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AN ECONOMETRIC MODEL OF TRANS-TASMAN
MIGRATION AFTER WORLD WAR II

Peter Brosnan and Jacques Poot

Discussion Paper No. 138

January 1986

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AN ECONOMETRIC MODEL OF TRANS-TASMAN MIGRATION AFTER WORLD WAR II

Peter Brosnan and Jacques Poot *

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January 1986

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The research was partly funded by Victoria University Internal Research Committee Grant 31/85. Special thanks are due to Prue Hyman and Alan Catt for the provision of data on the comparative cost of living and to David Pope and colleagues at Victoria University for comments. We would also like to thank Duc Nguyen and Linley Engelbrecht for research assistance and Cheryl Weir for the production of the charts.

ISBN0 949293 51 2

ISSN:0725 430X



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SUMMARY

In recent years there have been substantial net movements of persons from New Zealand to Australia, which has caused concern on both sides of the Tasman. However, there are few studies of this migration. This paper attempts to explain post-war gross migration flows across the Tasman in terms of combinations of economic and demographic variables within a behavioural cost-benefit framework. After a discussion of the salient features of Trans-Tasman migration (trends, motivations of migrants, and consequences), a four equation system is specified and estimated. One equation models the rate of New Zealand emigration and another the rate of emigration from Australia. A third equation models the probability of a New Zealand emigrant choosing Australia as a destination while the fourth equation models the corresponding probability of an Australian emigrant settling in New Zealand. Return migration is an important component of the flows. Moreover, the age composition of the population and the real cost of air travel are found to be important determinants of the emigration rates. The choice of Australia or New Zealand is found to be sensitive to changes in the demand for labour in the destination, while the attractiveness of Australia for New Zealand emigrants depends also on the potential gain in earnings or wages.

KEY WORDS: Trans-Tasman migration; return migration; human capital; cost-benefit approach; logit model.

INTRODUCTION

The economist's interest in migration is somewhat ambivalent. On the one hand geographic mobility is seen as an important labour market adjustment process; population redistribution has also implications for regional resource demands which, in turn, affects the regional demand for labour. On the other hand, contradicting results of studies during the 1960s and 1970s and a paucity of data appear to have resulted in relatively little current interest in this phenomenon. There appears to be in particular a paradox with respect to data availability: most migration studies focus on internal migration even though the more accurate and frequently available data are of international migration. A search of the economic literature for the past 10 years uncovered only a handful of articles on international migration and nearly all were descriptive rather than analytical.

The appeal of studying internal migration studies is that the matrix of migration flows usually consists of a manageable number of gross flows between spatial units of the same type (e.g. urban areas) for which the independent variables expected to influence migration are normally consistent and available. International migration studies are much more difficult. Migrants to (or from) a country come from (or go to) a wide range of other countries, and the data required for modelling the migration will often not be available or be incompatible between countries. More to the point, international migration is usually controlled while internal migration is not.

One example of international migration which is free, rather than controlled, is migration of residents between Australia and New Zealand. In fact the migration is so free that until 1 July 1981, citizens of Ireland and Commonwealth countries could enter Australia or New Zealand from the other side of the Tasman without visas while Australian and New Zealand citizens did not even require any travel documents. Since July 1981, Irish and Commonwealth citizens do require visas to enter Australia from New Zealand and Australian and New Zealand citizens require a valid passport. There are still no such restrictions on entry into New Zealand from Australia.

Despite the freedom of trans-Tasman movement, there are relatively few studies of the phenomenon. Recently Pope (1985) provided a brief overview from the Australian perspective. The most substantial work carried out in New Zealand is Andrew's (1980) masters thesis which contains a wealth of detail on the migration

flows but, useful though it is, it is largely descriptive, and does not attempt to comprehensively explain the pattern of trans-Tasman flows. Other useful studies are the papers presented at the Workshop on Population Flows between Australia and New Zealand or Vice-Versa held in 1979 (Pool, 1980a). Those papers are again largely descriptive and where they do put forward hypotheses (e.g., Wood, 1980), these are left untested. The remaining studies are articles published in the *Labour and Employment Gazette* (e.g. New Zealand Department of Labour, 1963), an article in the *Encyclopedia of New Zealand* (Marolle, 1966) and one econometric study (Butcher and Trent, 1979). Four other papers which have a bearing on the topic should also be mentioned here: Gould's (1984) analysis of New Zealand migration statistics for 1949-1981, Layton's (1983) study of British migration to New Zealand after World War Two which modelled the cross pulls exerted by Australia as a country of alternative destination, Grimes (1981) who modelled immigration and emigration as component parts of a model of the New Zealand labour market and a recent study by the New Zealand Department of Statistics (1983) which modelled New Zealand's immigration and emigration for the post-war period.

Given the lack of analytical studies of trans-Tasman migration, and shortcomings, which we discuss below, of the Butcher and Trent (1979) study, we decided to comprehensively model trans-Tasman migration for the period 1947 to 1985. Our reasons for choosing this topic were threefold. First, trans-Tasman migration has attracted a considerable amount of public interest in recent years. Secondly, as we mentioned above, much trans-Tasman migration is free migration and thus more amenable to econometric modelling. Thirdly, the data for our independent variables were available in comparable forms for both Australia and New Zealand.

Despite these attractions of the topic, the choice of data for our dependent variable - migration - was severely limited. The ideal data for our purpose would be trans-Tasman flows in each direction by persons with citizenship in either Australia or New Zealand. Unfortunately, such data are available only since 1979 and this information provides too few observations for time-series analysis. Consequently, we have had to use all permanent and long-term migration as our dependent variable, despite these flows including persons whose migration is subject to visa requirements. Before outlining the model and the empirical results, however, it is useful to focus first on some salient features of trans-Tasman migration.

SALIENT FEATURES OF TRANS-TASMAN MIGRATION

a) Trends

Trans-Tasman population movements have been occurring ever since the formation of the New Zealand colony. Indeed, there was considerable movement last century among the Australasian colonies, transportation difficulties notwithstanding, and there were many Australians in New Zealand. Sinclair claims that half of Auckland's 1851 population came from Australia and that it was seen as "Sydney transplanted" (Sinclair, 1980, p.100).

Table 1 shows the numbers and proportions of New Zealand and Australian born in the other country. We see, from this table that there are proportionately more Australians in New Zealand. This is not surprising given relative populations of the two countries. In fact, until the 1930s the number of Australians in New Zealand actually exceeded the number of New Zealanders in Australia. Since then the balance has swung the other way until, by 1981, there were 3.4 New Zealanders in Australia for every one Australian in New Zealand.

It can also be seen from Table 1 how rapid the increase of New Zealanders in Australia has been. The number increased by a half between 1966 and 1971 and almost doubled in the five years from 1976 to 1981. This implies that the increase in movement from New Zealand to Australia has been very rapid indeed and this can be attributed to two principal factors. Firstly, the rate of long term and permanent emigration from New Zealand increased substantially between 1967 and 1979, rising from a rate of 7.8 per thousand to 25.8 per thousand. At the same time, Australia became the intended destination of a higher proportion of emigrants. The proportion of emigrants going to Australia post World War II, had always fluctuated between 26 and 45 percent but from 1968 the proportion rose and since then has fluctuated between 42 and 61 percent.

The fluctuating nature of trans-Tasman migration is most obvious when we examine the pattern of net flows. These are depicted graphically in Chart 1 which shows total trans-Tasman arrivals in New Zealand net of total trans-Tasman departures. It will be noted from Chart 1 that net migration follows a cyclical pattern with the cycles averaging four to five years. Most striking immediately is that, despite

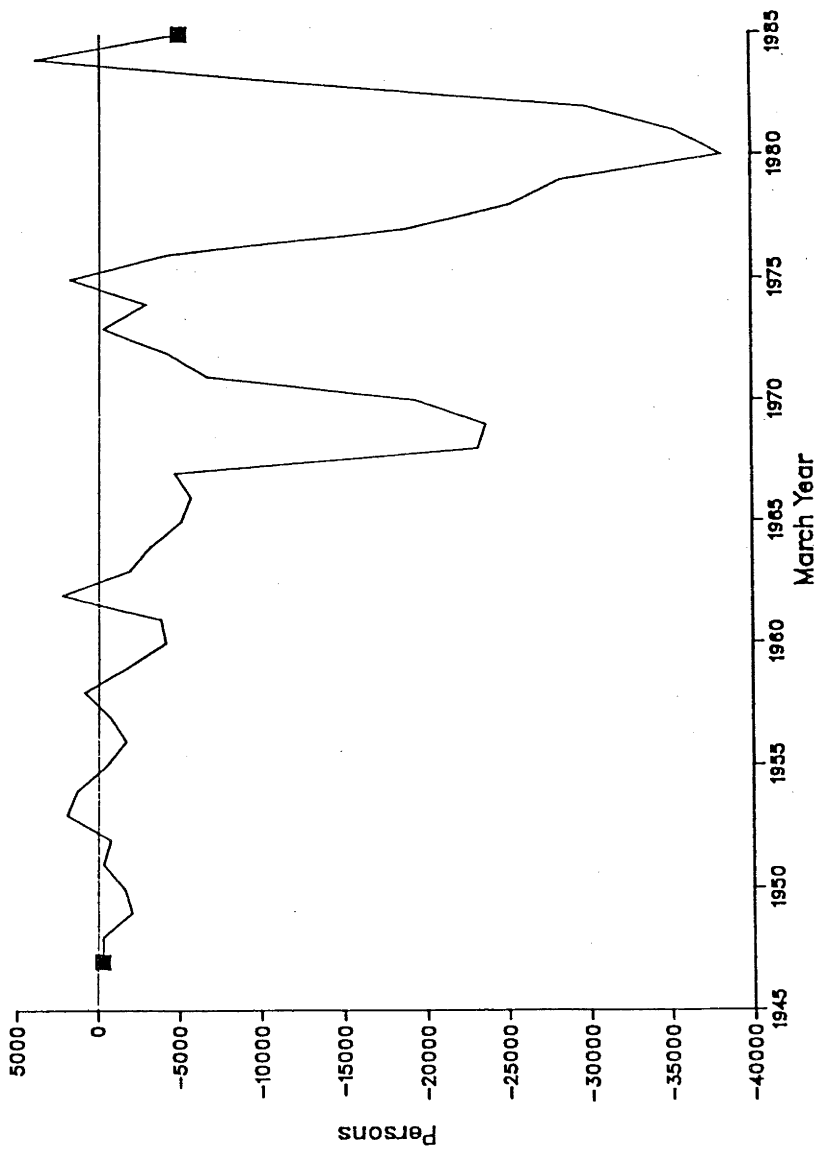
Table 1 Trans-Tasman Population Exchange : 1881-1981

<i>Census Year</i>	<i>NZ born in Australia</i>	<i>Australian Population</i>	<i>%</i>	<i>Census Year</i>	<i>Australian born in NZ</i>	<i>New Zealand population</i>	<i>%</i>
1881	6828	2250194	0.3	1878	16091	534030	3.0
1891	23870	3177823	0.8	1891	15943	668400	2.4
1901	25788	3773801	0.7	1901	26991	851666	3.3
1911	31868	4455005	0.7	1911	50029	1058063	4.7
1921	38611	5435734	0.7	1921	48045	1271664	3.8
1933	45963	6629839	0.7	1936	42009	1573810	2.7
1947	43610	7579358	0.6	1945	36789	1702298	2.2
1954	43350	8986530	0.5	1956	35916	2174062	1.7
1961	47011	10548267	0.4	1961	35412	2414984	1.5
1966	52485	11599498	0.5	1966	43374	2676919	1.6
1971	80466	12755638	0.6	1971	44084	2862631	1.5
1976	89791	13548500	0.7	1976	61151	3129383	2.0
1981	176713	14576300	1.2	1981	52614	3175737	1.7

Sources : C. Price, "Trans-Tasman Migration an Australian Viewpoint" in Pool, I. (ed.) *Trans-Tasman Migration*, Hamilton Population Studies Centre, University of Waikato, 1980, *Yearbook Australia*.

New Zealand Department of Statistics ; New Zealand Census of Population and Dwellings.

Chart 1: Net Trans-Tasman Migration:
Total Arrivals Minus Total Departures



the cycles, New Zealand has experienced net losses in most years. In only five years of the 1947-85 period did peaks of the cycles produce a positive balance in New Zealand's favour and the amplitude of the cycle has clearly increased in the periods since 1968.

b) Motivations of migrants

This substantially increased net migration to Australia is frequently explained in terms of a declining economic performance in New Zealand (e.g. Gould, 1984). Wood (1980) added to this explanation four other motivations for increased New Zealand - Australian migration: (a) New Zealanders believe that their chances of employment are broader in Australia (b) A certain knowledge that employment opportunities are diminishing in New Zealand against outdated information about opportunities in Australia (c) "Brighter lights and excitement" (d) The fact that an outflow has occurred already. On this point, Barrington and Davey (1980) directly surveyed migrants leaving New Zealand and determined that the presence of friends and relatives in Australia was important. They found that 85 percent of all emigrants had friends or relatives at the destination. Three quarters of migrants had somewhere to stay on arrival; one third had arranged a job. They also found that most Australia-bound migrants in their sample were either New Zealanders (84 percent) or Australians (9 percent). Thus this trans-Tasman flow would appear to be largely free migration.

What also emerges from the Barrington-Davey study is the importance of work-related factors in the decision to migrate. One third of migrants to Australia said they were going for a working holiday. Other important reasons were: change/way of life (28 percent), work/career opportunities (28 percent), wages (20 percent), and family situation (20 percent). The unrestricted access of New Zealand residents to employment in Australia and of Australian residents to employment in New Zealand have led some to talk of there being a common labour market between the two countries. This is clearly something of exaggeration since, as we note later in the paper, there are substantial differentials between the two countries. Nonetheless, Farmer and Andrew point to trans-Tasman flows of labour in specific occupations in response to changes in demand (1980, p. 59).

c) Consequences of Migration

The consequences of trans-Tasman migration have been considered more serious on the New Zealand side since New Zealand is losing more of its population through trans-Tasman migration than Australia, both relatively and absolutely. New Zealand concerns are both economic and psychological. The latter relate to New Zealand's self image: the large migration across the Tasman has the connotations of New Zealand as a "sinking ship". The economic concerns centre mainly on an alleged "brain drain" because of a net loss of skilled workers. Another concern is the impact of the cyclical nature of the trans-Tasman flow, which results in ups and downs in the demand for residential building and public services such as health care and schooling (Pool 1980b, pp.14-15). Positive effects are voiced as well: a common conjecture about the impact of the net outflow across the Tasman on the labour market is that it has contributed to New Zealand's low, by international standards, unemployment rate (e.g. Easton 1980, p.54). Australian concern is over the large number of New Zealanders receiving unemployment benefit in Australia and the disproportionate number of New Zealanders allegedly involved in Australian crime.

It should be noted that some of these concerns are based on myth. Pope (1985) showed that the negative consequences for Australia are exaggerated. While New Zealand immigrants have been typically younger than other migrant groups, they appear to do better economically than their Australian born peers. Furthermore, they can be found throughout the country and in all types of occupations and, while they have a higher unemployment rate than the Australians upon arrival, their long-term unemployment rate is the same as for the Australian born. Moreover, with respect to the brain drain, the population exchange appears to cover the broad spectrum of occupations (Farmer and Andrew, 1980, p.48-55) and the problem for New Zealand would thus appear to be a loss of human resources in general rather than a selective loss of the most highly trained persons. Nonetheless, when we look at specific occupations (e.g. nursing, building trades) migration does appear to be more selective than the aggregate data suggest.

THE THEORETICAL FRAMEWORK

The empirical analysis of trans-Tasman migration reported in this paper is based on the behavioural assumption which states that individuals and households compare explicitly or subconsciously, throughout their adult lives, the net present value of life time utility at their current location with the costs and benefits of shifting elsewhere. Present and expected future income is a major factor determining satisfaction at a given location and we would expect households to move to regions where they anticipate their combined human capital to be most productive, and thus to receive the highest reward, *cet. par.* However, migration also involves costs, both pecuniary (e.g. removal costs, job separation costs and job search costs) and non-pecuniary costs (the psychic cost of leaving friends and amenities). On the other hand, there are non-pecuniary benefits, such as a better climate or the amenities of a large city.

The cost-benefit approach to migration has been firmly rooted in the migration literature since Sjaastad's seminal paper (Sjaastad, 1962). The theory is of a microeconomic nature and is therefore obviously best tested with micro-level data. Several recent empirical studies with survey data have provided confirmation of the theory and associated hypotheses (e.g. DaVanzo, 1983; Herzog, Schlottmann and Johnson, 1984).

When aggregate migration data are considered, the cost-benefit model has been commonly translated into a push-pull factor framework which explains the positive net movement from depressed to expanding areas in terms of differentials in the standard of living and employment opportunities. However, a push-pull model of net migration intermingles supply and demand factors responsible for gross migration in both directions (see e.g. Pope 1976, pp.151-152) and this is undoubtedly one of the reasons for contradictory evidence on the relative importance of push versus pull factors. There are at least four other qualifications. Firstly, the actual net flow may contradict the expected direction due to the presence of externalities such as congestion and spillover effects, or due to return migration, for example to enable the migrant to transfer wealth gains to the home region or country. Secondly, the impact of quality of life aspects is difficult to measure and this is particularly relevant for the retirement and family reunion component of migration. Thirdly, not all permanent and long-term migration is the result of a completely free choice: transferrals of employees

need not follow the general trends. Finally, models of net migration do not capture the distinction between factors which influence the "emission" of migrants from areas and the determinants of the allocation of these migrants over potential destinations. For example, Lowry (1966) found that the total volume of out-migration from a given place depended on the size and structural properties of the resident population rather than economic opportunities, whereas the latter determined the choice of destination. Recent studies have shown that economic factors interact with composition effects in the explanation of outward migration (e.g., Schlottmann and Herzog, 1982; Poot, 1984b).

The behavioural theory of migration suggests that a migration model should focus on the propensity to emigrate from regions or countries. At the aggregate level, the observed emigration rate is assumed a function of composition effects such as age distribution and the size of the pool of those who migrated previously, while a perceived disutility arising from quality of life or economic factors can also play a role. Moreover, for any given destination, the proportion of migrants who choose that destination will depend on comparative advantage with respect to the present value of perceived life utility. The distinction between the emission of migrants and the allocation of the pool of migrants over destinations is consistent with the modern system's approach to geographic mobility (e.g. Alonso 1978; Porell and Hua, 1981; Poot, 1984b). The relevance of this approach to trans-Tasman migration is that it yields the hypothesis that the determinants of emigration from New Zealand to Australia can be divided into two groups: factors affecting the general propensity of the population to emigrate and factors determining the specific choice of Australia as destination. An identical argument applies to the flow from Australia to New Zealand. There is no theoretical reason why the two groups of factors would need to be mutually exclusive.

Since we wish to distinguish between factors affecting the general propensity to emigrate and factors determining destination choice, four behavioural equations need to be specified: one each for total emigration from Australia and New Zealand, one for the proportion of New Zealand emigrants departing for Australia and one for the proportion of Australian emigrants coming to New Zealand. Note that total immigration into Australia and New Zealand are not considered, since these heterogeneous aggregates can only be fruitfully analysed by a breakdown of the flow into countries of origin.

The four migration variables are all expressed as rates, named as follows: ZPROB, the crude New Zealand emigration rate per thousand of the population, ZAPROB, the percentage of New Zealand emigrants moving to Australia, APROB and AZPROB, the corresponding Australian concepts. Using rates has two advantages: their use reduces the problem of heteroscedasticity from which regression models of migration flows tend to suffer and, secondly, the approach allows a probability interpretation, which is thus attractive in terms of its theoretical underpinning. In order to use the four migration rates as dependent variables in regression equations, we need to transform these into logit form, since the logit model has better statistical properties than a linear probability model (e.g., Amemiya, 1981). For any migration rate p , the logit y is defined as $y = \log(p/(1-p))$ and, hence, on the basis of a linear regression model for y we may predict p by $\exp(y^*)/(1+\exp(y^*))$ with y^* being a predicted value of y .

In this paper we consider as an emigrant a person who, upon departure, has stated an intention of residing overseas for 12 months or more. It is well-known that some such emigrants return within twelve months and, alternatively, that persons departing short-term may decide to remain overseas. This type of "category jumping" may be particularly important in trans-Tasman migration because of the ease of movement between the two countries (see e.g. Pool, 1980b, pp.5-6). A recent study of post-war migration suggested that category jumping severely hampers the measurement and interpretation of external migration (Gould, 1984).

Gould argues that the *ex ante* measure of emigration based on self-reported intentions is unsuitable for the computation of the effect of emigration on population growth and as the dependent variable in regression models. In his opinion, an *ex post* measure is more appropriate for both purposes. While we agree with his first reason for discounting the permanent and long-term migration statistics, we strongly disagree with the latter contention. The behavioural theory of migration states that a migrant intends to emigrate on the basis of expectations of costs and benefits of this action. The possibility that intentions are revised in the light of conditions encountered in the destination are entirely consistent with this view. Since expectations are assumed to be rational in the sense of being a function of present and past observable variables, it is the *ex ante* measure of emigration that is the appropriate dependent variable in the model and not the *ex post* measure. Ironically, results of econometric models are often criticised for failure to incorporate *ex ante* information, whereas the external migration

statistics fortunately do provide us with such a measure. In order to guarantee that the dependent variables of the Australian and the New Zealand equations are of the same nature, Australian emigration is measured on the basis of information provided by the Australian departure cards, whereas New Zealand departure cards were used for the New Zealand data. Time-series of the dependent and explanatory variables are available from the authors on request.

EMPIRICAL RESULTS

a) Models for ZPROB

Given the modelling approach outlined above, we consider first a regression equation for ZPROB, the crude New Zealand emigration rate. Earlier attempts at modelling emigration have been Grimes (1981) and New Zealand Department of Statistics (1983). Grimes' model explained the quarterly emigration rate of the population aged 15-64 in terms of: (1) the rate of unemployment, (2) the ratio of the New Zealand to the Australian real wage, and (3) immigration with a lag of 9 quarters. The equation was estimated for the period 1962-79 and had $R^2 = 0.92$. The interesting feature of this model is the New Zealand/Australia relative wage variable. A theoretically more plausible variable would be a weighted average of measures of attractiveness of all potential destinations, weighted by the generalised cost of migration. Such an approach was successfully adopted for an New Zealand internal migration model in Poot (1984b). Since some measure of distance is commonly used as a proxy for the cost of migration, Australian conditions would dominate such an attractiveness index in the present application. Preliminary results showed that conditions in the United Kingdom, which attracts between a fifth and a quarter of New Zealand's emigrants, had little effect on the total emigration rate. Moreover, it was found that for the full post-war period, composition and push factors rather than relative pull dominated the regression model, as was earlier confirmed by the study of the Demographic Analysis Section of the New Zealand Department of Statistics (1983). Their most satisfactory model explained the level of emigration in terms of age composition, lagged immigration and unemployment. It was estimated for the period 1958-81 and had $R^2 = 96.7$ and $F = 224.9$. For these reasons, we adopted also the conventional approach of using New Zealand conditions only. The main objective was to test whether migratory behaviour was such that it could be captured by a structurally stable equation over the post-war period.

We considered a number of independent variables which capture salient features of the migration process. The age-composition effect is measured by ZYOUTHPC, the percentage of the population aged 15 to 29. Since young adults have a high propensity to leave New Zealand for a period of 12 months or more, this variable has a positive effect on the crude emigration rate. The second demographic variable in the model for ZPROB is ZIMIL5, permanent and long-term arrivals with a lag of five years. We expect that ZIMIL5 should have a positive coefficient and regard the variable as a proxy for the effect of return migration. The length of the lag would appear somewhat long, but specification tests rejected the hypothesis of a shorter lag.

With respect to macroeconomic conditions, our hypothesis is that individuals forecast their future state of well-being on the basis of readily available signals of economic performance. We considered six such signals. The expected sign of the variable in the regression analysis is indicated in brackets after the variable name. First, labour market conditions are measured by the unemployment rate, ZUNEMPR (+), and the percentage change in surveyed employment, ZEMPG (-). The first is published frequently, while the second is a proxy for job vacancies. The third economic variable is ZINFL (+), the annual rate of inflation, again a variable which has considerable media exposure. An alternative to ZINFL is the exchange rate, EXRATE (-). Instead of using a trade weighted exchange rate, EXRATE is simply the price of one New Zealand dollar expressed in Australian dollars, which is published in newspapers and by travelagents.

The migration literature suggests that political conditions also affects migration; when the population is dissatisfied with the government of the day, some will "vote with their feet" and emigrate. Empirical research has shown that the variables already mentioned are correlated with government popularity (Ursprung, 1984). Ursprung also considered the New Zealand balance of payments ZBP (+) as a popularity indicator, but within our framework of expectation formation this is less plausible, since information on monetary flows is less readily available to the general public than inflation, unemployment and the exchange rate and the information is also often misinterpreted.

The formation of expectations can be hampered by strong and sometimes erratic government intervention in markets. An example is the impact of the most recent general price and wage freeze in New Zealand, which commenced on 22 June 1982

and lasted 20 months. New Zealand had been subject to earlier price and wage freezes, but none lasted as long. While potential migrants awaited the impact of the ending of the freeze and the outcome of the 1984 election, decisions to migrate may have been delayed. To capture this, the dummy variable FREEZE (-) is introduced.

The final potential explanatory variable for ZPROB is the cost of travel overseas. Although a weighted average of airfares may have been more appropriate, a lack of information necessitated a simple measure: ZRFARE (-): the price of the least expensive one-way ticket Auckland-Sydney deflated by the New Zealand consumer price index.

The procedures by which a preferred specification is derived have recently been subject to considerable debate (e.g. Leamer, 1983; McAleer *et al.* 1985). The problem with estimating aggregate relationships is that, while theory provides guidance as to the type of variables which play a role, only proxy variables are usually available and the specification is guided by *a priori* information, possibly in a formal Bayesian framework, combined with statistical tests based on sample information. When many competing proxy variables are available, a technique such as principal components may avoid possible multicollinearity, but the results are often difficult to interpret. A number of criteria have been suggested in the literature to discriminate between competing specifications on the basis of sample information (see Amemiya, 1980). The approach adopted here is to add variables in a stepwise fashion until Mallows's C_p measure of the total squared error first reached a minimum value. It is well-known that this criterion is superior to Theil's maximum R^2 criterion. However, all criteria which rely on goodness of fit should be treated with caution and McAleer *et al.* (1985) suggest to carry out diagnostic tests of the preferred specification as a form of quality control.

The resulting model obtained by the above procedures is given by the following equation:

$$\begin{aligned} \text{Log (ZPROB/(1000-ZPROB))} = & -6.410 + 0.008 \text{ ZIMIL5} \\ & (0.002) \\ & (1) \\ & + 0.110 \text{ ZYOUTHPC} - 0.003 \text{ RFARE} + 0.013 \text{ ZINFL} - 0.341 \text{ FREEZE} \\ & (0.022) \quad (0.0005) \quad (0.006) \quad (0.076) \end{aligned}$$

period: 1952-85; $F = 151.6$; $R^2 = 95.8 \%$, $d = 1.267$

Standard errors are given in brackets. Since the model has the logit form, it was estimated by means of weighted least squares with the weights equal to the variance of n trials of a dichotomous choice process with probability $\text{ZPROB}/1000$ and n equal to the population at risk (see Johnston 1984, p.426). The fit of the model is good and all variables are significant at the 1 percent level, except for ZINFL which is significant at the 5 percent level. The Durbin-Watson statistic is in the inconclusive interval at the 5 percent significance level, but to correct for possible positive autocorrelation, the model was re-estimated with the disturbances following an AR (1) process. The autoregressive parameter was 0.301 with standard deviation 0.163, but the other coefficients changed only slightly. To test for structural change, it was assumed that a breakpoint could have occurred during the mid 1970s, when the first oil crises fed through economic conditions in New Zealand and abroad. However, a Chow test for structural stability after 1975 resulted in $F = 1.4$ with 10 and 18 degrees of freedom, which is not significant at the 5 percent level.

The model obtained thus suggests that post-war New Zealand emigration is the result of a mixture of demographic, economic and political conditions. Both baby boom cohorts and return migration boosted emigration, but the real cost of air travel had an impeding effect. Inflation appears the economic indicator to which the propensity to migrate is most sensitive, but the atypically low emigration during 1983 and 1984 can only be explained by the unusual conditions during the price and wage freeze.

(b) Models for ZAPROB

A wide range of variables could potentially affect the probability that a New Zealand migrant chooses Australia as the next country of permanent residence. Here

we restrict ourselves to one *a priori* hypothesis regarding ZAPROB. Given that a large proportion of trans-Tasman migrants will participate in the Australian labour market, it is expected that the conditional probability of migration to Australia is a function of differences between the two countries with respect to both income levels and employment opportunities.

Selection of a variable which adequately measures income differentials between Australia and New Zealand raises a number of issues. Firstly, cost-benefit theory predicts that the relevant income measure is the present value of lifetime earnings. In practice, current earnings are taken as a proxy for this and such a procedure is justified when migrants have a high internal rate of time preference and, moreover, when they base their expectations of lifetime earnings on current earnings. Secondly, the available statistics on income may not adequately measure the income potential of many migrants. Two measures are considered in this study: average weekly earnings for male units and the nominal weekly award wage of an adult male. Since trans-Tasman migrants are a cross-section of the labour force (Farmer and Andrew, 1980), we should expect the number of emigrants to Australia to be more responsive to an earnings differential than to a differential in the rates set by industrial awards.

A third problem with respect to measuring the potential gain in income through migration is that the extent to which migrants take differences in the cost of living into account is not certain *a priori*. Few New Zealanders contemplating migration would calculate whether their current expenditure would require more income in Australia since their knowledge of prices would be restricted to general notions; for example that manufactured goods are cheaper in Australia and that food is more expensive. This implies that a nominal income difference would perform better in a model for ZAPROB than a difference in real income, since high wage levels would attract migrants despite a high cost of living. Layton (1983) and Poot (1984b) provided some empirical support for such "money illusion" in migration. However, there are two ways of defining a nominal income difference: one definition takes exchange rate fluctuations into account and the other does not. Hence we may compute an income difference expressed in one of the two currencies or we may take the "face value" difference of the income levels. The latter procedure would be quite appropriate if migrants assume that a New Zealand dollar buys as much in New Zealand as an Australian dollar in Australia. Since information about the exchange rate is readily available, the former

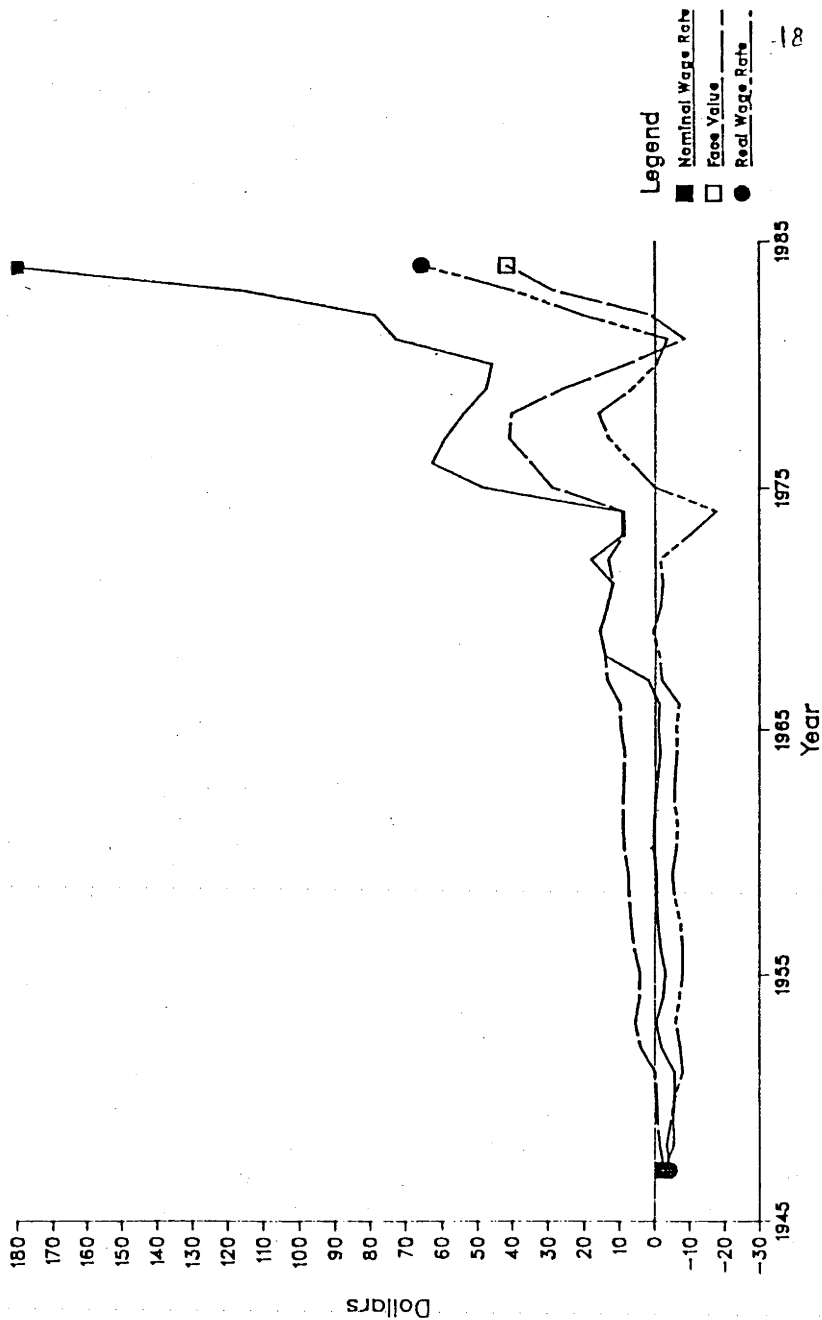
nominal income measure is nevertheless the more plausible. This is not only due to the migrant's lack of knowledge about Australian prices, but it is also the result of the high likelihood of a trans-Tasman migrant to Australia returning to New Zealand after some period of time. The return migrant will have accumulated wealth in Australia which, in real terms, has a higher value in New Zealand.

Summarising, six alternative measures of income difference are considered here: AZEARND, the current difference of the Australian and New Zealand level of surveyed male earnings expressed in Australian dollars; AZEARNFD, the face value difference (i.e. which implies an exchange rate of parity) and PPAZEARN, a measure of the difference in purchasing power of average earnings. This measure was constructed on the basis of bench marks provided by three surveys of cost of living differences (1963, 1969 and 1983) which were interpolated and extrapolated with the Australian and New Zealand consumer price indices. Chart 2 shows the post-war movement of the three measures and this chart is in particular indicative of the increase in the earnings gap with the purchasing power of the 1984 Australian level of weekly earnings being about 67 Australian dollars more than the weekly earnings in New Zealand. The corresponding measures of income on the basis of award wages are AZWAGED, AZWAGEFD and PPAZWAGE respectively. All income variables are expected to have a positive coefficient in the regression equation for ZAPROB.

Labour market conditions are measured by the percentage change in surveyed full-time employment and by the unemployment rate. AZEMPGD measures the differential employment growth in Australia compared with New Zealand and ZAUNEMPRD is the New Zealand rate of unemployment minus the Australian rate. Another measure of the difference in the "economic climate" between the two countries is ZAINFLD, the New Zealand rate of inflation minus the Australian rate. Given these definitions, we expect all three variables to have a positive effect on the conditional probability of emigration to Australia.

It has been suggested in the literature that the migration between two countries may be a function of conditions in specific third countries. For example, Layton (1983) showed that buoyant economic conditions in Australia negatively affected migration from the United Kingdom to New Zealand. How important is the third country effect for trans-Tasman migration? Our conjecture is that this effect is weak. The key influences are language and distance: to a British migrant the generalised cost of a move to

Chart 2: The Difference Between Average Male Weekly Earnings
in Australia and New Zealand



Australia or New Zealand are roughly equal and, hence, Layton's result is plausible. But to a New Zealand emigrant there are no real alternatives to Australia at the same distance. Moreover, since trans-Tasman migration is unrestricted for the majority of residents of either country, it has more the character of internal migration rather than international migration. Hence we expect the substitution elasticity of the choice of destination to be high for countries outside our "common labour market", but to be low for the choice between a trans-Tasman move and a move further away. This was confirmed by our finding that available measures of economic conditions in the United Kingdom such as real per capita GDP and inflation could not significantly improve the model specification reported below.

The strategy to choose a specification for ZAPROB involved estimating an equation for each of the six income differential variables combined with the other four variables. This gave rise to the following conclusions:

(i) ZAUNEMPRD and ZAINFLD contributed little to the explanatory power of the equation. None of these three variables was significant at the 10 percent level.

(ii) The income differential based on earnings generally performed better than the alternative differential based on award wages. Moreover, ZAPROB was more responsive to the nominal income differential AZEARND than the purchasing power adjusted differential PPAZEARN. The use of the face value difference, AZEARNFD, reduced the statistical performance of the model substantially.

(iii) March year 1983 and 1984 appeared to be outliers in that the proportion of migrants going to Australia was substantially lower than predicted by the model. The almost doubling of the earnings gap during 1982-84 coincided with a decline in ZAPROB from 62 percent in March year 1982 to 41 percent in March year 1984. The recent increase in emigration to Australia from 14,097 in 1984 to 21,964 in March year 1985, with a corresponding increase in ZAPROB from 41.3 percent to 49.5 percent is in line with what we would expect from the observed further increase in the earnings gap. Although the possible influence of the election of the Hawke government in March 1983 and the Lange government in 1984 on the outliers must remain a conjecture, the FREEZE dummy which applied to this period appeared significant and has been included in the model.

(iv) An essential variable in satisfactory specifications for ZAPROB involved the dependent variable with a one year lag, ZAPROBL1. The lagged dependent variable is often included in a model of aggregate time series data to control for autocorrelation resulting from measurement error and the influence of omitted variables. Moreover,

inclusion of ZAPROBL1 in the model allows us to test the partial adjustment hypothesis which states that an exogenous change in one of the economic variables in the model has a distributed lag effect on ZAPROB with geometrically declining weights (Johnston, 1984, Chapter 9).

The best model for ZAPROB is therefore as follows:

$$\begin{aligned} \text{Log (ZAPROB/(100-ZAPROB))} = & -0.163 + 0.668 \text{ ZAPROBL1} \\ & (0.111) \\ & (2) \\ & + 0.004 \text{ AZEARND} + 0.053 \text{ AZEMPGD} - 0.568 \text{ FREEZE} \\ & (0.002) \quad (0.019) \quad (0.169) \end{aligned}$$

period: 1948-85; $F = 44.1$; $R^2 = 82.7 \%$, $h = 0.338$

The model fits the data well. The small value of Durbin's h statistic reveals that no serial correlation remains after introducing the lagged dependent variable into the model. All coefficients are significant at the 1 percent level, except AZEARND which is significant at the 5 percent level. The coefficient of ZAPROBL1 suggests that 33.2 percent of the effect of a change in, for example, the earnings gap takes place in the first year, 22.2 percent in the second year etc.

It is of interest to compare our results with the model of Butcher and Trent (1979). Their model explains the level of emigration to Australia in terms of the percentage of the 15 to 19 year age group completing an apprenticeship, the size of the population aged 20 to 24, immigration from Australia lagged two years and a variable which measures a real wage differential. Although the model fitted the data well with $R^2 = 96.8$ percent, it had several drawbacks. First, by using the level of emigration instead of an emigration rate, heteroscedasticity is introduced since the disturbance term in this type of model is usually correlated with population size but no correction was made for this. Secondly, the Durbin-Watson statistic indicated autocorrelation. Thirdly, the Butcher and Trent specification was estimated over the 1954-77 period, which is 14 years shorter than our observation period. Re-estimation of the Butcher and Trent model over longer periods resulted in specifications which suffered from severe autocorrelation.

(c) Models for APROB

The mean crude emigration rate of Australia for the 1947-83 period was 6 persons per year per thousand of the population, which is substantially less than the corresponding New Zealand emigration rate of 10 persons per year per thousand of the population. Although composition effects undoubtedly play a role, we expect that two contributing factors may be firstly, that there is more opportunity for New Zealanders than for Australians to use trans-Tasman emigration as an investment in human capital, and secondly, that the scope for income gains through internal migration are on average larger in Australia than in New Zealand. Although comparisons between countries of internal geographic mobility are difficult, there is evidence that the internal mobility rate in Australia is higher than in New Zealand (Heenan, 1983; Poot, 1984a). Hence, the question presents itself whether Australian emigration can be explained by the same factors as New Zealand emigration. With respect to return migration it was found that a two year lag produced far better results. This suggests that the emigration spell of return migrants is considerably shorter in Australia than in New Zealand, but further research on this matter is clearly required. Starting with AIMIL2 (permanent and long term arrivals into Australia with a lag of two years), the Australian counterparts of the variables used in the analysis for ZPROB were added in a stepwise fashion and a model was selected on the basis of Mallows C_p criterion. This resulted in the following equation:

$$\begin{aligned} \text{Log (APROB/(1000-APROB))} = & -5.827 + 0.004 \text{ AIMIL2} \\ & (0.001) \\ & (3) \\ & + 0.049 \text{ AYOUTHPC} - 0.003 \text{ ARFARE} - 0.025 \text{ AUNEMPR} \\ & (0.015) \quad (0.001) \quad (0.009) \end{aligned}$$

period: 1953-83; $F = 95.0$; $R^2 = 92.6 \%$, $d = 1.390$

The equation is statistically satisfactory: the fit is good and there is no strong evidence of serial correlation. All explanatory variables are significant at the 1 percent level. As in the New Zealand case, return migration, age composition and the cost of air travel play a role in the explanation of the emigration rate. However, the proxy for economic conditions appeared to be unemployment rather than inflation. The negative, but significant effect of the Australian rate of unemployment, AUNEMPR, is remarkable. It reconfirms the result of many internal migration studies that the view that the

unemployment rate is a push factor with respect to aggregate migration flows is contradicted by the data (see e.g. Poot 1984a, Chapter 5). A practical explanation for this is that unemployment is highly selective. In particular manual labourers and other unskilled workers are more exposed to the risk of unemployment than skilled workers and the former group has a lower propensity to migrate than the latter. Moreover, the principal destination of Australian emigrants is the United Kingdom and Ireland, and as unemployment rose sharply in Australia, labour market conditions were even slacker in those countries, so that there was little to be gained from emigration, in particular for unskilled and semi-skilled workers.

(d) Models for AZPROB

Trans-Tasman migration is far more important relative to total New Zealand emigration than relative to total Australian emigration. Since World War II, on average 42 percent of New Zealand permanent and long term departures chose Australia as destination, whereas only 12 percent of Australian emigrants came to New Zealand. The model for AZPROB may therefore be expected to have quite different determinants compared with the model for ZAPROB. This is borne out by the mirror image of equation (2) which fitted badly with $R^2 = 35.9$ percent. What, then, are the determinants of the conditional probability of emigration to New Zealand? A number of considerations guided our specification. First of all, it is speculated that income differentials have little bearing on the Australia to New Zealand flow. The decision to migrate would, by and large, be motivated on the basis of non-pecuniary benefits. These would be an opportunity for a working holiday in a different and attractive environment for the Australian born, while New Zealand return migrants would also be attracted by the presence of relatives and friends. We expect return migration to New Zealand to be a large contributor to the Australia-New Zealand flow, hence ZDEPL2, permanent and long term departures to Australia with a lag of two years, is the first explanatory variable. The second hypothesis is that the age-composition effect affects both the propensity to emigrate and the conditional probability of emigration to New Zealand, since young adults would be more likely to choose New Zealand as destination than other Australian emigrants. Hence AYOUTHPC is the second explanatory variable. However, the cost of trans-Tasman migration would be an important consideration for young adults and this suggests the need to test the effect of the cost of air travel, ARFARE.

With respect to the effect of general economic conditions, a number of variables would be potential regressors: AZEMPGD, ZAUNEMPRD, ZAINFLD and EXRATE, all defined earlier in this paper. We had no a priori reasons to discriminate between these but, when combined individually with the variables listed above, only the coefficients of AZEMPGD and EXRATE were significant at the 5 percent level. Hence the following equation resulted:

$$\begin{aligned} \text{Log (AZPROB/(100-AZPROB))} = & -5.477 + 0.029 \text{ ZDEPL2} \\ & (0.004) \\ & (4) \\ & + 0.067 \text{ AYOUTHPC} - 0.061 \text{ AZEMPGD} - 0.001 \text{ ARFARE} + 1.975 \text{ EXRATE} \\ & (0.032) \quad (0.015) \quad (0.0007) \quad (0.437) \end{aligned}$$

period: 1949-83; $F = 11.7$; $R^2 = 61.1 \%$; $d = 1.924$

All variables have the expected signs and are statistically significant at the 1 percent level, except AYOUTHPC and ARFARE, which are significant at the 5 percent level. The fit of the model is reasonable and inspection of the OLS residuals produced the interesting result that the largest residuals occurred in turn-around years of the cycles of net trans-Tasman migration, in particular 1961, 1975 and 1979. This suggests that some aspect of the dynamics of trans-Tasman migration is still missing, although the partial adjustment respecification of equation (4) was statistically rejected.

(e) The full model

Some of the explanatory variables in this study appear in more than one equation. Moreover, the residuals of the equations may be influenced by "unobservables" which are identical across equations. In particular the impact of third country effects would be of this nature. This implies that the efficiency of the estimation technique can be improved by using a full information method rather than weighted least squares for individual equations. Hence improved estimates were obtained by applying Zellner's SUR (Seemingly Unrelated Regression) model, which is estimated by generalised least squares (Johnston 1984, p.488). This technique was applied to our model for the period 1953-83. Applying this procedure, we were no longer able to reject the hypothesis that the coefficient of ZINFL in equation (1) and of ARFARE in equation (4) were equal to zero. These variables were subsequently deleted from the corresponding equations (5) and (8) below. The resulting four equations are as

follows:

$$\text{Log (ZPROB/(1000-ZPROB))} = -7.831 + 0.009 \text{ ZIMIL5} \quad (5)$$

(0.002)

$$+ 0.163 \text{ ZYOUTHPC} - 0.002 \text{ RFARE} - 0.296 \text{ FREEZE}$$

(0.018) (0.0004) (0.126)

$$\text{Log (ZAPROB/(100-ZAPROB))} = -0.196 + 0.634 \text{ ZAPROBL1} \quad (6)$$

(0.116)

$$+ 0.006 \text{ AZEARND} + 0.034 \text{ AZEMPGD} - 0.461 \text{ FREEZE}$$

(0.002) (0.018) (0.189)

$$\text{Log (APROB/(1000-APROB))} = -5.807 + 0.004 \text{ AIMIL2} \quad (7)$$

(0.001)

$$+ 0.047 \text{ AYOUTHPC} - 0.003 \text{ ARFARE} - 0.024 \text{ AUNEMPR2}$$

(0.014) (0.001) (0.008)

$$\text{Log (AZPROB/(100-AZPROB))} = -7.610 + 0.029 \text{ ZDEPL2} \quad (8)$$

(0.005)

$$+ 0.118 \text{ AYOUTHPC} - 0.044 \text{ AZEMPGD} + 2.400 \text{ EXRATE}$$

(0.032) (0.016) (0.502)

The weighted R^2 for the system is 92.6 percent. The reader will confirm that the coefficients are generally similar those reported earlier, which were based on slightly different periods. The predicted dependent variables of equations (5) to (8) were compared with the actual observations in Charts 3 to 6, which shows that the model traces the time series very well over 31 years of the post-war period.

Chart 3: The Crude New Zealand Emigration Rate
Per Thousand of The Population

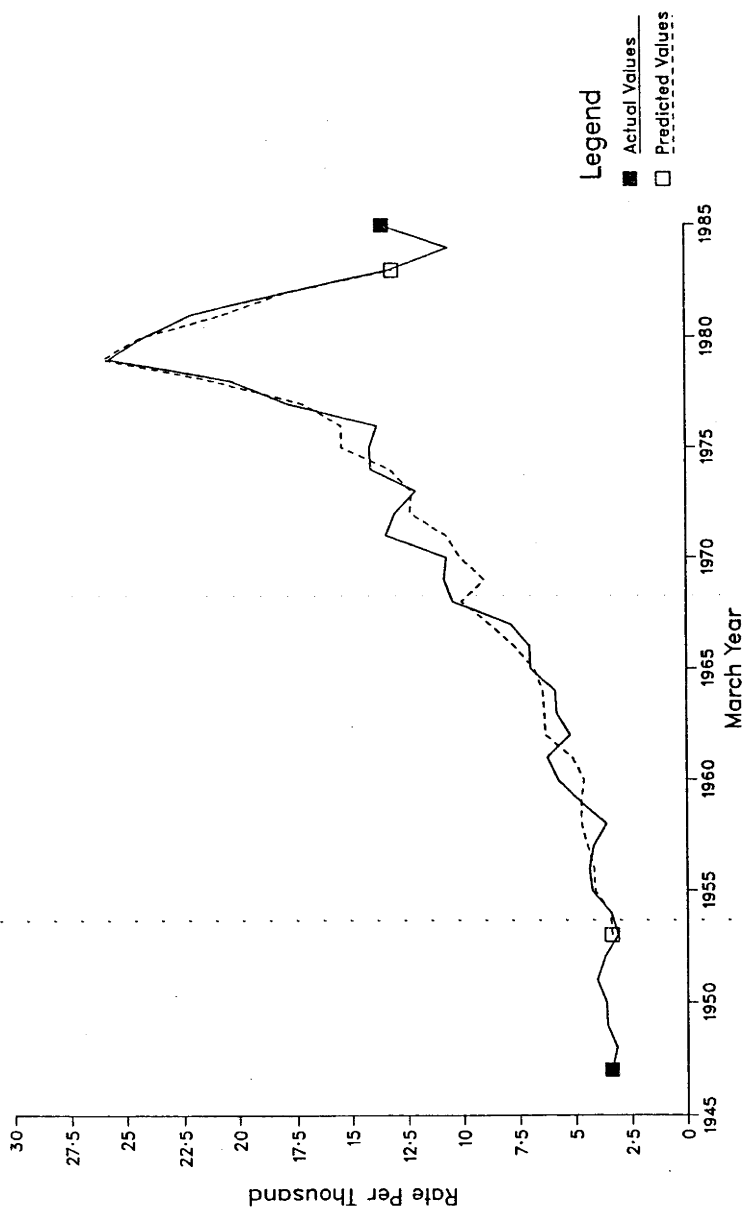


Chart 4: The Conditional Probability Of Emigration
To Australia

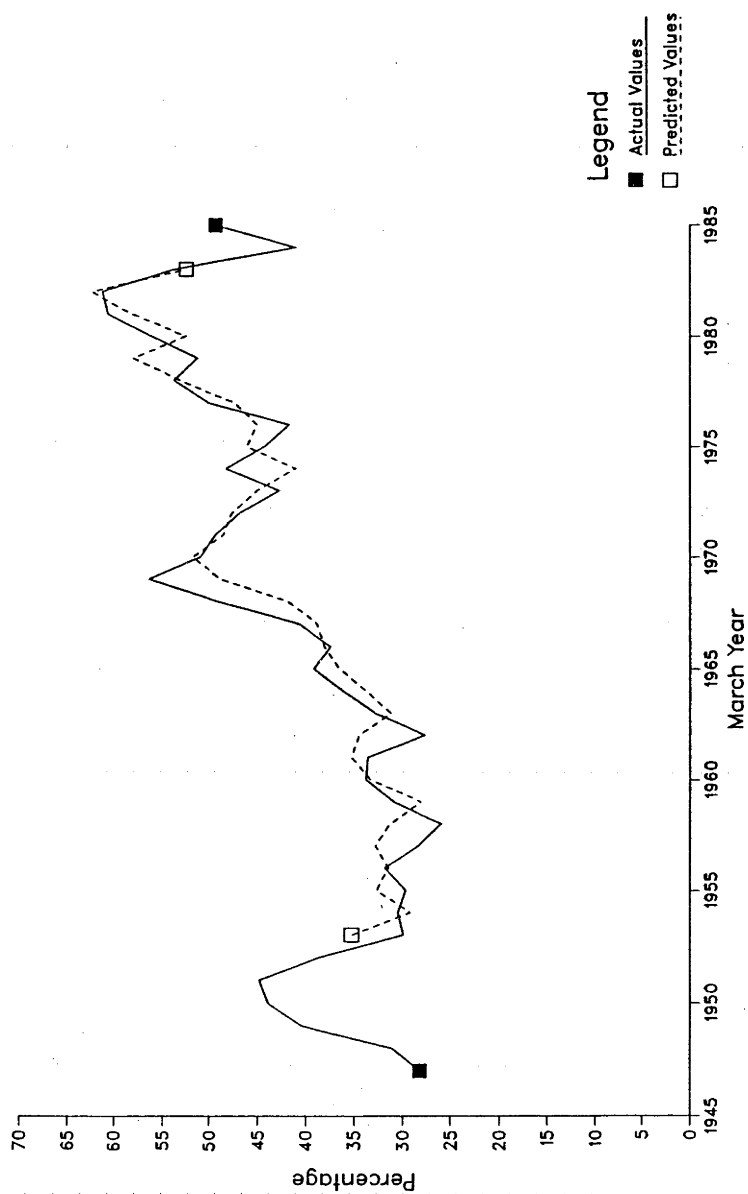


Chart 5: The Crude Australian Emigration Rate
Per Thousand of The Population

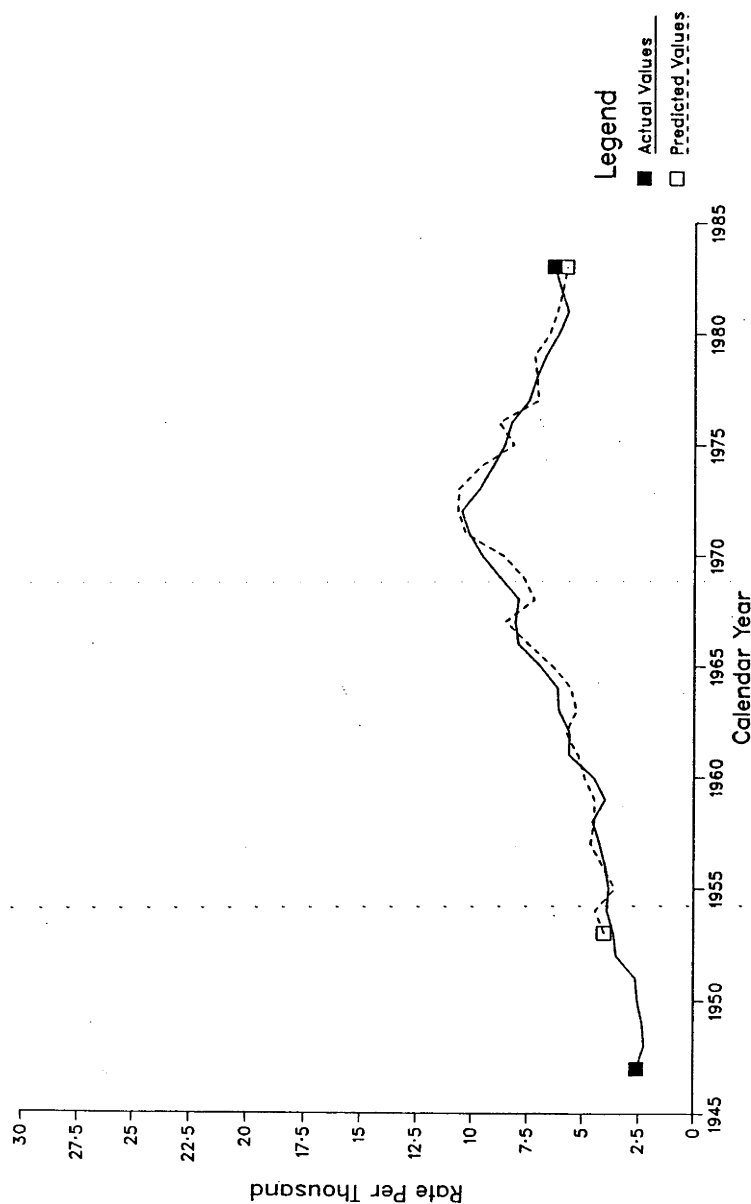
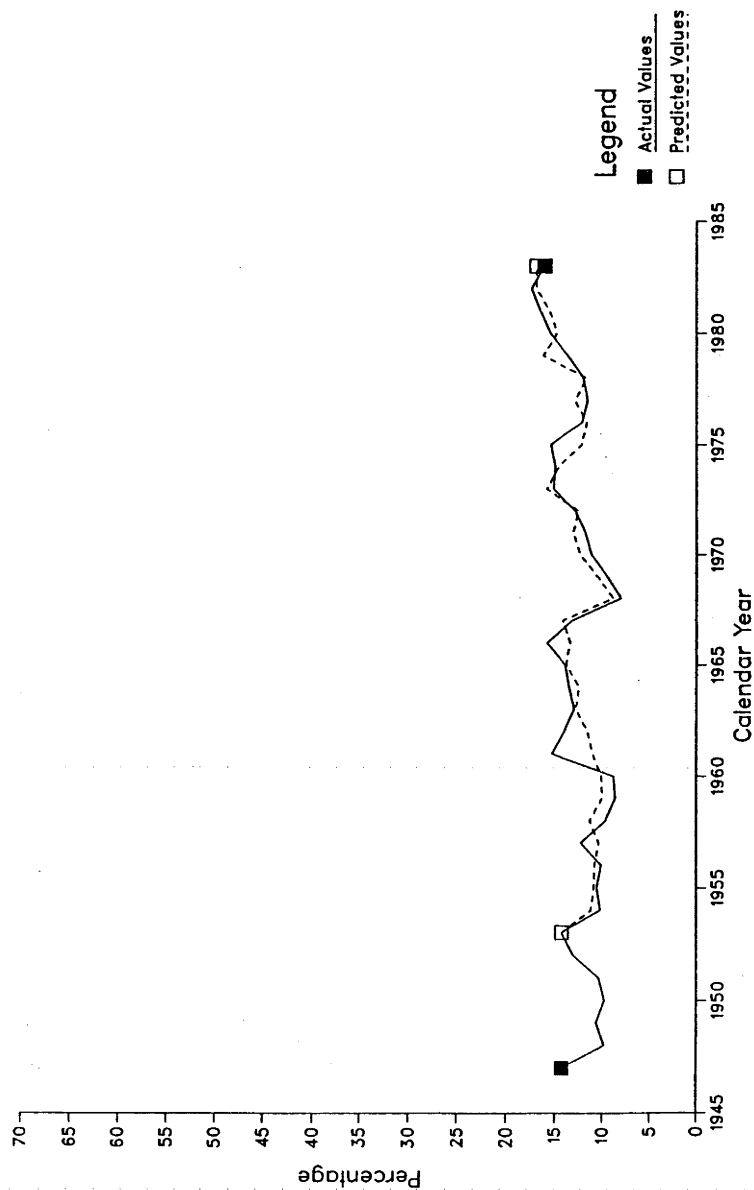


Chart 6: The Conditional Probability Of Emigration
To New Zealand



CONCLUSION

The results outlined above show that, despite our having less than ideal data, it is possible to satisfactorily model trans-Tasman migration using simple combinations of economic and demographic variables. Despite some differences between New Zealand and Australian equations, the model reveals similar processes at work. Obviously return migration is an important component of migration flows in both directions and the direction of the trans-Tasman flow is sensitive to relative employment opportunities. Moreover, age composition and the real cost of air travel are determinants of both the Australian and New Zealand emigration rate.

Many of the variables used here are also common determinants in internal migration studies. It was noted that the trans-Tasman flow is largely free migration and it is thus plausible that this migration process has the characteristics of internal migration. The finding that the relatively traditional economic and demographic variables generate a model which traces the post-war period reasonably well, reinforces this view. However, the migration flow from New Zealand to Australia appears more consistent with the human capital model than the flow in the opposite direction.

These results must be regarded as still tentative, for we believe the model can be refined further. It is clear from an examination of Charts 3 to 6 that the "turning points" in the migration cycles are not adequately predicted by the model, especially in some periods. This could reflect a dynamic structure, e.g. regarding the distributed lag pattern, which is more complex than the one incorporated in our model and further research on this is warranted.

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APPENDIX

List of Variables

Time span: 1947-1985

Dependent Variables

- APROB** The crude annual long term and permanent emigration rate per 1000 population from Australia (December year).
- AZPROB** The proportion of long term and permanent migrants from Australia who declare their country of next residence as New Zealand (December year).
- ZPROB** The crude annual long term and permanent emigration rate per 1000 population from New Zealand (March year).
- ZAPROB** The proportion of long term and permanent migrants from New Zealand who declare their country of next residence as Australia (March year).

Independent Variables

- AEMPG** Percentage annual growth in Australian employment (May/June).
- AIMIL2** Permanent and long term arrivals in Australia two (five) years previous in thousands (December year).
- AINFL** The annual percentage change in the Australian Retail Price Index (December year).
- ARFARE** The least expensive one-way air ticket, Sydney-Auckland in 1984 Australian dollars (31 September).
- AUNEMPR** Average Australian registered unemployment as a percentage of the labour force (June year).
- AYOUTHPC** Percentage of the Australian population aged 15-29 (June year).
- AZEARND** Australian average weekly earnings per employed male unit measured in Australian dollars less New Zealand average weekly earnings per employed male unit measured in Australian dollars (Australia, June year; New Zealand, October/November).
- AZEARNFD** Australian average weekly earnings per employed male unit measured in Australian dollars less New Zealand average weekly earnings per

employed male unit measured in New Zealand dollars (Australia, June year; New Zealand, October/November).

AZEMPGD AEMPG - ZEMPG.

AZWAGED Australian average nominal weekly wage rate for adult males measured in Australian dollars less New Zealand average nominal weekly wage rate for adult males measured in Australian dollars (31 December).

AZWAGEFD Australian average nominal weekly wage rate for adult males measured in Australian dollars less New Zealand average nominal weekly wage rate for adult males measured in New Zealand dollars (31 December).

EXRATE The exchange value of one New Zealand dollar in Australian dollars (31 September).

FREEZE Dummy variable; equal to one in March year 1983 and 1984, zero otherwise.

PPAZEARN Australian average weekly earnings per employed male unit measured in Australian dollars less New Zealand average weekly earnings per employed male unit adjusted for purchasing power in Australian dollars (Australia, June year; New Zealand, October/November).

PPAZWAGE Australian average nominal weekly wage rate for adult males measured in Australian dollars less New Zealand average nominal weekly wage rate for adult males adjusted for purchasing power in Australian dollars (31 December).

ZAINFLD ZINFL -AINFL.

ZAPROBL1 Logit of ZAPROB one year previous.

ZAUNEMPRD ZUNEMPR - AUNEMPR.

ZBP New Zealand overseas transactions current account balance measured in New Zealand dollars (December year).

ZDEPL2 Annual permanent and long term departures from New Zealand to Australia two years previous, in thousands (March year).

ZEMPG Percentage annual growth in New Zealand employment (October/November).

- ZRFARE The least expensive one-way air ticket, Auckland-Sydney in 1984 New Zealand dollars (31 September).
- ZIMIL5 Permanent and long term arrivals in New Zealand five years previous, in thousands (March year).
- ZINFL The annual percentage change in the New Zealand Consumer Price Index (December year).
- ZUNEMPR New Zealand registered unemployment as a percentage of the labour force (September).
- ZYOUTHPC Percentage of the New Zealand population aged 15-29 (March or December year).

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