THE UNEMPLOYMENT/VACANCY RELATIONSHIP IN AUSTRALIA

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ABSTRACT

One of the most important features of the Australian economy in the past two decades has been the structural deterioration of labour market performance, reflected in both an increase in the average rate of unemployment and an outward shift in the Beveridge Curve, which depicts the relationship between unemployment and vacancies. This paper attempts to uncover some of the causes for this structural deterioration, in terms of the factors affecting the UV relationship.

We find that the Beveridge Curve shifted out around 1974, consistent with an increase in the equilibrium rate of unemployment which is generally agreed to have occurred around that time. Using gross labour market flow data, we also investigate the determinants of the equilibrium Beveridge Curve in the 1980s. We find that the Beveridge Curve shifted further outwards in the 1980s. The most important determinant of this shift was the decline in the search effectiveness of the unemployed, reflected in the increasing incidence of long-term unemployment. Offsetting this influence during this time was the declining labour force participation of men, and the very large increases in female employment.

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1. INTRODUCTION

This paper examines the relationship between unemployment and job vacancies in Australia over the period 1966 to 1992, with particular emphasis on the period since 1979. This relationship, commonly known as the Beveridge Curve (BC), is of interest because it provides an indication of how effectively unemployed workers are matched with opportunities for employment; i.e. it forms a measure of the efficiency of the labour market. The mid-1970s saw a sharp increase in the unemployment rate for any given vacancy rate, implying a deterioration in this efficiency. Thus, the large increases in unemployment at that time were not only cyclical but reflected an increase in the equilibrium rate of unemployment, which has not since been reversed[1].

Our aim in this paper is to determine the causes of shifts in the unemployment/vacancy (UV) relationship. We use data on gross flows to and from employment, unemployment and outside the labour force to estimate an equilibrium Beveridge Curve. In doing so, we investigate the effects of job-search effectiveness, the ratio of unemployment benefits to average wages, industry and regional mismatch, and other variables in determining the position of the UV relationship and, by implication, the equilibrium rate of unemployment. We find some weak evidence of an outwards shift of the BC, and hence the equilibrium rate of unemployment, between 1980 and 1989.

Section 2 provides a background to the Beveridge Curve and reviews some of the existing literature. In Section 3 we estimate some simple functional forms for the BC over a sample period beginning in 1966. In Section 4 we estimate an equilibrium BC using a functional form suggested by Layard, Nickell and Jackman (1991). We extend the Layard et al. model to include exits outside the

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1 See Fahrer and Heath (1992) for analysis of the evolution of employment and unemployment since 1966.

labour force, and separate consideration of men and women, and offer some concluding remarks in Section 5.

2. CONCEPTS AND EXISTING LITERATURE

The inverse relationship between the unemployment rate and the vacancy rate was first examined by Dow and Dicks-Mireaux (1958) in their study of labour market conditions in Great Britain. However, it was Hansen (1970) who provided the most widely used justification for the existence of the UV curve. According to Hansen, the convex shape of the Beveridge Curve is caused by the effect that excess supply or excess demand for labour has on the matching of the unemployed to vacancies. Figures 1(a) and 1(b) illustrate his point.

The line segment AC is realised if there is excess supply of labour and the line segment BA is realised if there exists excess demand for labour. The EE curve reflects the fact that vacancies and unemployed workers cannot be perfectly and instantaneously matched, and its shape results from the assumption that the matching becomes better when the pressure of excess demand or excess supply increases. The distance between EE and the labour supply curve represents the number of unemployed, and the distance between EE and the labour demand curve represents the number of vacancies. When $w = w^*$ the labour market is in equilibrium, and the number of vacancies is equal to the number of unemployed. The Beveridge Curve is derived by plotting the number of vacancies against the number of unemployed.

This "traditional" approach to the UV curve has been criticised for several reasons. As Bowden (1980) points out, the position of the UV curve will be altered by a shift in either the labour demand or the labour supply schedule. Also, it is not clear that labour market equilibrium occurs only when the vacancy rate equals the unemployment rate.

An alternative derivation of the UV curve considers the flows into and out of unemployment. Following Borsch-Supan (1991), let N be the labour force, u the unemployment rate U/N, v the vacancy rate V/N, s the probability per time unit that an existing labour contract leads to a separation and p the probability per unit of

Figure 1(a)

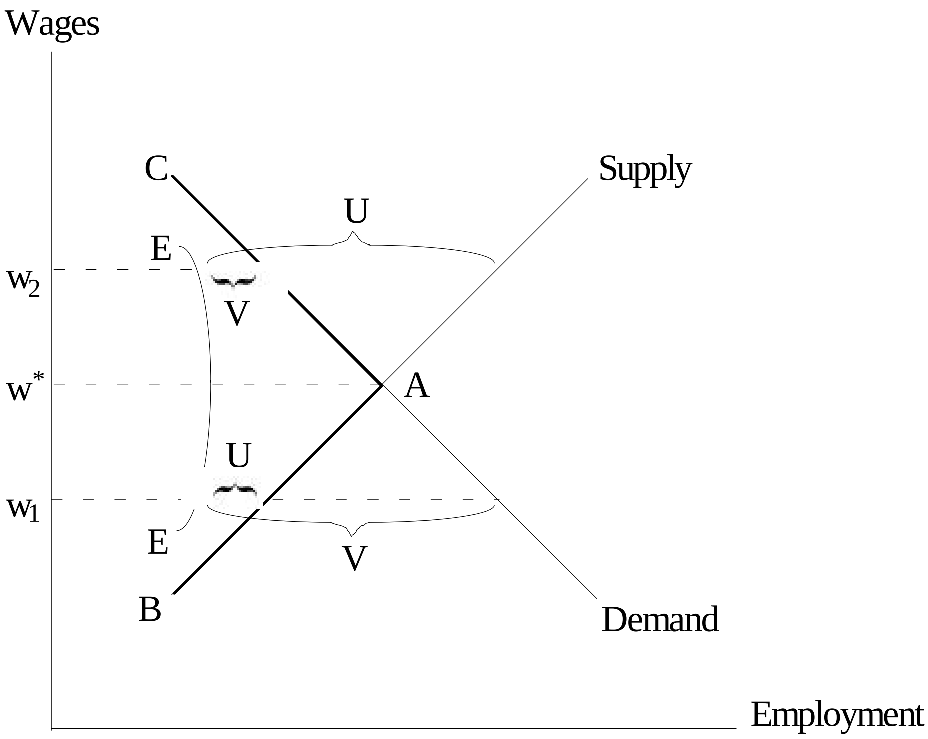
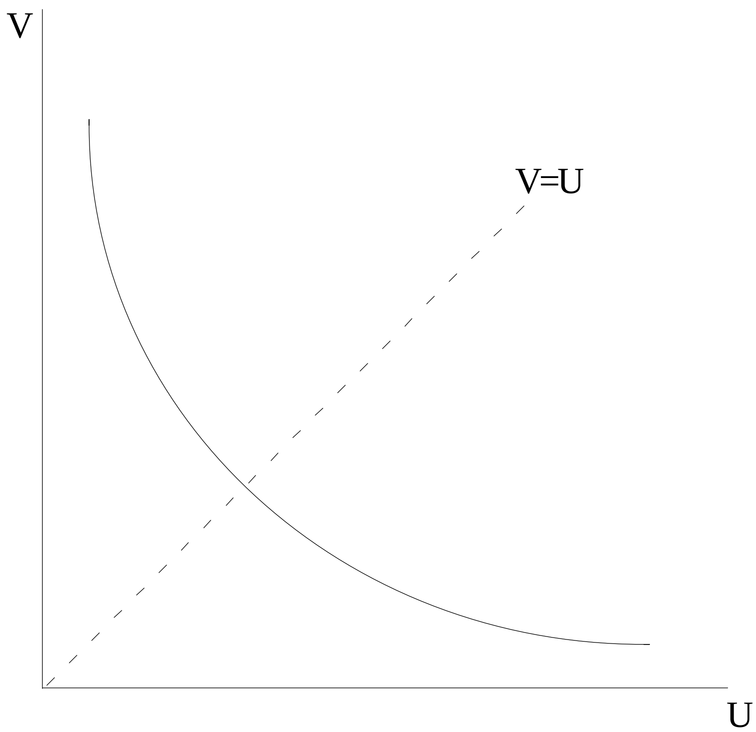


Figure 1(b)



time that an unfilled vacancy is matched with an unemployed worker. Assuming for simplicity that s is fixed and $p = p(v/u)$, $p' = 0$, the following flow equilibrium holds:

$$\dot{u} = (1-u)s - p(v/u)v = 0$$
$$\text{where } du/dv\big|_{\dot{u}=0} < 0$$

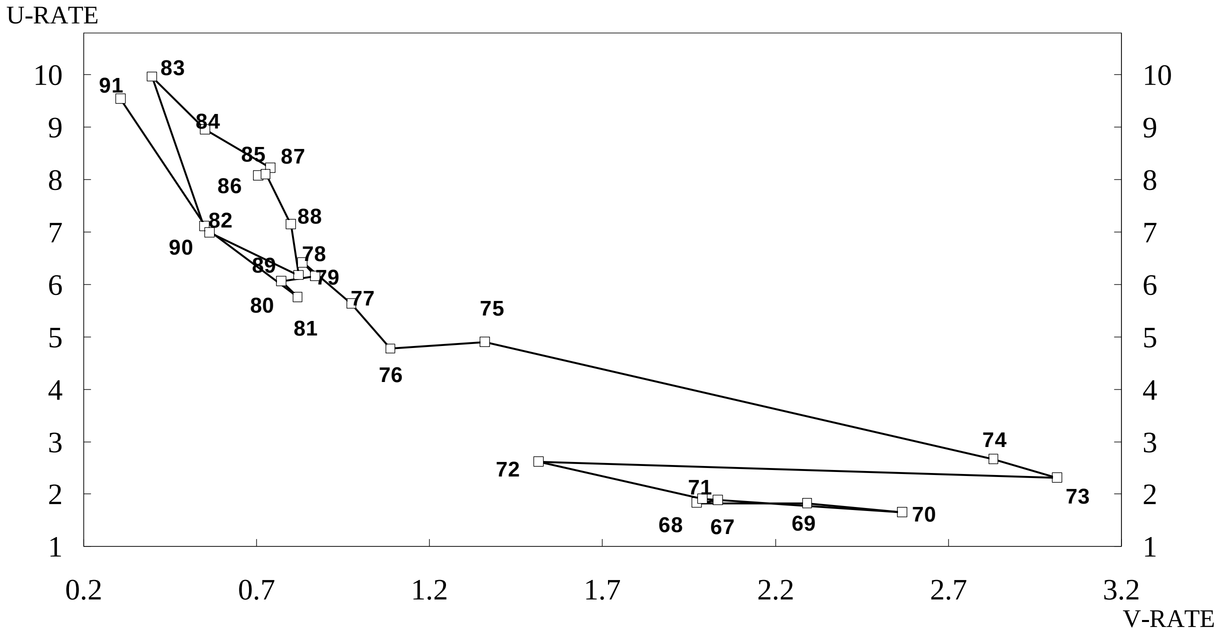
The Beveridge Curve, $\dot{u} = 0$, is convex to the origin if $p''(v/u) > 0$.

Bowden (1980) demonstrates that this curve is independent of aggregate demand and the real wage level. A change in aggregate demand or real wages simply results in an adjustment to a new equilibrium on the original $\dot{u} = 0$ curve. The fact that the BC is shown to be independent of the business cycle makes it possible to distinguish between structural and cyclical unemployment.

Some recent overseas studies have focused on the role of search effectiveness in determining the position of the Beveridge curve. In particular Budd et al. (1988), Jackman et al. (1989) and Layard et al. (1991) have all attributed a large role to the related features of a fall in search intensity and an increase in long-term unemployment to explaining the outward movement in the UV curve for Great Britain. In contrast, Blanchard and Diamond (1989) find little evidence of long-term unemployment affecting the UV relationship in the United States.

Australian studies have typically concentrated on a large apparent outwards shift in the UV curve in the early 1970s. Hughes (1975), Gruen (1978) and Harper (1980) all find evidence of an outwards shift in the UV curve sometime between 1972 and 1974. Both Hughes and Harper conclude the sharp fall in migration in the early seventies contributed to the outward shift in the curve. Hughes does not consider that the increases in the real level of unemployment benefits has made a contribution, while Harper finds evidence that it has. Withers and Pope (1985) re-estimate the Harper model using a different formulation of the migration variable. They confirm Harper's findings with respect to the level of real unemployment benefits, but find that migration has not played a role in shifting the UV curve.

Figure 2: UV Curve - Annual Averages - "Spliced" Vacancies 1967 - 1991



There has been no rigorous examination of the Australian UV relationship for the 1980s. From a visual inspection of a UV scatterplot Chapman (1990) concludes that there has been no obvious and large outward movement in Australia's UV curve over the latter part of the 1980's.

3. ESTIMATION OF SIMPLE BEVERIDGE CURVES

In this section we estimate some simple Beveridge Curves, i.e. regress the unemployment rate (or transformations of it) on the vacancy rate. Our purpose here is destructive rather than constructive. We aim to show that such simple methods cannot satisfactorily explain the relationship between these two variables and thus more sophisticated methods, such as we employ in Section 4, are necessary to do so.

Our starting point is Harper (1980), who estimates the following functional forms for the BC over the period 1952 to 1978[2]:

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[2] In making this point, we are **not** criticising Harper's study, which is in fact the most complete examination of the Australian unemployment-vacancy relationship to date of which we are aware. Harper could not have used gross flow data to estimate equilibrium Beveridge Curves, as we do in Section 4, since such data did not exist at the time he published his paper.

$$
\begin{aligned}
\log U_t &= b_0 + b_1 \log V_t + e_t \\
U_t &= b_0 + b_1 \log V_t + e_t \\
U_t &= b_0 + b_1 / V_t + e_t \\
\sqrt{U_t} &= b_0 + b_1 \sqrt{V_t} + e_t \\
\Delta \log U_t &= b_0 + b_1 \Delta \log V_t + e_t
\end{aligned}
$$

where U_t is the unemployment rate, V_t is the vacancy rate (the ratio of vacancies to the labour force) and ε_t is a random disturbance.

We estimate each of these relationships using seasonally unadjusted quarterly data over the period September 1966 to June 1992. This is the longest period for which consistent labour force data are available. The unemployment data refer to total unemployed (i.e. both full-time and part-time) and are measured at the mid-month of each quarter. Two vacancy series are used, "spliced" vacancies and "CES" vacancies.

The spliced vacancy series is similar to the NIF vacancies used by Chapman (1990), the primary difference being that the NIF series is seasonally adjusted. The series is created by splicing the ABS vacancy series onto the CES vacancy series[3]. For example, every June quarter CES unfilled vacancy observation is multiplied by the ratio of ABS vacancies to CES vacancies in June 1980. Similarly, every September CES vacancy figure is multiplied by the ratio of ABS to CES vacancies in September 1979, and so on.

The ABS vacancy series has a break in the December quarter 1983 when the sample basis moved from payroll tax records to a survey of employers. This resulted in an increase in the magnitude of the vacancies reported. Vacancies under both bases were reported in December 1983, and we have increased the payroll tax series proportionately.

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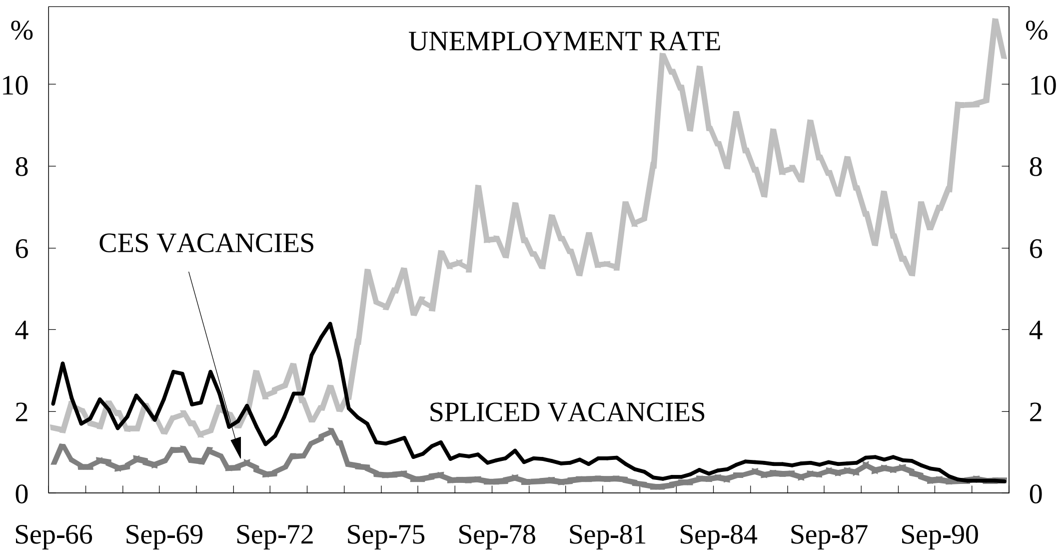
[3] From September 1966 to June 1979 the vacancies series is the Commonwealth Employment Service (CES) stock of unfilled vacancies. From September 1979, we use the ABS vacancy series. The CES vacancies are spliced on to the ABS series by taking a ratio of the two series during the overlapping period, September 1979 to June 1980.

Figure 3: Vacancy Rate and the Unemployment Rate - NSA



The "CES" vacancy series uses CES unfilled vacancy data from the September quarter of 1966 to the June quarter of 1992. Unfortunately the CES did not report unfilled vacancies during the period December 1980 to March 1983. The missing observations are constructed by applying the percentage changes from the ABS series.

The CES vacancy data are inferior to the ABS data in several respects: during periods of labour market slack, the fall in vacancies will be exaggerated as firms will not find it necessary to contact job seekers through the CES; the number of vacancies reported will vary as CES offices open and close; vacancies may be reported as unfilled when in fact they have been filled, but not by CES registered applicants; as notification of vacancies to the CES is voluntary, many vacancies are not registered; and the number of vacancies reported to the CES may vary as a result of changes in government or CES administrative policy.

The estimation results are presented in Tables 1(a) and 1(b). While the estimated coefficients on the vacancy variables have the correct sign and the standard errors of these estimates are small, the very low values of the Durbin Watson statistics indicate that the specifications are seriously in error. In all likelihood, the dynamics in these models (there aren't any) have been mis-specified. As a first step towards correcting this problem, we estimated an autoregressive distributed lag model, with initially four lags of the dependent variable (log U_t) and each exogenous regressor in the specification.

Table 1(a)
The "Harper" Specifications Using CES Vacancies

$\log U_t$	U_t	$\sqrt{U_t}$	$\Delta \log U_t$	Constant	$\log V_t$	$1/V_t$	$\sqrt{V_t}$	$\Delta \log V_t$	$\bar{R}^2$	DW
*				0.67 (6.4)	-1.03 (-12.4)				0.61	0.2
	*			1.80 (3.7)	-4.3 (-11.3)				0.56	0.2
	*			1.83 (2.4)		94.9 (5.9)			0.25	0.1
		*		3.9 (14.5)			-0.30 (-6.6)		0.30	0.1
			*	-0.14 (-6.7)				-0.10 (-1.9)	0.65	1.8

Table 1(b)
The "Harper" Specifications Using Spliced Vacancies

$\log U_t$	U_t	$\sqrt{U_t}$	$\Delta \log U_t$	Constant	$\log V_t$	$1/V_t$	$\sqrt{V_t}$	$\Delta \log V_t$	$\bar{R}^2$	DW
*				1.48 (29.9)	-0.90 (-23.3)				0.85	0.4
	*			5.17 (26.3)	-4.0 (-25.8)				0.87	0.5
	*			0.55 (1.3)		272.1 (16.4)			0.73	0.3
		*		4.2 (32.1)			-0.30 (-6.6)		0.75	0.4
			*	-0.15 (-7.3)				-0.17 (-2.9)	0.66	1.9

Note: Asterisks indicate the dependent variable for the particular regression.

All the regressions were estimated using OLS, and the figures in parentheses are the t statistics.

U_t and V_t refer to the unemployment rate and the vacancy rate respectively.

In addition to lags of log V_t, the regressors include the ratio of unemployment benefits to average earnings (the "replacement ratio"), the gap between actual and potential GDP, and a time trend[4]. The replacement ratio is included as a regressor since it measures the opportunity cost of unemployment i.e., as the replacement ratio increases, the incentive for the unemployed to search for employment falls, and so the Beveridge Curve shifts outwards, and for each vacancy rate, the unemployment rate increases. The GDP gap is included to account for the cyclical movements in the unemployment-vacancy relationship. Dummy variables were included to test for breaks in the relationship in September 1974 and September 1982.

The estimation was conducted sequentially by Ordinary Least Squares. A series of F-tests were carried out to identify and eliminate insignificant lags, resulting in the following specifications:

Using spliced vacancies:

$$\begin{aligned}\log U_t = &\underset{(2.9)}{0.24} + \underset{(8.4)}{0.58}\log U_{t-1} - \underset{(-2.3)}{0.09}\log V_{t-3} - \underset{(-5.0)}{6.48}\log GDPGAP_t \\ &+ \underset{(2.8)}{0.25}(\log RR_{t-2} - \log RR_{t-4}) + \underset{(3.5)}{0.002}\, Trend \\ &+ \underset{(6.6)}{0.33} D74{:}3 + seasons\end{aligned} \tag{1}$$

$$\overline{R}^2 = 0.99, \quad P(LM_1) = 0.23, \quad P(LM_4) = 0.028$$

Using CES vacancies:

$$\begin{aligned}\log U_t = &\underset{(2.6)}{0.12} + \underset{(9.3)}{0.60}\log U_{t-1} - \underset{(-3.3)}{0.16}\log V_{t-3} + \underset{(1.9)}{0.09}\log V_{t-4} \\ &- \underset{(-4.5)}{5.80}\log GDPGAP_t + \underset{(2.8)}{0.24}(\log RR_{t-2} - \log RR_{t-4}) \\ &+ \underset{(4.4)}{0.003}\, Trend + \underset{(6.6)}{0.33} D74{:}3 + seasons\end{aligned} \tag{2}$$

$$\overline{R}^2 = 0.99, \quad P(LM_1) = 0.12, \quad P(LM_4) = 0.018$$

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[4] The GDP gap was calculated using the Hodrick-Prescott filter, a technique which fits a non-linear trend through the data (Hodrick and Prescott 1981). The replacement ratio is that for single males aged over 21 with no dependants. We discuss the construction of the replacement ratio in detail in the Data Appendix.

where $P(LM_{\bullet})$ is the significance level at which a Lagrange Multiplier test for first or fourth order autocorrelation can be rejected.

As can be seen from equations (1) and (2), the results for both vacancy series are virtually identical. Lagged, but not contemporaneous, vacancies are significant, as is the first lag of log unemployment and the log GDP gap. The lagged, two quarter, change in the log of the replacement ratio is also significant, as is the deterministic time trend. There is clear evidence of a structural break in the third quarter of 1974, but not in 1982. The LM tests reject first-order serial correlation (at conventional significance levels), but there is some evidence of fourth order serial correlation.

The autoregressive distributed lag model is clearly an improvement on the static Harper specifications, but is still unsatisfactory in that it does not distinguish short-run movements in the Beveridge Curve, due to the business cycle, from changes in the equilibrium relationship between unemployment and vacancies. We address this issue in the following section.

4. AN EQUILIBRIUM MODEL OF THE UV RELATIONSHIP

Our model of the equilibrium Beveridge Curve is an extension of the work of Layard et al. (1991), who estimate this relationship for the United Kingdom. As far as application to Australia is concerned, the Layard model is deficient in two respects: it excludes women, and it assumes that all exits from unemployment are to employment. These distinctions are important because men and women behave quite differently in the Australian labour market; the flow from unemployment to outside the labour force is especially important for women. Our extensions to this model are thus to separately estimate the entry to, and exit from unemployment of men and women, and to separately estimate the exit from unemployment to employment, and to outside the labour force. We then aggregate these estimates to derive an equilibrium Beveridge Curve for the economy as a whole[5].

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[5] Separate Beveridge Curves for men and women cannot be estimated because the vacancy data are not gender specific; indeed anti-discrimination laws now prohibit the advertising of vacant positions by gender.

4.1 Outflows from Unemployment

We begin by considering the outflow from unemployment. Outflows from unemployment to employment are based on the hiring function:

$$H = h(V, cU) \tag{3}$$

The number of hirings per period (H) depends on the number of vacancies (V), the number of unemployed people (U), and their average effectiveness at searching for work, c. Thus hirings are affected not only by the number of vacancies and unemployed, but also by the behaviour of the unemployed. The number of hirings will rise as the unemployed, on average, become more effective job seekers.

The search effectiveness of the unemployed is determined by factors such as the level and availability of unemployment benefits, the time and effort the unemployed devote to job search, and the recruitment practices of employers. In particular, the search effectiveness of the unemployed is determined by the duration of unemployment. This operates through two mechanisms. Long-term unemployment is used as a screening device by employers, with the probability of being hired falling as the length of an unemployment spell increases. Secondly, long duration unemployment demoralises the individual, and leads to an erosion of their job skills. This explanation is referred to as "duration dependence" because the declining exit rates from unemployment are a function of the duration of the unemployment spell.

Of course it may be the case that exit rates fall with duration because the "best" job seekers find employment first. New entrants to unemployment are heterogeneous in the sense that they, *ex-ante*, vary in quality in terms of job skills, motivation, attachment to the labour force etc. Thus, exit rates for a heterogeneous group will decline with duration simply because the "best" individuals will exit most rapidly.

However, most of the available evidence favours duration dependence. Layard et al. (1991) cite evidence from British and USA studies which find adverse effects on motivation, morale and psychological health from extended periods of unemployment. They also present their own findings based on a comparision of the exit rate for new entrants compared with the overall exit rate. Under pure heterogeneity the ratio of the exit rate for new entrants to the aggregate exit rate should be constant over time. This is because the proportion of enthusiastic and unenthusiastic job seekers in the stock and in the inflow to unemployment will remain constant regardless of the state of the labour market. Layard et al. found that between 1969 and 1985 the overall exit rate fell by five-sixths, while the exit rate of new entrants fell by only just over one-half [6,7].

As search effectiveness is primarily a function of the duration of unemployment, we measure it using the following index:

$$\hat{c}_t = \sum_d h_{d0} f_{dt} \tag{4}$$

where h_{d0} is the exit rate at each uncompleted duration (d) in any arbitrarily selected year 0, while f_{dt} is the proportion of unemployed at that duration in year t. A rise in $\hat{c}$ implies an increase in unemployment effectiveness since a higher proportion of the unemployed are in short durations which have a higher exit probability.

The number of effective job seekers is cU. H(•) is assumed to be linearly homogeneous in V and cU. Thus both sides of equation (3) can be divided by cU:

$$\frac{H}{U} = ch\left(\frac{V}{cU}, 1\right) \tag{5}$$

Expressing the hiring function in log-linear form and substituting in $\hat{c}$ gives:

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6 Due to data limitations we were unable to perform a similar test. However, Trivedi and Hui (1988) using gross flow data find evidence of negative duration dependence for long-term unemployed in Australia.

7 See also Jackman and Layard (1991).

$$\log\frac{H}{U} = \log\hat{c} + b_1 \log\frac{V}{\hat{c}U} + b_2 X \qquad (6)$$
$$= (1-b_1)\log\hat{c} + b_1\log\frac{V}{U} + b_2 X$$

where H is hires, i.e. the number of unemployed, during each quarter, who find employment, and X is a vector of other variables which affect hires out of unemployment.

We estimated equation (6) separately for males and females, and in doing so experimented with many different explanatory variables in the regressor set X. These variables were:

- the replacement ratios for males and for all beneficiaries;
- the output gap;
- measures of state and industry mismatch;
- a time trend; and
- seasonal dummies.

We would expect the replacement ratios and mismatch indices to have a negative effect on hires, and the output gap to have a positive effect[8]. The Data Appendix contains a detailed explanation of how these variables are constructed.

We also estimated exits from unemployment to outside the labour force, with equations of the form:

$$\log\frac{NLF_{males}}{U} = b_m X \qquad (7a)$$

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[8] It may be the case that there is some correlation between some of these explanatory variables and $\hat{c}$. In particular $\hat{c}$ may be related to the replacement ratio and the measures of UV mismatch. A sustained rise in UV mismatch could lead to falling exit rates. However, cross correlations show no collinearity between state mismatch and $\hat{c}$, and only slight correlation between industry mismatch and $\hat{c}$. Furthermore, the plots of $\hat{c}$ and industry mismatch in Figures A2 and A3 indicate that there is no long term relationship between the two series.

$$\log \frac{NLF_{females}}{U} = b_f X \tag{7b}$$

where NLF_{males} is the number of men exiting unemployment by leaving the workforce, and similarly for $NLF_{females}$. The regressor set X included the same variables as enter the hires equations, and also other variables which might affect labour force participation. These were:

- the proportion of the unemployed aged over 55;
- the unemployment gap, calculated as the difference between actual and (Hodrick-Prescott) trend rates of unemployment;
- the proportion of the unemployed who have been so for more than one year (the long term unemployed); and
- the share of part-time employment in total employment.

Each of these variables, except the unemployment gap, might be expected to be positively correlated with the rate of exit from unemployment to outside the labour force. A rise in unemployment above trend, on the other hand, is generally accompanied by an influx of newly unemployed, highly committed job seekers who will have an above-average attachment to the labour force. Therefore when the unemployment gap rises, the proportion of the unemployed leaving the labour force should fall.

Our preferred equations are presented below. The sample period is 1979(4) to 1992(1), and the estimation method is by instrumental variables because, by construction, the UV ratio is correlated with each equation's disturbance term[9].

$$\log \frac{H_{males}}{U} = \underset{(1.2)}{0.3} + \underset{(4.1)}{0.86\hat{c}} + \underset{(10.0)}{0.19} \log \frac{V}{U} - \underset{(1.6)}{0.01} MM_{State} + \underset{(1.8)}{0.001} Trend + seasons \tag{8}$$

$$\bar{R}^2 = 0.73 \quad P(LM_1) = 0.12 \quad P(LM_4) = 0.15 \quad P(BP) = 0.50$$

9 With the exception of $\hat{c}$, lags of the contemporaneous regressors are used as instruments. $\hat{c}$ does not have an instrument. Random shocks to the outflow rate will, in expectation, be uncorrelated with $\hat{c}$.

$$\log \frac{H_{females}}{U} = \underset{(2.9)}{0.8} + \underset{(5.1)}{1.16} \log \hat{c} + \underset{(18.7)}{0.38} \log \frac{V}{U} + \underset{(6.6)}{0.005} Trend + seasons \tag{9}$$

$\overline{R}^2 = 0.89 \quad P(LM_1) = 0.28 \quad P(LM_4) = 0.05 \quad P(BP) = 0.94$

$$\log \frac{NLF_{males}}{U} = \underset{(-78.4)}{-1.7} - \underset{(-6.8)}{1.15}\, UGAP + \underset{(7.6)}{0.005} Trend + seasons \tag{10}$$

$\overline{R}^2 = 0.72 \quad P(LM_1) = 0.26 \quad P(LM_4) = 0.56 \quad P(BP) = 0.004$

$$\log \frac{NLF_{females}}{U} = \underset{(-1.2)}{-0.2} + \underset{(2.8)}{0.21} \log \frac{NLF_{females}}{U}_{-4} + \underset{(10.5)}{0.17} \log \frac{V}{U} \tag{11}$$
$$+ \underset{(1.7)}{0.07} \log \frac{Age_{55}}{U_f}_{-1} + seasons$$

$\overline{R}^2 = 0.84 \quad P(LM_1) = 0.16 \quad P(LM_4) = 0.23 \quad P(BP) = 0.71$

where P(BP) is the marginal significance level for the Breusch-Pagan test for heteroskedasticity. U is the total number of unemployed, i.e. male and female. We use total unemployment in the outflow equations as this makes possible the derivation of the aggregate equilibrium Beveridge Curve; see sub-section 4.3 below. The numbers in parentheses are t-statistics.

The BP test shows the likely presence of heteroskedasticity in equation (10), and so implied standard errors reported here are those consistently estimated by the Newey-West procedure.

The effectiveness index is robustly estimated for both hiring equations, as is the vacancies to unemployment ratio[10]. However, most of the additional explanatory variables do not fare as well. In no case was the coefficient on the replacement

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[10] The hypothesis of linear homogeneity, i.e. that the sum of the coefficients on the effectiveness index and UV ratio sum to one, is easily accepted for male hires.

ratio significantly different from zero; likewise for industry mismatch. Regional (state) mismatch does appear in the hiring equation for males, albeit only at the 12 per cent signficance level.

The failure of the replacement ratio to exert a significant effect on outflows is somewhat surprising, given its prominence in the literature. However, this failure might be explained by specific institutional features of the Australian benefit system (e.g. loss of entitlement following refusal of a job offer) or by tightened eligibility criteria and stricter application of the work search test[11]. It also accords with the findings of Trivedi and Baker (1985) and McMahon and Robinson (1984). Moreover, as pointed out by Atkinson and Micklewright (1991) in their extensive review of unemployment compensation and labour market transition, unemployment benefits impart both an income effect and substitution effect on job search. While the latter leads to less search, the income effect of higher unemployment benefits leads to more search, not less, since job search is generally costly. Perhaps the insignificance of the replacement ratio in our outflow equations is due to these two effects offsetting each other.

This result might also be due to our relatively short sample period. Figure 4 plots the unemployment rate for all persons against the replacement ratio for adult males[12]. It is apparent that during the mid 1970s the large rise in the unemployment rate was accompanied by a significant increase in the replacement ratio. However, between December 1979 and March 1992 (the period over which the outflow equations are estimated), there was no such correlation. Possibly, were we to have gross flow data over the time period depicted in Figure 4, we would find outflows to be affected by the replacement ratio.

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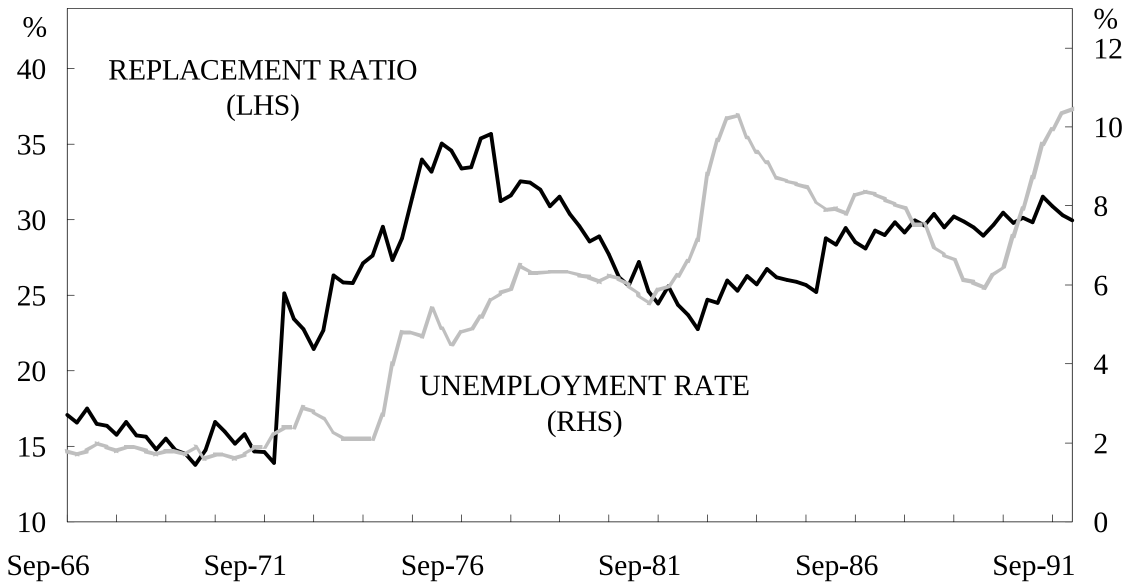
[11] In their 1991 annual report, the Department of Social Security claimed that the number of reviews of pension and benefit entitlements doubled between 1988-89 and 1990-91.

[12] The construction of the replacement ratio is discussed in the Data Appendix.

Figure 4: Replacement Ratio and the Unemployment Rate



Another possibility is that job search depends not on the value of unemployment benefits, but on the maximum length of time that such benefits can be received. This hypothesis cannot be tested with Australian data since unemployment benefits have always been receivable for unlimited periods of time.

In summary, we can conclude from the outflow equations for the 1980s that:

- there is no evidence that the increase in the proportion of males leaving unemployment by exiting the labour force is related to mismatch, long duration unemployment or age. A rise in cyclical unemployment leads to fewer exits; however, by construction, this variable cannot explain exits (and consequently the UV relationship) in the long run.

- the slight trend rise in male hires has been more than offset by falls in the search effectiveness index and the rise in regional UV mismatch;

- female exits from unemployment to outside the labour force are positively related to vacancies, which may indicate an added worker effect, i.e. married women enter (leave) the labour force in order to stabilise family incomes in response to falling (rising) labour demand. There is also a positive association between vacancies and the proportion of unemployed females aged over 55; and

- there is no relationship between the outflow rates of males or females and the replacement ratio. Nor, it appears, does UV mismatch by industry affect outflow. There is some evidence that mismatch by state affects male hires.

4.2 Inflows to Unemployment

We specifiy inflows simply as a function of the UV ratio, the replacement ratio, the output gap and a time trend.

The estimated equations describing the inflows to unemployment are:

$$\log\frac{S_{males}}{N} = -\underset{(-2.9)}{2.0} + \underset{(2.8)}{0.48}\log\frac{S_{males}}{N}_{-1} - \underset{(-3.4)}{0.19}\log\frac{V}{U} + \underset{(3.7)}{4.36}GDPGAP_{-2} + seasons \tag{12}$$

$\bar{R}^2 = 0.93 \quad P(LM_1) = 0.24 \quad P(LM_4) = 0.23 \quad P(BP) = 0.45$

and

$$\log\frac{S_{females}}{N} = -\underset{(-3.5)}{1.5} + \underset{(4.7)}{0.56}\log\frac{S_{females}}{N}_{-1} - \underset{(-3.8)}{0.10}\log\frac{V}{U}_{-2} + \underset{(2.2)}{2.65}GDPGAP_{-2} + seasons \tag{13}$$

$\bar{R}^2 = 0.89 \quad P(LM_1) = 0.46 \quad P(LM_4) = 0.10 \quad P(BP) = 0.82$

where S represents inflows to unemployment and N is the (aggregate) labour force.

Thus, for both men and women, inflows to unemployment increase when the ratio of vacancies to the numbers of unemployed falls, and when output is below trend. Neither of these results is surprising. We are also unable to detect a trend in either of the inflow equations.

4.3 Derivation of the Equilibrium UV Relationship

To derive the equilibrium Beveridge Curve, we equate aggregate long run outflows and inflows. The four long-run outflow relationships are:[13]

$$\log \frac{H_{males}}{U} = 0.29 + 0.86 \log \hat{c} + 0.19 \log \frac{V}{U} - 0.01 MM_{State} + 0.001 TREND \tag{14}$$

$$\log \frac{H_{females}}{U} = 0.78 + 1.16 \log \hat{c} + 0.38 \log \frac{V}{U} + 0.005 TREND \tag{15}$$

$$\log \frac{NLF_{males}}{U} = -1.75 + 0.005 TREND \tag{16}$$

$$\log \frac{NLF_{females}}{U} = -0.23 + 0.09 \log \frac{Age_{55}}{U_F} + 0.22 \log \frac{V}{U} \tag{17}$$

Aggregate outflows are:

$$\log \frac{O}{U} = \log \left(\frac{NLF_{males} + H_{males} + NLF_{females} + H_{females}}{U} \right) \tag{18}$$

which is clearly non-linear in the explanatory variables. Since we need to obtain a linear relationship in log (V/U) to derive the equilibrium Beveridge Curve, we linearise equation (18) by a Taylor series expansion around the mean value of log (V/U) over the sample period. The linearised expression is:

$$\begin{aligned} \log \frac{O}{U} \approx \log(A + B + C + D) + \frac{(0.56B + 0.97C + 0.47D)}{(A + B + C + D)} \\ + \frac{(0.22B + 0.38C + 0.19D)}{(A + B + C + D)} \log \frac{V}{U} \end{aligned} \tag{19}$$

---

13 Additive seasonal dummy variables were used in estimating the inflow and outflow equations. As a result the constants in the long-run equations are calculated as a simple annual average of the value the constant takes in each quarter.

where:

$$A = \exp(-1.75 + 0.005\,TREND)$$
$$B = \exp\left(-0.78 + 0.09\log\frac{Age55}{U_F}\right)$$
$$C = \exp(-0.19 + 1.16\log\hat{c} + 0.005\,TREND)$$

$$D = \exp(-0.18 + 0.86\log\hat{c} - 0.01\,MM_{State} + 0.001\,TREND)$$

Over the sample period the coefficient on log(V/U) is in the range 0.208 to 0.213, with a mean value of 0.210.

The accuracy of this linearisation can be gauged from Figure 5, which plots the non-linear and linear aggregate outflow equations. Clearly, the linear expression is an accurate approximation of the non-linear equation; the Root Mean Squared Percentage Error is only 0.7 per cent.

Figure 5: Actual and Estimated Long-Run Outflows

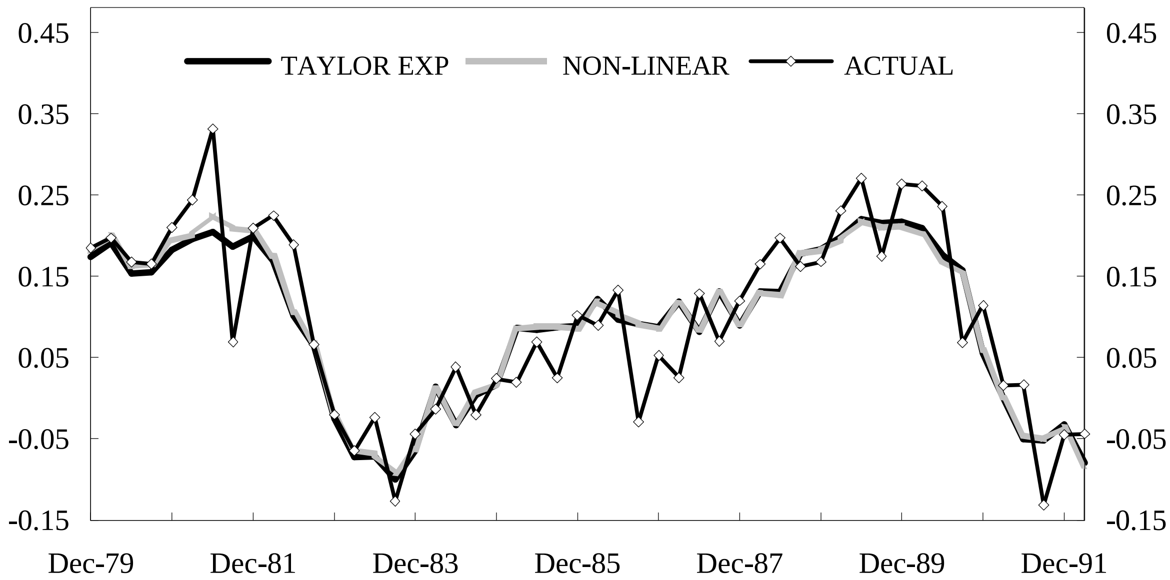


Figure 5 also provides some (weak) evidence of hysteresis operating through the outflows from unemployment. In large downturns, such as in 1982-83 and 1990-91, the equilibrium outflow rate followed the actual rate downwards. However, during the mild downturn of 1986-87 the equilibrium outflow rate stayed constant while the actual rate fell.

The long run inflow equations for males and females are:

$$\log \frac{S_{males}}{N} = -4.22 - 0.36 \log \frac{V}{U} \tag{20}$$

$$\log \frac{S_{females}}{N} = -3.76 - 0.22 \log \frac{V}{U} \tag{21}$$

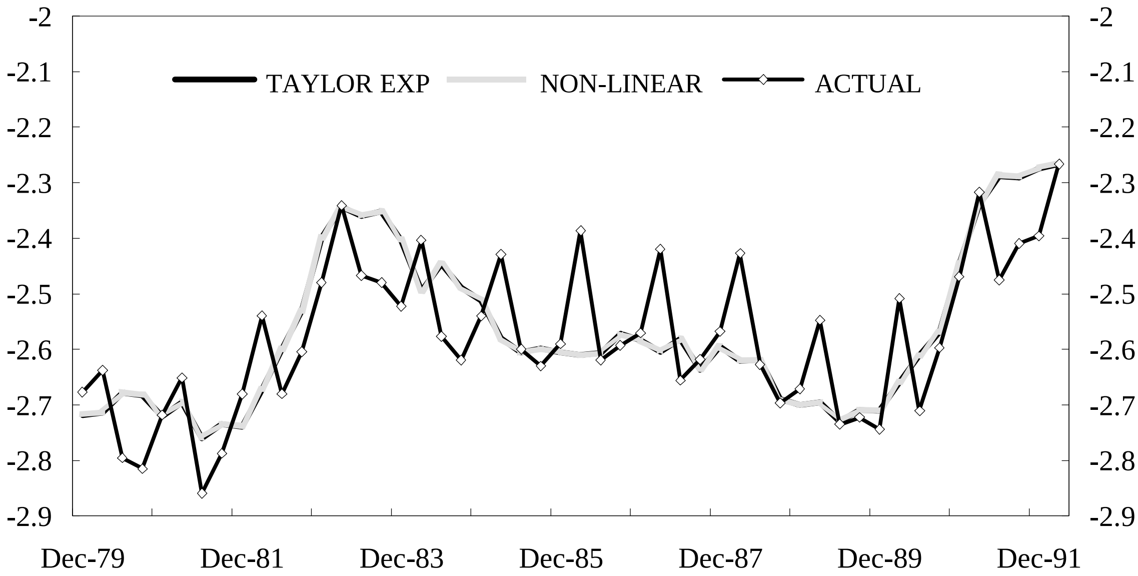
Aggregate inflows are therefore:

$$\log \frac{S}{N} = \log \left(\frac{S_{males}}{N} + \frac{S_{females}}{N} \right) \tag{22}$$

which is also non-linear in the explanatory variables. The Taylor series expansion around log(V/U) is:

$$\log \frac{\mathrm{S}}{\mathrm{N}} \approx -3.28 - 0.28 \log \frac{\mathrm{V}}{\mathrm{U}}. \tag{23}$$

Figure 6: Long-Run Inflow Expression



The accuracy of this linear approximation can be seen in Figure 6. There is no visible difference between the non-linear expression and its linearised form, with the RMSE only 0.09 per cent.

The steady state relationship between U and V is derived by equating logO and logS from equations (19) and (23):

$$\left(\frac{(0.22B+0.38C+0.19D)}{(A+B+C+D)}+0.28\right)\log\frac{V}{N}+\left(0.72-\frac{(0.22B+0.38C+0.19D)}{(A+B+C+D)}\right)\log\frac{U}{N} \quad (24)$$

$$+\log(A+B+C+D)+\frac{(0.56B+0.97C+0.47D)}{(A+B+C+D)}+3.28=0$$

where, once again:

$$A=\exp(-1.75+0.005\,TREND)$$
$$B=\exp\left(-0.78+0.09\log\frac{Age55}{U_F}\right)$$
$$C=\exp(-0.19+1.16\log\hat{c}+0.005\,TREND)$$
and
$$D=\exp(-0.18+0.86\log\hat{c}-0.01\,MM_{State}+0.001\,TREND).$$

Equation (24) is a complex expression from which it is not easy to discern the factors which shifted the Beveridge Curve. Using annual average data it is possible, however, to construct an equilibrium Beveridge Curve for each year from 1980 to 1991. In Figure 7 the equilibrium UV curves are plotted for 1980 and 1989. These two years are chosen for comparison, as with unemployment rates of 5.4 per cent and 5.8 per cent respectively (based on gross flow data), one might consider these to be years where the unemployment rate was close to its equilibrium. Figure 7 indicates that there has been a small outward movement of the UV curve.

Figure 7: Equilibrium Beveridge Curve

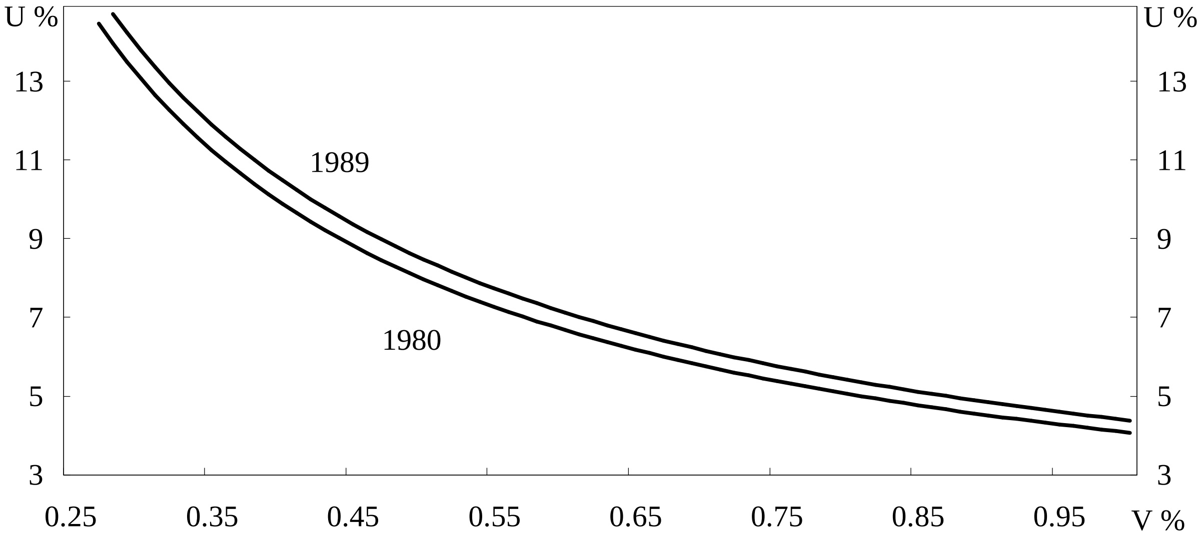
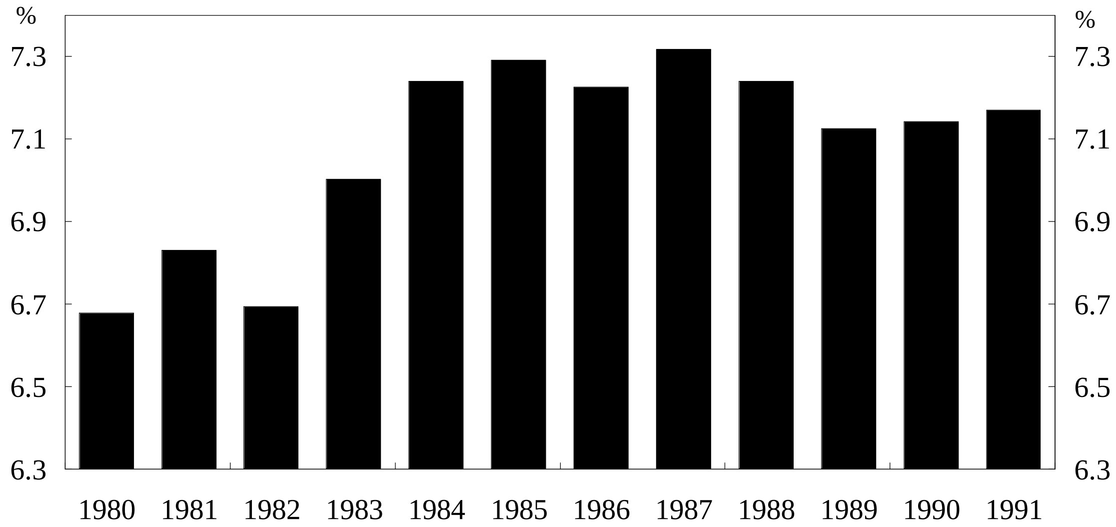


Figure 8 plots the equilibrium unemployment rate for each year coinciding with a vacancy rate of 0.6 per cent. This is the average vacancy rate over the sample period. By holding vacancies constant, Figure 8 illustrates the movement of the Beveridge Curve in each year. It is clear that most of the outward movement of the curve occurred in 1983 and 1984, and that the curve has only shifted back marginally since peaking in 1987[14].

[14] Figure 8 suggests that the position of the Beveridge Curve remained constant in 1990 and 1991. In fact, the results from estimation indicate that the curve shifted back towards the origin over these two years. This apparent inward shift of the curve is entirely due to a large measured rise in the effectiveness index beginning in 1990, which can be attributed to the sudden influx of newly unemployed (see the Data Appendix for a more detailed explanation). The resulting inward shift of the curve is therefore entirely misleading. The unemployment rates for 1990 and 1991 in Figure 8 have been generated by adjusting $\hat{c}$ to remove the large apparent, but spurious, rise in search effectiveness beginning in 1990.

Figure 8: Equilibrium Unemployment Rate at a Vacancy Rate of 0.6 Per Cent



To identify the forces driving the movement in the curve we need to look more closely at the inflow and the outflow equations.

From equation (23) we know that aggregate inflows are influenced only by vacancies and unemployment. As a result the factors which influence the outflow equations must also be the only ones influencing the position of the equilibrium Beveridge Curve.

Equations (14) and (15), describing the outflow from unemployment to employment for males and females attribute a very large role to the index of search effectiveness of the unemployed, $\hat{c}$. Figure A2 shows that $\hat{c}$ fell considerably over the 1980s as a result of the rise in long-term unemployment. In fact, the fall in $\hat{c}$ can be identified as the major cause of the outward shift of the Beveridge Curve. Offsetting the effect of $\hat{c}$ on the curve is the positive time trend in some of the outflow equations, which has moved the Beveridge Curve towards the origin. The time trend explaining male hires has only a small weight in the aggregate outflow equation, while the time trends explaining female hires and male exits from unemployment to out of the labour force are relatively important. The former possibly reflects the secularly increasing likelihood of unemployed women finding part-time jobs, due to the changing sectoral structure of the workforce[15].The latter probably represents declining male labour force participation in the 1980s.

Regional mismatch and the proportion of unemployed females aged over 55 also affect the position of the UV curve. Figure A3 does not provide any clear evidence of a long-term upwards trend in regional UV mismatch, with mismatch increasing during economic downturns and then returning to its previous level. There is also no evidence of a trend increase in the proportion of unemployed females aged over fifty-five.

Finally, we note that the existence of an equilibrium Beveridge Curve implies that equilibrium in the labour market is two dimensional. There is a range of possible "equilibrium" rates of unemployment, each associated with a vacancy rate. Each point on the UV loci describes a situation where inflows equal outflows. However, the particular UV combination which corresponds to the NAIRU will be determined primarily by the wage bargaining process. A complete analysis of labour market equilibrium therefore requires an examination of not just wage setting and unemployment (the traditional Phillips Curve approach) but also of vacancies and unemployment. Research along these lines has been conducted recently by Blanchard (1989) and Jackman, Pissarides, and Savouri (1990).

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[15] Fahrer and Heath (1992) examine this development in detail.

5. SUMMARY AND CONCLUSIONS

One of the most important features of the Australian economy in the past two decades has been the structural deterioration of labour market performance, reflected in both an increase in the average rate of unemployment and an outward shift in the Beveridge Curve. This paper has attempted to uncover some of the causes for this structural deterioration, in terms of the factors affecting the UV relationship. In common with other research in this area, we have found that the Beveridge Curve shifted out around 1974, consistent with an increase in the equilibrium rate of unemployment that is generally agreed to have occurred around that time.

However the main focus of the paper is our estimates of the equilibrium Beveridge Curve for the 1980s. Simple analysis of the vacancy rate and the unemployment rate would lead to the conclusion that the Beveridge Curve was stable during the 1980s. However, by using labour force gross flows data to estimate the equilibrium relationships, we have been able to identify offsetting influences acting upon the Beveridge Curve. We have found that the most important determinant of the equilibrium UV relationship is the degree of search effectiveness of the unemployed. Over the 1980s, the increased incidence of long term unemployment led to a decline in overall effectiveness, in turn causing the Beveridge Curve to shift further outwards. Offsetting this influence during this time was the declining labour force participation of men, and the very large increases in female employment.

DATA APPENDIX

Gross Flow Data

The gross flow data are taken from the Australian Bureau of Statistics publication, *The Labour Force Australia: Catalogue No. 6203.0*, and is available from August 1979.

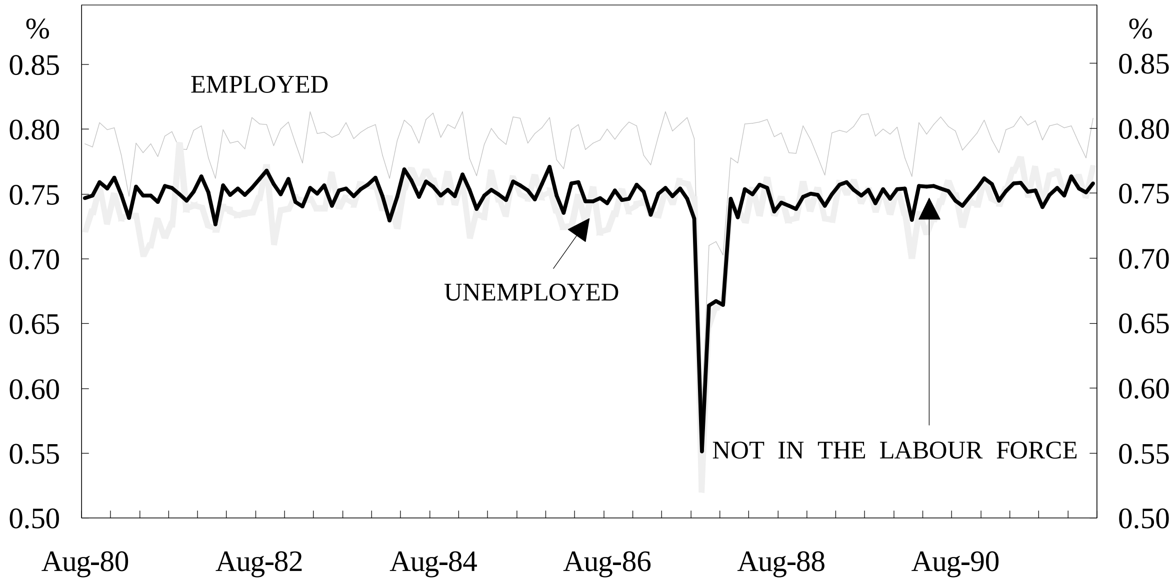
There are several sources of error in using the gross flow data:

- one-eighth of the labour force sample is replaced after each survey. Therefore the matched records from which the gross flow data are obtained can only be calculated for, at a maximum, seven eighths of the sample;
- respondents who change address in between surveys cannot be matched; and
- persons who live in non-private dwellings cannot be matched (non-private dwellings include hotels, motels, hospitals and other institutions).

The ABS estimates that those persons who can be matched in successive surveys represent about 80 per cent of all persons in the survey. About one-half of the remaining (unmatched) 20 per cent of persons in the survey are likely to have characteristics similar to those in the matched group, but the characteristics of the other half are likely to be somewhat different. It is possible to construct estimates of labour force stocks by aggregating the gross flow figures across categories in a particular period.

Figure A1 illustrates that the gross flow implied stocks are a relatively constant proportion of the full population labour force stocks. The large fall in 1987 is due to the survey basis being changed following the 1986 Census. It is also apparent that the implied unemployed and not-in-the-labour-force stocks for the gross flow data form a smaller proportion of the corresponding full population stocks. It is likely, therefore, that most of the error in using the gross flow data occurs in these two categories.

Figure A1: Ratio of Labour Force Stocks Implied by Gross Flow Data to Full Population Labour Force Stocks



The series derived from the gross flow data for estimating the equilibrium UV relationship are:

- male and female inflows to unemployment;
- male and female exits from unemployment to employment;
- male and female exits from unemployment to not in the labour force;
- the total stock of unemployed; and
- the labour force stock.

The quarterly flow data are simply calculated as the sum of the monthly flows, with the quarterly stocks calculated as the averages of the monthly stocks. To be strictly compatible with the vacancy data, the stocks should be calculated at the mid-month of the quarter. However, given the error caused by the changing population basis of the gross flow data, we felt that the error would be minimised by taking the average stock over the quarter.

Gross flow estimates were not published in October 1982. The October 1982 estimates have been calculated by taking an average of the October observations in 1981 and 1983.

Vacancy Data Used in Estimating the Inflow and Outflow Equations

The vacancies data is from the Australian Bureau of Statistics publication, *Job Vacancies and Overtime, Australia: Catalogue No. 6354.0*, and is available quarterly from March 1977. A job vacancy is defined as a job available for immediate filling on the survey reference date, and for which recruitment action had been taken. The vacancy data relate to the middle month of each quarter.

All vacancies for wage and salary earners are represented in the survey except those:

- in the Australian permanent defence forces;
- in enterprises primarily engaged in agriculture, forestry, fishing and hunting;
- in private households employing staff;
- in overseas embassies;
- located outside Australia; and
- available only to persons already employed by the enterprise or organisation (as typically happens in the State and Federal public services).

From March quarter 1977 to December quarter 1983, the sample was selected from employers registered to pay payroll tax and government organisations. From March 1984 the sample was changed to the ABS register of businesses. This resulted in an increase in the magnitude of the vacancies reported. Vacancies under both bases were reported for December 1983. The two series were spliced together by applying the growth rates from the payroll tax series to the new series.

Each observation in the vacancy series was multiplied by 0.74, in order to make the vacancy series comparable with the unemployment series from the gross-flows data. The 0.74 figure is the average value of the ratio of the unemployment stock implied by the gross flows data to the unemployment stock from the labour force survey. The September 1987 vacancy observation was multiplied by 0.66, as during this quarter a new labour force survey was being introduced. As a result the population represented by the gross flow data constituted a smaller proportion of the total population than usual. Accordingly, the corresponding vacancy observation was scaled down.

Construction of the Index of Effective Unemployed

The index is constructed as:

$$\hat{c}_t = \sum_d h_{d0} f_{dt}$$

where h_{d0} is the exit rate at each uncompleted duration (d) in any arbitrarily selected year 0, while f_{dt} is the proportion of unemployed at that duration in year t.

Two sources of duration data were considered, the Australian Bureau of Statistics, and the Department of Social Security. The ABS data are obtained from the labour force survey where respondents are questioned as to how long they have been unemployed. This data has proven to be unreliable as respondents tend to bunch their duration of unemployment around six months, 12 months, etc[16]. This results in a negative probability of leaving unemployment at some durations (which is impossible). The data from the Department of Social Security does not suffer from this problem as the data is derived from the Department's computer records. However the DSS data does have limitations, the most important being that it is restricted to unemployment benefit recipients[17].

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[16] Akerlof and Yellen (1985) call upon psychological theory to explain respondent error. They identify three sources of error of recall of unemployment duration:

- the loss of memory of unemployment spells;
- incorrect estimation of the duration of a remembered unemployment spell; and
- the incorrect dating of a remembered spell and the linking together of separate spells of unemployment.

[17] Junankar and Kapuscinski (1990) provide a detailed comparison of the DSS and the ABS unemployment series. In particular, they list the following reasons for the ABS and the DSS series to differ:

- recall error in ABS;
- respondent error in ABS;
- people claiming unemployment benefits when not eligible;
- people not claiming benefit when eligible, eg. because of the fear of being "stigmatised" as welfare recipients, or if the perceived "costs" of collecting unemployment benefits exceed the benefits;
- people who are not eligible for benefits (due to the income test), but are unemployed; and
- sampling error in the ABS series.

One of the implications of using DSS data is that the index can only realistically be calculated for males. Generally, an unemployed married woman appears as a dependent spouse on her husband's benefit entitlement (the reverse is only rarely true), or is precluded by the income test from benefit entitlement if her husband is employed. As a result, it is considered that DSS unemployment data relating to males only provides the most accurate reflection of the labour market.

Quarterly exit rates were calculated for the durations 0 to 13 weeks, 13 to 26 weeks and so on, with the highest duration defined as over 104 weeks. These exit rates were calculated by taking the stock of unemployed at a particular duration in a quarter and comparing it with those at the following duration in the following quarter. For example, the exit rate for the 0 to 13 week duration in February (of any year) is calculated as

$$h_{d(0\,to\,13)Feb} = \frac{d(0\,to\,13)Feb - d(13\,to\,26)May}{d(0\,to\,13)Feb},$$

where $d_{(0\ to\ 13)Feb}$ is the number of unemployed in February with duration less than 13 weeks, and similarly for $d_{(13\,to\,26)May}$. $h_{d(0\,to\,13)\,Feb}$ thus measures the proportion of those people who, in February, had been unemployed between 0 and 13 weeks and who left unemployment in the following 13 weeks.

Exit rates can be similarly calculated for the 13 to 26 week duration. However, subsequent durations are only recorded over 26 week periods. Hence for these durations we first calculated six monthly exit rates; for example, the six monthly exit rate for the 52 to 78 week duration in May is:

$$h_{d(52\,to\,78)\,May} = \frac{d_{(52\ to\ 78)May} - d_{(78\ to\ 104)Nov}}{d_{(52\,to\,78)Feb}}.$$

The six monthly exit rates are converted to quarterly exit rates by using the formula:

$$h_q = -(\sqrt{(-h_{sm}+1)} - 1)$$

where h_q and h_{sm} are the quarterly and six-monthly exit rate rates, respectively, and where we assume that the exit rate is constant over a six month period.

The six monthly exit rate for the duration 104 weeks and over is calculated by subtracting the exits from all other durations from total terminations of unemployment benefits. Exits within the first 26 weeks are calculated by subtracting the number in the 0 to 26 week duration at the end of the 26 weeks period from the number of new grants during the preceding 26 weeks. The exit rate for the 104 week and over duration in (say) February is:

$$h_{d(104+)Feb} = \frac{T_{May\ and\ Aug} - \left(G_{May\ and\ Aug} - d(0\ to\ 26)Aug + \sum_j E_{j(Aug)} \right)}{d(104+)Feb},$$

where T is terminations, G is grants and the summation is over all exits (E) from other durations.

To obtain the weights for the index, the exit rates for each duration were averaged for the period August 1985 to May 1991. This is the longest period for which exit rates can be calculated using the available data[18]. These are shown in Table A1.

Table A1: Average Quarterly Exit Rates - August 1985 to May 1991

Duration (Weeks)	Males	Females
Just Unemployed	0.58	0.61
0 to 13	0.43	0.45
13 to 26	0.32	0.35
26 to 52	0.27	0.31
52 to 78	0.20	0.24
78 to 104	0.19	0.23
104 and over	0.15	0.19

Source: Authors' calculations.
Note: The exit rate for the just unemployed is shown for completeness; it is not used for computing the index. It is calculated (for May) as $2*[1-(d_{(0\ to\ 13)}/Grants_{May})]$. We assume that the outflow rate over the first three months is constant. Therefore, by the end of a quarter, only half of the new entrants to unemployment who will exit within 13 weeks will have done so. The other half are assumed to exit in the following quarter.

Table A1 shows very clearly that exit rates decline as the duration of unemployment increases[19].

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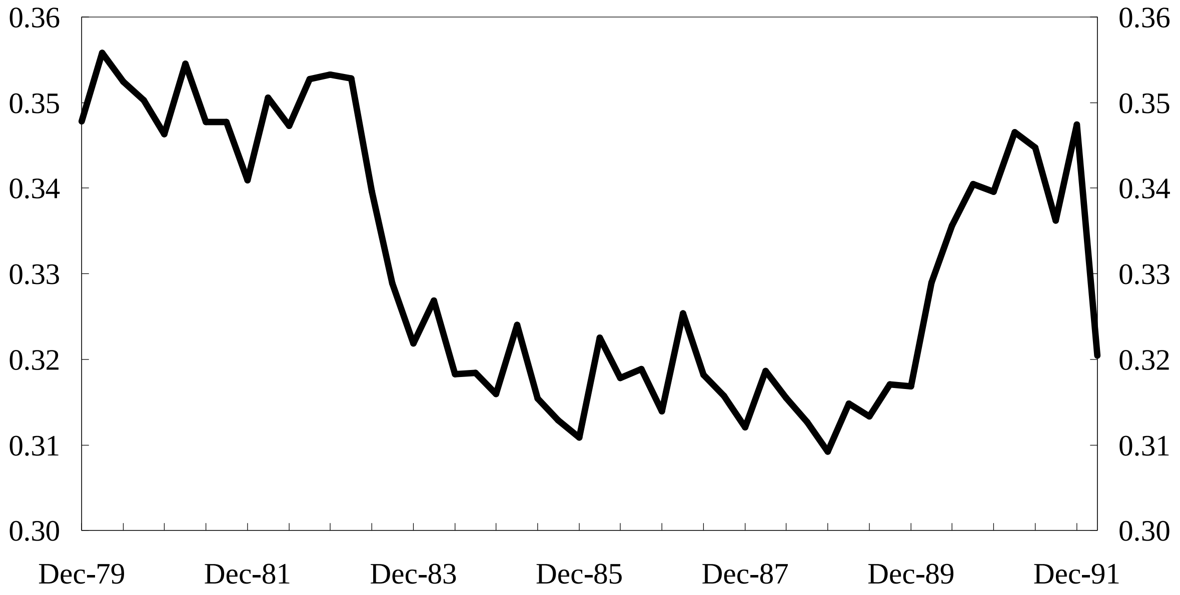
[18] The average exit rate was barely changed when calculated over a longer period for those durations where longer run data are available.

In Figure A2 we show the effectiveness index[20]. The important feature to note is that the drop in effectiveness in the the early 1980s (associated with the recession of 1982-83) did not recover until the end of the decade. Though the number of long-term unemployment benefit recipients has been falling since 1987, it appears that a significant part of the improvement in the effectiveness index can be attributed to the large influx of newly unemployed from the beginning of 1990. As a result care should be taken when interpreting the large improvement in the index since 1989[21].

Figure A2: Effectiveness Index for Males Receiving Unemployment Benefits



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[19] In interpreting our index as measuring search effectiveness of the unemployed, we are implicitly assuming that all exits from unemployment are to employment, but clearly this is not the case as it is quite likely that, as duration increases, the probability of exiting unemployment by leaving the labour force will increase. Fahrer and Heath (1992) show that this is especially true for women which may explain why the female exit rate, at all durations, is higher than the corresponding male exit rate. Thus our $\hat{c}$ is probably measured with some error as it includes the effects of both types of exit on unemployment duration. However, we do make the important distinction between each type of exit when estimating the equilibrium Beveridge Curve.

[20] The spikes in the figure reflect seasonality.

[21] The absence of a large improvement in the index coinciding with the recession of 1982-83 is due to the relatively low proportion of long-term benefit recipients at that time (compared with the mid 1980s). As a result the influx of newly unemployed did not have such a dramatic effect of the index.

Construction of the Mismatch Indices

Due to the convexity of the Beveridge Curve, differences in the UV ratio across different groups will affect the location of the aggregate Beveridge Curve. It is therefore important to see whether any apparent movements in the aggregate curve have been caused by either regional or sectoral mismatch[22].

Following Layard et al., mismatch indices were calculated by state and sector using the formula[23].

$$MM = 2\left[1 - \sum_{i=1}^{n} \frac{N_i}{N}\left(\frac{u_i v_i}{u\, v}\right)^{1/2}\right]$$

where, in category i, N_i is employment, u_i is the unemployment rate and v_i is the vacancy rate. A value of zero for the index indicates no mismatch.

The mismatch by state index was calculated simply by using published ABS data on vacancies and unemployment by state (including NT and ACT). Vacancies on a state by state basis are available since May 1979. As with all the ABS vacancy data

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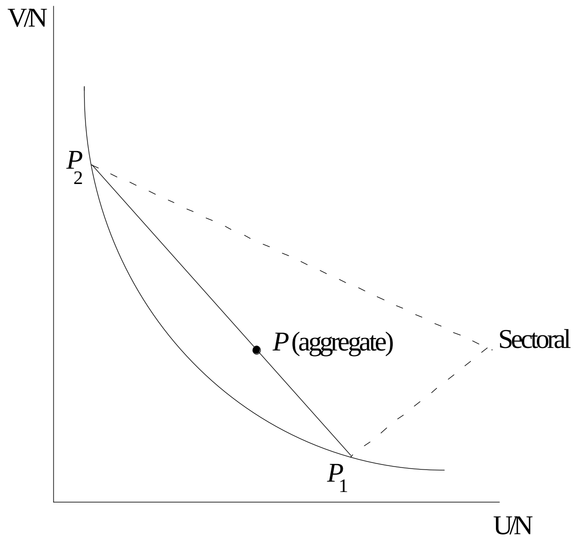
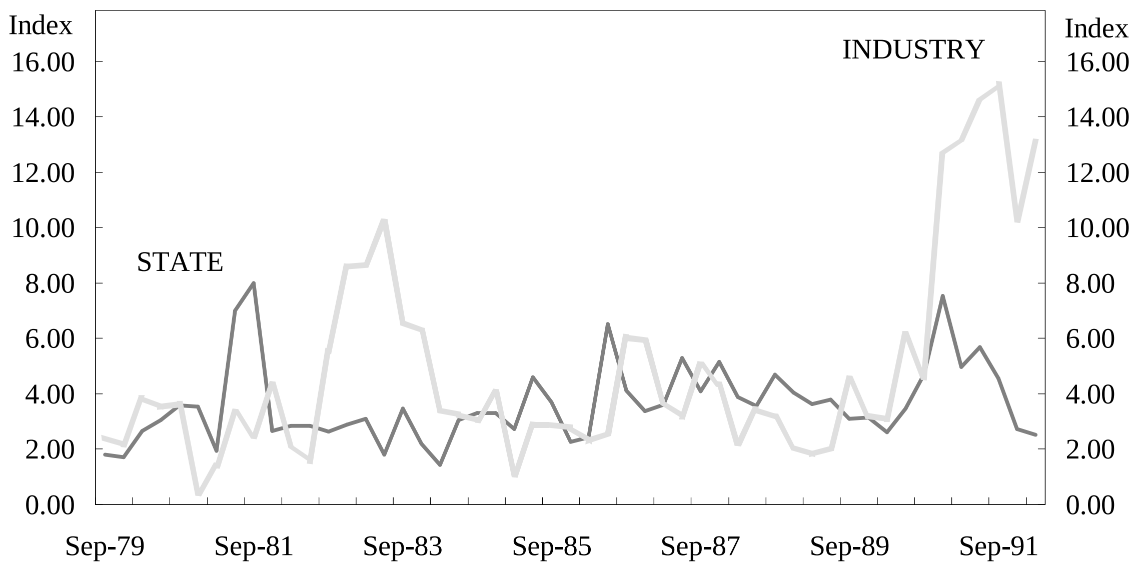
22 If *U/N* and *V/N* are the same across different groups then the aggregate UV curve will be identical to that shown in the figure. But if group one was at P_1 and group two at P_2 the aggregate UV curve would be at P. Because of the convexity of the relationship UV mismatch will always move the curve outwards.



23 See Layard et al. (1991) pp 325-328 for a derivation of this index.

used in this study, the vacancy data by state have been corrected for the change in the survey basis that occurred in November 1983. This was accomplished by applying the growth rates from the pre November 1983 payroll tax based series to the post 1983 register of businesses based vacancy series. To ensure compatibility with the vacancy data, the unemployment data are taken from the mid-month of each quarter.

Figure A3: UV Mismatch



Construction of the mismatch by industry index was restricted because vacancy data are available for only four sectors: manufacturing (which averaged 22 per cent of all vacancies in the sample period), wholesale and retail trade (23 per cent), public administration, defence and community services (28 per cent), and other (27 per cent)[24].

The two mismatch indices are shown in Figure A3. There appears to be slight upward trend in mismatch by both industry and state; however, the industry mismatch index is dominated by the recessions of 1982-83 and 1990-91, when it increased by about 400 per cent. The reason for this is that the job losses in these recessions were heavily concentrated in one sector - manufacturing. In the case of

24 "Other" comprises electricity, gas and water; transport and storage; communication; mining; construction; finance, property and business services; and recreation, personal and other services.

1982-83, the unemployed manufacturing workers eventually left that sector, either by finding employment elsewhere, or by leaving the workforce, and those that remained unemployed for over two years were no longer classified as in the manufacturing sector. The industry mismatch index thus returned to its trend after about two years.

Construction of the Replacement Ratio

The replacement ratio is a measure of the opportunity cost of remaining unemployed. It is calculated as:

$$R_t = \frac{B_t}{E_t},$$

where B_t is the average entitlement to unemployment benefits, and E_t is after-tax average weekly earnings. We calculated two replacement ratios, one for single adult males starting in March 1965, and one for all beneficiaries starting in September 1975.

For single adult males, B_t is simply the rate of benefit payable to a single person with no dependents. For all beneficiaries, B_t is calculated as a weighted average of all categories of all unemployment benefit recipients. The weights are the proportion of beneficiaries receiving a particular category of unemployment benefit. These categories are described in Table A2.

E_t proved simpler to construct. Average weekly earnings data for males and females were obtained from the Australian Bureau of Statistics (Catalogue nos. *6350.0* and *6302.0*). The series have a break at August 1981 when the data changed from being collected from payroll tax records to a survey based on the ABS register of businesses.

After-tax average weekly earnings were calculated for males back to March 1965, and for females back to September 1969. For the adult single male replacement ratio, E_t is just the after tax male average weekly earnings series. For the ratio representing all beneficiaries, E_t is the weighted average of male and female after tax earnings. The weights are the annual proportions of unemployment benefit recipients by sex.

One limitation of using after tax average weekly earnings to construct the replacement ratio is that it implies that the average wage is received for the entire financial year. However, a person who is unemployed part of the financial year will pay less tax than a person receiving average wages for the whole year. As a result, the measured replacement ratio will be biased towards lowering the opportunity cost of unemployment.

The replacement ratios for adult males and all beneficiaries are plotted in Figure A4. The adult male ratio increased sharply in the early 1970s (just prior to the deterioration in the labour market late in 1974) from around 15 per cent of AWE to around 25 per cent. It continued to rise until around March 1977, when it peaked at around 35 per cent of AWE. It then fell until about March 1983, and has since risen slightly.

The ratio for all recipients has followed the same pattern as the male ratio, but at a higher level, reflecting the fact that unemployment benefits received by women are the same as those received by men (in the same category), but wages earned by women are on average less than those received by men.

Figure A4: Replacement Ratio

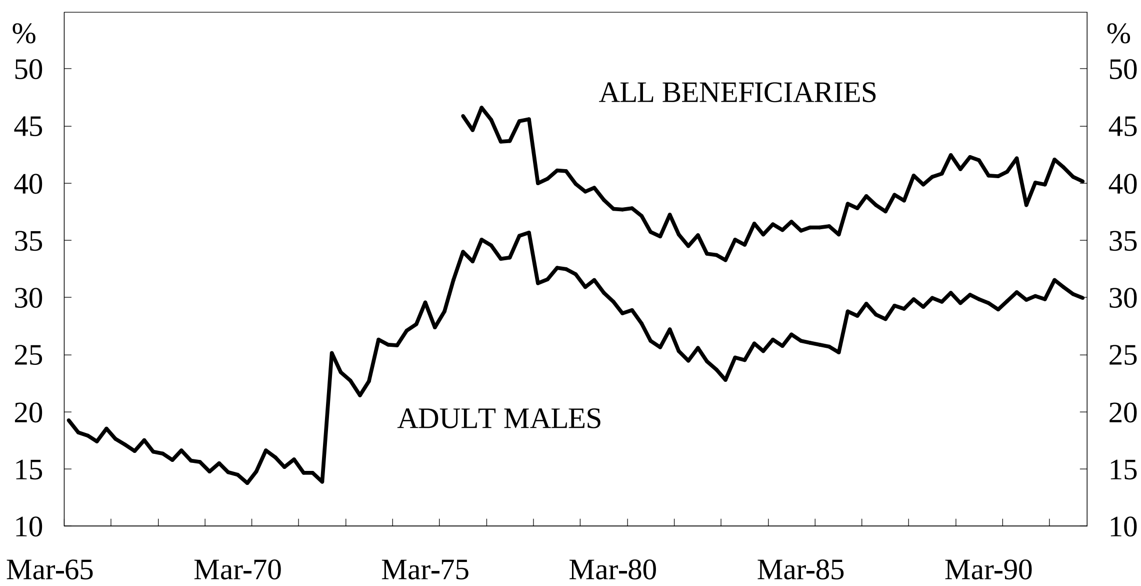


Table A2: Categories of Unemployment Benefits

Category	Comment
Under 18, Single	From November 1984 to November 1985, a higher tax rate was paid if the person had been in receipt of benefit for more than six months From January 1988 the under 18 years category has been named "Job Search Allowance". JSA has two rates of payment subject to a parental income and assets test.
18 to 20, Single	From June 1973 to November 1985, beneficiaries in this age bracket were paid the same rate of benefit as those 21 years and older. Since then they have been paid a lower rate. In September 1990 the "at home" rate was introduced. The 18 to 20 year old rate continued to be paid to those who do not live with a parent.
21 and over, Single	
Single with Children	From November 1978 a higher rate was paid to single beneficiaries with children.
Married Rate	
Additional Benefit for Children	From December 1987 three rates of additional benefit became available. These are: (in descending payment value) children 13 to 15 years, children under 13 years, and dependent student 16 to 24 years. An average of the three rates was used in calculating the ratio.

The information on the maximum rates of unemployment benefit payable, and on changes in entitlement were obtained from the following Department of Social Security (DSS) publications: *The Guide to the Administration of the Act,* and *Developments in Social Security: A Compendium of Legislative Changes Since 1908.*

The categories of benefit entitlement were weighted by the proportion of beneficiaries receiving a particular entitlement. Annual weights were calculated from 1975 based on information in the following DSS publications: *Ten Year Statistical Summary*, *Quarterly Survey of Unemployment Benefit Recipients,* and *Survey of Job Search and Newstart Allowance Recipients.*

Data on an annual basis were not available for recipients in the category, "single with children". However, quarterly data from February 1984 were available for this category, which had a virtually constant share at 1 per cent over this period. Hence this category received a weight of 0.01. Annual data were also not available for the average number of children for recipients in the "married" category, but again these data were available quarterly from February 1984. The average number of children for the "married" category over this period was 1.7, and for the "single with children" category was 1.5.

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