantly in the south-east and south-west corners of Australia. Sheep concentration is highest in this zone. Sheep are often grazed in association with beef cattle. To a lesser extent, livestock are grazed in rotation with crop production. As in the Wheat-Sheep Zone, a large proportion of properties combine wool growing with prime lamb production. That is, sheep meat production is an activity within its own right.

Meat cattle are produced in Australia using two quite different technologies,

(i) An intensive grazing industry located in each of the three BAE zones. On most properties in these zones, cattle are grazed in conjunction with sheep. The product is mainly high quality beef for domestic consumption.

(ii) An extensive northern Australian specialist beef industry located in the Northern Territory and in the Kimberley region of Western Australia and the Coastal Central and Peninsular Gulf regions in Queensland.

Much of the product from these northern regions is exported as lower quality manufacturing beef. Climatic and biological factors are such that there is virtually no alternative commodity prospects to beef cattle for the northern industry. The Northern Beef industry in ORANI is defined to include the Kimberley region in W.A., the Victoria River, Alice Springs, Darwin and Gulf and Barkley Tableland regions of the Northern Territory (these regions comprise the entire Northern Territory), and the Peninsular Gulf and Coastal Central regions of Queensland.[3]

3. The designation of the various regions is that used by the BAE in their Beef industry reports of the Northern Territory and Kimberley Region Beef Cattle Industry (BAE 1974(a)) and the Queensland Beef Cattle Industry (BAE 1974(b)).

The Milk Cattle and Pigs industry produces two products, meat cattle (commodity 6) and milk cattle and pigs (commodity 7). The remaining three industries, Other Farming Export, Other Farming Import Competing and Poultry are single product industries producing only the corresponding commodities.

Table 2 shows the shares of each of the agricultural industries in the aggregate production of agricultural commodities in the base year. The three BAE regional industries (industries 1 - 3) produce all the Australian output of wool, sheep and cereals (commodities 1 - 5) and about one half of the output of meat cattle (commodity 6). In addition they make minor contributions to the production of the remaining agricultural products (commodities 7 - 10) which are produced predominantly by specialist producers (industries 5 - 8).

## 4. CONCLUDING REMARKS

In giving a regional dimension to ORANI results we have adopted a disaggregation technique, i.e. we have run our economy-wide model and then as a second step we have disaggregated our results to the state-level. Regional results from this procedure (such as those presented at last year's conference) generally reflect an arbitary allocation of economy-wide results for "national" industries to the state level. For example, if our economy-wide results suggest that policy change x will generate a 10 per cent reduction in the output of steel, then in our regional disaggregation we have generally assumed that steel production falls by 10 per cent in each state. In ORANI 78 we have not changed our regional disaggregation procedure - - if policy change x is projected to produce a 10 per cent reduction in the output of "national" industry i , then we will, in general, continue to assume that the output of industry i falls by 10 per cent in each state. However, in the theoretical specification of ORANI 78, we have allowed the possibility of regional industries. Thus, for example, our economy-wide model could project 15 and 5 per cent reductions in the outputs of "national" industries i and j where i is NSW-steel and j is SA-steel. Then our regional disaggregation would imply that the output of NSW-steel would fall by 15 per cent in each state while that of SA-steel would fall by 5 per cent. But because SA-steel would be largely located in South Australia, while NSW-steel would be largely located in New South Wales, our regional results for steel would no longer reflect the arbitary apportioning of an economy-wide steel result to the regions.

With the currently operational version of ORANI 78, we have taken a first step towards the empirical introduction of regional industries into our economy-wide model. At present, the regional industries are all in the agricultural sector. With sufficient

TABLE 2

INDUSTRY SHARES IN THE PRODUCTION OF AGRICULTURAL COMMODITIES (1968/69)

| Industries / Commodities | Pastoral Zone | Wheat-sheep Zone | High Rainfall Zone | Northern Beef | Milk Cattle and Pigs | Other Farming Export | Other Farming Import Competing | Poultry |
|---|---|---|---|---|---|---|---|---|
| Wool | 0.217 | 0.425 | 0.358 | | | | | |
| Sheep | 0.151 | 0.505 | 0.344 | | | | | |
| Wheat | 0.042 | 0.928 | 0.030 | | | | | |
| Barley | 0.005 | 0.852 | 0.143 | | | | | |
| Other Grains | 0.020 | 0.796 | 0.184 | | | | | |
| Meat Cattle | 0.068 | 0.211 | 0.252 | 0.240 | 0.229 | | | |
| Milk Cattle & Pigs | | 0.080 | 0.069 | | 0.851 | | | |
| Other Farming Export | | 0.036 | 0.092 | | | 0.872 | | |
| Other Farming Import Competing | 0.016 | 0.050 | | | | | 0.934 | |
| Poultry | | | | | | | | 1.000 |

Source : Derived from the Bureau of Agricultural Economics (1973).

research resources and appropriate data, perhaps from regional input-output studies, regional industries could be defined for non-agricultural activities. There is no further theoretical problem given that ORANI 78 now has a rectangular structure. Perhaps the slightly surprising aspect of our current research is that the introduction of further regional detail into the ORANI model does not involve changes in either the theoretical structure of our economy-wide model or in our regional disaggregation method.

Participants at the conference will recall that we distributed results from ORANI 78 on the effects of a uniform change in all tariffs. There is insufficient space, here, to allow a discussion of those results. They are available from the authors. A paper illustrating the application of ORANI 78 in another context is Vincent, Dixon, Parmenter and Sams (1979).

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