VICTORIA UNIVERSITY OF WELLINGTON

GRADUATE SCHOOL OF BUSINESS
AND GOVERNMENT MANAGEMENT

WORKING PAPER SERIES 11/91

Long run concepts in New Zealand macroeconometric and CGE models

V.B. Hall*

* McCarthy Professor of Economics
Economics Group
Faculty of Commerce and Administration
Victoria University of Wellington

October 1991

ISSN 0114 7420
ISBN 0 475 11442-6

LONG RUN CONCEPTS IN NEW ZEALAND MACROECONOMETRIC AND CGE MODELS

V B HALL
Macarthy Professor of Economics
Victoria University of Wellington

ABSTRACT

This paper evaluates how published economy-wide New Zealand models have treated concepts relevant to the long run. These concepts, a number of which have only indirect linkages to the long run, include steady state growth, rational expectations, unit roots and cointegration, domestic and external debt sustainability (including intertemporal fiscal and foreign sector constraints), explicit supply (including physical capital accumulation), the interfacing of macroeconometric and computable general equilibrium (CGE) models, and the interfacing of New Zealand and Australian CGE models.

It builds on the comprehensive medium term oriented assessment of Wells and Easton (1983, 1986), and focuses primarily on RBNZ Model XII (Brooks and McDermott, 1990, Brooks and Gibbs, 1991), and the CGE models JOANNA, JULIANNE and JOANI (Philpott, 1989).

Keywords: Long run concepts, New Zealand macroeconometric and CGE models, steady state growth, unit roots and cointegration, debt sustainability, RBNZ Model XII, RPEP.

LONG RUN CONCEPTS IN NEW ZEALAND MACROECONOMETRIC AND CGE MODELS

V B HALL*

Victoria University of Wellington

1 INTRODUCTION

This paper evaluates how published economy-wide New Zealand models have treated concepts relevant to the long run. These concepts, a number of which have only indirect linkages to the long run, include steady state growth, rational expectations, unit roots and cointegration, domestic and external debt sustainability (including intertemporal fiscal and foreign sector constraints), explicit supply (including physical capital accumulation), the interfacing of macroeconometric and computable general equilibrium (CGE) models, and the interfacing of New Zealand and Australian CGE models.

Consideration is additionally given to a number of the eleven desirable model properties set out in Murphy *et al.*. (1986, pp 2-5, 112-118), used to assess the AMPS model for Australia, relative to NIF-10S and RBA82, and to Canada's SAM and MACE models. Of particular relevance to this paper are the properties requiring long run equilibrium paths to exhibit balanced growth and financial neutrality, and long run equilibrium to embody producer and household optimising behaviour wherever empirically justifiable. The degree of conformity of New Zealand models to the properties of dynamic stability under tenable policy regimes, and of incorporating rational expectations where plausible, are also considered.

In section 2, the paper features key aspects of the comprehensive assessment by Wells and Easton (1986). Sections 3 and 4 focus primarily on RBNZ Model XII and the Research Project on Economic Planning's (RPEP) CGE models JOANNA, JULIANNE and JOANI. Concluding remarks are presented in section 5.

* I acknowledge, without implication, very helpful discussions with Ray Brooks, Arthur Grimes, John McDermott, Bryan Philpott, and participants in a VUW Economics Research Workshop; also specific comments from David Rae and Darren Gibbs. Alice Fong has provided first class wordprocessing and secretarial assistance.

2 WELLS AND EASTON'S 1983 ASSESSMENT

2.1 Perspective

Wells and Easton's assessment came about through the Economic Monitoring Group of the New Zealand Planning Council commissioning the New Zealand Institute of Economic Research to survey the relative usefulness of then existing economy-wide models. The work was carried out in 1983, a summary review article was published as Wells and Easton (1983), and the full assessment subsequently appeared as Wells and Easton (1986).

One key objective of the study was (1986, p.(i)):

> "to provide an assessment of the ability of particular models ...
> to describe the effects of specified paths of exogenous and policy variables on:
> (i) the medium-term equilibrium configuration of the economy, and
> (ii) the adjustment of the economy to that configuration"

It was therefore basically medium-term rather than long-run in focus, though its assessment checklist included evaluating what equilibrium concepts had been embodied and what explicitly modelled processes led to equilibrium being achieved. Many of the long run concepts referred to above in section 1 were covered in Wells and Easton's study, so it provides a very useful starting point for this paper.

2.2 The Key Models and Issues Examined

The fourteen models summarized in Table 1 were evaluated, with particular emphasis being placed on the treatment of time, "sustainability", the government sector, the capital stock, and the possible interface of appropriate aggregate dynamic and multisectoral models. Given the focus of this paper, the further development since 1983 of New Zealand's models, and the subsequent best practice economic theoretic, econometric and CGE literature, comments can now be confined to two aggregate dynamic models and two multisectoral models.

Of the *aggregate dynamic models*, BHP (Bailey *et al..*, 1987) is a small open economy neo-classical growth model, designed to capture medium-term cyclical growth. It has eleven endogenous variables and has remained for some time primarily a theoretical rather than econometrically-estimated model. The equilibrium steady state growth paths of its endogenous variables have been explicitly solved for and its dynamic adjustment processes were shown to be stable for most sensible empirical parameter choices. The other relevant aggregate dynamic model, RBNZ 10 (Grimes *et al..*, 1983), was a relatively small

macroeconometric model with fifty five endogenous variables. It also has neo-classical growth model roots. It was specified so that one could obtain (p.7) "... steady state properties that conform with economic theory or with the institutional characteristics hypothesized to prevail in the domestic economy". However, Wells and Easton (1986, pp 31, 33) considered that it was not possible to solve explicitly for the 'whole model' steady state path, and suggested an alternative of simulating the model for an assumed set of steady state exogenous variable paths to discover whether (and possibly how) RBNZ 10's endogenous variables converged to a steady state.

The two very closely related *multisectoral models*, JOANNA and JULIANNE, were developed from conventional computable general equilibrium relationships, and used in the first instance to generate comparative static (instantaneous equilibrium) short run or long run results under either neoclassical or (neo)Keynesian assumptions. Both models run in a variety of forms, but essential differences between them relate to model use and solution technique. JOANNA is a general equilibrium model of Johansen type (Johansen, 1960), similar in concept to the IMPACT Project's ORANI module (Dixon *et al.*., 1982). The linearised model provides results in percentage change form. It is primarily suitable for examining the comparative static short run to medium term impacts of policy and other shocks. JULIANNE has an almost identical non-linear structural specification, but is solved by non-linear iterative solution techniques for its variables in level form. It is therefore relatively more suitable for (medium to longer-term) projection purposes. It can be run in semi-dynamic (SD) or in fully dynamic (DY) form.

2.3 Overview of the Issues Examined by Wells and Easton

Assessments explicit or implicit in their examination

- **Time, (equilibrium) steady-state growth, and adjustment processes**
  Only the BHP model provided an explicit solution for the steady-state growth paths of its endogenous variables, and checked for the stability of its dynamic adjustment processes. Wells and Easton considered that it was not possible to solve the total RBNZ 10 model for an underlying steady-state growth path, and were not aware of their suggested alternative procedure of simulating for an assumed set of steady-state exogenous variable paths having been carried out.

  The two multisectoral models were not significantly concerned with treatment of equilibrium in a steady-state sense. Instead their focus was on requiring goods market (but not necessarily factor market, fiscal and external) equilibrium. In short run and long run JOANNA, no explicit or natural time period is fixed for this type of

comparative static equilibrium to be achieved. For the levels form "dynamic" JULIANNE models, Wells and Easton (1986, pp. 214-216, 223-24) argue convincingly that, for particular exogenous variable sets, neither steady-state nor sustainable growth paths are necessarily achieved. The sustainability issue in this sense is not able to be addressed for the well-known reason that there is no model specification of how the savings necessary to finance the assumed aggregate investment are generated.

- **Sustainability**

  After defining sustainability as a concept in systems theory and optimal control, so that (1986, p. 287) "... sustainability would require that the achievement of desired paths for targets would not require unacceptable paths for the instruments at the policymaker's disposal", Wells and Easton chose to focus on the nature of long-run equilibrium rather than sustainability. In this context, they highlighted (1983, pp 92-93) the empirically important contrasting approaches in the BHP and HAYWOOD models. For the BHP model to have steady state real growth at the domestically determined natural rate, it had to *assume* exports grew at the same rate. On the other hand, the HAYWOOD model had to take labour force growth at the foreign sector constraining growth rate of real (purchasing power of) exports, if growing labour market disequilibrium were to be avoided.

- **Government Sector**

  Although acknowledging a close relation between the issues of sustainability and the government sector, Wells and Easton refer to domestic debt sustainability only in a very indirect sense. This was in the context of commenting that the CGE models made no allowance (1983, p.93)"... for the interaction between the real and monetary sectors of the economy via effects on the budget deficit and its financing".

- **Capital Stock**

  Two of Wells and Easton's summary comments in this area were that there are no official estimates of capital stocks and that the capital sector had been poorly modelled in virtually all models. However, the BHP model's domestic supply sector had an interrelated factor demand foundation, RBNZ 10 had plans for interrelated factor demand work and better modelling of labour demand and supply, and the CGE models had an imposed hierarchical decision making sequence for domestic production and factor demands.

- **Interfacing**

  Some of the above mentioned limitations (especially in the steady-state, sustainability, and capital stock areas) were seen as reducible in principle, through "integration" of an

appropriate aggregate dynamic structural model with a static multisectoral one. Detailed discussion focussed (pp 231-236) on the IMPACT Project's closure of ORANI by interfacing with RBII (Cooper and McLaren, 1983), and on an illustrative linkage of a "JOANNA" model to a "BHP" model. Consideration was given to whether interface could be achieved satisfactorily by iterating between models in an informal way rather than having to formally link them in a single model and computer programme.

Their major relevant recommendations

It was suggested that a satisfactory medium-term dynamic model with consistent sectoral growth paths could be constructed by interfacing a medium-term version of RBNZ and the CGE levels-form model JULIANNE. The inadequacy of the capital sector in most models was additionally highlighted.

2.4 Some Additional Comments and Major Subsequent Developments

With the benefit of hindsight, and by focusing on the additional criteria set out in section 1 of this paper, it can be further be pointed out that:

- neither BHP nor RBNZ 10 was explicitly concerned with evaluating whether long run financial neutrality was satisfied;
- producer optimising behaviour was treated in varying degrees of depth in BHP, RBNZ, JOANNA and JULIANNE, but household optimising behaviour is detectable only in JOANNA and JULIANNE;
- rational expectations specifications and/or solution procedures were not evident at all;
- unit root/cointegration testing had not been undertaken; and
- intertemporal fiscal and foreign sector constraints and debt accumulation relations had not been specified explicitly and endogenously, with the exception of the "Government Balance before Borrowing" and "Money Supply" identities in RBNZ 10, and the (one-way) government budget balance closure equation in JOANNA. Domestic and external debt sustainability issues were therefore not explicitly examined.

The two major subsequent developments have been the RBNZ's cointegration-based model RBNZ XII, and the RPEP/IAESR model JOANI. The latter is an interface of JOANNA and ORANI for the primary purpose of preliminary investigation of certain trans-Tasman economic issues. Key aspects of these developments are examined, with particular reference to longer run issues, in the next two sections.

3 RBNZ XII

3.1 Key features

The main purpose of RBNZ XII is expressed in Brooks and Gibbs (1991, p.1) as "... to provide an analytical tool for monetary and exchange rate policy analysis, and for medium-term forecasting". The model includes 43 behavioural equations and 62 identities, and has a basic structure broadly similar to that of its immediate predecessors. Its major innovative feature is the very comprehensive use of unit root and cointegration based techniques to underpin estimation of its long run relations. This distinguishes it not only from previous RBNZ models but also from other working macroeconometric models of significant size.

Its treatment of most of the concepts set out in section 1 is evaluated in sub-section 3.2, but the two interfacing aspects are left till sub-section 4.2.

3.2 Long run concepts

Long run (balanced) steady state growth

As was the case for RBNZ10, RBNZ XII has not been specified so as to be readily solvable for an explicit long run steady state version. In recent years this has been done for both the AMPS (Murphy *et.al..*, 1986, pp 55-59, Appendix A), and Murphy (1988b, pp 69-72; 1988a) models for Australia. Instead RBNZ took the route of checking whether the model exhibits sensible long run simulation properties.

Murphy *et. al..* (1986, p 10) have suggested desirable long-run features should include:

- Harrod-neutral technical progress;
- homogeneity, in the form of
  - constant returns to scale production processes,
  - private consumption being linear homogeneous in after-tax labour income and non-human wealth, and
  - money demand being linear homogeneous in an appropriate income variable; and
- a vertical long-run Phillips Curve, implying that the actual unemployment rate will return in the steady state to its natural rate.

In the Murphy (1988) model, once assumptions for the exogenous variables consistent with balanced growth had been set, plausible balanced growth paths were achieved. At that time, this meant assuming population growth and general government employment growth of 1.7

per cent per annum, growth in foreign import demand and general government purchases of 3.2 per cent per annum, and growth in the stocks of money and public sector securities of 10 per cent per annum. Harrod-neutral technical progress of 1.5 per cent per annum plus the 1.7 per cent population growth ensured domestic real growth of 3.2 per cent per annum; the domestic inflation path was therefore 6.8 per cent, and exchange rate depreciation 4.0 per cent per annum (given foreign price growth of 2.8 per cent). Similarly, in the early 1980's for New Zealand, Bailey *et. al.*. (1987, pp 727-738) chose both Harrod-neutral technical progress and population growth of around 2 per cent per annum, and money supply growth of around 12 per cent. This led to a then credible long run real growth path of around 4 per cent per annum and annual price inflation of around 8 per cent.

Although RBNZ XII has not been solved explicitly for its long run steady state version, it includes some concepts generally considered important for plausible balanced growth rates. It doesn't seem to either incorporate or reflect others, though. This could be contributing to unemployment and government debt outcomes which are still volatile in the longer term (eg after nine years),following shocks to such variables as the terms of trade and world growth.

Harrod-neutral technical progress and constant returns to scale were imposed in the private sector CES production function. However, no satisfactory empirical value for Harrod-neutral technical progress was able to be estimated. Its influence in the model was replaced by a "restructuring of the New Zealand economy" dummy variable, leading to labour input taking a one-step increased value of around 1.16 from the first quarter of 1985. There has clearly been very considerable structural change in New Zealand's labour and goods markets since 1985, but it could well be captured in a rather better manner than through a single switch dummy variable.

It does not seem possible to derive easily an explicit vertical long run Phillips Curve from the model's equations. However, initial inspection of the long run monetary policy simulation outcomes (i.e nine years in the short run version of the model, and eleven years in the long run version), suggests full model behaviour may not be inconsistent with the long run Phillips Curve being vertical.

Private consumption does not seem linear homogeneous in labour income and non-human wealth, though there are plans (Brooks and Gibbs, 1990, s.7) to test the homogeneity restriction that a ten per cent rise in permanent income leads to a ten per cent rise in long run consumption, following further re-estimation of the consumption equations. For the long run equations currently reported, the coefficients for income and wealth variables do not seem to sum to one, and the elasticity with respect to the inflation variable in the non-durables sub-group might be significantly different from zero. Nominal homogeneity, in the sense of ten per cent changes in price and other nominal variables having no effect on any of

the three real long run consumption sub-group variables, is imposed, thereby contributing importantly towards long run financial neutrality. Also of interest in this context is that Wong and McDermott (1990), using a very similar consumption data set but not unit root/cointegration methodology, tested a Rotterdam model specification and were not able to reject demand homogeneity.

It is not easy to judge whether real money demand is homogeneous in real income (and wealth), given the way the financial sector in RBNZ XII is modelled. This is partly due to the not unexpected difficulty the RBNZ has had establishing any stable long run demand equations for monetary aggregates (eg Greville, 1989), and partly due to its use of an "Almost Ideal Demand System" (AIDS)-based sub-model of non-bank private sector financial asset holdings (Wong, Grimes and Meads, 1989). The long run private sector credit equation exhibits (imposed) linear homogeneity in real private sector output, though private sector credit does not affect any other variable in the model. The joint hypothesis of demand homogeneity and Slutsky symmetry is unable to be rejected in a short run dynamic version of the financial asset portfolio sub-model, but cannot be accepted in its static long run form.

Long run financial neutrality

Financial neutrality, in the sense of an increase in the quantity of money leading to the same increase in the aggregate price level and no change in real variables, is not able to be assessed directly, as the monetary policy shock takes place through real short term interest rates. After nine to eleven years, deviations from control for aggregate real variables seem generally small, but the deviations of nominal money and "price" variables had not always converged completely.

There seem to be a range of mechanisms which are particularly important in contributing to this degree of financial neutrality. They include: the imposition of full wage indexation in the private sector nominal wage equation; the restriction (successfully tested) in the long run nominal effective exchange rate equation that there is a one-to-one reaction of nominal exchange rate movements to the ratio of foreign to domestic output prices; the imposition of nominal homogeneity in the consumer expenditure equations; and key theoretical restrictions placed on the core aggregate (producer) price equation also not being rejected. The latter involve the world price and unit labour cost coefficients being restricted to sum to one, and the world price and TWI coefficients being restricted to sum to zero.

As emphasized in Murphy *et. al.*. (1988, pp 10-11), whether financial neutrality holds will depend in particular on the source of the shock to the money supply. For example in AMPS, financial neutrality is demonstrated for the case where, from a temporary increase in the budget deficit, the stocks of money and bonds increase together. Then, in the Murphy

model, financial neutrality is shown to hold for an increase in the money supply via open market operations, as long as the subsequent reduction in government real interest payments is passed back to households via (for example) a lump sum tax cut. Hence, in light of this, and despite the comments made in the previous paragraph about the piecemeal contributions towards achieving financial neutrality in RBNZ XII, precisely how close the temporary cut in the real 90 day interest rate in RBNZ XII comes to achieving financial neutrality could well require further detailed examination.

Household and Producer Optimising Behaviour

Household consumption expenditure is explained basically through a modified life-cycle approach. Its three major disaggregated components include household disposable income and wealth as explanatory variables. Explicit optimising behaviour does not underpin them, despite some references to individuals having to make intertemporal choices, and Ricardian equivalence is neither imposed nor tested for.

The financial asset portfolio sub-model referred to above is derived from an "investor" static expenditure minimization problem, adapted from a consumer theory AIDS model.

In contrast, "private sector" producer behaviour has very explicit, carefully described dynamic optimisation underpinnings. As set out in Brooks and Gibbs (1991, Appendix 3), the infinite horizon optimisation problem for the representative firm is to maximize its discounted net cash flow/ profit, subject to its CES production function and an inventory (V)/economy sales ratio. Factor prices are assumed given to the firm; symmetric real quadratic adjustment costs are assumed for the number of employees (E), the non-dwelling capital stock (K), and deviations of actual hours paid per employee (H) from normal hours; and asymmetric real quadratic adjustment costs are assumed for deviation of actual capacity utilization (U) from normal. The five endogenous variables solved for are $\dot{E}$, $\dot{K}$, H, U and the residually determined $\dot{V}$. Long run behaviour is neoclassical and the various demand effects on hours and capacity utilization ensure significant Keynesian influences in the shorter run.

The Non-linear Seemingly Unrelated Regression (NLSUR) technique was used to estimate parameter values for the CES production function and its corresponding wage equation.

$$Q = \gamma\left[\delta\,(e^{\lambda D}\,E\cdot H)^{\frac{\sigma-1}{\sigma}} + (1-\delta)\,(K\cdot U)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$$

$$\log (E\cdot H) = \beta_1 - \sigma \log W + \log Q + \lambda(\sigma - 1)D$$

where D = O for 1965 (1) to 1984 (4)
D = 1 for 1985 (1) to 1987 (1)

"Satisfactory" estimates for the parameter values (which are consistent across the interrelated factor demand equations) were obtained, though it has been noted above that the statistically significant estimate of λ does not reflect a particularly ideal alternative specification. Econometric estimates for the theoretically derived equations for $\dot{E}$ and $\dot{K}$ were also satisfactory, but those for H and U were not and had to be replaced by estimates from somewhat simpler equations. As New Zealand's export supply remains significantly primary sector based, export supply was not integrated into the private sector dynamic optimisation problem.

Unit Roots and Cointegration

As emphasized in sub-section 3.1 above, the comprehensive use of unit root and cointegration tests in a macroeconometric model of significant size is the major innovative feature of RBNZ XII.

The particular way in which this was carried out is described clearly in Cruse and McDermott (1989) and in Brooks and Gibbs (1991, section 2). For the long run (equilibrium) equations, this involved:

- first, determining the order of integration of the time series relevant to the theoretically derived and/or institutionally conditioned behavioural equations. Phillips (1987) Z_t test and graphical inspection techniques were employed;
- secondly, estimating the cointegrating equations with relevant I(1) variables, using OLS, except for the above-mentioned NLSUR for the production function and 3SLS for the financial wealth portfolio sub-model. The residuals were tested for a unit root, using the Phillips Z_t test. Provided cointegration was achieved, the parametric adjustment suggested by Phillips (1991) was specified and the long run equations estimated. At that stage, any *a priori* restrictions were imposed, and tested for validity through retesting for a unit root.

Short run error correction model equations were then specified and estimated, again primarily by OLS, and the series of diagnostic tests set out in Cruse and McDermott (1989) and Brooks and Gibbs (1991) were then carried out.

Johansen (1988, 1989) cointegration and validity of restrictions tests were not performed, as programmed procedures were not available at the time of estimation of RBNZ XII.

It is of significant interest that Brooks and Gibbs (1991, sub-section 2.3) consider the extra estimation cost (primarily in terms of estimation being initially more time consuming)

associated with this model version has been " ... justified by the statistical and theoretical superiority of the results obtained ...".

Hence, for RBNZ XII's long run relations obtained through the use of unit root and cointegration methodology, particular attention has been paid to the long run in a statistical sense. This does not, of course, have to correspond with long run economic theoretic equilibrium in either a steady state growth or market clearing sense. The logical next step for this and other economy wide macroeconometric models would therefore be to check that each of these three aspects of the long run have been appropriately coordinated. Amongst other things, further developments in testing for cointegrated relationships will be necessary to ensure this becomes possible.

Dynamics

It is convenient to group under this heading RBNZ XII's treatment of intrinsic dynamics (including physical and financial capital accumulation), non-intrinsic dynamics (including rational expectations), and dynamic stability.

- **Intrinsic dynamics**

  In contrast to previous versions, RBNZ XII has a comprehensive explicit treatment of physical and financial capital accumulation, including endogenously determined interest payments on government and foreign debt. Limitations in equation specification are related more to data inadequacies than to inappropriate incorporation of economic theory.

  Physical capital is disaggregated into only two components at present, due to data limitations in the capital stock and investment areas. Net private investment in dwellings is "q theory" based, and the corresponding capital stock is assumed to depreciate at approximately 2.4 per cent per annum. The net business (or private sector other) investment is also "q" based, and incorporates a constant-over-time risk premium of around 20 per cent per annum (for a real interest rate bounded between 2 and 12 per cent per annum). That capital stock aggregate is assumed to depreciate at approximately 7.2 per cent per annum. It is foreshadowed in Brooks and Gibbs (1991, section 7) that this aggregate will be split into the three categories of commercial buildings, transport equipment and plant, and machinery and equipment, once data is available. It is acknowledged that this may also require altering the definition of the model's production sector, particularly in light of Government sector asset sales in recent years. Differing risk premia will clearly also have to be considered.

With respect to *financial capital accumulation*, government budget and foreign sector constraints are not new to RBNZ XII, but the endogenisation of the corresponding net interest payments and debt accumulations is. The government budget ("Table 2" government balance before borrowing) constraint separates aggregate net interest payments into those for domestic and external debt servicing. Each of these variables is in turn specified in relatively simple fashion, partly due to the sizeable nature of balancing items associated with data limitations. Domestic interest payments are then current domestic public debt (consisting of exogenously determined public authority and RBNZ holdings, and portfolio determined bank and non-bank private sector holdings) times an eight quarter average of the medium term interest rate on government securities. Fiscal deficits are assumed fully funded via domestic debt. Government external debt interest payments take the current $NZ value of government external debt (the foreign currency value of which is exogenous), times an eight quarter weighted average, of domestic and foreign interest rates.

The foreign sector constraint, and endogenous explanation of (gross) external debt accumulation and interest payments, are also treated theoretically correctly but in a necessarily basic fashion. Specification limitations are explicitly set out in Brooks and Gibbs (1991, section 3). For example, the exogenous balancing variable in the external debt identity partly captures inadequate data series and partly the less than ideal debt revaluation adjustment. The previous quarter's domestically valued external debt is simply revalued by the change in the only nominal exchange rate in the model (i.e the TWI, which is non-debt weighted).

Given New Zealand's high (but still quantitatively uncertain) net external debt/GDP ratio, it is surprising no sovereign risk premium is explicitly specified. However, one illustrative fiscal policy simulation (Brooks and Gibbs, 1991, sub-section 6.3) did incorporate both a monetary policy and a risk premium reaction function. The former required the real 90-day interest rate to rise if inflation deviated from control, and the latter had the real interest rate rising if the external debt ratio rose relative to control. The consequent outcomes were net adverse affects on real activity, but ameliorating effects on the levels of public and private debt. A more formal treatment of sovereign risk, and the possible trade-offs between accumulation of capital and external debt as illustrated for example in Bhandari *et al.*. (1990), therefore seems justifiable.

- **Non-Intrinsic dynamics**

  As explained above, the model's non-intrinsic dynamics are primarily ECM in nature, underpinned in some cases by Keynesian demand buffering mechanisms.

Expectations variables and mechanisms are conspicuously absent. No expectations variable is formally defined for any of the model's goods, labour or financial markets, and there is no formal role for either rational or model consistent expectations. This means that there is no scope for examining the differential effects of anticipated and unanticipated shocks, as done for example in McKibbin (1988) and in Murphy (1988b). Implicitly, however, backward looking adaptive inflationary expectations appear through the year-to-year inflation rate being the major difference between the various nominal and real interest rate variables. Moreover, it would appear that rational expectations have been consciously rather than inadvertently omitted, as according to Brooks and Gibbs (1991, section 5):

> "The key difference between the [monetary] transmission mechanism in the model and the real world is the way inflationary expectations are formed. Inflationary expectations are determined in the model as the historical outcome for inflation whereas inflationary expectations in the real world are formed as a result of both backward and forward looking behaviour. .....No such forward looking behaviour is built into the model because of the technical difficulty involved in doing so with such a large model".

- **Dynamic Stability**

  Although there is no formal statement to this effect, it would appear that the range of simulations conducted to date with the long run and short run versions of the model are generally consistent with dynamic stability being achieved after around ten years. However, for the short run version in particular, the response of variables such as unemployment, the stock to sales ratio, external debt/GDP and government debt/GDP following certain real shocks would seem to warrant further examination. The matter of stability in the face of alternative methods of financing a fiscal shock could also be investigated.

4 RECENT CGE MODELLING DEVELOPMENTS

4.1 IMPACT/ORANI and RPEP Research Directions

The research directions taken by CGE modelling on the two sides of the Tasman have been distinctively different over the past five years or so. This has partly been due to differing degrees of resource availability and commitments.

Neither can claim to have yet solved completely either such long run modelling challenges as the "overspecialization problem" (eg Horridge, Powell and Wilcoxen (1990)) or the

interfacing of appropriate macroeconometric and CGE models. This means that CGE-based models exhibiting sustainable steady state aggregate and sectoral growth paths, consistent with satisfactory dynamic paths towards domestic and external debt sustainability, have yet to be developed.

However, recent IMPACT/ORANI research has focussed on aspects of these areas. For example, the further development of ORANI as ORANI-F for medium-term forecasting purposes has been a significant step forward. ORANI-F additionally contains a detailed set of national and government accounts (NAGA), and some simple (average annual growth rate) dynamics for physical capital accumulation and foreign debt accumulation. Explanations have been provided in Dixon and Parmenter (1988, 1990) and Parmenter, Adams and Peter (1990). Similarly, the recent experimental interface of short-run ORANI^{+} and the Murphy model (see Breece *et al*, 1991) must also be regarded as further significant progress. A much broader review of the CGE research associated with IMPACT over the past decade or so has recently been presented in Powell (1991).

In contrast, the RPEP work has been shorter run in focus and has chosen to concentrate on developing significant much-needed new data. The latter has been particularly important for the maintenance and further development of a model in levels form, and has included the development of a comprehensive (unofficial) annual data base for sectoral investment and capital stock for the period since 1950 (Philpott, 1991), and the incorporation of data from the 1986/87 interindustry study. Both JOANNA and JULIANNE now have government budget balance closure equations, but have not been extended to reflect domestic or external debt accumulation. Perhaps of most significance in the model development area, however, has been the two country interface obtained from the two short run comparative static models JOANNA and ORANI. This substantially empirical innovative development of a preliminary nature could provide a suitable foundation for tackling a range of medium to long term dynamic issues. Some of its key aspects are now outlined.

4.2 JOANI

The Model

The JOANI model was constructed by Victoria University of Wellington's RPEP, in conjunction with the University of Melbourne's Institute of Applied Economic and Social Research, from the JOANNA model for the New Zealand economy and the ORANI model for Australia. Its use to date has been confined to the examination of (short run) aggregate and sectoral outcomes from alternative forms of trans-Tasman Closer Economic Relations (CER).

The model is based on theory and equations set out by Vincent (1983) and Meagher (1982) for a general multicountry Johansen-type model. A written description of JOANI is provided in Philpott and Nana (1988, section 3), and its detailed data base and equation specifications are set out in Nana and Philpott (1988).

The key element underpinning the interface is the separate identification and specification of three rather than two sources and destinations for New Zealand and Australian products, ie for each CER partner this means splitting the rest of the world into its trans-Tasman neighbour and a revised rest of the world. Sectoral/commodity concordance was achieved through a detailed examination of the NZSIC, ASIC and associated commodity classifications. For resource reasons, the current form of interface reflects JOANNA's 22 sectors and input-output commodities rather than ORANI's 112/114 sectors/commodities

The elasticities of substitution between goods from each of the three sources (ie domestic production, trans-Tasman imports or rest of world imports) were set at 2.0 for New Zealand and at the weighted average of those for the equivalent ORANI sectors. For labour and capital factor inputs within each country, the elasticities of substitution all remained at 0.5.

As the constituent models were both in percentage change form, the underlying data bases and corresponding coefficient values did not have to be for the same year, so long as the relevant equation "shares" remained relatively stable over time. In fact, the JOANNA base year was March 1981/82 and that for ORANI June 1977/78. This difference and the relatively historical nature of the base years clearly would have provided much greater difficulty if the aim had been to interface two models in levels form and to capture explicit dynamic behaviour.

Indicative Output

Some illustrative simulation results are presented in Table 2, for three different forms of CER. In each case, no change in real wage rates is assumed. CER was taken fairly simplistically as "free trade" (or zero protection) between New Zealand and Australia only. The second, somewhat more open form, was defined as CER plus the imposition of a common external tariff (CET) in both countries with respect to imports from the rest of the world. The CET was set at the minimum (commodity-specific) of the tariffs then existing in Australia or New Zealand. The third, and most open, scenario simulated was CER plus "free trade for imports from the rest of the world".

Given the conditioning assumptions, the illustrative results were not surprising. For example:

- significant increases in aggregate real sector activity and employment were recorded in both countries under all three scenarios;
- noticeable cost and consumer price reductions are evident in both countries, except in New Zealand under CER where expansionary activity with the existing capital stock led to some cost and consumer price increase;
- substantial changes occurred in the trans-Tasman balance of trade, with the relatively greater benefit going to New Zealand, in line with New Zealand's percentage of trade being much greater with Australia than Australia's with New Zealand; and
- the net overall effect on each country's balance of trade is adverse, due in New Zealand's case to the increased deficit with the rest of the world outweighing the trans-Tasman surplus.

Possible further developments

The interfacing of two short run comparative static CGE models, to produce results in percentage change form, can provide relatively limited insights into intercountry economic activity and to the ways those countries react to external shocks and internal supply side shocks. Moreover, the key empirical economic issues requiring analysis in this area no longer simply involve trade in goods and services in such a narrow sense. Some of these issues have recently been explored in preliminary non-modelling papers by Lloyd (1990), Lloyd (1991), Vandersyp (1990) and Grimmond (1991). Answers will need to draw on model results on the magnitudes and time horizons for "price" and quantity adjustments in each country's goods, labour, physical and financial capital markets. Labour and financial capital can be taken as reasonably mobile between the two countries, but physical capital/business fixed investment generally cannot be so in the short run.

The economic implications of a greater degree of harmonization of tax and other business laws, and the desirability or otherwise of some form of currency integration also require further analytical examination. To do this, properly interfaced macroeconomic and CGE models are ideally needed. As this has not yet been accomplished for either Australia or New Zealand, then the integration of one country's macro-CGE model with the other's must be still further off. Nevertheless, just as Wells and Easton argued that valuable insights could be obtained from informal linking of an RBNZ and a JULIANNE model, so too it is considered that valuable preliminary messages could be obtained from applying similar (external) shocks to an informal linking of four models such as MURPHY, ORANI-F, RBNZ XII and JULIANNE.

5. CONCLUDING REMARKS

The major innovative feature of *RBNZ XII* is its very comprehensive use of unit root and cointegration based techniques to underpin estimation of its long run relations. Its treatment of long run concepts is therefore heavily conditioned by its having focussed on the long run in a statistical sense, and a significant return from this is that its authors consider the statistical and theoretical results obtained are superior to those of previous models. But it also means at this stage of development that the resulting long run equations do not necessarily correspond with long run economic theoretic equilibrium in either a steady state growth or market clearing sense. In particular, explicit attention to steady state economic properties, and to rational expectations formulations and solution procedures has been negligible.

Considerable attention has been paid, in a range of ways, to trying to achieve long run financial neutrality and dynamic stability, though there remains scope for further focus on the sensitivity of long run outcomes to alternative sources of monetary shock and to alternative methods of financing a fiscal shock.

Traditional long run economic concepts (including the supply side, physical and financial capital accumulation and debt sustainability) have generally been treated well, but in some cases would have been specified better if more appropriate data had been available.

The *RPEP's CGE model research program* over the past five years or so has been short to medium term in focus, and has partly been associated with maintaining both "levels" and "percentage change" form models. Data base work has included the development of comprehensive (unofficial) sectoral investment and capital stock series for the period since 1950; and interfacing the two short run comparative static models JOANNA and ORANI has provided a useful foundation for tackling a range of more challenging trans-Tasman economic issues. This has necessarily mean't that significant medium to longer term issues, such as the incorporation of satisfactory physical capital accumulation, and domestic and foreign debt equations, together with the interfacing of suitable macroeconometric and CGE models, have yet to be undertaken.

Hence, long run (equilibrium) concepts are far from having been ignored in New Zealand's macroeconometric and CGE models, but the quality of treatment of individual concepts has been quite uneven. Best practice treatment is not found solely within any single model.

REFERENCES

Bailey, R.W., V.B. Hall and P.C.B. Phillips (1987), "A Model of Output, Employment, Capital Formation and Inflation", in G. Gandolfo and F. Marzano (eds.), *Keynesian Theory, Planning Models and Quantitative Economics,* Rome, Giuffré-Editore, 703-767.

Bhandari, J.S., N.Ul Haque and S.J. Turnovsky (1990), "Growth, External Debt, and Sovereign Risk in a Small Open Economy ", *IMF Staff papers*, 37 (2), 388-417.

Breece, J.H., K.R. McLaren, C.W Murphy and A.A Powell (1991), *Using the Murphy Model to Provide Short-Run Macroeconomic Closure for ORANI*, Impact Draft Preliminary Working Paper, July.

Brooks, R. and D. Gibbs (1991), *The Reserve Bank Econometric Model of the New Zealand Economy: Model XII*, Research Paper No.42, Reserve Bank of New Zealand, Wellington, August.

Brooks, R. and J. McDermott (1990), "Experiments with the Long-run Version of the RBNZ Model of the New Zealand Economy", paper presented to August 1990 Sesquicentennial Conference of the New Zealand Association of Economists, Auckland.

Cooper, R.J. and K.R. McLaren (1983), "The ORANI-MACRO Interface: An Illustrative Exposition", *Economic Record 59*, 166-179.

Cruse, P.F.J and J. McDermott (1989), *A User's Manual for the Estimation of the RBNZ Macroeconometric Model*, RBNZ Econometric Discussion Paper E 89/1.

Dixon, P. and B.R. Parmenter (1988), "Recent Developments in Forecasting with the ORANI Model", *Australian Economic Papers* 27, Supplementary Conference Volume 92-104.

Dixon, P. and B.R. Parmenter (1990), *Dynamics in ORANI, a Large Scale General Equilibrium Model*, Working Paper No. 1/1990, Institute of Applied Economic and Social Research, Melbourne, February.

Dixon, P., B.R. Parmenter, J. Sutton and D.P. Vincent (1982), *ORANI: A Multisectoral Model of the Australian Economy*, Amsterdam, North-Holland.

Easton, B.H. (1983), *A Medium Term Version of the RBNZ Model*, Working Paper 83.01, New Zealand Institute of Economic Research, Wellington.

Gallacher, J. and R.D. Bowie (1983), *Medium Term Review 1983*, New Zealand Institute of Economic Research, Wellington.

Greville, R.P. (1989), *Money and Credit Demand in New Zealand: 1973-1986*, Discussion Paper No. G89/7, Reserve Bank of New Zealand, Wellington.

Grimes, A., G.H. Spencer, K.G. Duggan and R.R. Dick (1983), *A Revised Reserve Bank Core Model with SNA Data*, Research Paper No.37, Reserve Bank of New Zealand, Wellington.

Grimmond, D. (1991), *Real Economy Aspects of Australia-New Zealand Currency Integration*, Report to Reserve Bank of New Zealand, NZIER, Wellington, February.

Haywood, E. (1980), *Forecasting the Economy in the Eighties,* Planning Paper No.10, New Zealand Planning Council, Wellington.

Haywood, E. (1983), *An Elementary Description of the Ministry of Works and Development National Impact Model*, mimeo, Ministry of Works and Development, Wellington.

Horridge M., A.A. Powell and P.J. Wilcoxen (1990), *Constraining Output Responses in Long-run Closures of ORANI: Some Suggestions*, Impact Project Preliminary Working Paper No. OP-70, Melbourne, May.

Johansen, L. (1960), *A Multisectoral Model of Economic Growth*, Amsterdam, North-Holland.

Johansen, S. (1988), "Statistical Analysis of Cointegration Vectors", *Journal of Economic Dynamics and Control* 12, 231-54.

Johansen, S. (1989), "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models", University of Copenhagen. Forthcoming in *Econometrica.*

Lloyd, K. (1990), "An Australia-New Zealand Currency Union: Costs, Benefits, and Prerequisites", *Policy* Winter, 9-12.

Lloyd, P.J., with a commentary by Sir Frank Holmes, (1991), *The Future of CER: A Single Market for Australia and New Zealand*, CEDA Monograph No.96 and Institute of Policy Studies, Victoria University Press, Wellington.

McKibbin, W.J. (1988), "Policy Analysis with the MSG2 Model", *Australian Economic Papers* 27, Supplementary Conference Volume, 126-150.

Meagher, G.A. (1982), The Theoretical Structure of a Multi-Region General Equilibrium Model, Economics Discussion Paper No. 3/82, La Trobe University, Melbourne.

Morgan, G. (1980), *A Model of the New Zealand Economy*, unpublished doctoral thesis, Wellington, Victoria University of Wellington.

Murphy, C.W., (1988a), *An Analysis of the Steady State Properties of a Macroeconometric Model*, mimeo

Murphy, C.W. (1988b), "Rational Expectations in Financial Markets and the Murphy Model", *Australian Economic Papers* 27, Supplementary Conference Volume, 61-88.

Murphy, C.W., I.A. Bright, R.J. Brooker, W.D. Geeves and B.K. Taplin, (1986), *A Macroeconometric Model of the Australian Economy for Medium-Term Policy Analysis*, Office of the Economic Planning Advisory Council, Technical Paper No.2, June.

Nana, G. and B.P. Philpott (1988), *The JOANI Two Country General Equilibrium Model: Data Base and Equations*, RPEP Occasional Paper No.92, Victoria University of Wellington, August.

O.E.C.D. (1981), *The Interlink System*, Paris

Parmenter, B.R., P.D. Adams and M.W. Peter (1990), *Australia's Medium-run Economic Prospects, including an Analysis of the Role of Immigration*, mimeo, IAESR, Melbourne.

Phillips, P.C.B (1987), "Time Series Regression with a Unit Root", *Econometrica* 55, 277-301.

Phillips, P.C.B (1991), "Optimal Inference in Cointegrated Systems", *Econometrica*, 59, 283-306.

Philpott, B.P. (1983), *Notes on the PEP Suite of Models for EMG Appraisal*, Internal Paper 145, Research Project on Economic Planning, Victoria University of Wellington, April.

Philpott, B.P. (1989), *General Equilibrium Modelling for New Zealand Economic Planning*, RPEP Occasional Paper No.97. Victoria University of Wellington, November.

Philpott, B.P. (1991), *Twentieth Annual Report*, RPEP Internal Paper 231, Victoria University of Wellington, May.

Philpott, B.P. and G. Nana (1988), *Quantitative Implications of Australia-New Zealand Free Trade: A Two Country General Equilibrium Model Analysis*, RPEP Occasional Paper No.93, Victoria University of Wellington, August.

Powell, A.A (1991), *A Decade of Applied General Equilibrium Modelling at the University of Melbourne*, Impact General Paper No. G97, September.

Procter, R. (1979), *GDP Growth and Energy Forecasting in New Zealand*, in Proceedings of a Seminar on Energy Forecasting, Victoria University of Wellington.

Vandersyp, C.J. (1990), "Closer Economic Relations and Currency Union", in K. Vautier *et.al.*. (eds.), *CER and Business Competition - Australia and New Zealand in a Global Economy*, Commerce Clearing House.

Vincent, D.P. (1983), *A Multicountry, Multisectoral General Equilibrium Model System with Endogenous Trade*, Working Paper No.174, Kiel Institute of World Economics, May.

Wells, G.M. and B. Easton (1983), "Some Issues in Economy-wide Modelling in New Zealand", *New Zealand Economic Papers* 17, 87-97.

Wells, G.M. and B. Easton (1986), *Economy Wide Models of New Zealand*, Research Paper No.33, New Zealand Institute of Economic Research, Wellington.

Wells, G.M. and L.T. Evans (1982), *A Critique of New Zealand Structural Macro-econometric Models and a Vector Autoregressive Alternative*, Economics Discussion Paper No.17, Victoria University of Wellington.

Wong, A. Y-T, A. Grimes and C.S. Meads (1989),*Modelling the Financial Asset Holdings of the Non-bank Private Sector in New Zealand*, Discussion Paper No. G89/8, Reserve Bank of New Zealand, Wellington.

Wong, A. Y-T and C.J. McDermott (1990), "Consumption of Durables, Non-Durables and Services in New Zealand: A System-Wide Analysis", *New Zealand Economic Papers* 24, 115-127.

TABLE 1
NEW ZEALAND'S MAIN ECONOMY-WIDE MODELS
(existing in 1983)

STRUCTURAL MODELS

Aggregate Dynamic

BHP	- Bailey-Hall-Phillips' model	Bailey *et al* (1987)
RBNZ	- Reserve Bank of New Zealand model	Grimes *et al* (1983)
INTERLINK	- New Zealand submodel of OECD model	OECD (1981)

Aggregate Static

CORA	- Easton's medium term version of RBNZ	Easton (1983)

Multisectoral Dynamic

EXPLAN	- Morgan's model	Morgan (1980)
NIM	- Ministry of Works and Development's national impact model	Haywood (1983)

Multisectoral Static

VICTORIA	- Linear programming model	)
JULIANNE	- Non-linear general equilibrium model in levels	) Philpott (1983)
JOANNA	- Linearised general equilibrium model in growth rates	)

NON-STRUCTURAL MODELS

Aggregate

HAYWOOD	- Haywood's growth model for New Zealand Planning Council	Haywood (1980)
PROCTER	- Procter's growth model for energy issues	Procter (1979)
WE	- Wells-Evans' reduced-form model	Wells and Evans (1982)

Multisectoral

MTR	- New Zealand Institute of Economic Research's medium term review model	Gallacher and Bowie (1983)
NATSEC	- New Zealand Planning Council's national sectoral model	Haywood *et al* (1983)

Source: Wells and Easton (1983, p.88)

TABLE 2
INDICATIVE JOANI MODEL AGGREGATE RESULTS+

	CER "free trade"		CER plus Common External Tariff (at minimum of existing)		CER plus "free trade for imports from rest of world"	
	NZL	AUS	NZL	AUS	NZL	AUS
Employment	0.9	0.1	2.1	0.6	3.5	2.0
Real GDP	0.7	0.1	1.5	0.6	2.8	2.0
Real private consumption	1.4	0.2	3.2	0.8	5.6	2.8
Real exports (total)	1.3	0.7	2.1	2.4	5.4	13.4
Real imports (total)	1.8	0.6	3.3	1.9	6.8	11.7
Consumer prices	0.6	-0.2	-0.0	-1.0	-2.8	-6.3
Balance of trade ($m)						
• trans-Tasman	171.8	-93.3	162.2	-86.5	87.8	-54.4
• other	-179.2	89.3	-260.4	78.9	-358.6	-284.7
Exports: trans-Tasman						
• volume	22.8	5.9	22.2	6.5	15.8	8.1
• price	0.7	-0.1	0.0	-0.8	-2.8	-5.3
• value	23.5	5.9	22.2	5.7	12.9	2.8
: other						
• volume	-2.4	0.4	-1.3	2.2	3.6	13.6
• price	0.6	-0.0	0.2	-0.6	-2.1	-3.9
• value	-1.9	0.3	-1.2	1.7	1.5	9.7
Imports: trans-Tasman						
• volume	7.3	30.5	7.7	29.2	9.6	20.1
• price	-12.3	-13.5	-13.1	-14.2	-17.5	-17.1
• value	7.3	31.1	6.9	29.2	4.5	17.2
: other						
• volume	0.7	-0.3	2.4	1.1	6.2	11.5
• price	0*	0*	-2.4	-1.7	-13.1	-13.3
• value	0.7	-0.3	2.4	1.1	6.2	11.5

+ Simulations are for unchanged real wage rates. All results are percentage changes, unless otherwise indicated
* Exogenous
Source: Philpott and Nana (1988, pp. 4, 14, 19, 21)

THE GSBGM WORKING PAPER SERIES

Victoria University of Wellington
GRADUATE SCHOOL of BUSINESS and GOVERNMENT MANAGEMENT

The main purpose of this series is to reach a wide audience quickly for feedback on recently completed or in progress research. All papers are reviewed before publication.

A full catalogue with abstracts and details of other publications is available, enquiries and to be included in our distribution list, should be sent to:

The Research Co-ordinator, GSBGM, Victoria University of Wellington, PO Box 600, Wellington, New Zealand
Tel: (04) 472 1000 x 8469; Fax: (04) 712 200

Code in bold denotes order number, eg: **WP 1/90**

--- Group denotes the author's academic discipline Group (note this does not necessarily define the subject matter, as staff's interests may not be confined to the subjects they teach).

WP 1/90 **Economics Group**
Hall, V.B.; T.P. Truong and Nguyen Van Anh 'An Australian fuel substitution tax model: ORANI-LFT. 1990 Pp 16

WP 2/90 **Accountancy Group**
Heian, James B. and Alex N. Chen 'An enquiry into self-monitoring: its relationships to physical illness and psychological distress.' 1990 Pp 16

WP 3/90 **Economics Group**
Bertram, I.G.; R.J. Stephens and C.C. Wallace 'Economic instruments and the greenhouse effect.' 1990 Pp 39

WP 4/90 **Money and Finance Group**
Keef, S.P. 'Commerce matriculants: gender and ability.' 1990 Pp 17

WP 5/90 **Economics Group**
Coleman, William 'Harrod's Growth Model: an illumination using the multiplier-accelerator model.' 1990 Pp 19

WP 6/90 **Quantitative Studies Group**
Jackson, L. Fraser 'On generalising Engel's Law: commodity expenditure shares in hierarchic demand systems.' 1990 Pp 9

WP 7/90 **Money and Finance Group**
Burnell, Stephen 'Rational theories of the future in general equilibrium models.' 1990 Pp 20

WP 8/90 **Management Group**
Shane, Scott A. Why do some societies invent more than others?' 1990 Pp 16

WP 8/90 **Management Group**
Shane, Scott A. Why do some societies invent more than others?' 1990 Pp 16

WP 9/90 **Management Group**
Shane, Scott A. Individualism, opportunism and the preference for direct foreign investment across cultures.' 1990 Pp 19

WP 10/90 **Economics Group**
Kunhong Kim 'Nominal wage stickiness and the natural rate hypothesis: an empirical analysis.' 1990 Pp 40

WP 11/90 **Economics Group**
Robert A Buckle and Chris S Meads 'How do firms react to surprising changes in demand? A vector auto-regressive analysis using business survey data.' 1990 Pp 18

WP 12/90 **Money and Finance Group**
S P Keef 'Gender Performance Difference in High School Economics and Accounting: Some Evidence from New Zealand.' 1990 Pp 18

WP 1/91 **Economic History Group**
Keith Rankin 'Gross National Product Estimates for New Zealand; 1859-1939.' 1991 Pp 27

WP 2/91 **Public Policy and Economics Group**
Sylvia Dixon 'Cost Utility Analysis in Health Policy.' 1991 Pp 43.

WP 3/91 **Accountancy Group**
Paul V. Dunmore 'A test of the effects of changing information asymmetry in a capital market.' 1991 Pp 34.

WP 4/91 **Economics Group**
Lewis Evans 'On the Restrictive nature of Constant Elasticity Demand Functions.' 1991 Pp 20.

WP 5/91 **Information Systems Group**
David G. Keane 'How senior executives think and work: implications for the design of executive information systems.' 1991 Pp 9.

WP 6/91 **Economics Group**
Hall, V.B. and R.G. Trevor 'Long run equilibrium estimation and inference.' 1991 Pp 29

WP 7/91 **Economics and Public Policy Groups**
Williams, Michael, and G. Reuten 'Managing the Mixed Economy: The Necessity of Welfare Policy' 1991 Pp 23.

WP 8/91 **Management Group**
Brocklesby, J; S. Cummings and J. Davies 'Cybernetics and organisational analysis; towards a better understanding of Beer's Viable Systems Model.' 1991 Pp 27

WP 9/91 **Accountancy Group**
Firth, Michael and Andrew Smith 'The selection of auditor firms by companies in the new issue market.' 1991. Pp 22.

WP 10/91 **Economics Group**
Bertram, I.G. 'The rising energy intensity of the New Zealand economy.' 1991 Pp 45.