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Abstract

In this paper we explore a new approach to understanding the evolution of the unemployment rate in Australia. Specifically, we use gross worker flows data to explore the consequences of assuming that there is no unique equilibrium rate of unemployment but rather a continuum of stochastic equilibrium rates which reflect the movement of the entry and exit rates over time. It is shown that the stochastic equilibrium unemployment rate and the observed unemployment rate are very closely related and we explore the reasons why this is so. We examine the short-run dynamics of the entry and exit rates (specifically, the impulse response functions) and the impact on the unemployment rate of shocks to the entry and exit rates and find that shocks to the entry rate have been more important than shocks to the exit rate in bringing about variations in the unemployment rate over our sample period. We then present a new way to disentangle the effects on the (equilibrium) unemployment rate of the business cycle and structural shifts. It would appear that there was a once and for all downward shift in the equilibrium rate(s) of unemployment in Australia in the early 1990s, which likely reflects the introduction of a more generous system of disability pension benefits.

KEYWORDS: Worker Flows, Business Cycle, Employment, Unemployment, Australia

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I Introduction

In this paper we present a new approach to understanding the evolution of the unemployment rate in Australia. Specifically, we use gross worker flows data for Australia to explore the consequences of assuming that there is no unique equilibrium rate of unemployment, but instead a continuum of stochastic equilibrium rates which reflect the movement of the entry and exit rates over time. In so doing we are following up on ideas to be found in Burgess and Turon (2005) and in Hall (2004 & 2005a). Besides taking the notion of a 'stochastic equilibrium' seriously, our contribution is to show that it provides a new way empirically to disentangle the effects on the (equilibrium) unemployment rate of the business cycle and structural shifts. In particular, using quarterly data for Australia for 1979:3 through to 2003:4, time series techniques are used to explore the properties of the entry and exit rates, and to evaluate both the implied time path of the stochastic equilibrium rate of unemployment and its persistence. We find that the entry rate is highly counter cyclical and that shocks to the entry rate have been more important than shocks to the exit rate in bringing about variations in the unemployment rate over our sample period. We also find evidence of a structural break in the relationship between the entry and exit rates to unemployment in Australia from the early 1990s, which likely reflects a change in social security arrangements. We show that this change implies a significant reduction in (stochastic) equilibrium unemployment rates and also a more rapid speed of adjustment of the actual rate to the equilibrium rate.

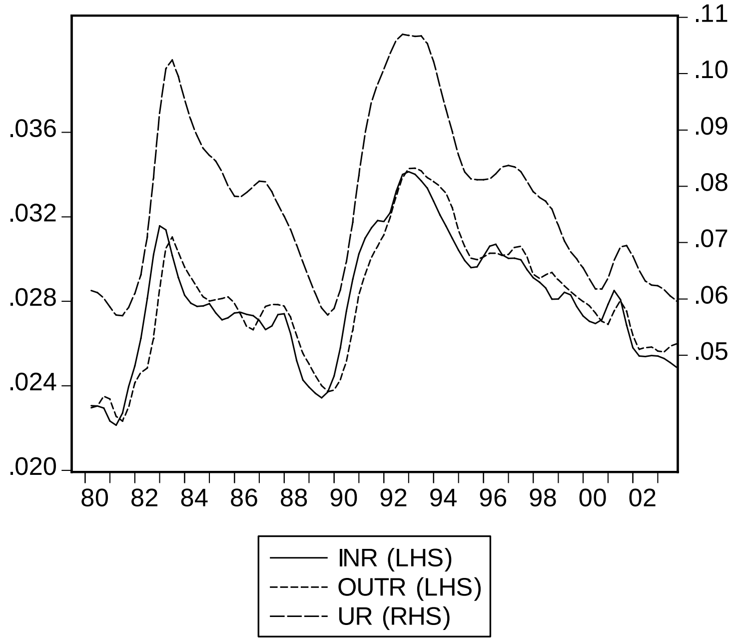
Key elements of the model of the stochastic equilibrium unemployment rate are presented in Sections 2 and 3. The model is extended to examine in further detail the relationship between the exit and entry rates to unemployment, and possible shifts in this relationship. In particular the negative relationship between entry and exit rates over the business cycle (the *en-ex* schedule) and its implications for the cyclical behaviour of the unemployment rate is highlighted. Section 4 uses time series methods to assess the properties of the observable entry and exit rates for Australia in order to ascertain the causal relationships between them and to draw out their role in determining the time path of the unemployment rate. The final section concludes.

II Dynamics of Unemployment

The main characteristics of the evolution of the unemployment rate in Australia are depicted in Figure 1 which shows (inter alia) quarterly averages of monthly values for the unemployment rate for persons over the period 1979:3 – 2003:4.[1] The unemployment rate (*UR*) is the uppermost series in the chart and is recorded on the RH scale. Notable are the two recession episodes of 1981-83 and 1990-93 and the long, slow recoveries which followed each. One aim of this paper is to present a new way of distinguishing those movements of the unemployment rate which are 'merely' associated with the business cycle from those which reflect a change in the underlying equilibrium rate, once cyclical factors have been allowed for.

FIGURE 1

Time Series of Inflow Rates, Outflow Rates and Unemployment Rates (seasonally adjusted and smoothed data)



The unemployment rate is defined as the ratio of the number unemployed (*U*) to the total labour force (*LF*). Allowing for both *U* and *LF* to vary over time, the change in the unemployment rate (*UR*) can be computed as:

$$\Delta(UR_t) = \frac{U_t}{LF_t} - \frac{U_{t-1}}{LF_{t-1}} = \frac{\Delta U_t}{LF_t} - \left(\frac{U_{t-1}}{LF_t}\right)\left(\frac{\Delta LF_t}{LF_{t-1}}\right) \tag{1}$$

where *Δ* represents a discrete change operator.

[1] All data used in this paper are taken from the monthly Labour Force Survey of households which commenced in 1978. For details of the data sources see the Appendix to this paper. So as to better display the underlying trends and cycles, the series depicted in Figure 1 are based on quarterly averages of monthly data which have been seasonally adjusted and smoothed using a 7-period Henderson moving average. This is because monthly and quarterly flows data, even when seasonally adjusted, are very noisy. However, in the econometric work which underpins results reported in this paper we use seasonally adjusted, but not smoothed, quarterly averages of monthly data.

Changes in the number unemployed over time (ΔU) reflect the balance between two flows, an inflow into unemployment (*IN*) and an outflow from unemployment (*OUT*). Thus:

$$\Delta U_t = U_t - U_{t-1} = IN_t - OUT_t \tag{2}$$

The evolution of inflow and outflow over time in Australia is depicted in the two inter-twined series below the unemployment rate series in Figure 1. The inflow rate (*INR* - solid line) is defined as the sum of the flows from employment and from not in the labour force into unemployment over the month, expressed as a proportion of the labour force. The outflow rate (*OUTR* - dashed line) is defined as the sum of the flows from unemployment to employment and to not in the labour force over the month, also expressed as a proportion of the labour force. Both *INR* and *OUTR* are recorded on the LH scale.

We find that *INR* and *OUTR* are I(1) and that the two series are cointegrated with a cointegrating vector of approximately (1, -1),[2] implying that, if the inflow rate increases, sooner or later, the outflow rate will rise by an amount equal to the rise in INR.[3] This is not a feature of Australian data alone - Balakrishnan & Michelacci (2001) find that Inflow and Outflow Rates for the US, UK, Germany, France and Spain also have cointegrating vectors of (1, -1).[4]

Given (2), equation (1) may be written as:

$$\Delta(UR_t) = \frac{(IN_t - OUT_t) - U_{t-1}\left(\Delta LF_t / LF_{t-1}\right)}{LF_t} \tag{3}$$

The two terms in the numerator on the RHS of (3) may be given a rather interesting interpretation. The last term, $U_{t-1}\left(\Delta LF_t / LF_{t-1}\right)$, measures the extent to which the number unemployed can change when there is a growing labour force and yet the unemployment rate remain constant.[5] The first term, $(IN_t - OUT_t)$, is simply the balance of inflows and outflows over any period and is equal to the observed (i.e. the actual) change in the number unemployed

[2] Another way to put this is to say that in the long run $IN_t - OUT_t = e_t$, where e_t is stationary with mean zero. Since the data are very noisy and contain seasonal patterns, the unit root and cointegration tests were performed on both the raw data (but allowing for seasonal patterns either with dummies or with 12-th order lags) and on smoothed data. All of the tests support the result that the data are non-stationary and cointegrated.

[3] Clearly inflow leads outflow, but the lag is short, typically only 1 or 2 quarters. Tests for causality indicate that inflow into unemployment Granger causes outflow from unemployment while outflow does not Granger cause inflow. This result is not surprising. Balakrishnan & Michelacci (2001) find the same for the US, UK, Germany, France and Spain over the period 1972:3 – 1989:4. Burgess & Turon (2005, p 433) also find this for UK claimant count data over the period 1967:1 – 1998:4.

[4] For a discussion of the significance of this finding in a business cycle context see Dixon (et al) (2003).

[5] For the unemployment rate to be constant over time we require the rate of growth in unemployment to equal the rate of growth in the labour force. That is, we require: $\Delta U/U = \Delta LF/LF$. This in turn implies that the magnitude of ΔU is such that it is exactly equal to the product $U(\Delta LF/LF)$.

over the period. Clearly, if the first term in the numerator (i.e. the actual change) exceeds the second (i.e. the change consistent with the unemployment rate remaining constant) the unemployment rate will rise. Only if the first term is exactly equal to the second is the unemployment rate constant. In fact, even when $(IN - OUT)$ equals zero, the unemployment rate can rise or fall depending on the rate of growth of the labour force. This should not be surprising. If the Labour Force is rising over time then the number unemployed must rise at the same rate to keep the ratio between the two (this is the unemployment rate, (U/LF)) constant. However, for the number unemployed to rise over time there must be a net inflow into unemployment, that is $(IN - OUT)$ must be positive, not zero.

Since the change in the labour force over a discrete period, like a month or a quarter, is likely to be small, it follows that $\Delta LF/LF$ is likely to be small (both in absolute terms as well as relative to the other component in the equation), hence we will follow other researchers and throughout treat[6]

$$\Delta\left(UR\right) \approx \left(\Delta U / LF\right) = (IN - OUT)/LF$$

III A Parsimonious model of Unemployment Rate Equilibrium and Short-run Dynamics

Although flows between three labour market states (employed, unemployed and not in the labour force) are involved, it is useful to model unemployment dynamics in a parsimonious fashion with the aid of only a single entry rate to unemployment and a single exit rate from unemployment.[7]

By definition, given (2):[8]

$$\Delta U_t = \left(\frac{IN_t}{E_t}\right)E_t - \left(\frac{OUT_t}{U_t}\right)U_t = en_t E_t - ex_t U_t \qquad (4)$$

[6] For Australian data (see data description in the Appendix) the standard deviation of the net flows term (the first term on the RHS of (3)) is 0.0015 while the standard deviation of the labour force growth term (the second term on the RHS of (3)) is 0.0001.

[7] Three states are involved because our measure of *IN* includes flows into unemployment from ‘not in the labour force’ as well as from employment while our measure of *OUT* includes flows from unemployment to ‘not in the labour force’ as well as to employment.

[8] As with Burgess & Turon (2005) and other papers dealing with flows, for any period (quarter) *t*, figures for stocks refer to the value at the beginning of the period while the figures for flows are the flows that occurred during the period.

where en is the "entry rate" into unemployment defined as $en\left(=IN/E\right)$ and ex is the "exit rate" from unemployment defined as $ex\left(=OUT/U\right)$; E is the total number of employed and U is the total number unemployed.[9]

Dividing both sides of (4) by the labour force ($LF = E + U$) yields an expression for the motion of the unemployment rate:

$$\frac{\Delta U_t}{LF} \approx UR_t - UR_{t-1} \approx en_t - \left(en_t + ex_t\right)UR_{t-1} \tag{5}$$

From (5), the 'flow equilibrium' in the sense of $\Delta U_t = 0 \ \forall \ t$, or what Hall calls the "stochastic equilibrium unemployment rate" (Hall, 2003, p 148 and 2005a, p 399), (UR_t^*) is given by:

$$UR_t^* = \frac{en_t}{en_t + ex_t} = \frac{1}{1+\left(ex_t/en_t\right)} \tag{6}$$

The main advantage of this framework is that we can study the behaviour of an unobservable variable (the equilibrium rate of unemployment) by studying the behaviour of observed variables (entry and exit rates), and once we understand the determinants and dynamics of the behaviour of *en* and *ex* we also have an explanation for the behaviour of the equilibrium rate.

Inspection of (6) shows that the (partial) derivatives of UR^* with respect to the entry and exit rates are: $\left(\partial UR^*/\partial en\right) = UR^{*2}\left(ex/en\right)\left(1/en\right)$ and $\left(\partial UR^*/\partial ex\right) = -UR^{*2}\left(1/en\right)$ and so a rise in *en* increases UR^* while a rise in *ex* reduces UR^*. This implies that the elasticity of the equilibrium unemployment rate with respect to the entry rate is $\left(\partial UR^*/\partial en\right)\left(en/UR^*\right) = \left(ex/en\right)UR^*$ while the elasticity of the equilibrium unemployment rate with respect to the exit rate is $\left(\partial UR^*/\partial ex\right)\left(ex/UR^*\right) = -\left(ex/en\right)UR^*$. In other words the two elasticities are equal in value but of opposite sign. Notice also that $\left(ex/en\right)UR^* = \left(ex/\left(en+ex\right)\right)$. If *en* were very small relative to *ex*, the ratio (*ex/(en + ex)*) would be approximately equal to 1 and so we would expect the long-run elasticity of the unemployment rate with respect to the entry rate and the exit rate to be (approximately) equal to 1 and -1 respectively.[10] (However, the reader should note that these are

[9] Note that our measure *en* in (3) is the same as Hall's separation rate *s* and Burgess and Turon's inflow rate *i*, and that our measure *ex* in (3) is the same as Hall's finding rate *f* and Burgess and Turon's outflow rate *x* (Hall, 2004, p 5 & 2005a, p 398; Burgess and Turon, 2005, p 425).

[10] The value of *ex*/(*en* + *ex*) computed using the means is 0.92.

'ceteris paribus' elasticities in that they do not take into account any interdependencies between the entry and exit rates – we elaborate on this in section IV.)

Insights about the dynamics of the observed unemployment rate can be obtained by substituting (6) into (5) to give:

$$UR_t - UR_{t-1} = \left(en_t + ex_t\right)\left(UR^* - UR_{t-1}\right) \tag{7}$$

Equation (7) shows that the higher is $\left(en + ex\right)$ the faster is the adjustment to any disequilibrium. This shows that the determinants of the equilibrium rate and the determinants of the short-run dynamics, and especially the 'persistence' of the unemployment rate, are intertwined (the degree of persistence will equal $1-(en+ex)$). In particular, changes in the equilibrium rate are *necessarily* accompanied by changes in the rate of adjustment and in persistence.[11] (We develop this point further in the next section of the paper.)

Before proceeding, we note that the unemployment rate (*UR*) and the ratio of the number unemployed to the number employed (*U/E*) are monotonically related. By definition:

$$UR = \frac{U}{LF} = \frac{1}{1+\left(E/U\right)} = \frac{1}{1+\left(1/\left(U/E\right)\right)} \tag{8}$$

which implies that we can explain the behaviour of the unemployment rate by explaining the behaviour of the ratio of the number unemployed to the number employed. Here also, if we had flows equilibrium at the prevailing entry and exit rates, that is inflow ($en \times E$) equals outflow ($ex \times U$), we can solve for the 'stochastic equilibrium' ratio of the number unemployed to the number employed at any moment in time:

$$\left(U/E\right)_t^* = \frac{en_t}{ex_t} \tag{9}$$

The advantage of looking at the ratio of the number unemployed to the number employed (*U/E*), rather than the unemployment rate (*U/LF*) is that, while the equilibrium unemployment rate is related in a non-linear fashion to the entry and exit rates, equation (9) shows that there is a simple linear relationship between the logarithm of the ratio of unemployment to employment in any period and the logarithms of the entry and exit rates. For convenience of exposition, we call

[11] This suggests that we may not want to pay much attention to time series studies of persistence and structural breaks in unemployment rates which regress the unemployment rate on the lagged unemployment rate and allow only for intercept changes.

(9) the ‘stochastic equilibrium unemployment ratio’ to distinguish it from the ‘stochastic equilibrium unemployment rate’ (6).

IV Cycles and Shifts in Equilibrium Unemployment Rates

We proceed now to our time series analysis of the exit and entry rates for Australia using quarterly data for the period 1979:3 to 2003:4. The analysis considers the time series properties of the two series, their relationship with each other, and how they inform us about the equilibrium unemployment rates and ratios shown in equations (6) and (9).

(i) Entry, Exit and the implied Time-Varying Equilibrium Unemployment Rate in Australia

Figure 2 shows the evolution of the entry (en) and exit (ex) rates for Australia. Both series are highly variable. Figures given refer to quarterly averages of monthly rates for the sample period 1979:3 – 2003:4. The entry to unemployment rate, *en*, rises sharply in the recessions of 1981-3 and 1990-93 and falls in the subsequent recovery phases, while the exit from unemployment rate, *ex*, falls during the recession periods and increases during the recovery phases. Table 1 presents some descriptive statistics.

Some comparisons of the Australian, US and UK experiences are worthy of note. For the entry rate in the US, Hall (2004, 2005a & b) finds no cyclical response for the most recent (2001) recession and, indeed, his “tentative conclusion is that a constant separation [entry] rate is the best approximation over past decades” (2005b, p 15).[12] On the other hand, Burgess and Turon (2005) observe similar marked cyclical variations in the entry rate for the UK as we find for Australia. Data for all three countries show that the exit rate from unemployment is strongly counter-cyclical.

Visual inspection of the variables *en*, *ex* and the actual unemployment rate *UR* suggest that they may be random walks or at least highly persistent series (the values of the first-order auto-

[12] In his address to the 2004 Australian Conference of Economists, Hall argued that “Employed workers do not lose jobs more frequently in recessions than in other times. Unemployment rises because the exit rate from unemployment is lower, not because the entrance rate is higher” (2004, p 14). To explain fluctuations in the unemployment rate we “must explain persistent changes in job-finding rates” (2004, p 3) and should not focus on explaining changes in job-separation rates. In his most recent empirical paper on this subject he writes “Because the separation rate is close to constant – or at least does not rise in recessions – all of the burden of explaining fluctuations in the unemployment rate falls on variations in the rate that job-seekers find jobs” (2005b, p 22).

correlation coefficient (ρ) are given in Table 2). Formal tests shown in Table 2 indicate that each of the series may be treated as I(1) variables with no statistically significant structural breaks.[13]

FIGURE 2

Entry and Exit Rates (seasonally adjusted data)

TABLE 1

Descriptive Statistics: 1979:3 – 2003:4

	Entry Rate	Exit Rate	Unemployment Rate
Mean	0.030	0.368	0.077
Std. deviation	0.004	0.038	0.015
Coefficient of variation	12.45 %	10.37 %	19.05 %
Correlations			
Entry rate	1.000		
Exit rate	-0.650	1.000	
Unemployment rate	0.899	-0.854	1.000

[13] The *en* and *ex* series are actually bounded from above and below and, strictly speaking, the infinite realisations of the stochastic processes that describe them are therefore ultimately stationary, perhaps with a near unit root. In practice, for finite realisations, particularly in small samples such as ours, it is quite possible for the bounded processes to mimic the appearance of unbounded random walks. In such cases, to avoid potentially spurious results, it is safest to treat the series as if they were generated by unit root processes.

TABLE 2

Unit Root Tests: 1979:3-2003:4

	Entry Rate	Exit Rate	Unemployment Rate
ρ	0.922	0.928	0.939
ADF	-2.039	-1.689	-2.992 *
ZA(1)	-3.430	-3.416	-4.148
ZA(2)	-2.728	-2.953	-3.999
ZA(3)	-3.988	-3.554	-4.577

* This is significant at the 5% level but not at the 1% level. Application of other tests, such as the Phillips-Perron test support the inference that the series is not stationary.
ADF is the Augmented Dickey-Fuller test with intercept. The order of lag is based on the SIC and the 5% critical value is -2.891 while the 1% critical value is -3.50.
ZA(1) is the Zivot-Andrews test which allows for a shift in the intercept; the 5% critical value is -4.8
ZA(2) is the Zivot-Andrews test which allows for a shift in the trend; the 5% critical value is -4.42
ZA(3) is the Zivot-Andrews test which allows for a shift in the intercept and trend; the 5% critical value is -5.08

Since the data are not stationary, it is not particularly meaningful to compute a single 'natural' or 'equilibrium' rate since there is clearly no mean-reversion behaviour. Instead (and as we have foreshadowed) we propose to work with the 'stochastic equilibrium' unemployment rate $UR_t^* = en_t / \left(en_t + ex_t \right)$ as this is the unemployment rate which ensures $\Delta U_t = 0$. This is not only statistically desirable but (potentially at least) provides us with a new and powerful way of sorting out cyclical from non-cyclical influences on the unemployment rate. (Further justification for working with the 'stochastic equilibrium' unemployment rate is provided below.)

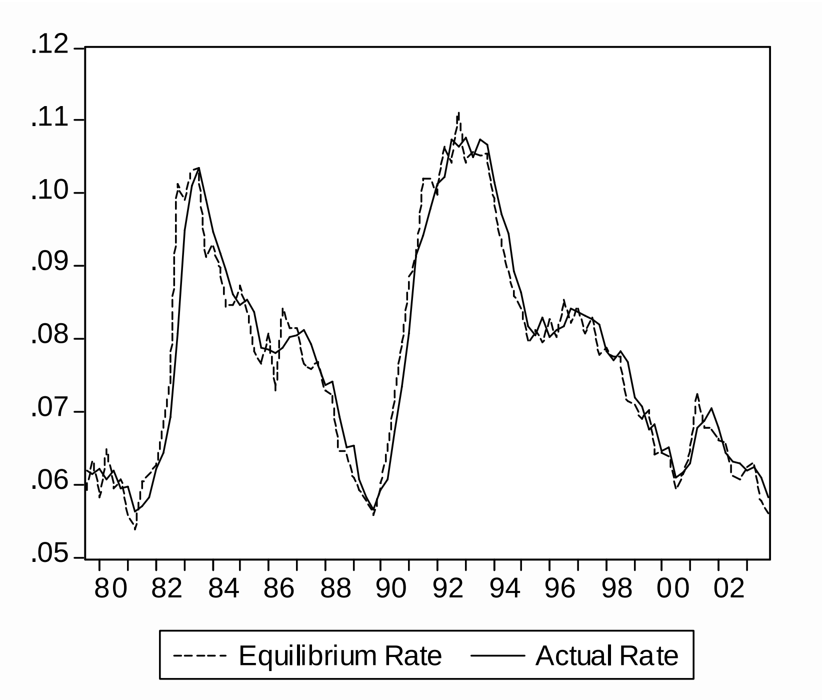
Figure 3 compares the stochastic equilibrium unemployment rate UR_t^* for Australia (computed using equation (6) and the observed values of en_t and ex_t in each period) with the observed unemployment rate. The two series are closely related with r = 0.97.[14] The mean absolute deviation of the observed unemployment rate from the equilibrium rate is very small, 0.003, while the observed unemployment rate has a mean of 0.077 and a standard deviation of 0.015. As Hall (2004, p 5f & 2005a, p 398) has noted, the close correlation between the actual and stochastic equilibrium rate suggests that it may be safe to neglect 'turnover dynamics' when

[14] Hall (2005a, p 398) and Burgess and Turon (2005) also note the close relationship (for the USA and the UK respectively) between the actual rate of unemployment and the equilibrium rate (as defined here).

modelling the actual rate of unemployment and simply focus on the stochastic equilibrium rate and its determinants. It would appear that this is the case for Australia.[15]

FIGURE 3

Actual and Stochastic equilibrium unemployment rates (seasonally adjusted data)



To see why the stochastic equilibrium and actual unemployment rates are so closely related we combine (6) and (7), to obtain an expression for the gap between the observed rate of unemployment and the equilibrium rate. It is

$$UR_t - UR_t^* = \left(en_t + ex_t - 1\right)\left(\frac{en_t}{en_t + ex_t} - UR_{t-1}\right) \tag{10}$$

If ($en_t + ex_t$) is high and/or shocks to *en* and *ex* are small, the actual unemployment rate in any period would be close to the stochastic equilibrium rate. In fact, the sample average of (*en + ex)* is about 0.4 so that, on average, just under one-half of any disequilibrium gap is closed in any quarter. If we think of this in a Koyck-type framework where UR_t on the one hand is related to UR_t^* and UR_{t-1} on the other, the implied mean lag is short, being 1.5 quarters.

Finally, and in relation to the dynamics of the system, we have already noted (see equation (7) above and the related discussion) that the rate of adjustment of the observed unemployment rate

[15] Although one of the points we make in this paper is that in modelling entry and exit we are, at one and the same time, modelling the long-run equilibrium *and* the short-run dynamics. Unlike Hall, we do not see the two as independent of each other.

to the equilibrium rate is given by the sum of *en* and *ex*. For our data set the value of the sum of *en* and *ex* is negatively correlated with both the observed unemployment rate and with the stochastic equilibrium rate (UR^*), with correlation coefficients of -0.80 and -0.83 respectively. This implies that if the (equilibrium) unemployment rate is low the speed of adjustment will be high, and it will be at a maximum when the unemployment rate is at its minimum, and vice-versa. This systematic cyclical variation of the speed of adjustment (and by implication, of unemployment rate persistence) seems an important feature of the aggregate labour market not noted by others.

(ii) Interrelations between the Entry and Exit Rates and the Role of Each in Determining the Historical Time Path of the Unemployment Rate

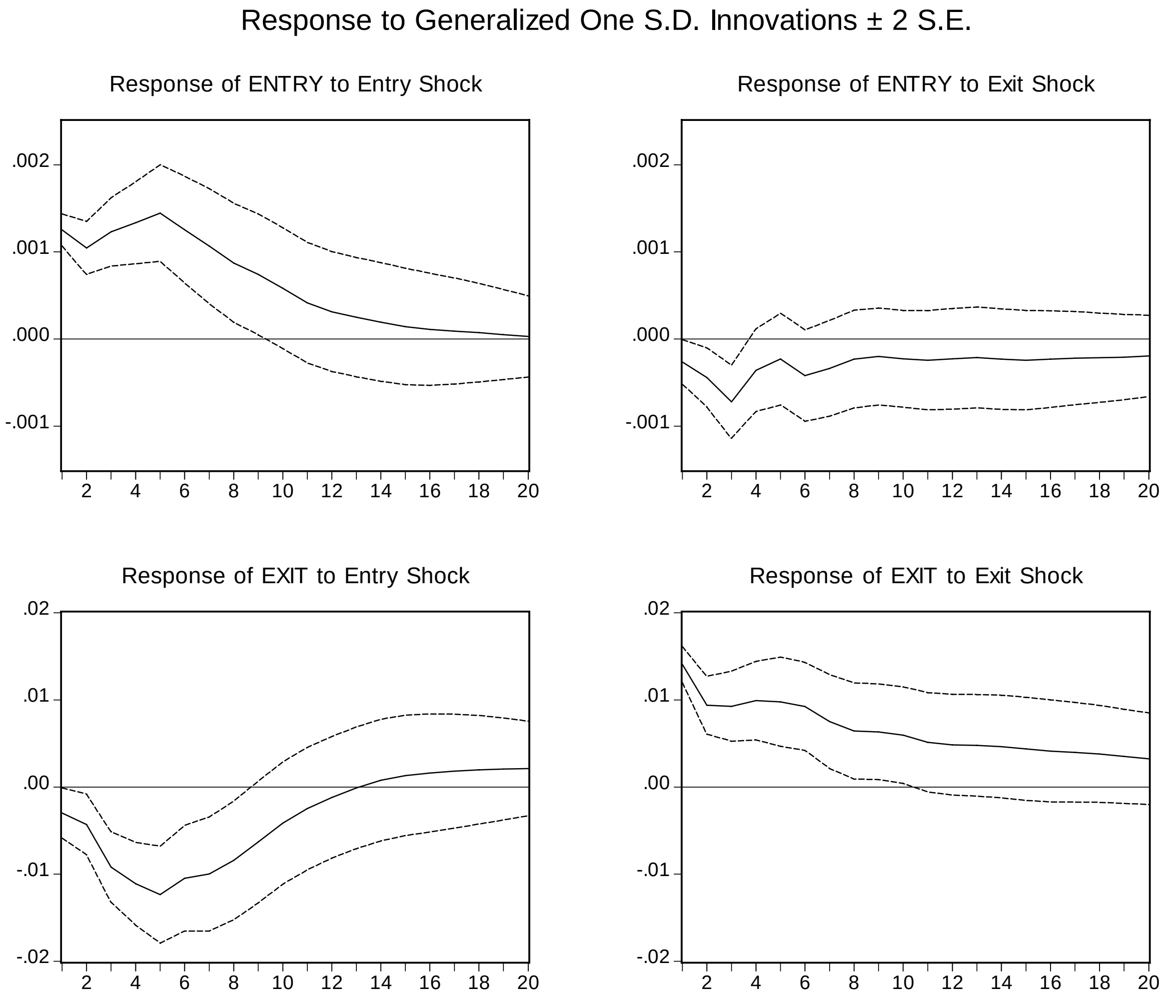
A bivariate VAR was estimated and the resulting impulse responses are shown in Figure 4.[16] The results show that, irrespective of the ordering of the variables, the effect of an entry innovation on the exit rate is initially negative and 'falls' over time while, for all intents and purposes, the entry rate is not affected by shocks to the exit rate.[17] The impulse response functions of own innovations (entry shock on entry rate and exit shock on exit rate) are as expected. Variance decomposition analysis shows that about 50% of the variations in *ex* is explained by its own shocks within 6 quarters. Note that the length of time it takes the rates to revert to zero reflects the (near) unit root properties of the data *en* and *ex*.

Figure 5 shows a simulated time path of the unemployment rate when the entry and exit rates follow the impulse response functions noted here.[18] Following a one standard deviation shock to entry (that is a change from say the average value of 0.030 to 0.031), the unemployment rate initially increases and then declines reflecting both the 'direct' effect of the entry rate upon the unemployment rate and also the indirect effect working via the effect of changes in the entry rate upon the exit rate. In contrast, following a one standard deviation shock to the exit rate (that is a change from say the average value of 0.368 to 0.382), the behavior of the unemployment rate reflects only the response of the unemployment rate to the exit rate, as the entry rate is not significantly affected by a shock to the exit rate.[19]

[16] The order of lag suggested by both the Akaike Information Criterion and Hannan-Quinn Information Criterion was 5; the results of the VAR are available on request.
[17] The results are essentially the same as those found by other authors, for example Burgess and Turon (2005, p 435) for the UK.
[18] The time path for the unemployment rate has been computed using equation (5) above.
[19] In both cases, because the series show high persistence, it takes the unemployment rate some time to return to its initial value.

FIGURE 4

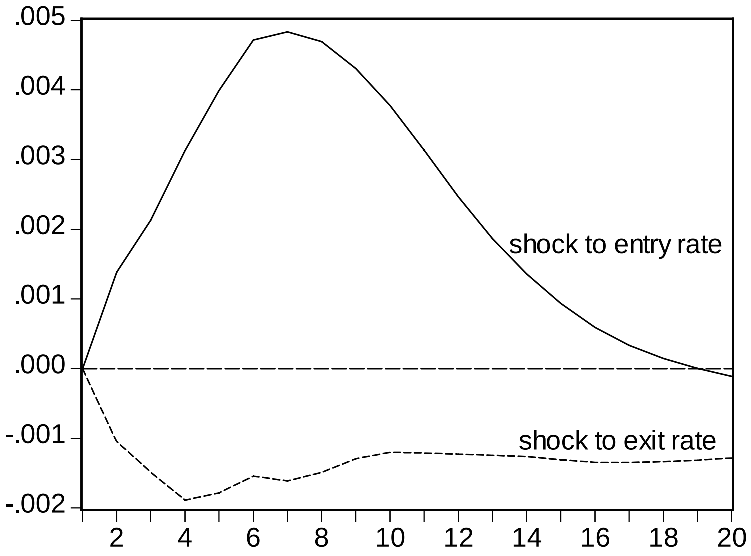
Impulse Response Functions for Entry and Exit rates



While Figure 5 shows that shocks to entry have a bigger impact on the unemployment rate than do shocks to exit, this does not, by itself, demonstrate that historically shocks to the entry rate have been the dominant source of variations in the unemployment rate. To investigate this we follow Burgess and Turon (2005, p 434) and utilise the VAR results together with equation (5) to compute two hypothetical historical unemployment rate series - one where there are no exit rate innovations (whilst allowing the exit rate to vary in response to innovations to the entry rate) and another where there are no entry rate innovations. Figure 6 shows the two series which result. The solid line in the figure, labelled 'shocks to the entry rate', shows what the unemployment rate would have been over time had there been no shocks to the exit rate. The broken line labelled 'shocks to the exit rate', shows what the unemployment rate would have been over time had there been no shocks to the entry rate. These time paths may be compared with that for the actual unemployment rate over the period which is given in Figure 1 above.

FIGURE 5

Implied Impulse Response of the Unemployment Rate



Visual inspection of Figure 6 in relation to Figure 1 suggests that shocks to entry have been more important as a source of variation in the unemployment rate than have shocks to the exit rate. The correlation coefficient between the actual unemployment rate series and the 'no exit shocks' series is (r =) 0.925 while the correlation coefficient between the actual series and the 'no entry shocks' series is (r =) 0.373. We conclude that historically shocks to entry have mattered more for unemployment dynamics than have shocks to exit.[20]

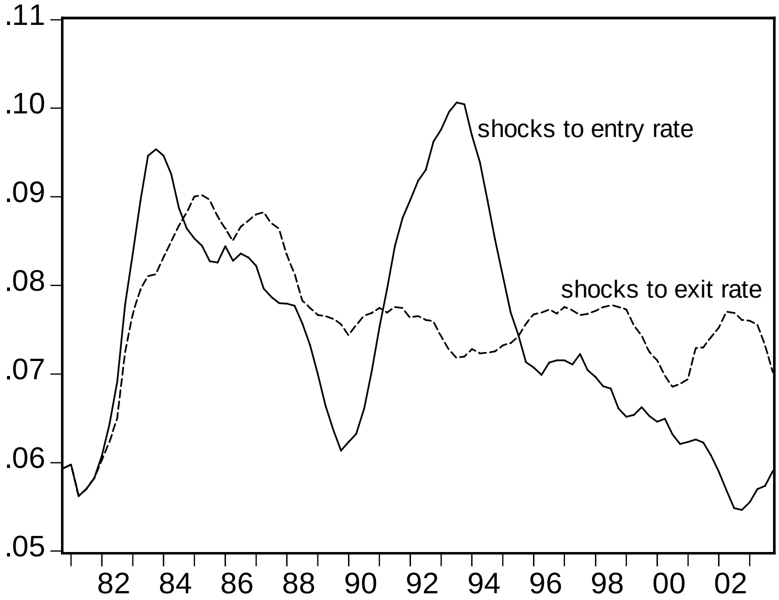
(iii) Entry and Exit Rates Over the Cycle

As mentioned earlier, in this paper we follow an approach in which there is no unique equilibrium rate of unemployment but rather a continuum of rates which reflect, amongst other things, the movement of the entry and exit rates over the cycle. Earlier we saw that both the entry and exit rates are cyclical and that they move inversely to each other. We can take all this a little further.

[20] Burgess and Turon (2005) investigate the source of shocks to UK entry and exit rates and conclude that "shocks to the inflow rate have been far more important for unemployment dynamics than shocks to the outflow rate" (p 436).

FIGURE 6

Two hypothetical unemployment rate histories: one with no shocks to the exit rate but with 'shocks to the entry rate' (solid line) and one with no shocks to the entry rate but with 'shocks to the exit rate' (broken line)



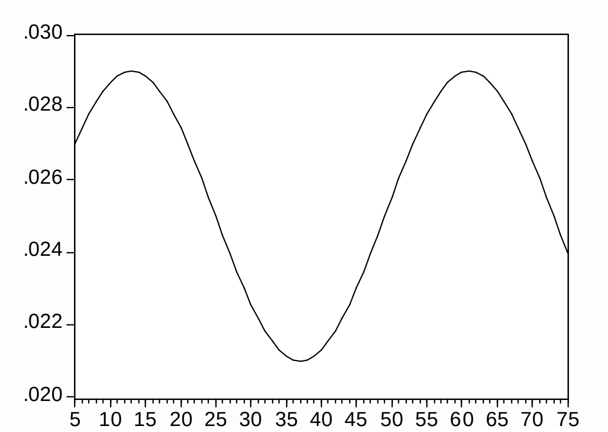
We have seen that the entry rate is cyclical and that, for all intents and purposes, the entry rate is not affected by shocks to the exit rate, ie that entry may be treated as an exogenously determined variable. A stylised cyclical entry rate is depicted in the top panel of Figure 7. If there is a stable monotonic (and inverse) relationship between the exit rate and the entry rate then, as the entry rate varies, we would expect the exit rate to move inversely to the entry rate.[21] This means that we can think in terms of an *ex-en* schedule, which expresses a negative relationship between the two over the cycle, as depicted in the middle panel in Figure 7. As the entry rate fluctuates over the course of the business cycle we would observe repeated movements up and down along this schedule. As a result of these changes, the unemployment rate would move in a cyclical fashion (this presumes that the elasticity linking the exit rate to the entry rate

[21] Given that the entry rate is exogenous, there will be a stable monotonic relationship between exit and entry rates if the exit rate is related in a stable and predictable fashion to the (inherited) stock of unemployment. So the casual chain we envisage is one where there is a (say) positive shock to the entry rate which raises the number unemployed, given the exit rate. As the number unemployed rises, the probability that any one unemployed person may escape from unemployment will fall. (See Dixon (et al) (2003) and Table 1 of this paper for evidence of the inverse relationship between exit and unemployment rates in Australia.) All of which is to say that, we would expect the entry rate and the exit rate to exhibit an inverse relationship along the lines discussed in the text.

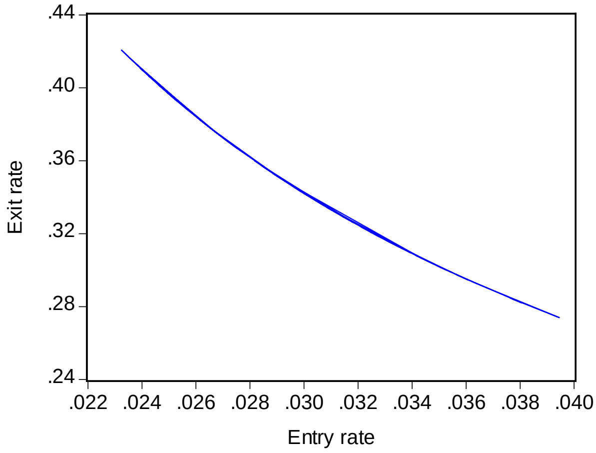
FIGURE 7

Stylised ex-en schedule and the resultant cycle in the unemployment rate

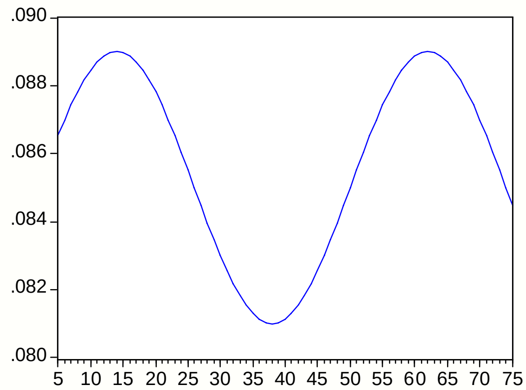
(a) Cyclical movement in en



(b) The associated ex-en schedule



(c) The resultant cycle in the unemployment rate



is less than 1 – we shall see that this is indeed the case shortly), as depicted in the lowermost panel of Figure 7.[22]

While these stylised figures, and especially the notion of an *ex-en* schedule, provide an interesting set of ideas to help us understand unemployment dynamics over the business cycle, it is of more interest to know if the relationship between *ex* and *en* has indeed been unchanged over the period once we allow for their 'normal' inverse relationship over the cycle. In other words, have there been any systematic shifts in the *ex-en* schedule (and thus in the equilibrium rates of unemployment) over time? In exploring this we hope to demonstrate a new method by which it is possible for researchers to isolate cyclical movement from structural shifts in the equilibrium unemployment rate. It is also of interest to obtain an estimate of the elasticity of the exit rate with respect to the entry rate as this determines how amplified the response of the unemployment rate will be to a shock in the entry rate.

(iv) Shift in the ex-en Schedule and in the Equilibrium Unemployment Rate

Figure 8 presents the observed values of *ex* measured on the vertical axis and *en* on the horizontal axis (annual averages have been used so as to better reveal the movement of *ex* relative to *en* over time). The evolution of *{ex-en}* takes the form of a series of loops going from upper left to bottom right in the contraction phase of the business cycle and then back from bottom right to upper left in the recovery phase. The corners mark the periods when the contraction phase of the two recessions start (upper LH corner) and end (bottom RH corner). Two features stand out. First, there is a negative relationship between *ex* and *en.* As argued above, this leads naturally to the notion of a continuum or schedule of 'temporary equilibrium' unemployment rates which is more or less stable over the business cycle. Second, it would appear that there has been a shift upwards (outwards) in the 'schedule', in other words, in the relationship between *ex* and *en* over time. Towards the end of the second recession of the early 1990s the curve drifts to the right before looping up towards the upper left hand. It would appear that, once cyclical factors are allowed for, there was a marked and sustained shift in the curve relating *ex* to *en* at the end of the contraction phase of the recession in the early 1990s.

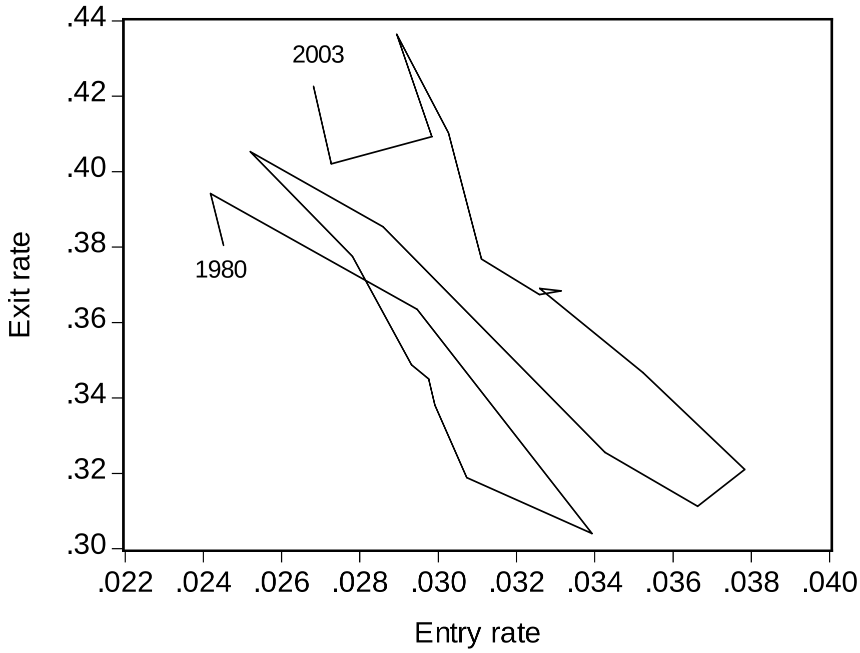
A possible explanation of this structural shift is a change in social security policy in the early 1990s which favoured movement to not in the labour force by taking a Disability Support

[22] Burgess & Turon (2005, p 443) report that UK entry and exit rates are inversely related.

Pension relative to moving to or staying on unemployment benefits.[23] A number of commentators in Australia have remarked upon the rapid and sustained rate of exits from the labour force following the introduction of a 'Disability Reform Package' by the Australian Government in 1991 (eg O'Brien, 2000 and Cai & Gregory, 2004).

FIGURE 8

X-Y Line Chart of Exit and Entry Rates (Annual Averages)



We turn now to an econometric representation of the relationship between *ex* and *en* and an attempt to test for and quantify the size of the (sustained) rise in *ex* relative to *en* in the early 90s. The most straightforward way to examine this is to look at the (cointegrating) relationship between the exit and entry rates. We shall work in logarithms to allow interpretation in terms of elasticities and also because the ratio of unemployment to employment is linearly related to the logarithms of *ex* and *en*, as in equation (9) above.

We use quarterly data over the period 1979:3-2003:4. Earlier we noted that visual inspection of the variables *en* and *ex* suggest that they may be random walks or at least highly persistent series. Formal tests indicate that both log(*ex)* and log(*en)* may be treated as I(1) variables. We find that log(*ex)* and log(*en)* are cointegrated with a constant and an allowance for a single one-

[23] Of course, this will alter the participation rate as well as the unemployment rate.

time shift in the long run component of the relationship.[24] A vector error correction model also shows the entry rate to be weakly exogenous. Inspection of the raw data and experimentation with a shift dummy switching from 0 to 1 at different dates shows that the *ex*-*en* curve seems to have shifted outwards around 1992:3. Table 3 presents the result of the error correction model with a one-time deterministic break.

The results show that the long-run elasticity of *ex* with respect to *en* is -0.620, implying that as *en* (say) rises by 1% the ratio of *ex* to *en* will fall by 1.6% and the (equilibrium) unemployment rate will (*ceteris paribus*) rise by 1.6% - a little over one and one-half times the percentage increase in *en*.

The estimated coefficient on the shift dummy in the fitted equation is 0.132. Recall that a shift upwards in the *ex*-*en* line (a positive coefficient on the dummy variable) represents a fall in the equilibrium rate of unemployment (*ceteris paribus*). In this case, the point estimate of 0.132 translates into an estimated shift equivalent to an increase in the exit rate of 14%, given *en*.[25] With a long-run elasticity of UR^* with respect to *ex* of approximately 1 this means a fall in UR^* (given *en*) of 14%. So that instead of the observed mean value of the (equilibrium) unemployment rate over the period 1992:3-2003:4 of 7.9% we would, but for the shift upwards in *ex*, have seen an (equilibrium) unemployment rate of 9.0% - a not insignificant difference of (slightly over) one percentage point.

Another important implication of this result can be gleaned from an inspection of equation (5) above. This equation shows that the degree of persistence in the unemployment rate is given by $\left(1-\left(en+ex\right)\right)$. Clearly, the rise (upwards shift) we have noted in the level of *ex*, given *en*, resulted in a reduction not only in the equilibrium rate of unemployment but also in an unambiguous reduction in the persistence of the unemployment rate and a rise in the speed with which the actual unemployment rate adjusts to the equilibrium rate.

[24] The Gregory-Hansen test for a null of cointegration with a one-time shift in the intercept was clearly accepted at the 5% level of significance.

[25] There has been some considerable discussion in the econometrics literature of the most appropriate measure of the proportional change in the dependent variable that implied by the coefficient on as shift dummy when the dependent variable is in logarithms. (See Halvorsen & Palmquist (1980), Kennedy (1981) and Derrick (1984) for examples). Suffice to say that for our specific application the size of the estimated values of both the coefficient on the dummy and its standard error are so small that alternative measures yield essentially the same result.

TABLE 3

Estimates of Error Correction model: 1979:3-2003:4

$$\Delta \log(ex)_t = \lambda(\log(ex)_{t-1} - (\beta_0 + \beta_1 \log(en)_{t-1} + \beta_2 D_{t-1})) + \sum_{i=0}^{p} \gamma_i \Delta \log(en)_{t-i} + \sum_{i=0}^{p} \theta_i \Delta \log(ex)_{t-i} + \varepsilon_t$$

where p the order of lag is determined by the SIC; ε_t is an error term and D is a dummy variable with a value of zero over the period 1979:3-1992:2 and a value of 1 over the period 1992:3-2003:4.[26]

Parameters	Coefficient (standard error)
λ	-0.363 (0.077)
β_0	-3.234 (0.378)
β_1	-0.620 (0.107)
β_2	0.132 (0.024)
γ_2	-0.205 (0.085)
γ_3	-0.192 (0.084)
γ_4	-0.164 (0.082)
Q(1)*	2.351 (0.125)
Q(4)	2.749 (0.601)
Q2(1)	0.114 (0.736)
Q2(4)	1.730 (0.785)

* Q is the Ljung-Box test for autocorrelation in the residuals and Q2 is the equivalent test for autocorrelation in the squared-residuals. The terms in parenthesis are the p-values.

V Concluding Remarks

This paper has applied time series methods to data on the gross flows of labour into and out of unemployment for Australia for the period 1979 through 2003 to explain the cyclical behaviour and persistence of the stochastic equilibrium unemployment rate $UR_t^* = en_t / (en_t + ex_t)$ and of the stochastic equilibrium unemployment ratio $(U/E)_t^* = en_t / ex_t$. In particular, we show how the stable inverse relationship between the entry and exit rates, together with the empirical fact that entry rates are weakly exogenous, determines the cyclical behaviour of the equilibrium unemployment rates. This allows us to illustrate a new way to disentangle the effects of the business cycle from the effects of structural shifts on the (equilibrium) unemployment rate.

[26] EViews 5.1 is the package utilized. The results reported only include the significant lag terms.

It would appear that the relationship between the entry and exit rates from unemployment in Australia is such that the elasticity of exit with respect to entry is in the order of –0.6, implying that if the entry rate were to rise by 1% the equilibrium unemployment rate (and within a few months the actual unemployment rate) will rise by (roughly) 1.6%. The empirical work also shows that the *exit-entry* schedule shifted out (up) in Australia in the early 1990s, and the size of the shift was equivalent to a reduction in the equilibrium unemployment rate(s) of around one percentage point, a not insignificant change. The timing, direction and extent of the shift are consistent with it reflecting a dramatic rise in the proportion of people of work force age who moved from employment to unemployment and then to a disability pension, the entry criteria for which were altered with the introduction of a 'Disability Reform Package' by the Australian Federal Government in late 1991.

Data Appendix

Data on gross flows between various labour market states has been published on a monthly basis by the Australian Bureau of Statistics (ABS) since February 1980. Measures of gross flows between two months are compiled from data collected as part of the monthly Labour Force Survey (LFS) and reflect the matching of responses by individuals in the second month's survey with responses by the same individuals in the first month's survey. These matched records are then 'expanded up' to yield population estimates which, for various reasons, typically 'represent' around 78 per cent of the total civilian population aged 15 years and over. This means that the balance of flows given in the published flows data will not equal recorded changes in stocks (such as the total number unemployed). Given the purpose of this paper, it is desirable to adjust the raw flows data so as to ensure that net flows and sums of rows and columns in the flow tables are equal to their stock counterparts.

The raw data on gross flows until March 2003 is taken from the tables of "Estimates of labour force status and gross changes (flows) derived from matched records .." published in the ABS publication Labour Force: Australia, Cat No 6203.0. Raw data for March 2003 on is taken from the ABS datacube 6291.0.55.001 series GM. Where data was missing due to a new sample being rotated in, unpublished data was obtained from ABS microfiche and we have used that as the raw data for those periods.

The data set used in this paper is based on computed flows between 3 states (employed, unemployed and not in the labour force). The 'RAS' method, utilised to update input-output tables, has been applied to the published gross flows data to force the flow column and row totals (and thus ratios like the unemployment rate) to be exactly equal to that of the labour force survey stocks data. The approach entails an iterative method. Initially all row entries are adjusted upwards by first expressing the value given in each cell across the rows of the flows table for the matched records as a proportion of the raw data's row totals and then multiplying each of those proportions by the relevant stock figures (ie the total number in Australia who are employed, unemployed and not in the labour force) for the first of each pair of months. This ensures (i) that the sum of the entries across the rows of the 'new' flows table sum to the total number in each labour market state in the first of each pair of months as reported for Australia as a whole in the LFS, and (ii) that the implied unemployment and participation rates in the rows of the 'new' flows table correspond exactly to those rates given for Australia as a whole in the LFS for the first of each pair of months. However, it is important that the column totals and any ratios involving the column totals (eg the unemployment rate) be consistent with the stock proportions for the second of each pair of months. Mere adjustment across the rows will not achieve this. Instead, we now need to carry out the same procedure adjusting the 'new' figures in each column to make them consistent with the distribution of the population across states in the second of each pair of months. We continue in this manner, iterating by making adjustments across rows and then across columns until: (i) sums of each of the rows and columns are equal to the relevant population given by the 'stock' data for the second of each pair of months and (ii) any ratios involving the row or column totals (eg the unemployment rate) differ from the published ratios given in the LFS for their respective months (rows for the first month in each pair and columns for the second month in each pair) by less than 0.001.

Compared with calculations based on the 'raw' flows data, the effect of the adjustments is to raise the unemployment rate (slightly) and lower the participation rate (slightly) – indicating that the RAS method is successfully dealing with the biases in the raw data identified in Dixon (2003). With respect to the flows themselves and the transition probabilities, the main effect is to lower the proportion of those initially unemployed who flow from unemployment to employment, and to raise the proportion of those initially unemployed who remain unemployed. Other changes (which are even smaller in magnitude) are: (i) to raise the proportion of those initially employed who flow from employment to not in the labour force and to lower the proportion of those initially employed who remain employed, and (ii) to lower the proportion of those initially not in the labour force who flow from not in the labour force to employment and to raise the proportion of those initially not in the labour force who remain not in the labour force.

Having said all that, while there are some differences in the mean values of some variables, the time series properties and inter-relationships in the raw data and in the stock-consistent data are virtually identical. In other words, the results reported in the paper are not an artifact of the procedure by which the data has been made stock-consistent.

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