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Modelling a Regime-Shifting New Zealand Beveridge Curve

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Abstract

This paper offers new insights into Beveridge curve analysis by modelling the vacancy-unemployment rate relationship within a Markov regime-switching environment in which the probability of curve-shifting is determined endogenously by shift factors. Shift factor candidates include structural factors (such as labour market participation and net migration) and cyclical variables (such as GDP growth and real interest rates). This approach enables us to estimate regime-specific parameters and the role played by shift factors in influencing the transition probabilities of switching between regimes. We illustrate our model with an application to New Zealand.

Keywords

Beveridge curve
regime-shifting
New Zealand

JEL Codes

C3; E2; J6

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1. Introduction

Richard Layard and Charles Bean (1989, p.371) once remarked that 'macroeconomics was invented to explain the persistence of unemployment'. Some two decades on from this remark - in 2008 - the overall OECD unemployment rate was 5.5 percent with a range from 2.4 percent in Norway, to 3.6 percent in New Zealand, 7.8 percent in France and 10 percent in the Slovak Republic. One could argue that this relatively wide range represents different labour market frictions in the sense that some countries are better at matching workers to employment than others.

Beveridge curve analysis - the relationship between unemployment and vacancies - is one approach to studying labour market efficiency. It is derived from a framework that views employment as the outcome a matching process (M) of vacancy-filling (V) by the unemployed (U), by those already in employment (E) and by those not in the labour force (N), that is, $M = m(U,E,N,V)$. By concentrating on the U-V component of the matching process, one can see immediately that Beveridge curve analysis implies some potentially strong assumptions about the behaviour of the E-V, N-V and E-E (churning) relationships. (See Mumford and Smith 1999). Despite these limitations, there is now an extensive literature on the unemployment-vacancy (U-V). Themes of particular interest include the nature, stability and elasticity of the U-V relationship, and cyclical and structural influences and, if structural, the likely variables.[1]

The 'cyclical-structural' issue is of special importance given its potential policy implications. Identifying factors contributing to increase labour market efficiency is essential information for policy makers. Among the potential shift factors discussed in the literature are structural factors such as the participation rate, the replacement ratio or employment benefits. They reflect the ability of the unemployed to be matched to vacancies. In addition, studies of the British labour market (Wall and Zoega 2002) and the German labour market (Kosfled *et al*. 2008) have shown that the position of the Beveridge curve can also be related to the business cycle. In particular, an anticlockwise movement of the U-V locus is typical of an adjustment path towards the steady state as vacancies adjust more rapidly than unemployment in a recovery phase. (See Bowden 1980, Blanchard and Diamond 1989). While the list of shift factors is potentially infinite, Petrongolo and Pissarides (2001) note that despite empirical support for a range of variables, the microeconomic support for these shifts is tentative only. Furthermore, Wall and Zoega (2002) note that Beveridge curve shifts over time are difficult to detect non-arbitrarily. While steps have been taken in this direction, for instance using time trends, none is satisfactory and one is often left with mere visual inspection.

In this paper, we offer new insights into Beveridge curve analysis by modelling the unemployment-vacancy rate relationship within a Markov regime-switching environment

[1] Benchmarks in this literature include Blanchard and Diamond (1989), Nickell *et al*. (2003) and Petrongolo and Pissarides (2001).

where regime-specific parameters can be estimated. In our model, the probabilities of shifting from one curve to another are determined endogenously by the value of selected shift factors. We examine two sets of shift factors. First, we examine structural variables that unambiguously reflect the degree of job market efficiency, namely, the participation rate and net migration. These factors are expected to have an impact on the position of the Beveridge curve. Secondly, we examine business cycle variables, namely GDP growth and the real interest rate. The effect of a change in business cycle variables can translate into the economy moving along the curve and shifting the curve. One advantage of our framework is that it enables us to determine which effect is taking place.

Applied to New Zealand, our work suggests, among other things, that an increase in the participation rate, most of which is due to an increase in the female participation rate, increases labour market efficiency unambiguously. That is, the Beveridge curve shifts inwards as a greater proportion of women enters the job market. We also show that an increase in net migration translates into a deterioration of matching efficiency. This suggests that over our study period New Zealand has been losing more qualified workers than it has been able to attract.

Regarding business cycle variables, we find that an increase in GDP growth is associated with a fall in unemployment and a deterioration of matching efficiency. This confirms the presence of an anti-clockwise adjustment pattern around recoveries as documented in the UK (Wall and Zoega 2002), the US (Valetta 2005) and as discussed in Bowden (1980) and Blanchard and Diamond (1989). This finding might also be consistent with the impact of technologically-driven shocks to GDP: some unemployment is reduced, but others who are unemployed are unable to satisfy an increase in skilled vacancies. Finally, in the case of the real interest rate, we find that changes in the rate have had no impact in terms of Beveridge curve shifts in New Zealand.

The published New Zealand literature on the Beveridge curve is relatively modest. It includes Hicks and Chin (1984), Chapple, Harris and Silverstone (1996), Nickell *et al.* (2003), Silverstone (2004) and Razzak (2008). Australian contributions include de Francesco (1999), Webster (1999) and Groenewold (2003). For the period of the 'reform decade' in New Zealand, 1985-1995, Chapple *et al.* (1996, p.153-154) found - somewhat surprisingly given the scale of change in New Zealand - no significant shifts in the Beveridge curve. On the other hand, Silverstone (2004) found that shift factors (such as the participation rate and regional growth differences) may have influenced the New Zealand Beveridge curve over the period 1990-2004. His contribution also included initial work on calculating a hiring rate and a matching function. Razzak (2008, p.9), covering a similar period (1990-2006), found that New Zealand's matching function exhibited decreasing returns to scale rather than the constant returns to scale found in numerous other country studies. 'Decreasing returns to scale means that New Zealand's labour market needs to be more than double in size in order to double matching. The matching process in New Zealand has been costly'. Razzak also found some support for shift influences on the matching function including the share of young workers in the labour force, the share of skilled labour in total employment and the replacement ratio.

In Australian work, Groenewold (2003, p.80) found that a co-integration relationship existed between the unemployment and vacancy rates when four shift variables were added: the real wage, the replacement ratio, the proportion of long-term unemployed and the proportion of females in the labour force. He also found that structural changes were of greater importance than aggregate demand shocks in explaining the increase in the Australian unemployment rate over the two-decade period from around 1980.

In what follows, Section 2 is mainly an analysis of New Zealand vacancy data while Sections 3 and 4 cover our specification work and estimation results, respectively. Section 5 contains our conclusions.

2. Data Sources

Vacancies

The availability and quality of job vacancy data is a commonly discussed issue in most Beveridge curve studies. New Zealand is no exception. An official vacancy series began in 1955 and ended in 1980 while its successor ceased in 1997. In 1990, the ANZ Banking Group began a monthly count of job advertisements in New Zealand newspapers. The initial coverage of Auckland, Wellington and Christchurch was extended, in 1994, to four other areas (Waikato, Hawke's Bay, Manawatu and Otago). From 2000, the newspaper count was supplemented with a count of internet job advertisements from several major websites.

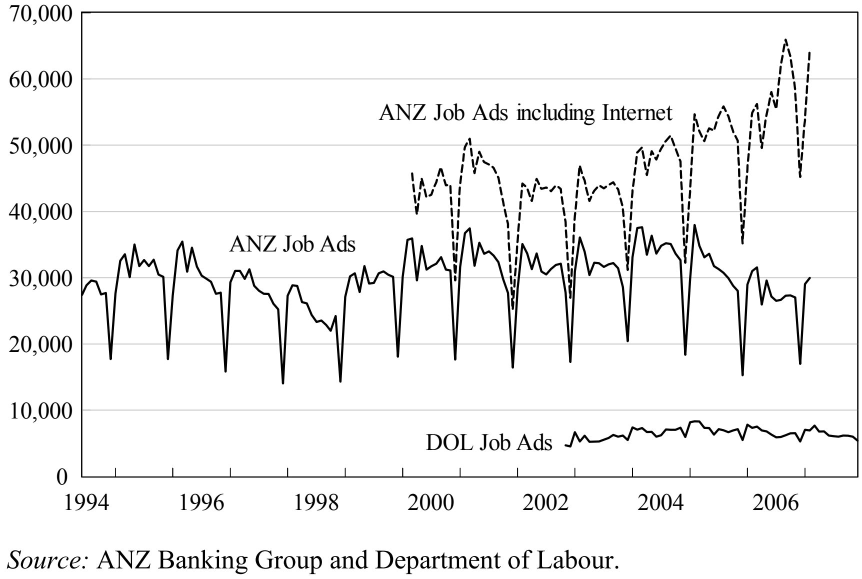
An official vacancy series of job vacancy data began in 1955 and ended in 1980 while its successor ceased in 1997. In 1990, the Australia and New Zealand Banking Group (ANZ) began a monthly count of job advertisements in New Zealand newspapers. From 2000, the newspaper count was supplemented with a count of internet job advertisements from several major websites. After some 17 years, the ANZ Bank discontinued their job count series in 2007. There were several reasons for this development. First, the series was a raw rather than individual job count: multiple jobs within one advertisement counted as one job, repeated ads within the same month were included and there was no separation of of regional and national job ads within each newspaper. Secondly, the ANZ bank found that duplicated job advertising counts from internet-based advertising made the series an unreliable economic indicator. Thirdly, the Department of Labour had started its own series, which we use in this study. [2]

[2] In May 2008, the Department of Labour announced it was no longer publishing the monthly Job Vacancy Monitoring (JVM) figures saying that the decision was based 'on concerns that the JVM figures, which were gathered from newspaper advertisements only, may no longer be a reliable representation of labour market change because of the growth of internet advertising. As soon as a new system is in place, the Department will resume publication of an advertised vacancies series'.

From 2002, the Department of Labour (DOL) began publishing and classifying a monthly count of individual job advertisements in 25 newspapers. This new series avoids the significant duplication arising from raw counting in other series such as vacancy data published by the ANZ Banking Group. The Department of Labour confined its job vacancy measure mainly to newspaper advertisements arguing that there has not been a fundamental change in employers' decisions to advertise vacancies in newspapers over the recent past (Department of Labour, 2008). After some experimentation, we found that the application of principal components to the ANZ newspaper series produced a good proxy for the DOL newspaper series thereby allowing us to 'backdate-by-proxy' the DOL series a further eight years to 1994:06. The proxy series was constructed as follows:

First, all seven ANZ job ad series from 1994:06 to 2007:02 were included (namely, Auckland, Wellington, Christchurch, Waikato, Hawke's Bay, Manawatu and Otago). We used the principal components default settings in EViews to form the series *anz_pc*. The first principal component, comprising approximately an equal linear combination of all but the Auckland and Canterbury series, accounted for two thirds of the total variance of the seven newspaper series. Two principal components accounted for almost 90 percent of the total variance. Secondly, we regressed the Department of Labour job vacancy series (*dol_jv*) against *pc_anz* and 11 monthly seasonal dummies over their common period 2002:11 to 2007:02. Finally, we 'backward forecast' from 2002:10 to 1994:06 to give our proxy *dol_jv* series. [3] Figure 1 illustrates the outcome of our calculations.

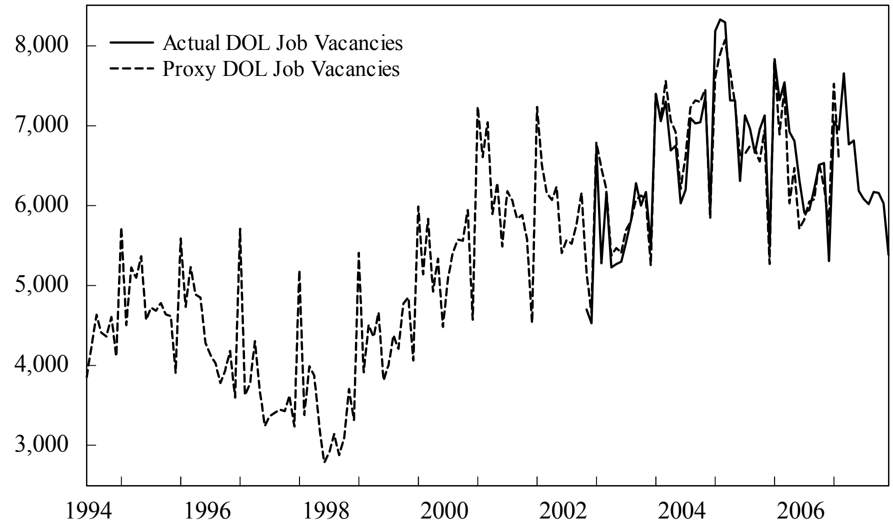
Figure 1. Job Advertisements in New Zealand 1994-2007
Monthly, Number



Source: ANZ Banking Group and Department of Labour.

[3] It is interesting to note, perhaps, that of the seven newspapers in the ANZ series, Otago and Manawatu have the highest correlations (at 0.81) with the DOL series over the common sample period 2002:11 - 2007:02. This is followed by Canterbury, Hawke's Bay and Wellington (at 0.66), Waikato (at 0.62) and Auckland a distant seventh (at 0.20).

Figure 2. Actual and Proxy Department of Labour Job Vacancies 1994-2007
Monthly, Seasonally Adjusted, Number



Source: ANZ Banking Group and Department of Labour.

Table 1 provides summary statistics on the actual DOL series and the ANZ-based proxy series over their common period 2002:11 to 2007:02. The statistics include a very high correlation (0.92) and acceptable differences between actual and proxy maximum and minimum values, standard deviations and related statistics. The mean absolute monthly error of 340 job ads corresponds to just four percent of average monthly DOL job vacancies.

Table 1. Actual and Proxy Department of Labour Job Vacancy Series
Descriptive Statistics, Common Period 2002:11-2007:02, Number

	Actual	Proxy
Median	6673	6577
Maximum	8330	8073
Minimum	4530	4660
Standard Deviation	883	813
Jarque-Bera	0.55	1.40
Mean Absolute Error (actual-proxy)	340	
Correlation	0.92	

Unemployment

We used an ARIMA process in RATS to interpolate the official quarterly unemployment data to a monthly unemployment rate series. This process was chosen in preference to simple linear interpolation method that would only use information from adjacent quarters.

Figure 3 shows the number of seasonally-adjusted unemployed persons and vacancies between 1994 and 2007. The correlation is -0.91. The series is characterised overall by persistence and by counter clockwise looping around an OLS regression. The ratio of the number of vacancies to unemployed is, on average, 1:20 with a range from 1:10 to 1:45. The

1:20 ratio may be compared, for example, with around 1:3 for the United States 2002-2003 (Shimer 2005) and 1:7 for Australia. Given these comparisons, and the observation that the average quarterly gross flow from unemployment to employment alone over the 1994-2007 was around 25,000 persons, one clear implication of New Zealand's 1:20 ratio is that a relatively high number of vacancies are not advertised in newspapers.

Figure 3. Number of Vacancies and Unemployed Persons 1994-2007

Monthly, Seasonally Adjusted, Thousands

Source: ANZ Banking Group, Department of Labour and Statistics New Zealand.

3. Specification

Labour market activity is typically decentralized, uncoordinated and costly. In this frictional environment, activity between firms and workers could be represented by a matching function. Parallel to the production function, the matching function assumes that the number of successful matches formed in the labour market is the output from a function where the inputs are the number of vacancies (V) posted by firms and the number of unemployed (U) workers looking for a job. Letting M represent the number of matches, this yields:

$$M = Am(U,V) \qquad M_{U,}\ M_V > 0 \tag{1}$$

where m is the matching function and A represents the efficiency with which inputs are converted into output. Behind the matching function is the idea that the greater the number of unemployed workers or posted vacancies the greater the number of matches. There is supporting evidence (for example, Petrongolo and Pissarides 2001) that matching can be represented by a Cobb-Douglas function with constant returns to scale[4] to give:

[4] Although Baker, Hogan and Ragan (1996) show that neglecting on-the-job search generates biased estimates of the matching function parameters.

$$M = AU^{\eta}V^{1-\eta} \quad (2)$$

In this flow approach to unemployment, the matching function represents the flow out of unemployment. The evolution of the mean level of unemployment is then given by the difference between the flow of workers who enter unemployment and the flow of workers who exit unemployment. In equilibrium, when the two flows are equal, mean unemployment is constant. Specifically, the number of separations (*S*) is equal to the number of new matches (*M*) formed given by the matching function so that *S*=*M*. Dividing both sides of this equality by the size of the workforce (*L*) gives

$$\frac{M}{L} = \frac{S}{L} = A\left(\frac{U}{L}\right)^{\eta}\left(\frac{V}{L}\right)^{1-\eta} \quad (3)$$

If this steady-state condition holds, then the equilibrium unemployment rate, $u = U/L$, can be expressed as a function of the equilibrium vacancy rate, $v = V/L$. Given the separation rate (s), equation 3 becomes:

$$\ln(u) = \alpha + \beta \ln(v) \quad (4)$$

where $\alpha = \ln(s) - \ln(A)$ and $\beta = (\eta - 1)/\eta$.

Equation 4 is the Beveridge curve. It is convex to the origin by the properties of the matching function and corresponds to the isoquant of the matching function such that the number of matches formed is just equal to the number of matches destroyed. Given the separation rate, there exists a unique vacancy rate that keeps the unemployment rate constant.

Over the business cycle, assuming the separation rate is unchanged, unemployment and vacancies are negatively related so that the economy moves along the curve. The equilibrium concept behind the Beveridge curve, then, is the equality between the flow in and the flow out of unemployment. It does not correspond to a particular equilibrium level of unemployment or vacancies.

An interesting issue is when the Beveridge curve shifts inwards and outwards. Such shifts have been documented in many countries (see, for example, Jackman *et al.* 1990, Bleakley and Fuhrer, 1997, Wall and Zoega 2002 and Groenewold 2003). From our basic theoretical framework, these shifts have two sources: a change in the separation rate (s) or a shift in the efficiency of the matching process (A). Traditionally, the literature has focused on changes in A as separation rates tend to be constant. For instance, a stable rate of inflow (separation rate) and a falling rate of outflow (a falling A) can explain the increase in UK unemployment from the late 1970s to the mid-1990s (Wall and Zoega 2002). Outward shifts of the Beveridge curve are then associated with a deterioration in the matching process, and vice versa. What, then, causes deterioration or improvement in matching efficiency?

Changes in matching efficiency, A, reflect structural changes in the ability of the unemployed to be matched to vacancies. The list of variables believed to influence matching efficiency, as illustrated in Table 2, is extensive.

Table 2. Conventional Beveridge Curve Shift Influences

Selected List
employment protection
unemployment duration
replacement rate
participation rates (including self-employment)
net migration
benefit duration
active labour market policies
educational attainment
union density
bargaining system
tax wedges
owner-occupied housing ratio
regional mismatch

In this paper we pursue the search for possible shift factors and offer new insights on the methodology to isolate and explain these shifts. As mentioned in our introduction, shifts in the Beveridge curve are difficult to detect non-arbitrarily. Some rely on simple visual inspection, others on quadratic time trends (Layard, Nickell and Jackman 1991 and Blanchard and Diamond 1989). Albæk and Hansen (2004) examine whether the hiring function has moved at the same time as the Beveridge curve, in which case the shift in the Beveridge curve can be attributed confidently to a change in mismatch rather than separation.

In our paper, we use the Markov-switching approach in which the probabilities of shifting from one curve to another are determined endogenously by the value of selected shift factors.

We examine two sets of shifts factors. First we look at two variables that unambiguously reflect the degree of job market efficiency, namely, the participation rate and net migration. We think of net migration as a measure of international participation in the New Zealand labour market, by contrast to the more traditional (domestic) participation rate. The impact of a change in net migration depends on whether the average qualification of workers entering the country is greater or smaller than those leaving the country.

The recent literature on the Beveridge curve has tried to clarify the role played by cyclical factors in matching efficiency (for example, Wall and Zoega 2002; Valetta 2005, Kostler *et al.* 2008). We therefore include two business cycle variables - real GDP growth and the real interest rate - to see whether they too can explain shifts in the Beveridge curve. That the real interest rate can shift the Beveridge curve is supported by Phelps (1994) and Blanchard and Wolfers (2000) who attribute a significant impact of the real interest rate on long-term unemployment. It is also supported by the hysteresis effect caused by long spells of unemployment: even though a higher real interest rate first moves the economy down its Beveridge curve (firms' discounted profits are smaller so they offer fewer vacancies), higher unemployment translates into fewer employable workers next period and hence a possible outward shift of the Beveridge curve.

4. Estimation

This section explores the possibility that an analysis of the Beveridge curve within a single-regime context is too restrictive. Suppose we initially model the Beveridge curve in a single-regime context such that

$$\ln u_t = \alpha + \beta \ln v_t + \lambda \Omega_t + \sum_{i=1}^{l} \gamma_i \ln u_{t-i} + \varepsilon_t \tag{5}$$

where Ω denotes other variables influencing *u* (such as the real interest rate, participation rate income growth and net migration in the context of this study) and $\varepsilon_t \sim i.i.d.N(0,\sigma_\varepsilon^2)$. The dynamic behavior of *u*, however, might be subject to regime shifts. If so, it is possible to improve on econometric approaches that make no allowance for such shifts. Suppose a discrete random variable S_t takes two possible values [S_t = (0,1)] and serves as an indicator for the state of the labour market at time *t*. The expected component of u_t, conditional on the value of S_t, is given by equation 6,

$$E(\ln u_t \mid S_t) = [(1-S_t)\alpha_0 + S_t \alpha_1] + \beta \ln v_t + \lambda \Omega_t + \sum_{i=1}^{l} \gamma_i \ln u_{t-i} + \varepsilon_t \tag{6}$$

where the unobserved indicator variable S_t, evolves according to the first-order Markov-switching process described in Hamilton (1989),

$$\begin{aligned} P[S_t = 0 \mid S_{t-1} = 0] &= p = \Phi(\delta_0) \\ P[S_t = 1 \mid S_{t-1} = 0] &= 1 - p \\ P[S_t = 1 \mid S_{t-1} = 1] &= q = \Phi(\delta_1) \\ P[S_t = 0 \mid S_{t-1} = 1] &= 1 - q \end{aligned} \tag{7}$$

The fixed transition probabilities of being in Regime 0 or 1 are *p* and *q*, respectively, with $0<p, q<1$and Φ() the cumulative normal distribution function ensuring that the transition probabilities lie in the open interval (0,1). The model defined by equations 6 and 7 can be denoted as Markov-switching Model I. Since β is not regime-varying, this model only allows for shifts in the Beveridge curve intercept between α_0 and α_1.

Model I features transition probabilities that are fixed. In this study, we are also interested in the extent to which the variables represented by Ω are responsible for pushing the economy into Regime 0 or Regime 1. We can, therefore, extend the fixed two-state Markov-switching chain to allow for the possibility of time-varying transition probabilities. This enables us to specify:

$$\begin{aligned} P[S_t = 0 \mid S_{t-1} = 0, \Omega_{t-1}, \Omega_{t-2}, \cdots] &= p_t = \Phi\left(\delta_0 + \sum_{i=0}^{m} \vartheta_i \Omega_{t-i}\right) \\ P[S_t = 1 \mid S_{t-1} = 1, \Omega_{t-1}, \Omega_{t-2}, \cdots] &= q_t = \Phi\left(\delta_1 + \sum_{i=0}^{n} \kappa_i \Omega_{t-i}\right) \end{aligned} \tag{8}$$

This specification gives rise to Markov-switching Model II. In this model, a change in Ω can influence u through two channels in u-v space. First, there is a mean equation effect in terms of a movement along a given Beveridge curve. Secondly, there is the possibility of a shift in the Beveridge curve through the impact of Ω on the transition probabilities.

Tables 3a and 3b report results based on the OLS and Markov-switching models, respectively. Having started with a maximum of six lags, the inclusion of two lags on u together with contemporaneous Ω_t (in equations 6 and 8) was found to be acceptable using various model selection procedures. For each of the three variables represented by Ω, the log likelihood values associated with both the OLS estimate and Markov-switching Model II are also reported. In each case, the application of the LR-test proposed by Davies (1987) leads to the rejection of the single-regime OLS model in favour of Markov-switching Model II.

If we initially focus on the estimates that incorporate the participation rate (characterised by the largest log likelihood value), our results indicate the presence of a regime-invariant Beveridge curve slope of β = -0.040 giving a long-run elasticity of β^L = -0.559. This estimate can be compared with the Australian study by Groenewold (2003) who obtained long-run Beveridge curve elasticities between -0.35 and -0.64 once shift factors were taken into account. We find evidence of a shifting Beveridge curve characterised by the intercepts α_0 = 1.467 in Regime 0 and α_1 = 1.447 in Regime 1. The null $\alpha_0 = \alpha_1$ is rejected at the one percent significance level with $\chi^2(1)$ = 128.9. We therefore regard Regime 0 as being characterised by a larger intercept and an 'outer' Beveridge curve and Regime 1 as an 'inner' Beveridge curve.

While $\lambda<0$ suggests a direct negative relationship between the participation rate and u in the mean equation, we find that the participation rate influences significantly the transition probabilities of switching between regimes. This is confirmed with $\vartheta_0 < 0$ which indicates that an increase (decrease) in the participation rate leads to a reduced (increased) probability of remaining in Regime 0. In a similar vein, $\kappa_0 > 0$ indicates that an increase (decrease) in the participation rate leads to an increased (reduced) probability of remaining in Regime 1. Since $\alpha_0 > \alpha_1$, this evidence is consistent with an inward shift in the Beveridge curve in response to a rise in the female participation rate in particular. This increased participation may be due to more females receiving a wage higher than their reservation wage and to relative opportunities. Given the low average wage in New Zealand, it may be easier for women with a degree to obtain a wage that is higher than their reservation wage.

Figure 4a presents the inferred probability of being in Regime 0 in any month while Figure 4b plots the inferred probabilities of switching from Regime 0 to Regime 1 (1-p) superimposed against the log of the participation rate. It is the more recent years that have been associated with a shifting Beveridge curve. This is marked by a sharp fall in the probability of being in Regime 0 (with an 'outer' Beveridge curve). This is accompanied by a sharp increase in the probability of shifting to Regime 1 that tracks an increase in labour force participation.

Table 3a. Ordinary Least Squares Results

	OLS (real interest rate)	OLS (participation rate)	OLS (cyclical GDP)	OLS (net migration)
α	0.003	1.487**	-0.000	-0.055
β	-0.017*	-0.027***	-0.015*	-0.019**
λ	0.001	-0.348**	-0.008**	0.000
γ_1	1.649***	1.660***	1.657***	1.659***
γ_2	-0.667***	-0.700***	0.668***	-0.674***
LL	424.799	496.819	476.527	494.507

Notes: Estimates are for the single-regime model described by equation 5. The superscripts ***, ** and * denote rejection of the zero null at the 1, 5 and 10 percent significance levels, respectively.

Table 3b. Markov-Switching Results

	MS Model II (real interest rate)	MS Model II (participation rate)	MS Model II (cyclical GDP)	MS Model II (net migration)
α_0	-0.021***	1.467***	-0.003***	-0.009***
α_1	0.006***	1.447***	0.013***	0.007***
β	-0.017***	-0.040***	-0.024***	-0.035***
λ	0.001***	-0.333***	-0.015***	-0.000
γ_1	1.643***	1.511***	1.551***	1.554***
γ_2	-0.662***	-0.583***	-0.571***	-0.583***
σ	0.0001***	0.0001***	0.0001***	0.0001***
δ_0	-0.019	355.312***	1.120***	1.307***
δ_1	2.358***	-235.482***	0.235	1.563***
ϑ_0	-0.029	-84.044***	-0.050	-0.003*
κ_0	0.424	56.415***	2.828***	-0.000
β^L	-0.899	-0.559	-1.160	-1.184
Null	35.877	128.933	76.475	68.712
LL	432.851	510.363	486.330	505.403

Notes: Estimates are for the regime-switching model described by equations 6 and 8. The superscripts ***, ** and * denote rejection of the zero null at the 1, 5 and 10 percent significance levels, respectively. β^L denotes the long-run Beveridge curve elasticity and is measured by $\beta/(1-\gamma_1-\gamma_2)$. Null refers to the null hypothesis $\alpha_0 = \alpha_1$.

Figure 4a. Inferred Probability of Regime 0

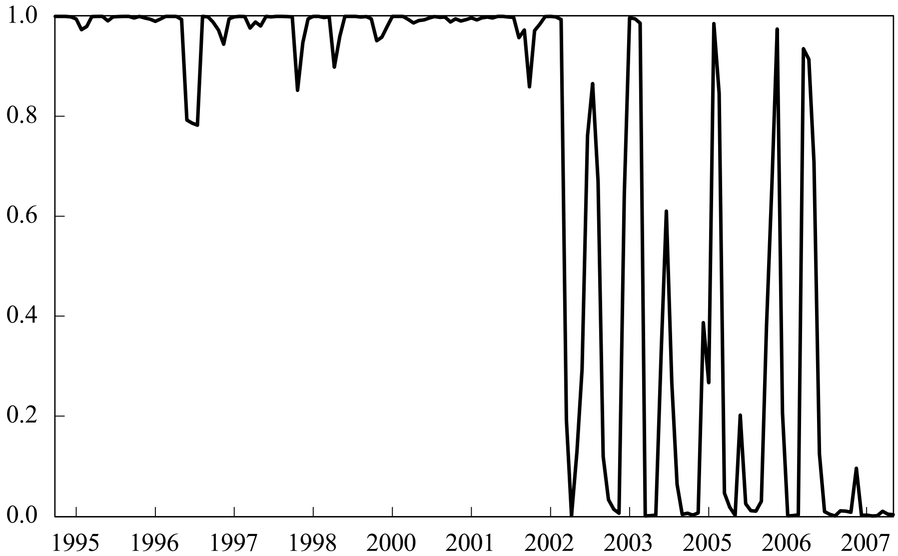
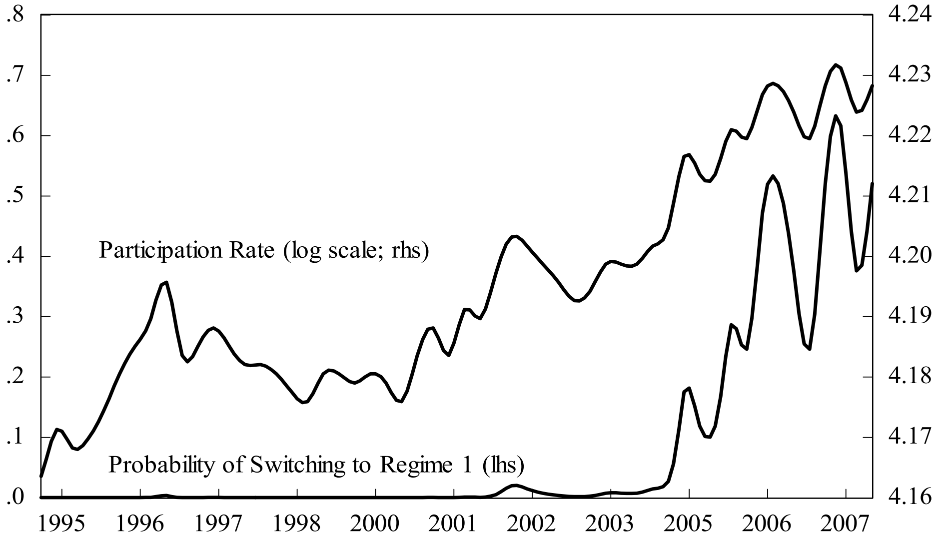


Figure 4b. Probability of Switching to Regime 1 and Participation Rate



We also provide estimates based on the inclusion of the three alternative drivers of Beveridge curve shifts. In each case, we find that $\alpha_0 < \alpha_1$ suggesting that Regime 0 is now characterized by the 'inner' Beveridge curve. In the case where Ω represents GDP growth, $\kappa_0 > 0$ suggests an increase (decrease) in GDP growth is associated with an increase (a reduction) in the probability of remaining in Regime 1. This evidence is consistent with the Beveridge curve shifting outwards (inwards) as a result of an increase (a decrease) in GDP growth. This is accompanied by λ<0 which suggests a direct negative relationship between the GDP growth and u in the mean equation. While a fall in u might normally be expected from an increase in growth, we find there is also a decrease in matching. Where Ω represents net migration, we are able marginally to reject the null $\vartheta_0 = 0$ at the 10% significance level.

One would expect immigration policy to be based on attracting suitably qualified people to join the domestic labour force. However, our finding suggests that an increase in net migration may actually be associated with an outward shift in the Beveridge curve and a reduction in matching. Finally, in the case where Ω represents the real interest rate, we find $\vartheta_0, \kappa_0 = 0$ which indicates that changes in the interest rate have no impact in terms of Beveridge curve shifts.

5. Conclusions

The participation rate has been increasing steadily in most developed economies since the 1960s. A large part of this 50-year trend is due to more women choosing to work. In countries such as Spain and the US women now comprise the majority of the workforce with potentially important effect on unemployment and job market efficiency (*The Economist* 2009). In this study of the New Zealand labour market over 1990-2007, we are able confirm that the increase in the participation rate in New Zealand, most of which is due to an increase in female participation, is associated with an inward shift in the Beveridge curve reflecting an improvement in matching. Although limited to New Zealand, this finding favours policies that encourage women to participate in the workforce. By contrast an increase in net migration, which we interpret as an index of international participation into the New Zealand labour market, is found to shift the Beveridge curve outward, which corresponds to a deterioration in matching.

Echoing the recent literature on the influence of cyclical variables on the position of the Beveridge curve, we show that an increase in GDP growth translates into less unemployment but also into less efficient matching. This finding confirms the presence of anti-clockwise adjustments around recoveries as documented in other countries such as the UK (Wall and Zoega 2002) or the US (Valetta 2005). While a rise in the real rate of interest may lead to a rise in the unemployment rate, there is no evidence that the Beveridge curve will shift.

These findings assume a hidden Markov process for the shift factor in the Beveridge curve. A Markov-switching approach offers valuable new insights into the behaviour of the Beveridge curve where episodes of more or less efficient matching can be identified and analysed. This is in contrast to existing studies where shifts are detected by visual inspection or using time trends. Moreover our approach allows for the transition probabilities between regimes to be endogenously determined by the values of the shift factors.

There are obvious reservations with our investigation: the use of interpolated data, problems with the measurement of vacancies and the selection of appropriate shift influences including their microfoundations. In addition many of the traditional shortcomings in this literature apply here too. While addressing these issues constitute an avenue for future research, we believe that applying the Markov switching model to the study of the Beveridge curve opens an interesting avenue of research by identifying factors that affects positively or negatively labour market efficiency, therefore providing useful guidance for policy makers.

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