

THE SNAPSHOT MODEL
A NON-TECHNICAL DESCRIPTION

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1. INTRODUCTION

Six government agencies are at present working on a co-operative project called IMPACT¹, which is aimed at producing a series of related econometric models of the Australian economy. The models should have wide application in economic analysis.

This paper describes one of these models, called SNAPSHOT².

SNAPSHOT is being designed to produce a picture of how the Australian economy might look in a relatively distant future year, under certain assumptions. At the moment, the target year is 1990, but this will be varied depending on the application.

In the SNAPSHOT model, considerable savings in complexity are being achieved by not attempting to trace the likely progress of the economy between the present time and the future target year. That is, the model will produce a "snapshot" picture of the 1990 economy, but not a "cine film" of progressive changes from now to 1990 and beyond - hence the name "SNAPSHOT".

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1. The IMPACT Project has recently issued its first progress report: Alan A. Powell, The IMPACT Project: An Overview, March, 1977 ... First Progress Report of the IMPACT Project, Vol. 1 (Canberra. Australian Government Publishing Service 1977).
 2. The SNAPSHOT model was formulated by Peter B. Dixon, John D. Harrower and Alan A. Powell, in, "SNAPSHOT, a Long Term Economy-Wide Model of Australia: Preliminary Outline", Impact of Demographic Change on Industry Structure in Australia, Preliminary Working Paper No. SP-01, Industries Assistance Commission, Melbourne, February 1976 (mimeo), pp. 26. Other detailed technical papers describing the mathematical and computational solution of the model and the specification of consumption behaviour have been issued.

2. HOW SNAPSHOT WORKS

Like most econometric models, SNAPSHOT will be embodied in a computer program.

The user will input to this program three specific "scenarios" which embody his assumptions regarding three important aspects of the 1990 economy. These are:

- a technology scenario, specifying the inputs of materials, labour and capital equipment which each industry group would require in producing a unit of output, given the technology which the user assumes will be current in 1990.
- SNAPSHOT is designed to deal with about a hundred industry groups*
- a demographic scenario, which incorporates the user's assumptions on the likely size and structure (age, family size, worker participation rates, etc.) of the Australian population in 1990.
- an international trading scenario, specifying assumptions on 1990 world commodity prices and also specifying assumed levels of Australian exports and limits to which imports, as a share of the Australian market will be restricted for that year.

The computer program will then take these input data (which can be regarded as a partial picture of the 1990 economy) and perform on them a series of complex calculations designed to derive plausible conclusions as to other aspects of the 1990 economy (i.e. to fill in the picture).

The calculations cannot be described in detail here, but a few important points can be noted:

* The groupings used are those adopted by the Australian Statistician in producing the 1968-69 input-output tables - see Australian National Accounts, Input-Output Tables, References No. 7.9.

- there is a general assumption in the model that 1990 will be, roughly speaking, an "average" year - e.g. that the business cycle will be at neither a peak nor a trough at that time
 - . this assumption can be seen as a consequence of the "snapshot" nature of the model: since the dynamic progress of the economy up to 1990 is not modelled, no conclusions can be drawn as to transient economic patterns such as the business cycle
- an important feature of SNAPSHOT is that it will incorporate a rigorous economic accounting framework inter-connecting the many aspects of the economy which it models
 - . this means that it will produce a coherent picture of the 1990 economy, giving estimates of industrial output, relative prices, industry employment levels, etc. which are all mutually consistent.
- as a consequence, when the model produces "strange" results the reason will usually be that there is an unnoticed inconsistency in one or more of the scenarios which were input
 - . as an example, a conclusion that very high export taxes would be levied in 1990 might stem from an inconsistency between the technology and international trading scenarios, the former assuming that Australian industry would be highly efficient by world standards in 1990 while the latter specified that exports would be very low
 - . the model can thus be used to test the internal consistency of a set of scenarios.
- the model, and hence the calculations carried out by the computer program, are founded in widely accepted theories as to inter-relationships in the economy.
 - . it is a truism, however, that no economic theory, no matter how complex, can begin to match the complexity of the real world

- SNAPSHOT is best regarded, therefore, not as a method of forecasting what the Australian economy actually will be like in 1990, but rather as a means of carrying out the heavy calculations needed to derive the theoretical consequences of given assumptions on technology, demography and international trade.

The result of the calculation is, as noted above, computer output which fills out the partial picture of the 1990 economy which was input. Specifically, the model produces estimates, for the year 1990, of economic indicators such as:

- the industrial composition of the economy, i.e. the level of output of each of the hundred or so industry groups considered by the model
- the relative prices of the output of the different industry groups
- likely real wage levels, and likely profitability (measured as return on capital employed)
- the necessary skill composition of the workforce (SNAPSHOT distinguishes nine skill categories) and likely manpower requirements
- the standard of living, as measured by per capita real income
- the export subsidies (or taxes) and import tariffs needed to achieve the levels of exports and imports specified in the trade scenario
- and many others.

Some examples of specific analysis made possible by SNAPSHOT are given later. First, however, we consider the input scenarios in a little more detail.

3. THE SCENARIOS

Devising a set of input scenarios for the model, is, in itself, no small task. The technology scenario, for example, must specify the materials which each of the hundred-odd industry groups will buy from each other industry group, the types of capital good each group will need, each group's requirements

for each of nine classes of labour, and so forth. The other two scenarios are simpler, but still quite complicated.

It is anticipated, therefore, that rather than drawing up each new set of scenarios from scratch, most users will adapt, for their own purposes, a set of basic scenarios which are being drawn up by members of the IMPACT team.

The basic technology scenario is being compiled by the Department of Industry and Commerce, in a two-phase project. The first phase involves deciding upon the (relatively few) industry groups which are likely to experience the most important technological changes by 1990. In the second phase, experts on each of the selected industries will be consulted and a consensus view attained on the specific effects of changing technology on each of these industries' requirements for materials, labour and capital - the information needed for the technology scenario. The remaining industry groups will be assumed to have (broadly speaking) the same requirements in 1990 as at present.

Demographic scenarios are prepared somewhat differently. A scenario could, for example, be drawn up on the basis of the Borrie Report^{*}. A particularly useful source of demographic scenarios, however, will be another IMPACT model called BACHUR00, which is specifically designed to produce demographic projections in a form directly usable by SNAPSHOT.

The international trade scenario specifies 1990 world commodity prices, export levels and upper limits to import penetration for each Australian industry. Several alternative trade scenarios are being drawn up by the Department of Overseas Trade for use with the SNAPSHOT model.

* Australian Government National Population Inquiry (Chairman: W. D. Borrie): "Population and Australia - A Demographic Analysis and Projection", Canberra, Australian Government Publishing Service, 1975, 2 Vols., pp xxxiv + 760.

4. EXAMPLES OF THE USE OF SNAPSHOT

This section gives three examples of the many ways in which the SNAPSHOT model, when completed, could be used to aid economic analysis.

In each of the examples, 1990 technology is assumed to be that specified in the basic technology scenario being drawn up by the Department of Industry and Commerce. Other technology scenarios are of course possible, and would give rise to yet further examples.

Example A: Assume that Australia's population had evolved, by 1990, in some stated way (e.g. along a path projected in the Borrie Report). Further assume that government policy in 1990 would be to ensure, through the use of export subsidies, import tariffs, etc., that exports formed a given proportion of each industry's output and that no more than a given proportion of domestic demand was met by imports. What, then, would be

- the output of each industry group?
- the consequential demand for labour of each occupational group?
- the (relative) price of each industry group's product?

Example B: Assume that certain (stated) Australian industries obtain, by 1990, significant new export markets.

What effects would this development have

- on industries which compete for labour and/or capital with these exporting industries?
- on industries which supply materials and/or capital goods to the exporting industries?

How would the Australian market for skilled labour change, and which industries would expand or contract as a result?

Example C: Suppose that a number of alternative immigration policies are being considered for Australia.

SNAPSHOT can help the decision maker in at least two ways: it can provide him with the theoretical economic consequences of each of the proposed policies and, for each proposal, it can indicate other (non-immigration) areas where consequential policy changes might be needed to allow the economy to function at its full potential. Of course, SNAPSHOT could in no sense decide the policy question - the policy maker must take into account a wide range of other factors on which SNAPSHOT, like any other model, must remain silent. But the information which it can provide will be of very great help to the policy maker.

The analysis might proceed as follows.

First, each of the alternative immigration policies would be translated into a demographic scenario suitable for input to the SNAPSHOT model. This could be done by using the BACHUROO model, or alternatively by working from Borrie projections. A technology and an international trade scenario would also be drawn up; the standard scenarios would probably be used here, but the analysis could be made fuller by repeating it in total for alternative technology and trade scenarios, and hence checking the sensitivity to these factors of the main results.

The different sets of scenarios would then be input in turn to successive runs of the SNAPSHOT computer program. The output would indicate the theoretical consequences of each immigration policy in terms of factors like industry outputs, employment requirements, price levels, wages, profits, total gross domestic product, per capita increase, required tariff levels, etc., etc. - valuable information for the policy maker.

The analysis need not, however, end there. One of the alternative immigration policies considered would undoubtedly be the situation, if current policy were to remain in force. The consequences of each of the other alternatives can then readily be compared with the current policy results, to produce useful indications as to other policy changes which might be needed, in the immigration field or outside it, if the alternative were adopted. Thus, for example, the analysis can point out that a given immigration policy implies, say,

- a future number of employees in certain skill groups
 - . and hence from an analysis of the current trends, a possible need for changes in educational and training policies
- a shortfall in capital investment in certain industry groups
 - . and hence a need to begin encouraging such investment; or
- production bottlenecks caused by low availability of certain capital goods
 - . and hence the need either to encourage the industry producing such goods or to look for supplies from overseas.

By making a series of runs of the model using different combinations of such policies with the alternative immigration policies under consideration, considerable insight can be gained into the likely consequences of each possible decision.

5. THE PRESENT STATE OF THE PROJECT

The development of the SNAPSHOT model can be divided into three stages.

In the first stage, the theoretical structure itself (and the computer program which embodies it) will be developed and tested. Testing is done by inputting various sets of historical data, say from 1962-63 to 1971-72, and checking the realism of the output. This stage should be completed by about mid-1977.

The second stage involves fully developing the basic scenarios, to allow reasonable outputs for 1990 to be computed. At the end of this stage (probably in late 1977) a usable version of the SNAPSHOT model will have been constructed. Its use will, however, be restricted to the IMPACT team, at least until a reasonable degree of expertise in handling the model, and confidence in the soundness of the results produced, is attained.

The third stage could be considered on-going, in that it will entail continual enhancement and refining of the model throughout its "lifetime": as examples, more target years could be included for consideration, industry groupings could perhaps be made more flexible, new and interesting scenarios could be developed and ways might be found to improve the theoretical structure of the model. During this stage successive versions of the model will be made available for direct access by the agencies participating in the IMPACT project and, at a later time (depending on resources available for training, etc.) to other interested organisations.

6. SUMMARY

The SNAPSHOT model - one of a range of models being developed within the IMPACT project - is described schematically in Figure 1.

The figure shows how base year data, and a set of demographic, technological and international trade scenarios for the target year, are fed into the computer program which embodies the SNAPSHOT model.

As explained above, the model is designed around a rigorous economic-accounting framework, and therefore produces and outputs estimates of other economic indicators (industry outputs, employment by occupational class, profits, balance of trade, etc.) which are consistent with each other and with the set of input scenarios. Such estimates cannot be achieved without a model of this kind.

In the course of a given analysis, the model can be run several times with appropriate variations in the scenarios. In this way the effects of alternative policies in a wide variety of fields can be studied, and information produced which is of the highest value to the decision maker.

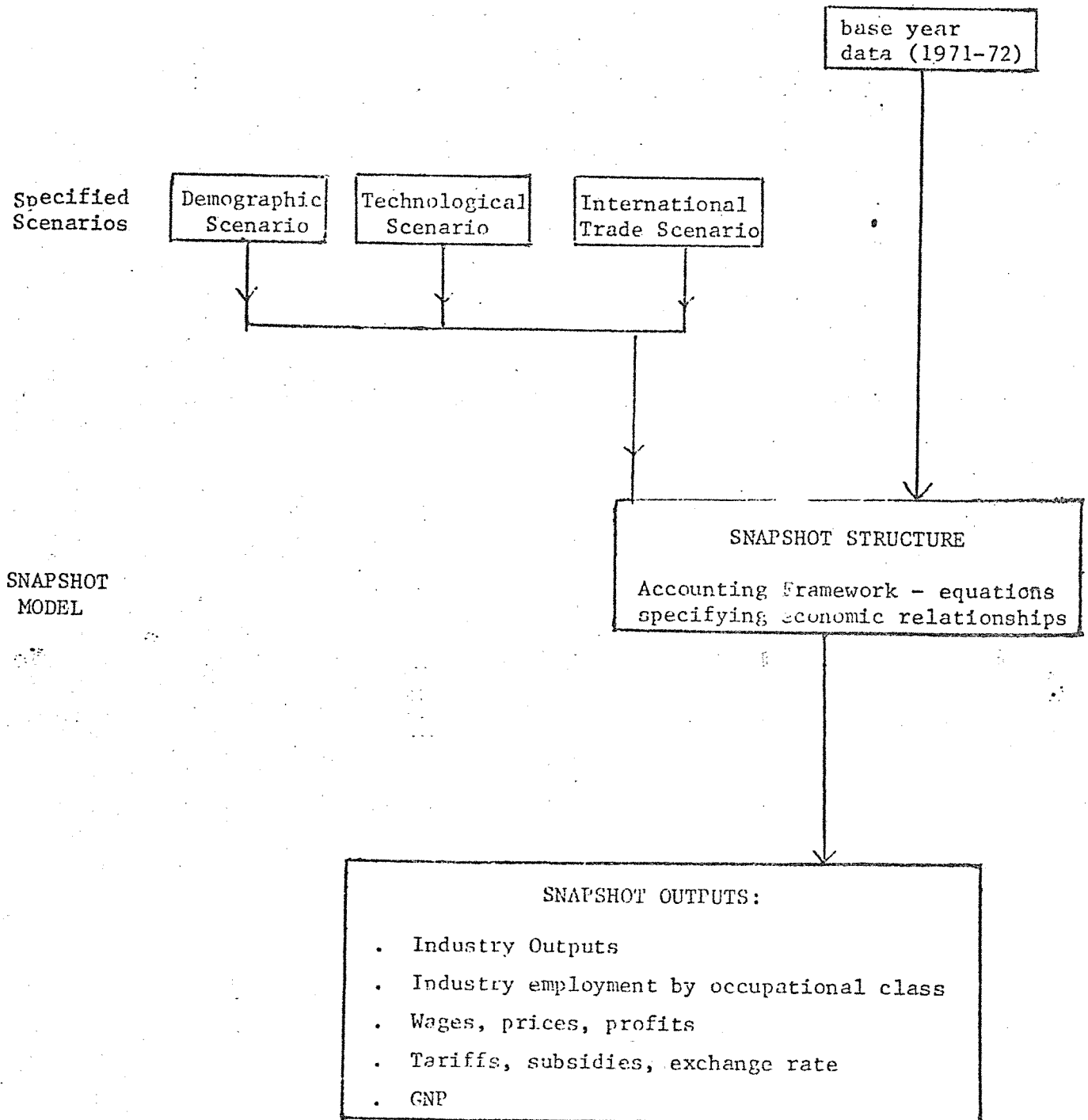


Figure 1: Schematic Representation of the SNAPSHOT model.