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U N I V E R S I T Y

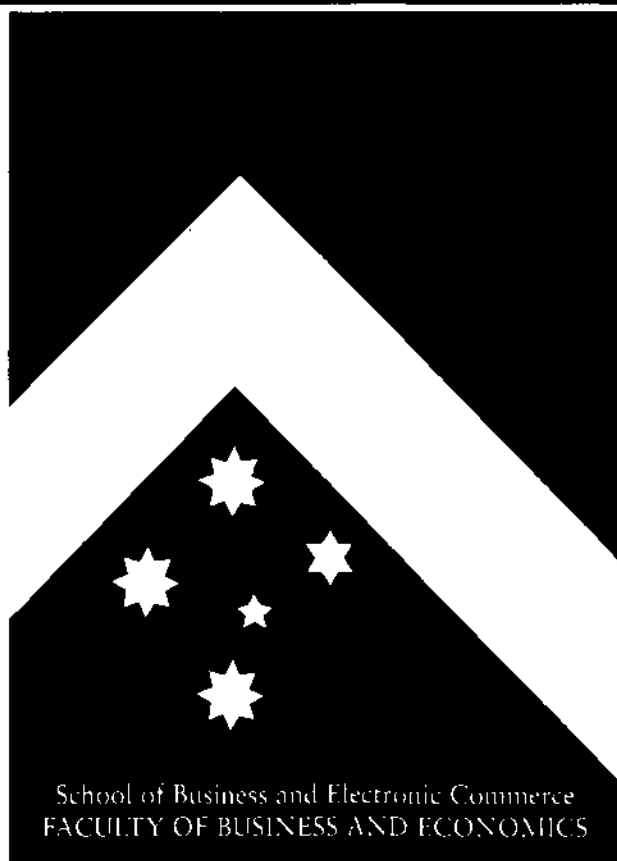# Working
Paper Series

Why Victorians move to Queensland: An Attempt at Econometric Modelling

by
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School of Business and Electronic Commerce
FACULTY OF BUSINESS AND ECONOMICS

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An Attempt at Econometric Modelling

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Gennadi KAZAKEVITCH

Abstract

The issue of inter-regional migration as a function of regional labour market disparities is well known. It is especially important for a country such as Australia with both different and dynamic structures of regional economies, a continuing high level of external migration and a long-term trend of disparities in employment opportunities across the states and regions.

The paper discusses an approach to an econometric model of inter-state migration in Australia. Internal population movement from a particular region is measured in relation to the regional level of unemployment. In contrast to previous attempts to construct such a model, inter-regional migration is explained using an essentially non-linear function of unemployment ratio(s) to compare particular regions.

The other factor under consideration affecting regional labour markets in Australia is external migration. The inflows of external migration to Australia are not homogeneously distributed across the states. However, the regional differences in immigration are mostly predetermined by certain social and demographic factors rather than by current disparities in employment opportunities. For this reason these inflows are considered as exogenous variables, which in themselves contribute to the disparities in regional labour markets.

August 1996

Background

Theoretical approaches and modelling techniques. Economic factors of internal population movement are one of the essential and well developed issues of regional economic theory. Both historically and logically, the reasons people move from one region to another were initially explained within the framework of the neoclassical economic theory. Extensive empirical evidence and attempts to apply modelling, however created the necessity to relax and/or modify neoclassical assumptions as well as to develop alternative approaches.

The neoclassical approach to economic factors of population movement is based on the standard model of labour supply. According to the standard model (Osberg, Gordon and Lin, 1994), individuals maximise their utility which is derived from consumption and hours of non labour time. Consumption is constrained by income, based on earnings. Labour and non labour time are constrained by the total time available. The time individuals are willing to work is a function of earnings. As individuals are faced with a situation where the actual supply of the number of jobs, or hours of work available, may fall short of the desired level, they have two options: (i) continue to look for a job in their region; or (ii) move to a different region. Therefore, the problem is to structure economic factors affecting such a decision.

In terms of the neoclassical theory, areas where unemployment (and therefore, *unemployment differentials*) is increasing above the average, relative wages (and therefore, *wage differentials)* are falling. As a result, on the one hand, relative demand for labour is increasing, while on the other hand, net migration to other regions is occurring, hence reducing relative labour supply (Pissarides and McMaster, 1990). The process of migration stops as soon as the system achieves a compensative equilibrium.

Empirical evidence and experience in designing applied models does not always confirm the traditional neoclassical theory. Given this, attempts are often made to modify the existing neoclassical model or to suggest alternative ones.

The most obvious extension of the neoclassical theory of migration is a simultaneous consideration of personal economic motivation either to migrate to a

different region or, based on inter-industrial differences in wages to change the industry of employment within the same region. This approach was developed in Osberg, Gordon and Lin (1994).

One aspect of personal motivation was studied by Thomas (1993). Basing his study on British material, he attempted to explain why, in contrast to neoclassical theory, there was a consistent outflow of people from areas where employment opportunities and wages were high. Thomas found that decisions to move were based on disparities in housing prices.

A number of researchers combined a traditional gravity model with wage and unemployment differential factors. According to a demo-geographic adaptation of Newton's gravity model, the population of a region is considered to be a mass concentrated at its centre, and a total migration between a pair of regions is considered as a function of gravitational attraction between them. The mass increases with the increase in population; however, the greater the distance between the regional centres the lower the attraction for perspective migrants. Lowry (1966) realised that the gravity estimate could be corrected with a special coefficient derived from employment and wage disparities between two regions. He tested his model using US Data. Attempting an adaptation of Lowry's model to the UK, Rolfe (1981) came to the conclusion that for the British case, a housing constraint variable should be introduced, in addition to such conventional variables as gravitational attraction, employment and wage differentials.

Attempting to link migration with wage and unemployment disparities in Canada, Wrage (1981) came to the conclusion that the direct cause-effect relationship did not work. In fact, he attempted to prove a reversed link. He explained internal migration both as a factor of interregional capital movement, disparities in employment and earnings - as not a cause but as a result of migration.

Foot and Milne (1989) base their theory on the well known labour economic concept of the similarity of physical capital and investment in human capital. Their model is based on the consideration by households of the anticipated cost and benefits associated with the decision to migrate. The costs include information seeking, moving, and the opportunity costs of any income foregone during the move. The benefits include the expected income to be earned in a new location (which depends on employment

opportunities and wage rates) and the quality and availability of infrastructure, such as public and other social services.

Jackman and Savouri (1992) suggested a different theoretical framework called *job-matching*. They based their study of interregional migration in Great Britain on the assumptions that: only unemployed people look for work; there are no systematic (wage) differences in job categories between regions; distance is immaterial to the unemployed; and an unemployed person in a given region is equally likely to take up vacancy in any part of the country. In their framework, migration is seen just as a special case of job matching in which a job-seeker in region i is matched to a job in region j.

Another approach used to explain the dependence of internal migration on differences in relative economic opportunities between the origin and destination regions was developed by Gabriel, Shack-Marquez and Wascher (1993). Their notion is based upon the idea that the decision to migrate involves a choice among a number of mutually exclusive destinations. Individuals make pairwise comparisons and choose the location yielding the highest expected net discounted return on migration. Apart from relevant economic and amenity-related conditions, socio-psychological factors are considered as affecting individual traits associated with the propensity to migrate.

The majority of researchers looking at factors of interregional migration, use econometric techniques for empirical evidence of their theories as well as for forecasting purposes. This means that parameters of equations derived from a particular theory are directly estimated using time series and/or cross-section data. Especially interesting are those works in which the usage of econometric methods explicitly allow the inclusion of model assumptions and conditions not considered previously.

For example, Greenwood and Hunt (1984A) designed a simple time series model using explicit assumptions about the interdependency of regional labour markets. While estimating parameters, direct adding-up constraints are imposed, which in most other studies were assumed implicitly. These restrictions are clearly interpretable: interregional migration within a closed system must sum to zero, and therefore, the sum of inward flows of migration is equal to the sum of outward flows. The authors admit, however, that whilst giving a more precise instrument for forecasting, their approach is more demanding on the number of time-series observations than are commonly

available. In a later paper by Milne and Foot (1995) this approach was further developed with new restrictions suggested.

In Liaw and Ledent (1987) the maximum quasi-likelihood method is used for the parameter estimation of a model derived from the random utility choice theory. Conceptually, the model represents a two level choice process. Firstly, people decide whether to stay or leave. Secondly, they choose a specific destination.

An original approach to the econometric modelling of regional labour market transformation and adjustment using the concept of Markov process was introduced by Seninger, 1985. The supply side of the regional labour market system was derived from occupational mobility flows and used as the basis for a *job vacancy chain model.* The model was formulated as a Markov process of job transfer probabilities. An analogous method was used by Neilson Associates, (1986) for their studies on the tendencies of internal migration of overseas born Australians. The purpose of their study was to forecast the effective demand for adult migrant education programs.

Input-output techniques are an alternative to econometric modelling in the studies of regional labour markets. However, despite considerable experience accumulated during more than three decades of extensive regional input-output studies, existing models include some deficiencies, restricting applications to the analysis of employment. Holub and Tapeiner (1989) outlined those deficiencies with regard to input-output models applicable to both national and regional models: (i) either the assumption of a homogeneous labour force, or a non-substitutability between different types of labour; (ii) sectoral demand is assumed to be the only factor affecting production and therefore, employment decisions; and (iii) there is no feedback, affecting sectoral (and regional) decision making, from employment to production.

Attempts to overcome those deficiencies are methodologically promising. Extended input-output models are, theoretically, more precise. However, they require more expensive procedures for obtaining the necessary information from primary sources than traditional regional input-output models. Holub and Tapeiner (1989), extended input-output models towards a description of qualification structure of employment in each sector of an economy. Structural changes reflected by their model affect, therefore, not only the quantity of labour demanded for each particular industry, but also changes in the qualification structure.

Madden and Trigg (1990) suggested (to our knowledge) the most advanced approach to incorporating internal migration into an inter-regional input-output model. Based on a two-regional model, they disaggregate consumption among employed, unemployed and internal migrant households. A certain proportion of jobs created in a regional economy are assumed to be taken by immigrants. However, being statistically sophisticated, this model, like any other input-output model does not address the problem of economic and social motivation to migrate.

Empirical Evidence. International experience in empirical research on factors of internal population movement is not homogenous across nations. From the Australian perspective, the most useful are studies of market economies located on large territories with different structures of regional systems (US - Gabriel, Shack-Marquez and Wascher (1993), Kahley (1989), Kuznets (1964), Walker, Ellis and Barff, (1992), Ellis, Barff and Renard, (1993); Canada - Wrage (1981, Liaw and Ledent (1987), Foot and Milne (1989), Plane (1989), Osberg, Gordon and Lin (1994); Mexico - Greenwood (1978); Brazil - Graham (1970)). However, if the territory of a country is relatively small, but regional disparities take place, then provided developed regional statistics exists, concepts and methodology applied to those countries might be useful from the Australian perspective also (UK - Jackman and Savouri (1992A and 1992B), Pissarides and McMaster (1990); Italy - Schachter, Kraus and Kim (1978) and Salvatore (1991), Netherlands - Van Dijk and Folmer (1986)).

Walker, Ellis and Barff (1992) and Ellis, Barff and Renard (1993) combined literature on external and internal population movement. They developed a model of the mobility of labour in the United States linking various flows of migration on the basis of occupational status of the worker, production and institutional relations in the economy and economic restructuring

A peculiarity of a geographically small country is reflected in Jackman's and Savouri's (1992A and 1992B) application of their job-matching understanding of interregional migration to Great Britain. They do not exclude both options from their consideration: when people can live in one region and work in another and when a job match involves the household migrating. However, if migration occurs then, normally it is a result of a successful job search rather than a pre-condition for it.

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Two of the most comprehensive geo-demographic projects on internal migration in Australia were commissioned by the Bureau of Immigration and Population Research (BIR) (Bell (1992) and Bell and Cooper(1995)).

The earlier project referred to 1981-86 data and was mainly based on the 1986 *Census of Population and Housing*. The study covered historical trends, patterns and ethno-demographic characteristics of interregional migration across the states, territories and statistical divisions. Even though economic restructuring was not a direct subject of that project, implicitly it was taken into consideration when the interregional population movement caused by a change in industrial structure of regional economies was estimated.

The later project was devoted to a special case of internal migration (which was considered earlier in another project commissioned by BIR - Neilson Associates, 1986). The demographic structure and factors causing inter-regional migration were studied with regard to overseas born Australian residents.

At the state level, internal migration has been studied by Oosterhaven and Dewhurst (1990) of the University of Queensland. In their expanded input-output model, the previously mentioned vacancy-chain approach was used to reflect the mobility of the labour market. Their model appears especially relevant for immigration estimates.

Different aspects of interstate unemployment and wage disparities, and of their impact on internal migration were studied by Nicolaas Groenwold and his colleagues at the Centre for Regional Economic Analysis of the University of Tasmania (Groenwold (1991 and 1993) Groenwold and Hagger (1994). In Groenwold and Hagger (1993) the most advanced (to our knowledge) econometric model of inter-regional migration in Australia was designed. As in many other studies, inter-state migration in Australia is explained as a function of wage and employment differentials. However, employment and wage differentials themselves are considered endogenous variables. It has been shown, that in the state of equilibrium, employment and wage differentials compensate each other but do not approach zero values.

Recent Australian Tendencies. Statistical data of the most recent decade (Australian Bureau of Statistics, 1982-1994) shows that the states demonstrating the trend of huge outward interstate migration were Victoria and New South Wales (NSW). On the other hand, the major recipient state was Queensland. The flows of

interstate migration between other states were relatively minor with no sustainable direction which could be explained in aggregated terms as socio-economic phenomena.

The composition of data on internal migration, earning and unemployment disparities for the same period of time leads to a hypothesis that the well known dependence of interstate migration on both wage and unemployment disparities, which was previously proved with regard to Australia (Groenwold 1993), is no longer current. A possible explanation of this new tendency is that during 1980s Australia's prosperous time of low unemployment ended. Consequently, people started to realise that the difference between being employed or being unemployed was more important for their decision making concerning migration matters than any assumed gain in earnings.

Another hypothesis is based on simultaneous consideration of data on interstate and overseas migration. The inflows of immigrants to Australia are not homogeneously distributed across the states. The major recipients of newcomers to Australia are Victoria and New South Wales - the same states which experience huge outward interstate migration. However, the regional differences in overseas immigration are mostly predetermined by certain social and demographic reasons rather than by current disparities in employment opportunities: newcomers seek family reunion and closeness to their ethnic communities. In other words, the areas of destination by immigrants are predominantly determined by the immigration of previous periods of time. They can, however, choose to shift from the state of arrival either if they find, or hope to find employment interstate. Therefore, the inflow of external migrants may be considered as an exogenous factor, which itself contributes to the disparities in regional labour markets and causes interstate migration.

A Model

The above mentioned hypotheses have been checked with regard to the recent situation in the labour markets of Victoria.
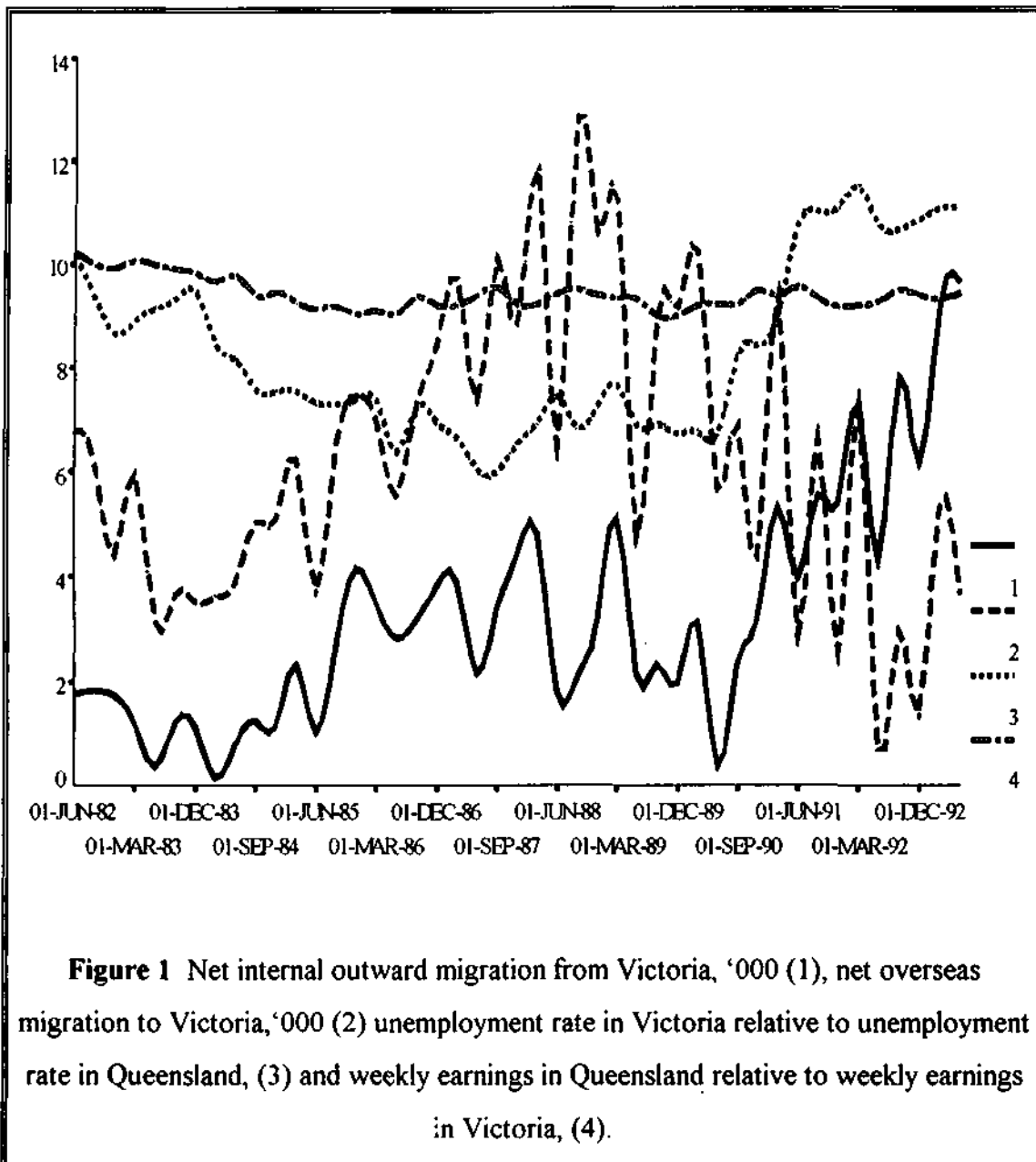
The dynamics of the net internal outward migration to the state (I_t), net external (overseas) inward migration to the state (E_t), unemployment and wage ratios (U_t and W_t) is illustrated below (Figure 1) using Victorian quarterly data of June-1982 - June-1993. (Australian Bureau of Statistics, 1982-1994). The Queensland data is used as the basis for measurement of unemployment and wage disparities, as Queensland is the major destination for interstate migrants from Victoria. Unemployment and wage disparities are measured as the following ratios:

$$U_t = \frac{u_t}{u_t^*} \quad \text{and} \quad W_t = \frac{w_t^*}{w_t}, \tag{1}$$

where u_t and w_t are unemployment and average weekly earnings in the state where the internal migration originated from, whereas u_t^* and w_t^* are corresponding variables for the state which internal migration is predominantly designated to.

For the purpose of a better diagrammatic representation on the one graph, together with the other variables, both variables U_t and W_t are multiplied by 10, so that if U_t or W_t > 10, then a corresponding factor contributes to the propensity to move from the state, and if U_t or W_t < 10. then there is an opposite effect.

As it shown on the graph, there was no obvious link between internal outward migration and wage disparities. On the other hand, there was a strong correlation between the inward external migration and the outward interstate migration, which was especially strong within the period of time between 1983 and 1990 when employment opportunities in Victoria where better than in Queensland. It means that both of the following tendencies occurred:

Figure 1 Net internal outward migration from Victoria, '000 (1), net overseas migration to Victoria,'000 (2) unemployment rate in Victoria relative to unemployment rate in Queensland, (3) and weekly earnings in Queensland relative to weekly earnings in Victoria, (4).
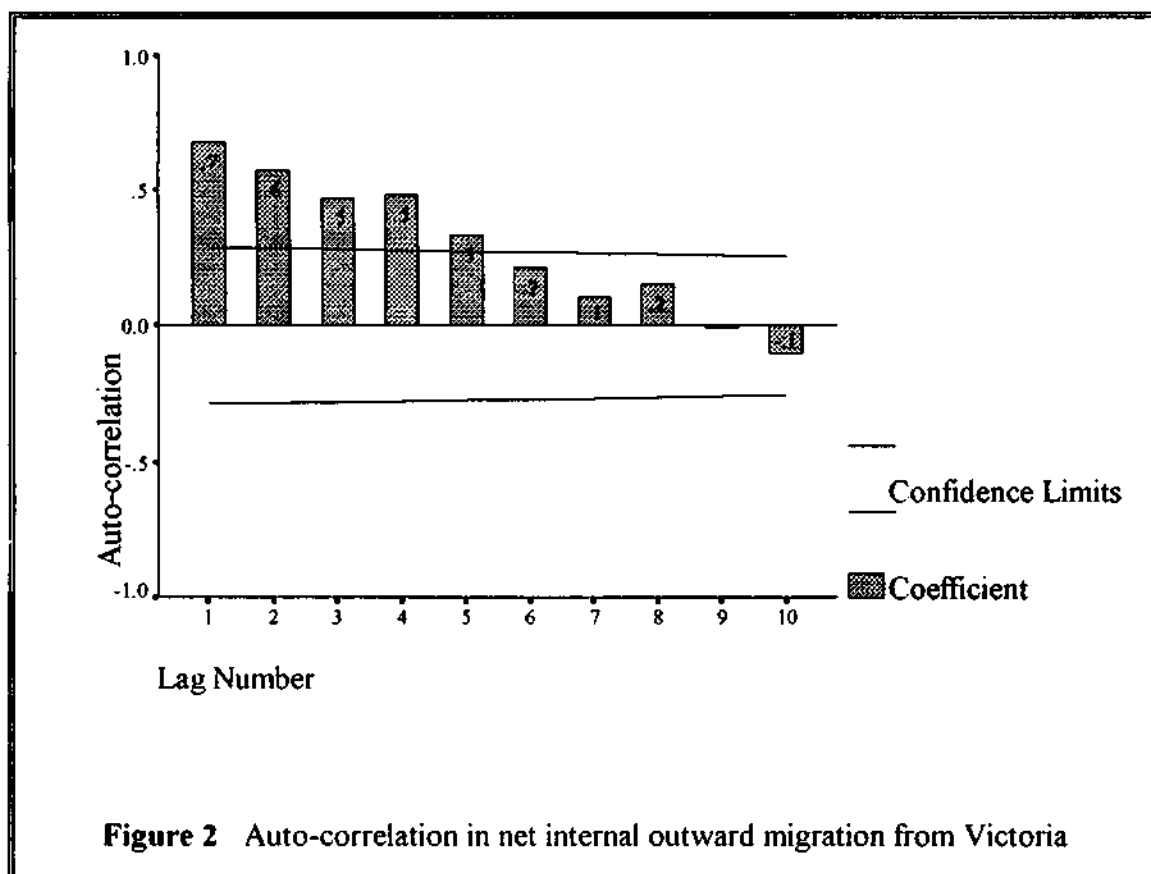
(i) Some newcomers to Australia arrive in Victoria (or NSW) and then, after a short while, move to Queensland; and

(ii) Intensive overseas migration to the state causes additional difficulties in the state labour market and, therefore, contributes to the propensity of the existing population to migrate interstate.

There was an even stronger positive relationship between interstate migration and the unemployment ratio, especially during the period when oversees migration to Victoria (as well as to Australia as a whole) dramatically decreased in 1990-1993. As that period was also characterised by a considerable increase in the number of

Victorians moving to Queensland, it is realistic to assume that the latter relationship was not a linear one.

Another phenomena, which affects the choice of a model explaining the recent net outward migration from Victoria, was the considerably strong auto-correlation in the variable I_t itself. As it is shown on the Figure 2, especially strong are the first and second order auto-correlation coefficients. An intuitive interpretation of this kind of auto-correlation can be suggested. One of the reasons people ultimately decide to move interstate is a positive feedback from their friends, who have shifted to that state, about the current employment, housing and social opportunities they experience in their new area of residence.

Figure 2   Auto-correlation in net internal outward migration from Victoria

The simultaneous consideration of the above-mentioned dependencies gives the following general expression explaining interstate migration:

$$I_t = f(E_t, I_{t-1}, U_t, a), \qquad (2)$$

where a is a vector of parameters and dependence on unemployment ratio U_t is likely to be non-linear. As a result of experimenting with different variants of the model (2) the best approximation was achieved by the specification:

$$I_t = a_1 E_t + a_2 I_{t-1} + a_3 \left(U_t\right)^{a_4} + a_5. \qquad (3)$$

This specification, however, adds a new dimension for interpreting the model. It is now possible to separate the impact of external overseas migration I_t^e and unemployment disparities I_t^u:

$$I_t = I_t^e + I_t^u, \qquad (4)$$

where

$$I_t^e = a_1 E_t + a_2 I_{t-1} \qquad (5)$$

and

$$I_t^u = a_3 \left(U_t\right)^{a_4} + a_5. \qquad (6)$$

Meanwhile, expression (5) is, obviously, analogous to the well known model of geometrically distributed investment lag (Koyck, 1954). It can be associated with the reduced form of the distributed lag model, so that (5) is equivalent to:

$$I_t = \sum_{\tau=0}^{\infty} a_1 a_2^{\tau} E_{t-\tau} + I_t^u + a_2 I_{t-1}^u \qquad (7)$$

If the following condition is fulfilled:

$$0 < a_1 < 1; \quad 0 < a_2 < 1, \tag{8}$$

then the expression (7) can be interpreted as showing that the outward interstate migration depends upon inward overseas migration not only associated with the current period of time, but also with a number of previous time periods. This impact includes the over time distribution of the decisions by overseas migrants to move further across the country, as well as a lagged affect of external migration on the decisions to move made by longer-term Australian residents.

The analogy to Koyck's geometrically distributed investment lag model induced an euristic idea on how to improve the estimate of the parameters of the model (3), which substantially involves auto-correlation in its random component:

$$\varepsilon_t = \alpha \upsilon_{t-1} + \upsilon_t. \tag{9}$$

It is suggested here to use a parameter estimating procedure combining the Levenberg-Marquart non-linear least squares and the linear three-pass least squares method, which was developed especially for the reduced form of Koyck's model. (Taylor and Wilson, 1964).

At the first stage parameters are estimated of the initial equation:

$$I_t = a_1 E_t + a_2 I_{t-1} + a_3 \left(U_t \right)^{a_4} + a_5 + \varepsilon_t \tag{10}$$

At the second stage the lagged random component in (9) is replaced with its estimate which is obtained with the help of a parameter estimate of stage one:

$$v_{t-1}^* = I_{t-1} - a_1 E_t - a_2 I_{t-1} - a_3 \left(U_t \right)^{a_4} - a_5 \qquad (11)$$

and the second stage estimates are derived for the equation:

$$I_t = a_1' E_t + a_2' I_{t-1} + a_3' \left(U_t \right)^{a_4'} + a_5' + \alpha' v_{t-1}^* + v_t \qquad (12)$$

including the coefficient α for the lagged random component.

At the third stage the lagged random component is re-estimated using the second stage estimate a_2' for the lagged variable I_{t-2}:

$$v_{t-1}^{**} = I_{t-1} - a_1 E_t - a_2' I_{t-1} - a_3 \left(U_t \right)^{a_4} - a_5, \qquad (13)$$

which is then used for computing unbiased and consistent parameter estimates of the equation:

$$I_t = a_1'' E_t + a_2'' I_{t-1} + a_3'' \left(U_t \right)^{a_4''} + a_5'' + \alpha'' v_{t-1}^{**} + v_t \qquad (14)$$

The third stage parameter estimates are given in the Table 1. They show an acceptable level of approximation which is illustrated by the graph (Figure 3).
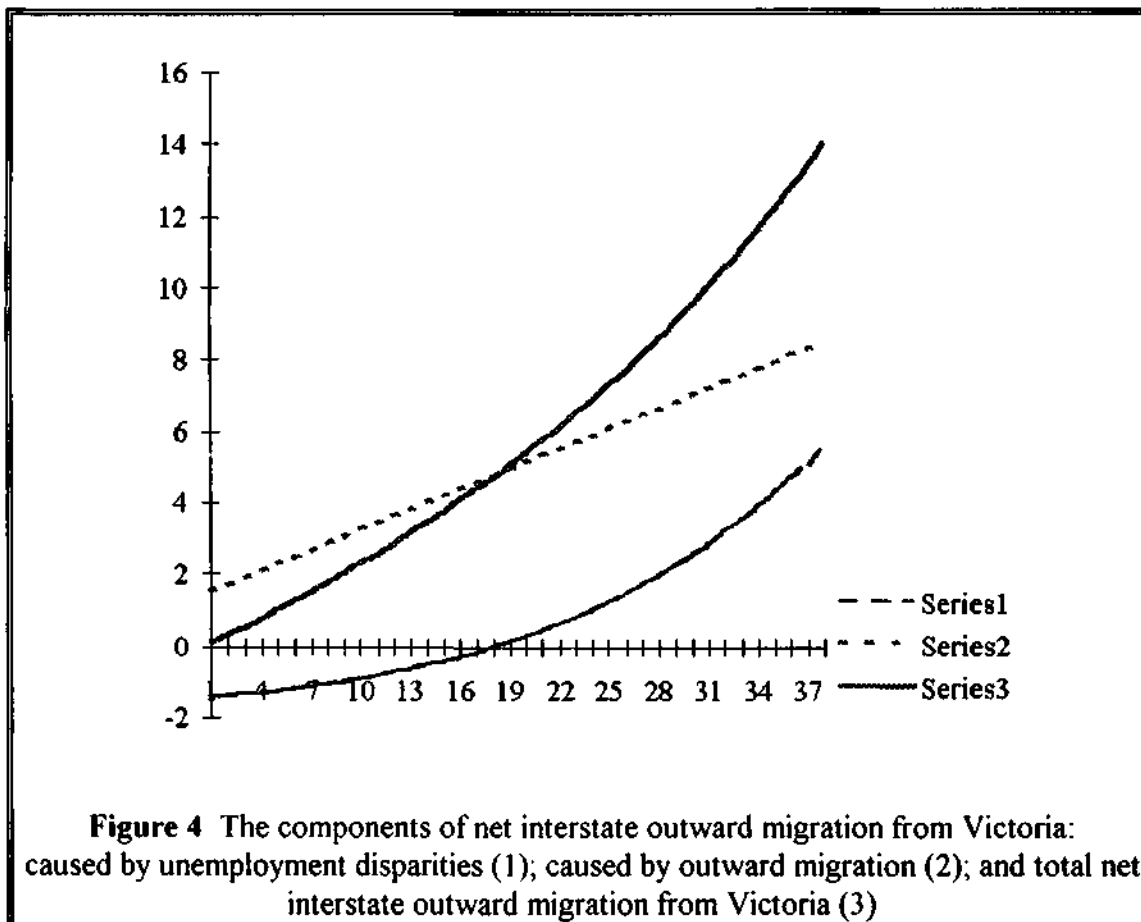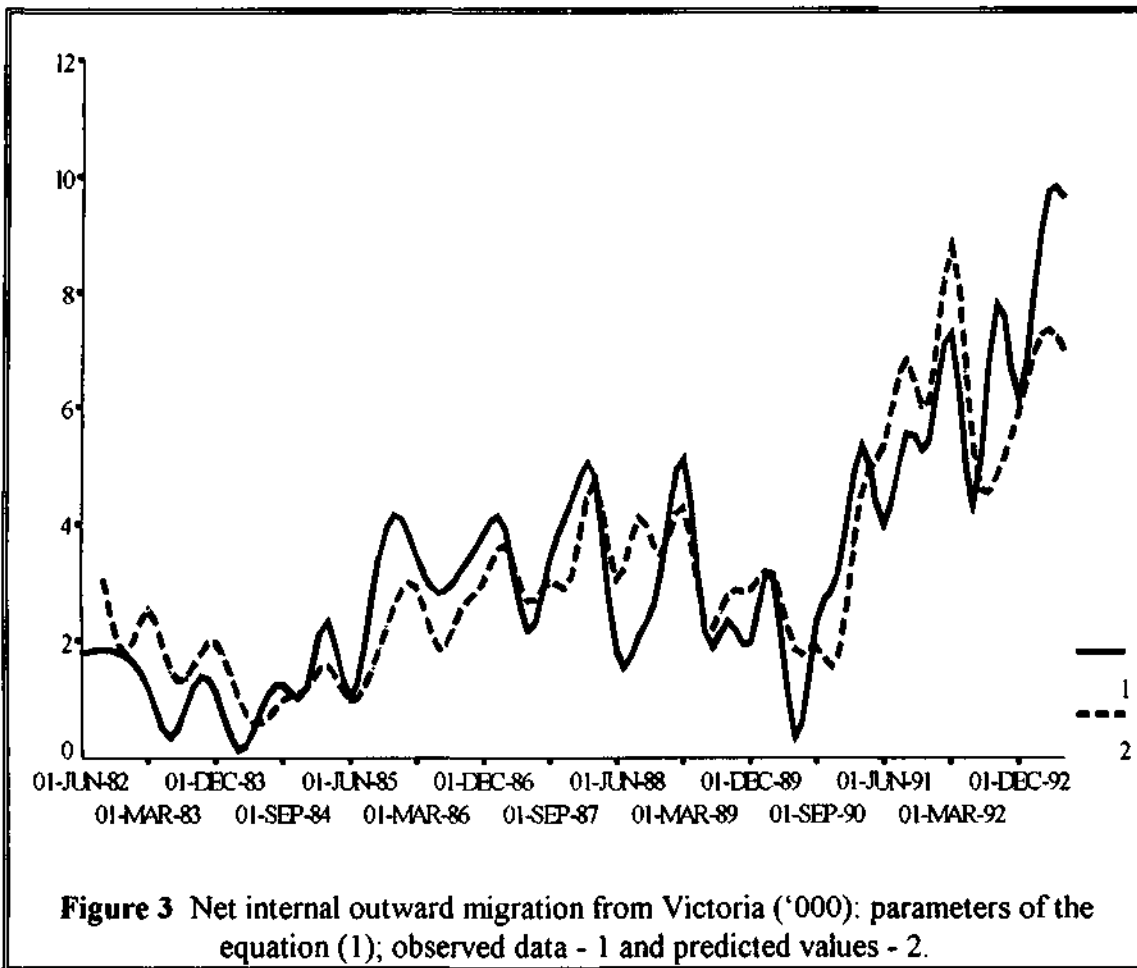
A diagrammatic representation (Figure 4) of the model (14) was plotted with the values of both factor variables sorted in ascending order. The graph confirms the above-mentioned preliminary conclusions based on empirical data. It illustrates the two-component explanation of the reasons for outward interstate migration by unemployment ratio and inward overseas migration.

The earlier one, even though it caused a negative impact on outward migration, was, however, overridden by the sustainable inward overseas migration. If the impact of both components is positive then it shows a socially significant tendency of outward interstate migration that Victoria and NSW were experiencing during early 90s.

	Parameter	St. error
a_1	0.37916	0.084
a_2	0.38537	0.078
a_3	2.69475	0.107
a_4	5.48225	1.204
a_5	-1.80429	0.240
α	0.295415	0.021
R^2	0.76955	0.221

Table 1 Third stage parameter estimates for the equation (14)

Figure 3 Net internal outward migration from Victoria ('000): parameters of the equation (1); observed data - 1 and predicted values - 2.

Figure 4 The components of net interstate outward migration from Victoria: caused by unemployment disparities (1); caused by outward migration (2); and total net interstate outward migration from Victoria (3)

An Application: An Estimate of Outward Migration
from the La Trobe Region of Victoria

The above model appears to be useful for a particular application. Compared to the Australian state statistics, apart from demographic projections and employment data, there is no regularly updated economic information on regions within the states. In particular, there is no data available on interregional migration from and to small regions. On the other hand, structural changes and structural disparities are substantial causes of inter-regional migration differentiated across regions smaller than the states. This was evident in the La Trobe Valley region of Victoria which traditionally has been dependent on a few major industries such as electricity supply, forestry, pulp and paper manufacturing. As a result, the deregulation and subsequent privatisation of the Victorian electricity supply industry the number of jobs in the industry was reduced in 3 years from about 10,000 to 2,500 of about 30,000 jobs in the region (DEETS, 1993 and 1995).

Decrease in Population	Model Estimate	Estimate Based on ABS Data
No of People	1,461	1,403
% to the Population of the Region in 1986	1.96	1.88

Table 2 The decrease in population of La Trobe Valley in 1996-1993

The model (4)-(6) was used for rough estimation of the outflow of population from the La Trobe Valley. Based on the qualitative knowledge of the situation in the region, the following assumptions were adopted:

(i) there was no considerable inflow of overseas migrants to the region in the late 80s - early 90; and

(ii) the majority of internal migrants from the region left the state of Victoria for Queensland.

Following assumption (i), only the component I_t^u of interstate migration caused by unemployment disparities was considered. Assumption (ii) enables the use, for a part of Victoria, the parameters of the model (4)-(6) estimated for Victoria as a whole.

The unemployment ratio for the La Trobe Valley, with respect to the State of Queensland, was calculated. An estimate of internal migration from Victoria was computed using equation (6), which then was reduced proportionally for the number of people residing in La Trobe Valley. The result was compared with the ABS projection of the decline in population the of the La Trobe Valley from 1986 to 1993. Both results (Table 2) show that the estimates based on the two methods appear to be very close to each other and confirm the predicting ability of the model.

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