New Zealand Labour Market Dynamics: Pre- and Post-global Financial Crisis

Weshah Razzak

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Abstract

A persistent increase in the unemployment rate ignites speculations about whether the changes to unemployment are structural or cyclical. The New Zealand economy has been through major restructuring since the mid-1980s. The labour market's institutional changes were the last in the sequence of these reforms. As reforms began to take effect and expectations adjusted, unemployment in New Zealand has declined steadily and persistently since 1993-1994. Along the way, however, transitory increases in unemployment occurred. Major increases occurred after the Asian financial crisis and the global financial crisis with similar dynamics.

JEL CLASSIFICATION J60, C2, C3

KEYWORDS Natural Rate of Unemployment; Speed of adjustment of the New Zealand labour market; estimation

Executive Summary

The New Zealand economy went through major restructuring, starting in the mid-1980s. As reforms began to take effect and expectations adjusted, unemployment in New Zealand has declined steadily and persistently since 1993-1994. Temporary changes in unemployment occur because of economic shocks, such as *unanticipated* monetary and fiscal policy shocks, productivity shocks, and financial crises, e.g., the Asian financial crisis and the recent global financial crisis. These events push the unemployment rate and its natural rate around, creating gaps between them and slowing the adjustment of the labour market to its natural rate. We estimate the natural rate of unemployment from the pools of workers who move in and out the labour force. Then we estimate the speed of adjustment of the observed unemployment rate to this natural rate over the period 1992-2012.

There have been concerns about the increase in the unemployment rate after the global financial crisis. Important issues in analysing the recent increases in the unemployment rate are whether these increases are cyclical versus structural and the speed of adjustment of the unemployment rate to its natural rate (NRU). We consider these issues by estimating the NRU and the speed of adjustment. We use labour market gross flows and a modified the Beveridge curve to estimate the NRU. We provide different estimates of the speed of adjustment.

We found that first, the estimated time series of the natural rate of unemployment (NRU) in New Zealand to be significantly lower than the actual unemployment rate over the sample 1992-2012. Over the past two decades, the average NRU is estimated to be 4.6 percent whereas the average unemployment rate is 6.2 percent. So on average, the observed unemployment rate has been mostly higher than our measured NRU. In December 2012, we estimate the NRU to be somewhere between 4 and 4.5 percent while the unemployment rate is still much higher. Second, both the unemployment rate and the estimated NRU are persistent. Third, the level of the NRU is affected by *unanticipated* monetary policy shocks and by *unanticipated* fiscal policy shocks. Unanticipated monetary and fiscal policy shocks and TFP shocks reduce the NRU. Unanticipated fiscal policy shocks are associated with lower NRU and they have significant effects. Total factor productivity (TFP) shocks have much larger effects on the NRU and they are more significant than policy shocks. Fourth, available proxy measures of labour market institutions such as the minimum wage and union density have no effects in general, but union density seems to be positively associated with the NRU. Fifth, typically the speed of adjustment is a measure between zero and 1. Our estimates are between 0.10 and 0.50. On that scale, the speed of adjustment of the unemployment rate to the NRU take between 2 and 10 quarters to be complete. Sixth, the speed of adjustment increases after major recessions. There was a transitory increase in the unemployment rate in the late 1990s and early 2000s after the Asian financial crisis and similarly after the recent global financial crisis. The speed of adjustment increased markedly after the slowdown in the late 1990s and increased even faster after the most recent recession in the aftermath of the global financial crisis. Seventh, the main components of the NRU are the job finding rate and the job separation rate (flows in and out of unemployment) indicate that the former is significantly more volatile than the latter. The latter is strongly negatively correlated with GDP over the business cycle frequencies. It increases sharply in recessions, but the magnitudes of the increase vary from one recession to another. Eighth, the Beveridge curve, which describes a negative relationship between the vacancy rate and unemployment, is not sufficient to draw conclusions about the NRU. It requires an additional curve, i.e., the job creation curve (JCC), which summarizes the demand for new jobs by firms. The resulting estimate of the NRU using this method is in line with the initial estimates: between 3.5 and 4.5 percent in December 2012.

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New Zealand Labour Market Dynamics: Pre- and Post-global Financial Crisis

1 Introduction

A persistently high unemployment rate generates discussions and speculations that the increase in unemployment is structural and not cyclical, Diamond (2013). Typically, people do not worry about low unemployment, but that does not make it less structural. Structural unemployment refers to changes in demographics and sectoral shifts, which are persistent, and supply shocks, which are beyond the control of monetary and fiscal policies. Structural unemployment can also refer to changes in the composition of unemployment, i.e., change in the long-term unemployed or the demographic make-up of the unemployed (Lazear and Spletzer,2012). In search theory (Pissarides, 2000) unemployment is frictional, and results from mismatches between jobs and workers. In such models, the labour market is rarely in equilibrium.

Looking closer at the New Zealand data, the *average* percentage of the long-term unemployed (for more than 53 weeks) to the total unemployed over the period from 1986 to 2012 is 3.6 percent. This rate has been falling steadily over the period from 1995 to 2012. In 2008, it hit its lowest value of less than 1 percent. Then it began to rise again in the aftermath of the global financial crisis and the subsequent global slowdown. It was 2.9 percent in 2012. However, the percentage of the unemployed between 27-52 weeks has remained stable with an average of 1.5 percent for the 25 years from 1986 to 2012 and only slightly increased after the global financial crisis.

In New Zealand, unemployment has been declining steadily. Over the sample period 1992-2012, shocks and institutional changes affect the adjustment process by nudging the unemployment rate and its natural rate away from each other. The unemployment rate was in double digits in the early 1990s. The Employment Contracts Act was passed into law in 1991, which constituted a significant institutional change in the labour market. The average unemployment rate fell from 10.6 percent for the period from June 1991 to June 1993 to slightly above 7 percent for the period from September 1993 to September 2000, a three percentage point fall. The Employment Relations Act, Working for Families, and other changes in the labour laws were introduced in the late 2000s; the unemployment rate fell to 4.5 percent from December 2000 to September 2009, i.e., another three percentage point reduction. This steady and slow decline in the unemployment rate has the marks of a structural change in the economy. However, just like after the Asian financial crisis, there has been a transitory increase in the unemployment rate in the aftermath of the global financial crisis and the subsequent economic slowdown. The average unemployment rate from December 2009 to December 2012 was 6.67 percent. This recent fast increase in the unemployment rate is high in comparison with the slow decline observed between 1992 and 2009. Reinhart and Rogoff (2009), and Jorda, Schularick and Taylor (2011) show that jumps in the unemployment rate is a typical cyclical fluctuation, which follow most financial crisis.

The objective of this paper is to analyse the recent increases in the unemployment rate; examine whether these increases are cyclical versus structural, and estimate the speed of adjustment of the unemployment rate to its natural rate (NRU). We consider these issues by estimating the NRU and the speed of adjustment. We use labour market gross flows, Hall (2005) and Yashiv (2007); and a modified the Beveridge curve to estimate the NRU, Daly *et al.* (2012). We provide different estimates of the speed of adjustment. [1]

The dynamic of the labour market, gross flows, and the Beveridge curve in New Zealand have been studied in the past by Chapple *et al.* (1996), Dutu *et al.* (2009), Griffiths (2013), Grimmond (1993), Silverstone and Bell (2011), Silverstone (2001, 2005), Silverstone *et al.* (1995), and Woolf (1989), and Craigie *et al.* (2012) among others. This paper compliments the above literature, but it differs in a few ways. It studies the effect of the recent global financial crisis, provides different methods of estimation, and modifies the Beveridge curve analysis along the lines suggested by *Daly et al.* (2012).

There are eight main findings in this paper. First, the estimated time series of the NRU in New Zealand is significantly lower than the actual unemployment rate over the sample 1992-2012. Over the past two decades, the average NRU is estimated to be 4.6 percent whereas the average unemployment rate is 6.2 percent. So on average, the observed unemployment rate has been mostly higher than our measured NRU. In December 2012, we estimate the NRU to be somewhere between 4 and 4.5 percent while the unemployment rate is still much higher, which is consistent with Sliverstone and Bell (2011) finding. Second, both the unemployment rate and the estimated NRU are persistent. Third, the level of the NRU is affected by *unanticipated* monetary policy shocks and by *unanticipated* fiscal policy shocks. Unanticipated monetary and fiscal policy shocks and total factor productivity (TFP) shocks reduce the NRU. Unanticipated fiscal policy shocks are associated with lower NRU and they have significant effects. TFP shocks have much larger effects on the NRU and they are more significant than policy shocks. Fourth, available proxy measures of labour market institutions such as the minimum wage and union density have no effects in general, but union density seems to be positively associated with the NRU. Fifth, typically the speed of adjustment is a measure between zero and 1. Our estimates are between 0.10 and 0.50. On that scale, the speed of adjustment of the unemployment rate to the NRU take between 2 and 10 quarters to be complete. Sixth, the speed of adjustment increases after major recessions. There was a transitory increase in the unemployment rate in the late 1990s and early 2000s after the Asian financial crisis and similarly after the recent global financial crisis. The speed of adjustment increased markedly after the slowdown in the late 1990s and increased even faster after the most recent recession in the aftermath of the global financial crisis. Seventh, the main components of the NRU are the job finding rate and the job separation rate (flows in and out of unemployment) indicate that the former is significantly more volatile than the latter. The latter is strongly negatively correlated with GDP over the business cycle frequencies. It increases sharply in recessions, but the magnitudes of the

[1] Note that the NRU is a different concept from the Non-Accelerating Inflation Rate of Unemployment (NAIRU). The latter defines equilibrium unemployment as the rate associated with a unique constant inflation rate. This definition is inconsistent with the long-run vertical Phillips curve, which implies no trade-off between inflation and unemployment in the long run (Friedman, 1968) and Phelps (1968). It follows that the natural rate implies that any inflation rate can be consistent with the equilibrium unemployment rate in the long run.

increase vary from one recession to another. Eighth, the Beveridge curve, which describes a negative relationship between the vacancy rate and unemployment, is not sufficient to draw conclusions about the NRU, Daly *at al.* (2012). It requires an additional curve, i.e., the job creation curve (JCC), which summarizes the demand for new jobs by firms. The resulting estimate of the NRU using this method is in line with the initial estimates: between 4.0and 4.5 percent in December 2012.

Next, we discuss the measurement of the NRU. In section 3 we derive an estimable equation for the speed of adjustment. Section 4 includes the estimation and analysis of the data. Section 5 modifies the Beveridge curve framework to estimate a third approximate measure of the NRU for New Zealand. Section 6 is a conclusion.

2 Estimating the Natural Rate of Unemployment

There are many different ways to estimate the natural rate of unemployment. We follow Yashiv (2007) and compute the natural rate of unemployment from the labour market gross flows data. Let the unemployment rate be u_t and the natural rate of unemployment u_t^*. Let U be the pool of unemployed workers; N be the pool of non-employed workers – the out of labour force, and E be the pool of employed workers. There is a flow from $N \Rightarrow E$ and $E \Rightarrow N$. Let these flows be M^{UE}, which is hiring flows into employment from unemployment, and M^{NU} be hiring flows from outside the labour force into employment. Let S^{EU} and S^{NU} be the separations rates corresponding to the hiring rates above. The unemployment dynamics are given by the following:

$$U_{t+1} = U_t(1 - P_t^{UE}) + d_t^{EU} E_t + F_t^{NU} - F_t^{UN}, \qquad (1)$$

where P_t^{UE} is the job finding rate, i.e., flows from $U \Rightarrow E$, $P^{UE} = M^{UE}/U$; d_t^{EU} is the separation rate from employment, which is S^{EU}/E and $F_t^{NU} - F_t^{UN}$ is the *net* inflow of workers from out-of-labour force $N \Rightarrow$ U.

Unemployment grows at a constant rate equal to the rate of growth of the labour force L in the steady state, say g^L and the unemployment rate is constant u^* (lowercase), then:

$$u_1^* = \frac{\dfrac{F^{NU} - F^{UN}}{L} + d^{EU}}{P^{UE} + g^L + d^{EU}} \qquad (2)$$

And, $L = U + E$ (3)

When the L is not growing (or immigration growth is constant) we get

$$\frac{F^{NU} - F^{UN}}{L} = g^{L} = 0 \text{, thus (6) reduces to:}$$

$$u_2^* = \frac{d^{EU}}{P^{UE} + d^{EU}} \tag{4}$$

Figure 1 plots the seasonally adjusted unemployment rate; the two estimates u_1^* and u_2^* along with an estimate derived from the Band-Pass filter (Christiano and Fitzgerlad, 2003) for comparison. Table 1 reports the descriptive statistics. The averages of the NRU estimates u_1^* and u_2^* are remarkably lower than that of the actual unemployment rate and they are equally volatile. The average unemployment rate over the past two decades is 6.2 percent whereas the gross flows suggest that the average NRU is approximately 4.6 percent.

Figure 1 also shows that there is a large and a persistent gap between the actual unemployment rate and the NRU. This is consistent with labour market models with search friction (Pissarides, 2000). In such models, the matching of jobs with work seekers is not always successful. Thus, unlike the neoclassical model in which wages clear up the market, the labour market does not clear period-by-period in search models. Some job openings remain unfilled and job seekers remain unemployed. Given these estimates of the NRU and the gap with observed unemployment, we expect the speed of adjustment in the New Zealand labour market to be low.

Our estimates of the NRU are sensible because the job finding rate P^{UE} and the separation rate from employment d^{EU}, which are the main components of our estimate of the NRU, are within the range of OECD estimates (Hobijn and Sahin, 2007). Their samples vary across countries, but the average job finding rate across countries in the sample is about 13 percent. The U.S. has the highest job finding rate of 56.30, Australia has 17.05, and New Zealand is 21.71 over the period 1986 to 2004. Our estimate for New Zealand over the sample from September 1990 to December 2012, is 20.17 percent. However, that job finding rate is relatively volatile with a standard deviation of 3.56. The OECD average estimate for the separation rate is 1.3. New Zealand was not included in their sample. Our estimate for New Zealand over the same sample is 1.0 with volatility one tenth of the job finding rate. Again, New Zealand separation rate is lower than the average rate of the OECD.

3 The speed of adjustment of the labour market

Assumes that the firm minimizes the expected present value of a loss function like:[2]

$$L = E_t \sum_{j=0}^{\infty} \delta^j \left[\frac{1}{2} (u_{t+j} - u^*_{t+j})^2 + \frac{\theta}{2} \Delta u^2_{t+j} \right] , \qquad (5)$$

where δ^j is the discount factor. A loss arises when the employment level is different from the profit-maximizing level of employment and the cost of adjusting employment is measured by θ.

The Euler equation is:

$$\delta u_{t+1} - (1 + \delta + \theta^{-1}) u_t + u_{t-1} = -\frac{u^*_t}{\theta} \qquad (6)$$

Solving the Euler equation gives the optimal policy:

$$\Delta u_t = (1 - \mu)(\bar{u}_t - u_{t-1}) , \qquad (7)$$

where μ is the stable root and $\bar{u}$ is $(1 - \delta\, \mu) E_t \left[\sum_{j=0}^{\infty} (\delta \mu)^j\, u^*_{t+j} \right]$.

The following equation is an estimable stochastic equation for the speed of adjustment:

$$\Delta u_t = \gamma (u^*_t - u_{t-1}) + \xi_t , \qquad 0 < \lambda < 1 \qquad (8)$$

To estimate the single equation (8) we use our previously estimated measures of u^*_t.

We also estimate the speed of adjustment in a system of two equations. The idea is that the NRU is endogenous and can be affected by a number of shocks, which we must control for. There is an argument about the effects of institutions and shocks on the NRU. Nickell *et al.* (2005) argue that differences in unemployment across OECD countries can be explained by differences in labour market institutions. Phelps (1994), Oswald (1997), and Pissarides (2000), for example, argue that shocks to global capital or product markets drive the natural rate.

2 Nickell (1985).

The first equation in the system is the same equation (8) – in levels; and a second equation is for the NRU as a function of its past values and a vector of shocks and variables representing labour market institutions. The system is given by:

$$u_t = \gamma u_t^* + (1-\gamma)u_{t-1} + \varepsilon_{1t} \tag{9}$$

$$u_t^* + \alpha u_{t-1}^* + \beta \mathrm{A}_t + \varepsilon_{2t}, \tag{10}$$

where A includes TFP, unanticipated monetary and fiscal policy shocks and two measures of labour market institutions: the growth rates of the minimum wage to average wage ratio and the union density. Only unanticipated shocks have *real* effects. It is a standard assumption that anticipated monetary policy shocks have no effect on real variables, but unanticipated shocks do, see for example Barro and Gordon (1983). The assumption is that, in equilibrium, people form expectations and the policymaker optimizes in each period subject to the way that people form expectations. Still, measuring monetary policy shocks is highly controversial in the literature, see for example, Bernanke and Mihov (1998), Cochrane (1998), Baglino and Favero (1998), Rudebusch (1998), Christiano et al. (1999), and Bernanke et al. (2005). In this paper we assume that the Reserve Bank of New Zealand (RBNZ) sets policy each period as if it is using the Taylor rule (Taylor, 1993).[3] This is a form of flexible inflation targeting, in which the central bank reacts to both inflation's deviation from the target and to the output gap.

Let the Taylor rule be:[4]

$$i_t = \rho[\bar{r} + \pi_t + \lambda_1(\pi_t - \bar{\pi}) + \lambda_2 \tilde{y}_t] + (1-\rho)i_{t-1} + \zeta_t, \tag{11}$$

where i_t is the nominal 90-day interest rate; $\bar{r}$ is a constant denotes the natural real rate of interest; π_t is quarterly inflation rate; $\bar{\pi}$ is the inflation target set equal to 1.5 (midpoint of the 1-3 percent target); and $\tilde{y}_t$ is a measure of the output gap measured by the HP filter. The coefficient ρ measures the serial correlations in interest rate.[5] The equation is

[3] Plantier and Scrimgeour (2002) provide estimates of the Taylor rule for New Zealand. A recent updated estimate of the Taylor rule by the Reserve Bank of New Zealand is found in Kendall and Ng (August 2013). I became aware of it after this paper was writes. They estimated the response to inflation's deviation from the target over the period 1992q1 -2012q4 to be 0.5, i.e., 1.5 in total and the response to the output gap to be also 0.5. Their results seem to suggest that the RBNZ has been following the Taylor rule rather precisely over that sample. Taylor has repeatedly criticized the fed for not adhering to first principles and adhering to simple rules in the past decade, see for example Taylor (2012).

[4] See Taylor (1993), and for New Zealand estimates Plantier and Scrimgeour (2002).

[5] There are some arguments about whether the central bank actually observes inflation at the current period or whether lagged inflation should be used, or inflation's forecast. We will assume that current inflation is largely observed by the central bank to avoid measuring expected inflation. There are more arguments about the measurement of the output gap. We use the HP filter. Finally, there is also an argument about interpreting the coefficient of the lagged interest rate. It has been suggested that the central banks pursue interest rate smoothing, see Drew and Plantier (2000), but we will adhere to the econometrics of estimating this equation and assume it is rather important to have a lagged dependent variable to soak up the serial correlation, see Rudebusch (2002).

estimated using Least Squares with a Newey-West variance-covariance matrix for the standard errors. The unanticipated monetary policy shocks are the residuals ζ_t.[6]

The second unanticipated aggregate demand shock is a fiscal policy shock, namely, nominal government expenditures shock. Measurement of this shock is equally controversial.[7] In the absence of any model, we regress the growth rate of nominal government expenditures on a constant and a number of lags. Testing for the significance of the lags leaves four lags only. The unanticipated shocks are the residuals from this regression.

We also include the log of TFP. The TFP is computed using a constant return to scale Cobb-Douglas production technology $y_t = TFP_t k_t^{a_1} L_t^{a_2}$, where y_t is real GDP; K_t is the stock of capital; L_t is working age population (15-64); a_1 and a_2 are the shares of capital and labour. These shares are approximately 0.40 and 0.60, respectively, and they are estimated averages from the National Income Account by the ratio of gross operating surplus to GDP. The stock of capital is computed using the Perpetual Inventory Method with the initial quarterly stock of capital is assumed to be three times as large as real quarterly GDP, and the depreciation rate 8 percent.[8]

Finally, we will examine the hypothesis that both institutions and shocks might influence the speed of adjustment. Phelps (1994) and Blanchard and Wolfers (2000) argue that shocks drive the natural rate of unemployment, but the speed of adjustment in the labour market is affected by labour market institutions. Smith and Zoega (2007) tested OECD data and found that institutions have no effect on the equilibrium level of unemployment. They found that institutions affect the transmission of global influences that determine the equilibrium level.

To test this we make γ a function of the labour market institutions. This is particularly difficult in the New Zealand context for two reasons. First, the measurement of labour market institutions is difficult, especially when using quarterly data. There are no quarterly data to measure institutions. Second, we do not expect labour market institutions to change our estimates significantly because our sample of two decades is relatively a short period of time. Measurements notwithstanding, we will use data published by OECD on the minimum wage and the union density as measures of New Zealand's labour market institutions.

We will estimate a state-space system where the speed of adjustment is a state variable, affected by the shocks above and the two labour market institution measures mentioned above. The OCED data for the minimum wage / average wage ratio are annual and available from March 1992 to December 2011. Union density is only available from 1999

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6 My own research on estimating the Taylor rule suggests that the equation is very sensitive to the method of estimation. GMM estimates for example, are different and they are highly sensitive to the choice of the instruments. See Razzak (2003).

7 For example, see Lucas (1973), Barro (1977) and (1978), and Barro and Rush 1980.

8 It goes without saying that such a method is prone to measurement problems stemming from the assumptions used in the construction of the data. That said, however, it is a widely used method and is probably better than using expenditures data.

to 2011.[9] We use the Quadratic Match Average method to have quarterly data. We use the growth rates in the regressions. The sample, however, will be shorter. Unfortunately, having both the speed of adjustment and the natural rate of unemployment as state variables in a state-space system is not straightforward. All the shocks above, except for TFP, are I(0) – stationary – by construction. But we will test and show that TFP, u_t and u_t^* are cointegrated so the regressions are balanced in terms of the number of unit roots.

4 Estimation

The time series properties of the data

We present a number of regressions. We estimate the single equation (8) and the system of equation (9) and (10). Then we estimate a state-space system with the speed of adjustment as a state variable, and examine the effects of various shocks and labour market institutions on it. Finally, we estimate the effects of the shocks and labour market institutions on the job finding rate and the job separation rate.

Before we estimate anything, we examine the time series properties of the data. The variables u_t, u_1^* and u_2^* have slowly decaying autocorrelation functions. Figures 2, 3, and 4 plot the autocorrelation functions. Shocks to unemployment and the NRU die off only slowly, more so for the unemployment rate than the NRU. This persistence is confirmed by formal tests for unit root. The three variables are individually tested for the presence of a unit root using a battery of common test statistics with different specifications (with or without linear trend) and lag structures tested using a variety of information criteria. The tests could not reject the null hypothesis of a unit root. Although all common tests for unit root suffer from small sample problems and low powers against stationary alternatives, the results are consistent with the literature where the unemployment rate is usually found to be persistent. These statistics suggest that the slow declining unemployment rate and the NRU over the sample are more likely to be driven by institutional changes in the labour market and in the rest of the economy.

Similarly, we used a variety of commonly used tests for cointegration. We test the unemployment rate, NRU and TFP in levels. We reject the hypothesis that there is no cointegration. This result is consistent with both micro and micro theory, whereby these variables are highly linked,(Blanchard and Katz,1999). Thus, we can estimate the speed of adjustment using a single equation model and the systems of equations described earlier in levels.

Stability of the parameters

We also test for the stability of the estimated parameters. The instability might occur because of the change in institutions. The Employment Contracts Act was passed in 1991, before the beginning of our sample, but the Employment Relations Act was introduced in 2000. And, there are other institutional changes such as Working for Families which was introduced in 2005 and the 90-day trial period for employment in

[9] May *et al.* (2003) has a longer series, which begins from 1991. We do not access to these data.

2009. We test for stability of the parameters using the Chow test and the likelihood ratio test.

Identification

For the system of equations, we also check whether the system is identifiable. The system of equation (9) and (10) satisfies the order condition, which is a necessary but not sufficient and the rank condition, which is a sufficient condition for identification. The system is over-identified.

Single equation estimate of the speed of adjustment

Table 2 reports two single-equation estimates of the speed of adjustment. Each equation has a different measure of the NRU, u_{1t}^* and u_{2t}^*, which are defined in equations (2) and (4). The results show that the speeds of adjustments are 0.09 and 0.1, respectively. The estimates are low. The parameters are stable as indicated by the tests for stability reported in table 2. Low speed of adjustment is defensible if the labour market is largely described by a search and matching type model and the stylized fact that we use estimates for the NRU, which are significantly far removed from observed unemployment.

System of equation estimates

Table 3 reports the estimates of the speed of adjustment using the system of equations above. The table has seven columns. The first column reports the coefficients. The next six columns are divided into two blocks, one for using u_{1t}^* as a measure of the NRU and the other is for u_{2t}^*. For each we report three regressions. The first column of the first block includes the shocks only. The second includes the shocks plus the minimum wage / average wage growth rate as a measure of institutions, and the third, includes the shocks, the minimum wage / average wage and the union density as another measure of institutions. The samples are different because the labour market institution variables are shorter than the rest of the data. The same is for the second block.

The estimated speed of adjustment is still treated as a constant parameter. The estimates are nearly identical to those reported from the single-equation estimate. The unanticipated monetary and fiscal policy shocks are significant, but the latter is more so than the former. Unanticipated expansionary fiscal policy reduces the NRU. And TFP shocks have negative significant level effects (semi-elasticity) on the NRU in the long run. The increase in TFP reduces the NRU significantly. The minimum wage / average wage growth rate is insignificant in all regressions, but the growth rate of the density function increases the NRU.

State-space

In addition to the stability tests we reported in table 2 earlier, we estimate the speed of adjustment as a state variable in a state-space form. We allow the speed of adjustment to be a state variable and a function of the shocks defined and the labour institution variables defined earlier.

$$u_t = \gamma_t u_t^* + \lambda u_{t-1} + \eta_t \quad (12)$$

$$\gamma_t = \gamma_{t-1} + \theta \mathrm{A}_t + \mu_t \quad (13)$$

$$\eta_t = \eta_{t-1} + v_t \quad (14)$$

Table 4 reports the estimated coefficients and figure 5 plots the smoothed time-varying estimate of the speed of adjustment. We report four estimates in table 4, which has two blocks: one is when the variances of the state variables are estimated from the data. The other is where we imposed small variances to smooth the data. Under each block we have two columns. One column without the labour institution variables and the other with them included because the labour market institution variables are shorter samples. The filtered estimates are less than 0.10, which are very consistent with our previous estimates.

The smoothed estimates are interesting. First, they are higher than our previous point estimates; the final estimates are 0.44 and 0.50. Second, the speed of adjustment has been increasing over time. Third, unanticipated monetary policy shocks have negative effects on the speed of adjustment. These shocks reduce the NRU. Since the NRU is below the unemployment rate in New Zealand, these shocks increase the gap between the observed unemployment rate and the NRU, hence a slower speed of adjustment. Neither unanticipated fiscal policy shocks nor TFP shocks have any effect on the speed of adjustment. Fourth, the speed of adjustment increases after recessions. It increased after the Asian crisis in 1998 and increased even faster after the recent global financial crisis. This finding seems consistent with Schumpeter (1934). The idea is that adjustments speed-up after recessions (depressions). The fact that the Schumpeterian creative-destructive forces show up in faster adjustments is present in the data. Carroll *et al.* (2002) and Mills and Timmins (2004) provide empirical evidence of a rapid creation-destruction force in the New Zealand labour market. Also see McMillan (2004). Finally, none of the labour market institution variables is significant. The most plausible explanation for the lack of correlation is that the measures of institutions do not vary significantly over the sample, while unemployment does, thus the correlation is small.

Figure 5 plots the smoothed estimates of the speed of adjustment as a state variable for the regressions which do not include the labour market institution variables. The top panel corresponds to the first estimate of the system where the variances of the state variables are estimated from the data. The bottom panel is a smoother estimate in which we imposed arbitrary values for the variances to be 0.001 and 0.07, respectively.

To summarise, the estimates of the speed of adjustment varies across different methods of estimations and assumptions. The fixed-point estimate, where the estimator is a single equation or a system of equations, is very small, 0.10 (the speed of adjustment lies between zero and one). The state-space system estimate is larger in magnitude. The standard errors around the estimate are between 0.10 and 0.50. These estimates are plausible because the speed of adjustment varies with the business cycle. They increase after recessions and the financial crisis, and decline during expansions.

Job finding and job separation rates

Before we turn our attention to the Beveridge curve we examine the relationships between the components of the NRU, namely the job finding rate and the job separation rate, see equation (4).

The data are plotted in figures 6 to 15. Figure 16 plots the cyclical fluctuations (Band-Pass asymmetric filter, Christaino and Fitzgerald, 2003) of the job finding and the job separation rates. The former is pro-cyclical whereas the latter is strongly negatively correlated with the business cycle. The amplitudes of the cyclical fluctuations of the job separation rate are relatively higher than those of the job finding rate; even though the job finding rate is more volatile as shown earlier. Although the job separation rate increased sharply during the 1998 recession in the aftermath of the Asian financial crisis, it increased relatively less in the 2000-2001 recession and sharply after the most recent recession in 2010. The amplitude of the cycle in the recent recession is lower than the one after the Asian financial crisis. The job finding rate, however, is pro-cyclical with smaller amplitudes than the job separation rate.

The evidence from the U.S. data are controversial. The prevailing orthodoxy is that unemployment increases sharply during recessions and the job separation rate drives that process, Blanchard and Diamond (1990). This has been challenged by Hall (2005) and Shimer (2007), who argued that the job finding rate over the business cycle is highly volatile whereas the job separation rate is less volatile or acyclical. Yashiv (2007), Fujita and Ramey (2009), and Elsby *et al.* (2009) provide evidence that the job separation rate is the driver of high unemployment. These plots seem consistent with the Blanchard-Diamond (1990) view of the U.S. data that recessions are periods of sharp rise in unemployment. And they are also consistent with most recent findings that the job finding rate is pro-cyclical, see Hall (2005) and Shimer (2007), however, the job separation rate is not acyclical in New Zealand.

Canova *et al.* (2013) argue, correctly, that the evidence above is based on unconditional correlation analysis, which makes the interpretation difficult. The response of the unemployment rate depends on the source of the shock.

We examine the effects of the following shocks: the level of TFP, the two proxies for unanticipated demand shocks, the monetary policy shocks, and the fiscal policy shocks, as well as the two measures of the labour market institution, i.e., the growth rate of the minimum wage/average wage ratio and the growth rate of the union density.

Table 5 and table 6 report regression results. Monetary and fiscal policy shocks do not affect the job finding rate. However, these shocks have significant effects on the job separation rate. In other words, policy shocks contribute more to job separation than job finding. Unanticipated expansionary policy shocks are aggregate demand shocks and they seem to reduce the job separation rate. This *asymmetry* is rather interesting even though it is only marginally significant, which should be tested further in future research. The question is why aggregate demand policies seem to be associated with job separation more than job finding. In both the job finding and job separation rate regressions, TFP shocks have very sizable coefficients that are statistically significant.

TFP reduces the job separation rate by more than increasing the job finding rate. Institutions are found to be statistically insignificant, hence not reported.[10]

5 The Beveridge curve and the NRU

Brauer (2007) views the NRU as the *average* rate of unemployment that would prevail in the absence of business cycle fluctuations. It represents frictional or structural unemployment. Frictional unemployment reflects the time spent by the unemployed to search for a job whereas structural unemployment reflects mismatches between labour demand and the skills and geographical location of the unemployed.

The empirical relationship between vacancies (on the vertical axis) and unemployment rate (the horizontal axis) is the Beveridg curve (BC). Empirical analysis of New Zealand BC is in, for example, Craigie at al. (2012), Razzak (2009), and Silverstone (2006). The position of the BC may indicate the state of the economy over the business cycle. For example, the unemployment rate increases and vacancies decline during recessions. The curve shifts and changes in the slope occur often, which complicate the picture. The further away the shift of the BC from the origin the less efficient the matching processes is because a certain level of vacancy would be associated with a high level of unemployment. Inefficient labour markets are believed to indicate mismatches between the unemployed workers and the available jobs. In addition to mismatches, factors that may shift the BC curve may include skill mismatches, changes in the labour force participation rate, the unemployment duration, and policy changes.

Recent advances in this literature modify the theory of the BC. Daly *et al.* (2012) study that the BC. They provide a model, which essentially shows that the BC by itself does not determine an equilibrium combination of vacancies and unemployment. What is needed is another curve intersecting the BC in the same space. This curve is the job creation curve (JCC), which is determined by firms' recruiting behaviours. Firms hire workers to produce output. They create vacancies up to a point where the expected value of a job match equals the expected search cost to fill the vacancy. The expected value of a job match is equal to the marginal product of labour. The expected search cost is a combination of the firm's direct recruiting cost and the probability that a job is filled.

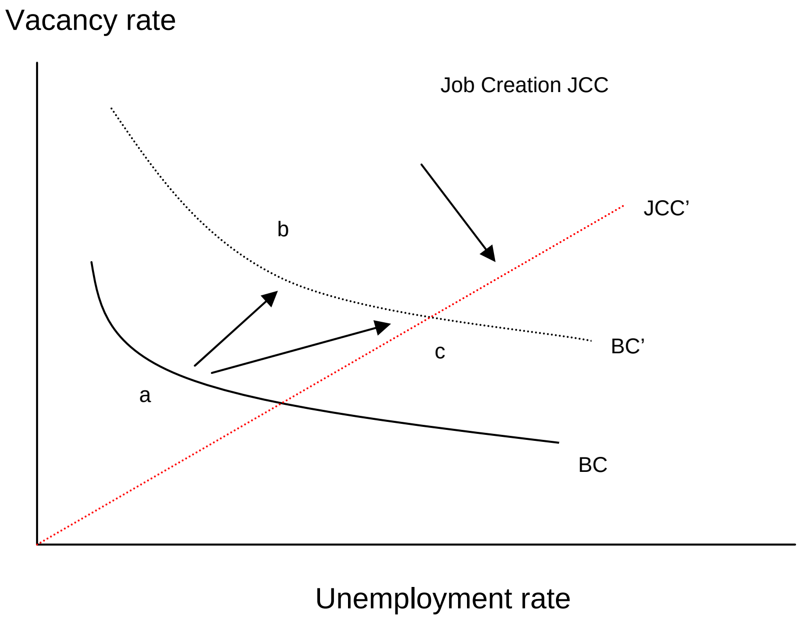
The probability of filling a job increases with the unemployment rate. That implies that the JCC is *upward* sloping, which implies that firms create more job vacancies when unemployment is higher (we showed earlier that the speed of adjustment increased during recessions in New Zealand, especially after the most recent recession).

The slope of the JCC depends on a number of variables, such as the job separation rate, the level of recruiting costs, and the value of jobs, which is reflected in labour productivity and the value of output. In general, the slope depends on the structure of the product and labour markets in which firms operate and the wage bargaining process. It may also depend on the interest rate. Factors that shift the JCC include changes in the expected

[10] We experimented with the lags of the shocks. We added up to four lags (arbitrarily). None of the lags is found to be significant, except for the third lag of the unanticipated monetary shocks in the job finding equation. We also tried the U.S. output gap as a measure of global demand shocks, and the variance of the U.S. output gap as a proxy for uncertainty in the global economy. None is found to be significant. The statistical results are not reported.

value of jobs that are associated with changes in the marginal product of labour. In recession, the aggregate demand falls; this reduces the marginal product of labour, and in turn reduces the value of creating jobs. This causes the JCC to rotate down (to the right) resulting in a higher unemployment rate *with no shifts* in the BC. Thus, the measured unemployment rate increases without a change in the NRU. Another example for shifts in the JCC is when the firm search costs change. For example, if the probability of filling a vacancy falls because of rising mismatch, the JCC rotates down.

To summarise, the equilibrium unemployment rate is determined jointly by the intersection of the BC and the JCC as in the following sketchy. Studying the BC alone is not sufficient to draw conclusions about the NRU.



Consider a shift in the BC from BC to BC' (upward shift). For a given JCC, this shifts the equilibrium from point (a) to point (b). The equilibrium unemployment rate increases by less than the outward shift in the curve because the JCC is positively slopped. And the extent of the change in the equilibrium unemployment rate depends on the steepness of the JCC (its slope). For the equilibrium unemployment rate to change by the same amount of the outward shift in the BC, the slope of the JCC must be flat, or must shift outward or downward as well, as in the movement from point (a) to (c). The insight is that the shift in the BC and by how much is insufficient to explain what causes the unemployment rate to change. Information about the job creation rate is needed, i.e., the demand of labour by the firm. Also, to distinguish what part of the increase in the unemployment reflects purely cyclical fluctuations in labour demand, and what parts are related to other transitory and permanent factors that cause a rise in the NRU, we have to understand what causes the shifts of the BC and JCC and the permanency of these shifts.

Figure 17 plots the BC for New Zealand using the vacancy rate and the observed unemployment rate. Our vacancy rate data are derived from the ratio of job advertisements (ads) to the labour force. There are two data series for job ads, which vary in quality and have some sharp movements. The newspapers ad series is the longest. It is a monthly series from the 1990s. The other series is the Internet ads series, which is shorter from 2004 onwards. We use newspaper job ads data.

The BC shifts. Typically, a shift away from the origin implies less matching efficiency; however, Daly *et al.* (2012) argue that such a shift is hard to interpret for three reasons. First, the BC not only shifts but also tilts so that a horizontal shift is not uniform across all levels of the vacancy rate. Second, estimating real-time movements in the BC is difficult because the size of the implied shift depends heavily on the specific month or quarter chosen. These shifts vary, and recently observed points are near a very flat segment of the BC, which combines large changes in the unemployment rate with small changes in vacancy rates. Third, figure 18 shows that following a labour market shock, the movement of the unemployment-vacancy rate follows a counter-clockwise adjustment pattern. This pattern occurs because firms can adjust their targeted hiring rapidly when the labour market conditions improve, but the matching process that will effectively reduce unemployment lags behind the increase in labour demand, as shown by Blancahrd and Diamond (1989).

Daly *et al.* (2012) explain that the unemployment-vacancy combinations observed in the aftermath of a recession may represent the labour market adjustment process back to a stable BC rather than an outward shift in the BC. It is important to note that changes in the estimates of NRU during the period 2009 and 2012, which we plotted in figure 1, are much smaller in magnitude than the shifts in the BC plotted in figure 17.

Daly *et al.* (2012) provide a rudimentary estimate of the JCC and plot that against the observed BC to accurately assess the change in the NRU for the United States. They estimate a long-run JCC by regressing the vacancy rate on a constant term and the NRU. The latter is taken from the Congressional Budget Office. We do the same for New Zealand. Only estimates of the JCC from March 2004 to December 2012 using the vacancy rate v_t ,which is based on the newspapers ads only and our measure of the NRU, u_2^* , produce an upward slopping JCC. The estimated curve looks like this:

v_t	= 0.096+	0.032 u_t^*
	(0.3697)	(0.1196)
R^2	0.27	

The equation is estimated by OLS. Consistent standard errors are estimated using the Newey-West method. *P* values are in parentheses. The intercept is insignificant. The slope coefficient is only marginally significant. These estimates are obviously crude, but they are the only estimates for New Zealand. Figure 19 superimposes the estimated JCC curve above on the BC (the vacancy-unemployment space) for the period 2004 to 2012 (the JCC passes through the origin since the intercept in the regression above is statistically indifferent from zero).[11]

Each point represents the cyclical movements along a given BC. In other words, each point represents the cyclical fluctuations in labour demand for a given natural rate of unemployment. The solid upward line is the estimated relationship between the average level of vacancies and our estimate of the NRU, which is reported in the regression above. So, we can read the value of the NRU on the x-axis from a point where the BC and the JCC intersect, which is only in December 2008. At this point, the NRU is 3.56 percent, which is even smaller than the average values reported in table 1, and the vacancy rate is

[11] The BC (the vacancy-unemployment rate) has an intercept 2.5 and a negative slope -0.34. Both are significant at the 95 percent level.

0.48 percent. The NRU in December 2012 is somewhere between 4 and 4.5 percent, which is not far from our previous average estimate of 4.6. However, the average unemployment rate is 6.2 percent indicating that the labour market is still far away from its natural rate.

6 Conclusion

The stochastic process that has been driving the unemployment rate in New Zealand is best described by a persistent decline, which is a result of a product of structural and institutional reforms since the mid-1980s. While these forces have been working to lower the unemployment rate, various shocks nudged the process along the way and might have caused a few episodes of transitory, sometimes sharp, increases in unemployment, which might have delayed adjustments. The underlying natural rate of unemployment behaves similarly, yet it is estimated to be significantly lower than the unemployment rate. Our average estimate over the past two decades is about 4.5 percent compared with the unemployment rate's average, which is 6.2 percent.

The natural rate and its main components, the job finding rate and the job separation rate, are significantly affected by total factor productivity shocks but not by labour market institutions. TFP shocks lower the natural rate of unemployment by reducing the job separation rate by more than increasing the job finding rate over the business cycle. Unanticipated monetary and fiscal policy shocks also affect the job finding and separation rate in the same way.

We may accept the stylized fact that the labour market adjustment has been incomplete over the past two decades, which is consistent with search theory (Pissarides, 2000). Our estimated speed of adjustment is a low of 0.10. The smoothed state-space estimate of the speed of adjustment noticeably increases after recessions. It increased during the recession in the aftermath of the Asian financial crisis, and increased by much more during the recent recession in the aftermath of the global financial crisis. These stylized facts are consistent with the Schumpeterian creative-destructive theory, and with New Zealand empirical evidence reported in Carroll *et al.* (2002), Mills and Timmins (2004), and McMillan (2004).

Unanticipated monetary shocks reduce the speed of adjustment because they reduce the job separation rate over the cycle, which reduces the natural rate and increases the gap between the natural rate and unemployment rate. The fact that labour market institutions do not affect the speed of adjustment seems in consistent with Blancahrd and Wolfers (2000) and Phelps (1994), who argue that the speed of adjustment in the labour market is a function of institutions rather than shocks, but maybe because the data we have are badly measured, or maybe because they do not change significantly over the sample, thus the correlation with the speed of adjustment is weak.

The two variables that represent the labour market institutions, i.e., the minimum wage / average wage ration and the union density, are not well measured (we converted annual data to quarterly data) and that they are shorter than the rest of the variables. We found no significant effects from these variables on the speed of adjustment. However, the latter is positively associated with the natural rate of unemployment.

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Tables

Table 1

Descriptive Statistics of Different Measures of the Natural Rate of Unemployment u_t^*, March 1992 –December 2012

	Mean (percent)	Standard Deviation
Unemployment Rate	6.21	1.87
(i) Structural Measure u_1^*	4.60	1.75
(ii) Structural Measure u_2^*	4.67	1.75

(i) This is measured in equation (2).

(ii) This is measure in Equation (4).

Table 2

Least Squares Single Equation Estimates of the Speed of Adjustment
(March 1992 –December 2004)

$$u_t = \gamma u_t^* + (1-\gamma) u_{t-1}^* + \varepsilon_t$$

Coefficient γ	Estimate	P value	Estimate	P value
u_{1t}^*	0.099	(0.0000)	-	-
u_{2t}^*	-	-	0.10	0.0000
$\overline{R}^2$	0.97		0.97	
Chow test	0.18	(0.9473)	0.20	(0.9344)
Log Likelihood Ratio	0.77	(0.9425)	0.87	(0.9285)

u_{1t}^* is measured in equation (2).

u_{2t}^* is measured in equation (4).

We use HAC standard errors and co-variance (Bartlett kernel – Newey-West fixed bandwidth 4.

Chow is a test of the null hypothesis that there are no break points in 2000q1-2000q4. (Employment Relations Act). Test distributed $F_{4,78}$; for breaks in 2005q1-2005q4 (working for families); and for breaks in 2009q1-2009q4 (the 90-day trial period for employment).

Table 3

Estimating Speed of Adjustment in a System of Equation

$$u_t = \gamma u_t^* + (1-\gamma)u_{t-1} + \varepsilon_{1t}$$

$$u_t^* = \alpha u_{t-1}^* + \beta A_t + \varepsilon_{2t}$$

	u_{1t}^*			u_{2t}^*		
	Mar92-dec12	Mar92-Dec11	Mar99-Dec11	Mar92-dec12	Mar92-Dec11	Mar99-Dec11
γ	0.098	0.098	0.098	0.10	0.10	0.10
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$\bar{R}^2$	0.97	0.97	0.97	0.97	0.97	0.97
σ	0.29	0.29	0.29	0.29	0.29	0.29
α	0.72	0.70	0.61	0.73	0.71	0.61
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
A						
$UMPS_t$	-0.21	-0.23	-0.43	-0.24	-0.26	-0.43
	(0.1824)	(0.1780)	(0.0702)	(0.1338)	(0.1156)	(0.0699)
$UFPS_t$	-0.09	-0.08	-0.10	-0.09	-0.09	-0.10
	(0.0139)	(0.0175)	(0.0277)	(0.0080)	(0.0091)	(0.0173)
$\ln TFP_t$	-0.38	-0.41	-0.48	-0.38	-0.41	-0.49
	(0.0003)	(0.0004)	(0.0009)	(0.0003)	(0.0003)	(0.0007)
$\Delta \ln(w/\overline{W})_t$	-	-0.08	-0.03	-	-0.09	-0.05
		(0.4265)	(0.8404)		(0.3962)	(0.7876)
$\Delta \ln UD_t$	-	-	0.24	-	-	0.24
			(0.0449)			(0.0512)
$\bar{R}^2$	0.66	0.65	0.60	0.67	0.67	0.61
σ	0.84	0.85	0.74	0.82	0.83	0.73

- u_t^*'s are as defined in equation (2) and (4). P values are in parentheses.

- A includes: $UMPS$ are unanticipated monetary policy shocks are the residuals from the Taylor rule; $UFPS$ are unanticipated fiscal policy shocks are the residuals from an AR(4) of the growth rate of nominal government expenditures; TFP shocks are total factor productivity shocks measured by the residuals of a constant return to scale Cobb-Douglas production function; $w/\overline{W}$ is the ratio of minimum wage to average wage; and UD is union density.

Table 4

The Maximum Likelihood Estimates of the State-Space System

$$u_t = \gamma_t u_t^* + \lambda u_{t-1} + \eta_t$$

$$\gamma_t = \gamma_{t-1} + \theta \mathrm{A}_t + \mu_t$$

$$\eta_t = \eta_{t-1} + \nu_t$$

	Variances of state variables estimated		Variances of state variables imposed	
	Mar92-Dec12		Mar2000-Dec11	
λ	0.43	0.17	0.27	0.06
	(0.0000)	(0.0658)	(0.0057)	(0.7245)
γ - final estimate	0.51	0.48	0.45	0.44
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
θ				
$UMPS_t$	-0.03	-0.05	-0.02	-0.05
	(0.0045)	(0.0205)	(0.0352)	(0.2547)
$UFPS_t$	-0.04	-0.56	-0.08	-0.68
	(0.8925)	(0.1429)	(0.8142)	(0.3406)
$\ln TFP_t$	-0.0001	0.0006	-0.0003	-0.0000
	(0.9444)	(0.8875)	(0.8502)	(0.8991)
$\Delta \ln(w/\overline{W})_t$	-	0.29	-	-0.25
		(0.8806)		(0.9346)
$\Delta \ln UD_t$	-	0.48	-	0.73
		(0.6899)		(0.7781)
η_t - final estimate	1.66	3.23	3.02	4.16
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Log Likelihood	-12.01	-4.55	-17.61	-12.98
Akaike criterion	0.46	0.52	0.55	0.79
Schwartz criterion	0.64	0.83	0.67	1.02
Hannan-Quinn criterion	0.53	0.64	0.60	0.87

- u_t^*'s are as defined in equation (4).- A includes: $UMPS$ are unanticipated monetary policy shocks are the residuals from the Taylor rule; $UFPS$ are unanticipated fiscal policy shocks are the residuals from an AR(4) of the growth rate of nominal government expenditures; TFP shocks are total factor productivity shocks measured by the residuals of a constant return to scale Cobb-Douglas production function; $w/\overline{W}$ is the ratio of minimum wage to average wage; and UD is union density. The latter two measures of labour market institutions are insignificant, hence they are not reported.

Table 5

The Job Finding Rate and Shocks

Dependent Variable jfr_t

Sample Dec 1993 – September 2012

	Coefficient	P value
Constant	4.10	0.0056
jfr_{t-1}	0.57	0.0000
$UFPS_t$	0.85	0.2078
$UMPS_t$	0.01	0.4687
$\ln TFP_t$	0.92	0.0236
$\bar{R}^2$	0.49	
σ	0.11	

HAC standard errors and co-variance (Bartlett kernel – Newey-West fixed bandwidth 4.

Table 6

The Job Separation Rate and Shocks

Dependent Variable jsr_t

Sample Dec 1993 – September 2012

	Coefficient	P value
Constant	-4.27	0.0003
jsr_{t-1}	0.60	0.0000
$UFPS_t$	-1.43	0.0616
$UMPS_t$	-0.05	0.0181
$\ln TFP_t$	-1.37	0.0003
$\bar{R}^2$	0.73	
σ	0.11	

HAC standard errors and co-variance (Bartlett kernel – Newey-West fixed bandwidth 4.

Figure 1

The unemployment rate and three estimates of the natural rate of unemployment

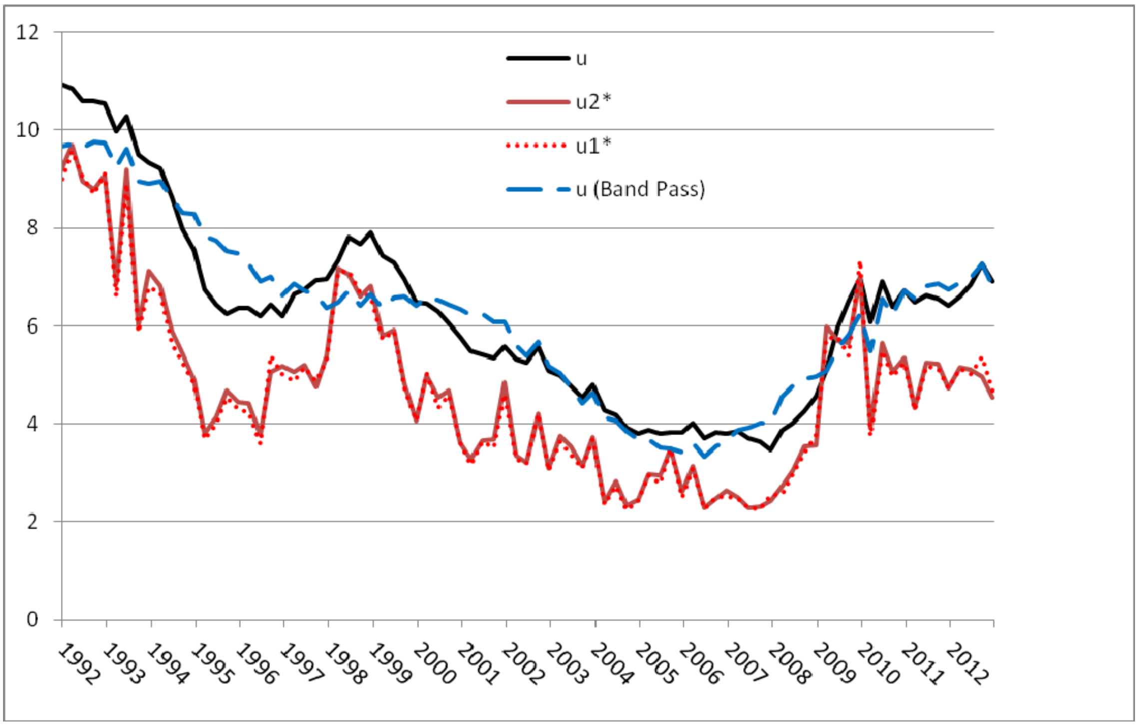


Figure 2

The autocorrelation function of the unempoyment rate

March 1992 – December 2012

<table>
<tr><th>Autocorrelation</th><th>Partial Correlation</th><th></th><th>AC</th><th>PAC</th><th>Q-Stat</th><th>Probability</th></tr>
<tr><td>. |*******</td><td>. |*******</td><td>1</td><td>0.944</td><td>0.944</td><td>77.642</td><td>0.000</td></tr>
<tr><td>. |******|</td><td>. | . |</td><td>2</td><td>0.891</td><td>-0.009</td><td>147.59</td><td>0.000</td></tr>
<tr><td>. |******|</td><td>.*| . |</td><td>3</td><td>0.820</td><td>-0.192</td><td>207.54</td><td>0.000</td></tr>
<tr><td>. |***** |</td><td>. | . |</td><td>4</td><td>0.747</td><td>-0.065</td><td>257.90</td><td>0.000</td></tr>
<tr><td>. |***** |</td><td>. | . |</td><td>5</td><td>0.676</td><td>0.006</td><td>299.69</td><td>0.000</td></tr>
<tr><td>. |**** |</td><td>.*| . |</td><td>6</td><td>0.594</td><td>-0.142</td><td>332.39</td><td>0.000</td></tr>
<tr><td>. |**** |</td><td>. | . |</td><td>7</td><td>0.522</td><td>0.023</td><td>357.93</td><td>0.000</td></tr>
<tr><td>. |*** |</td><td>. | . |</td><td>8</td><td>0.451</td><td>0.002</td><td>377.24</td><td>0.000</td></tr>
<tr><td>. |*** |</td><td>. | . |</td><td>9</td><td>0.383</td><td>-0.034</td><td>391.40</td><td>0.000</td></tr>
<tr><td>. |** |</td><td>. | . |</td><td>10</td><td>0.325</td><td>0.019</td><td>401.70</td><td>0.000</td></tr>
<tr><td>. |** |</td><td>. |*. |</td><td>11</td><td>0.278</td><td>0.087</td><td>409.37</td><td>0.000</td></tr>
<tr><td>. |** |</td><td>. | . |</td><td>12</td><td>0.241</td><td>0.016</td><td>415.19</td><td>0.000</td></tr>
<tr><td>. |** |</td><td>. | . |</td><td>13</td><td>0.215</td><td>0.048</td><td>419.90</td><td>0.000</td></tr>
<tr><td>. |*. |</td><td>. | . |</td><td>14</td><td>0.195</td><td>0.016</td><td>423.84</td><td>0.000</td></tr>
<tr><td>. |*. |</td><td>. | . |</td><td>15</td><td>0.182</td><td>0.006</td><td>427.32</td><td>0.000</td></tr>
</table>

Figure 3

The autcorrelation function of the natural rate of unemployment u_1^*

March 1992 – December 2012

<table>
<tr><th>Autocorrelation</th><th>Partial Correlation</th><th></th><th>AC</th><th>PAC</th><th>Q-Stat</th><th>Prob</th></tr>
<tr><td>. |******|</td><td>. |******|</td><td>1</td><td>0.801</td><td>0.801</td><td>55.886</td><td>0.000</td></tr>
<tr><td>. |******|</td><td>. |** |</td><td>2</td><td>0.767</td><td>0.348</td><td>107.65</td><td>0.000</td></tr>
<tr><td>. |***** |</td><td>. | . |</td><td>3</td><td>0.666</td><td>-0.042</td><td>147.22</td><td>0.000</td></tr>
<tr><td>. |**** |</td><td>**| . |</td><td>4</td><td>0.532</td><td>-0.239</td><td>172.82</td><td>0.000</td></tr>
<tr><td>. |**** |</td><td>. |*. |</td><td>5</td><td>0.501</td><td>0.137</td><td>195.79</td><td>0.000</td></tr>
<tr><td>. |*** |</td><td>.*| . |</td><td>6</td><td>0.364</td><td>-0.141</td><td>208.07</td><td>0.000</td></tr>
<tr><td>. |** |</td><td>. | . |</td><td>7</td><td>0.319</td><td>0.016</td><td>217.59</td><td>0.000</td></tr>
<tr><td>. |** |</td><td>. | . |</td><td>8</td><td>0.241</td><td>-0.034</td><td>223.11</td><td>0.000</td></tr>
<tr><td>. |*. |</td><td>. | . |</td><td>9</td><td>0.171</td><td>-0.004</td><td>225.93</td><td>0.000</td></tr>
<tr><td>. |*. |</td><td>. | . |</td><td>10</td><td>0.127</td><td>-0.053</td><td>227.51</td><td>0.000</td></tr>
</table>

Figure 4

The autocorrelation function of the natural rate of unemployment u_2^*

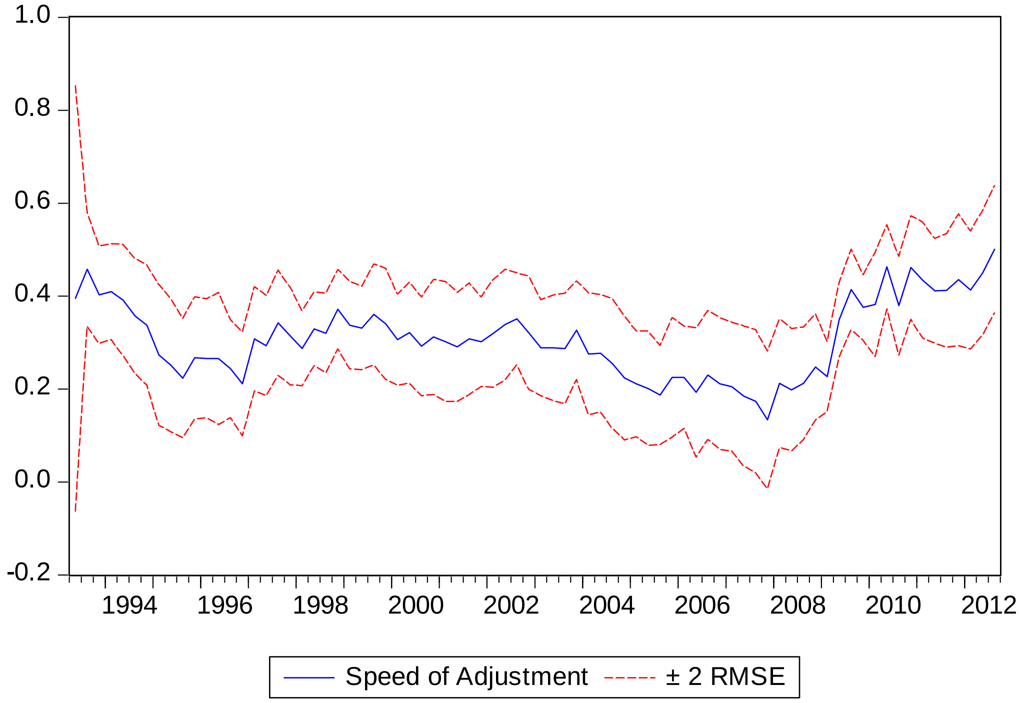
March 1992 – December 2012

<table>
<tr><th>Autocorrelation</th><th>Partial Correlation</th><th></th><th>AC</th><th>PAC</th><th>Q-Stat</th><th>Prob</th></tr>
<tr><td>. |******|</td><td>. |******|</td><td>1</td><td>0.810</td><td>0.810</td><td>57.098</td><td>0.000</td></tr>
<tr><td>. |******|</td><td>. |** |</td><td>2</td><td>0.773</td><td>0.340</td><td>109.74</td><td>0.000</td></tr>
<tr><td>. |***** |</td><td>. | . |</td><td>3</td><td>0.675</td><td>-0.045</td><td>150.38</td><td>0.000</td></tr>
<tr><td>. |**** |</td><td>**| . |</td><td>4</td><td>0.545</td><td>-0.233</td><td>177.23</td><td>0.000</td></tr>
<tr><td>. |**** |</td><td>. |*. |</td><td>5</td><td>0.518</td><td>0.159</td><td>201.80</td><td>0.000</td></tr>
<tr><td>. |*** |</td><td>.*| . |</td><td>6</td><td>0.378</td><td>-0.174</td><td>215.02</td><td>0.000</td></tr>
<tr><td>. |** |</td><td>. | . |</td><td>7</td><td>0.327</td><td>-0.005</td><td>225.03</td><td>0.000</td></tr>
<tr><td>. |** |</td><td>. | . |</td><td>8</td><td>0.247</td><td>-0.031</td><td>230.82</td><td>0.000</td></tr>
<tr><td>. |*. |</td><td>. | . |</td><td>9</td><td>0.183</td><td>0.048</td><td>234.06</td><td>0.000</td></tr>
<tr><td>. |*. |</td><td>.*| . |</td><td>10</td><td>0.137</td><td>-0.076</td><td>235.88</td><td>0.000</td></tr>
<tr><td>. |*. |</td><td>. | . |</td><td>11</td><td>0.088</td><td>0.049</td><td>236.64</td><td>0.000</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>12</td><td>0.068</td><td>0.015</td><td>237.11</td><td>0.000</td></tr>
<tr><td>. |*. |</td><td>. |*. |</td><td>13</td><td>0.082</td><td>0.170</td><td>237.78</td><td>0.000</td></tr>
<tr><td>. |*. |</td><td>. | . |</td><td>14</td><td>0.086</td><td>0.007</td><td>238.54</td><td>0.000</td></tr>
<tr><td>. |*. |</td><td>. | . |</td><td>15</td><td>0.088</td><td>-0.030</td><td>239.34</td><td>0.000</td></tr>
</table>

Figure 5

The Smooth Estimates of the Speed of Adjustment using State-Space Variances Estimated from the Data

Smoothed Speed of Adjustment State Estimate



Variance Imposed

Smoothed Speed of Adjustment State Estimate

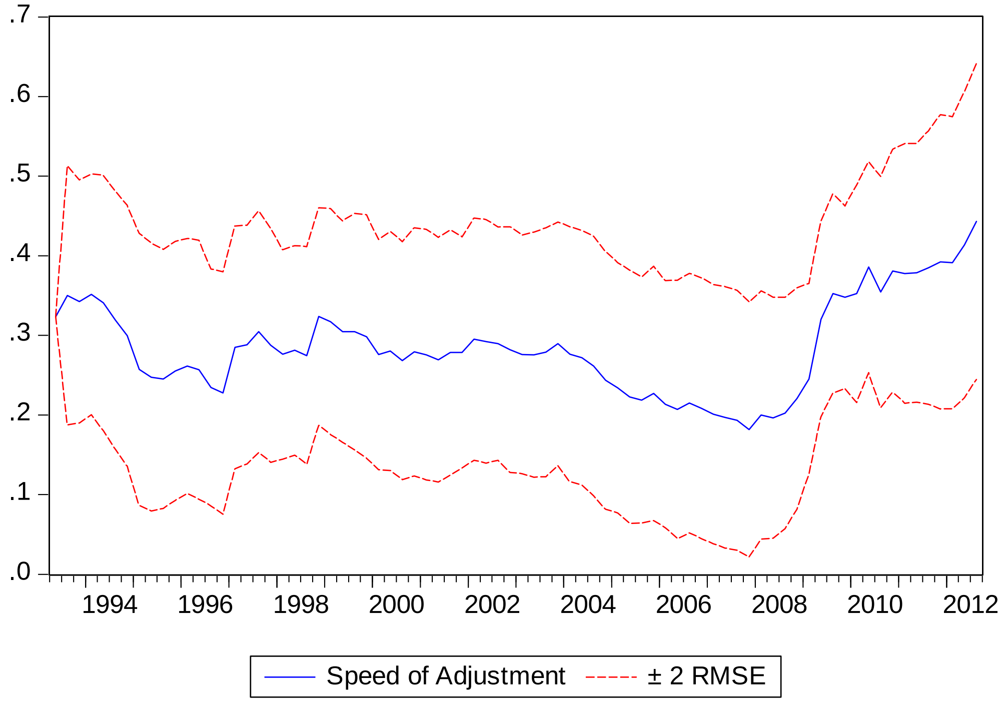


Figure 6

Job Finding Rate and TFP Shocks

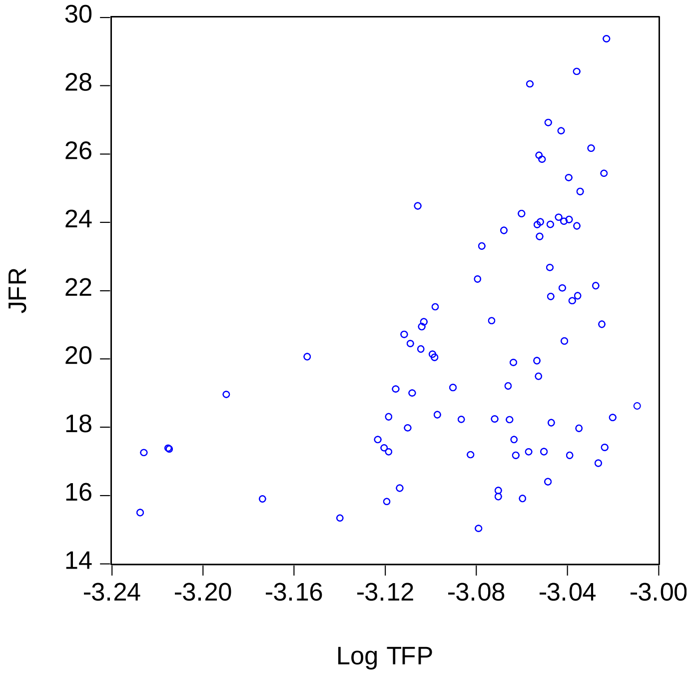


Figure 7

Job Finding Rate and Unanticipated Monetary Policy Shocks

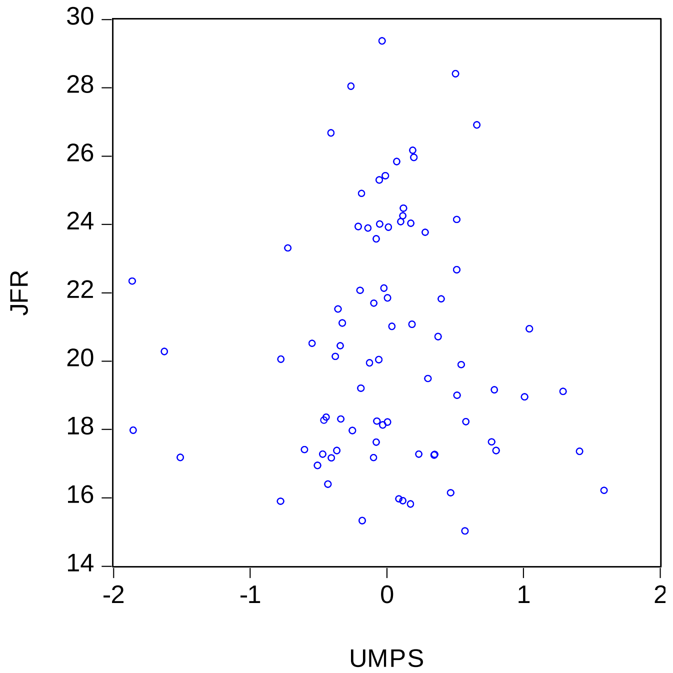


Figure 8

Job Finding Rate and Unanticipated Fiscal Policy Shocks

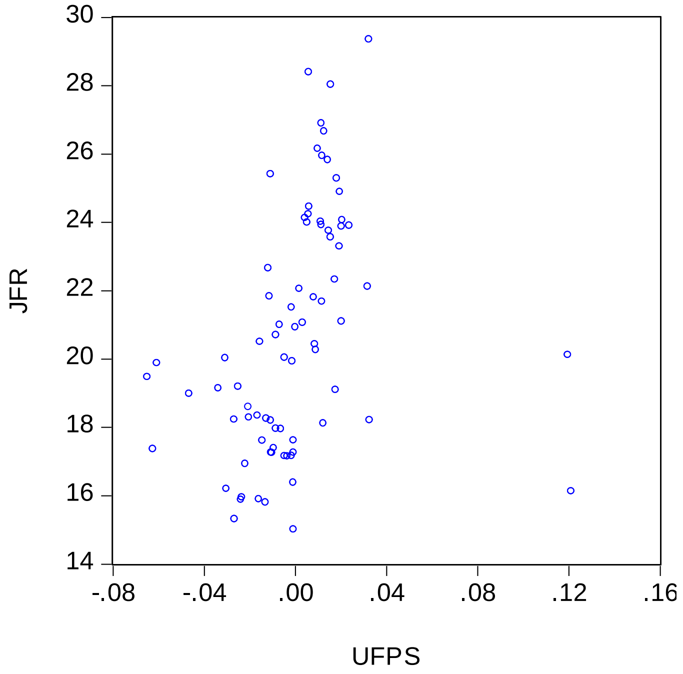


Figure 9

Job Finding Rate and the Growth Rate of Minimum Wage/Average Wage Ratio

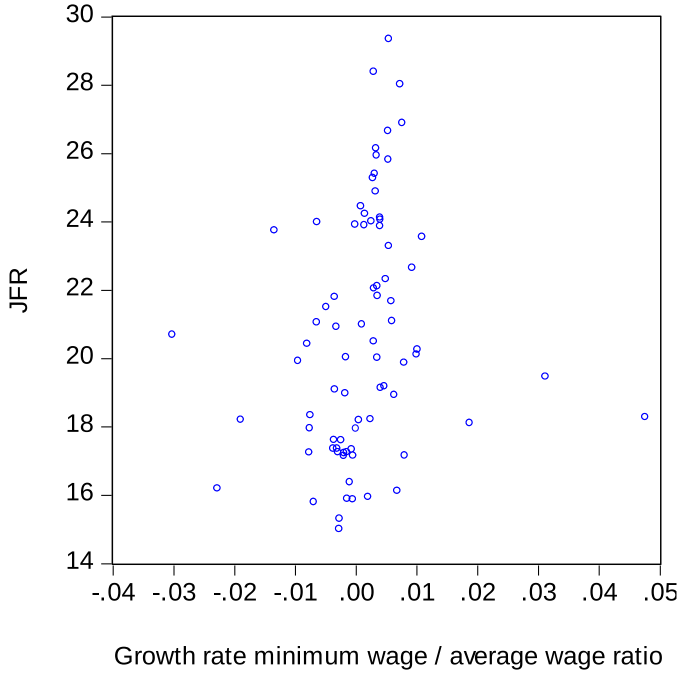


Figure 10

Job Finding Rate and the Growth Rate of Union Density

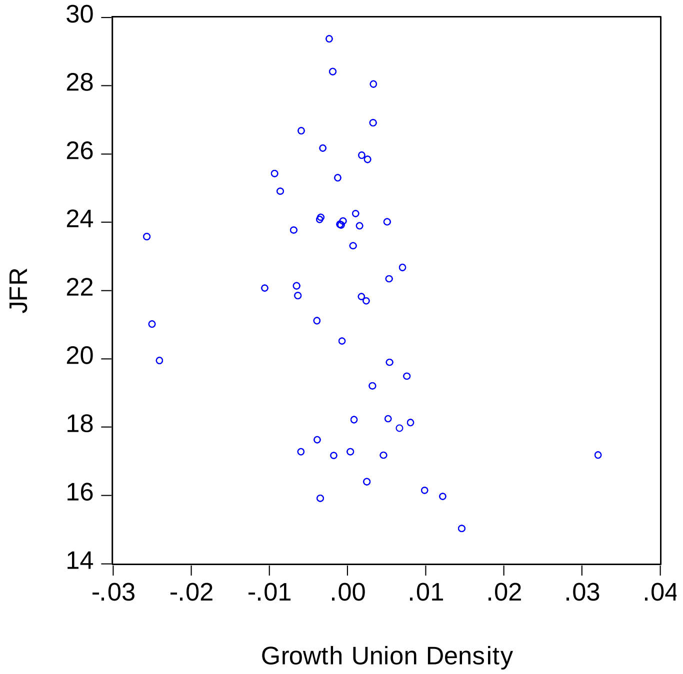


Figure 11

Job Separation Rate and TFP Shocks

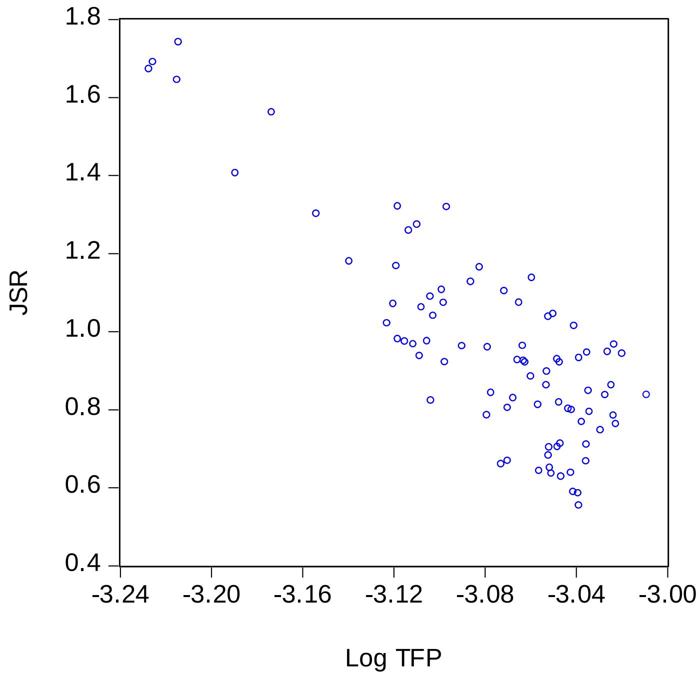


Figure 12

Job Separation Rate and Unanticipated Monetary Policy Shocks

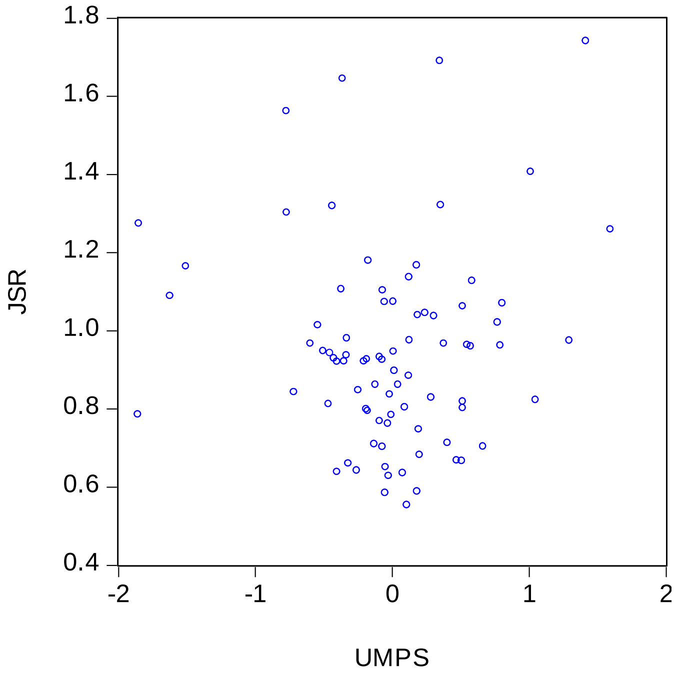


Figure 13

Job Separation Rate and Unanticipated Fiscal Policy Shocks

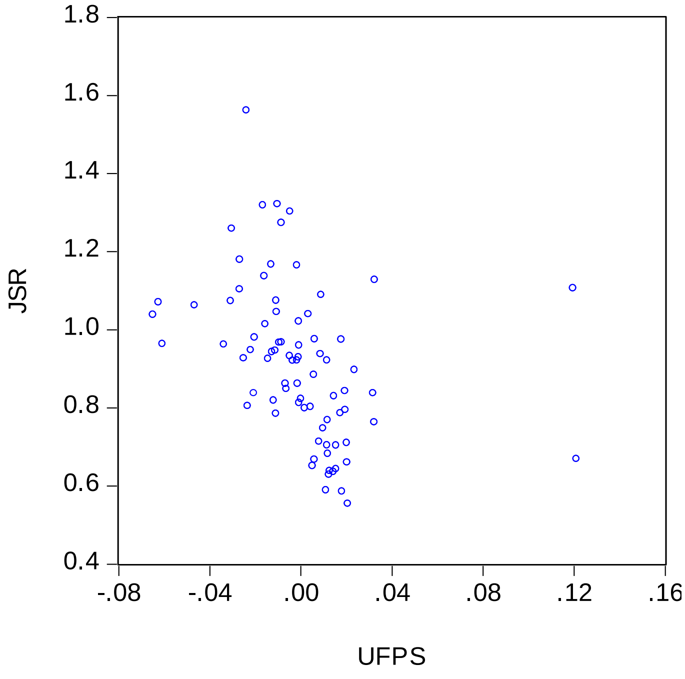


Figure 14

Job Separation Rate and the Growth Rate Minimum Wage / Average Wage Ratio

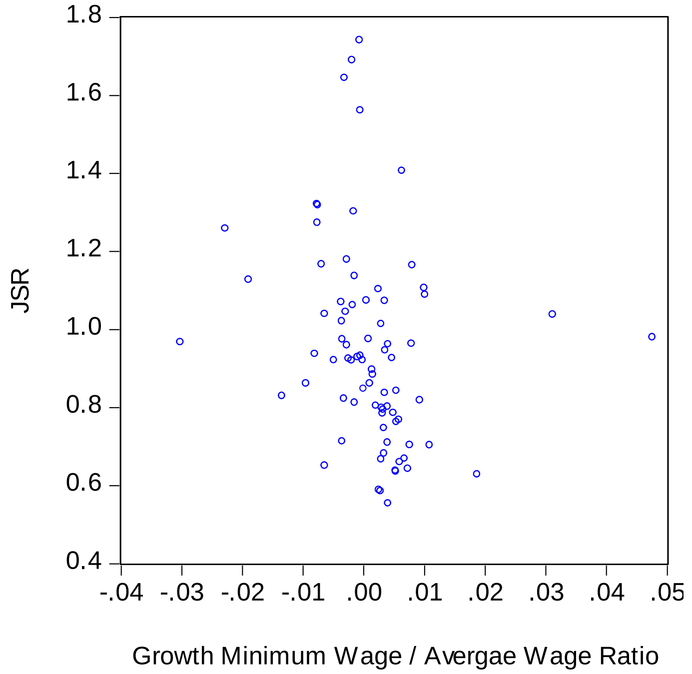


Figure 15

Job Separation Rate and the Growth Rate of Union Density

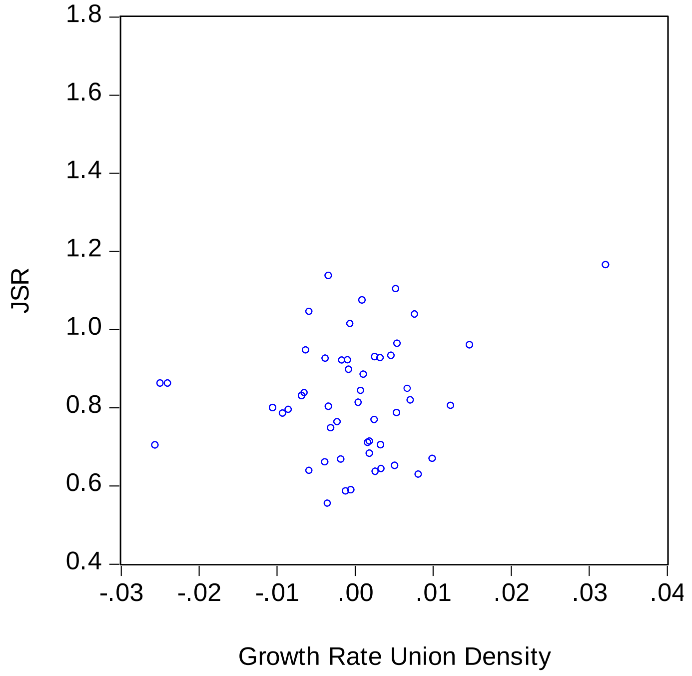


Figure 16

Business Cycle Fluctuations of Job Finding and Separation Rates

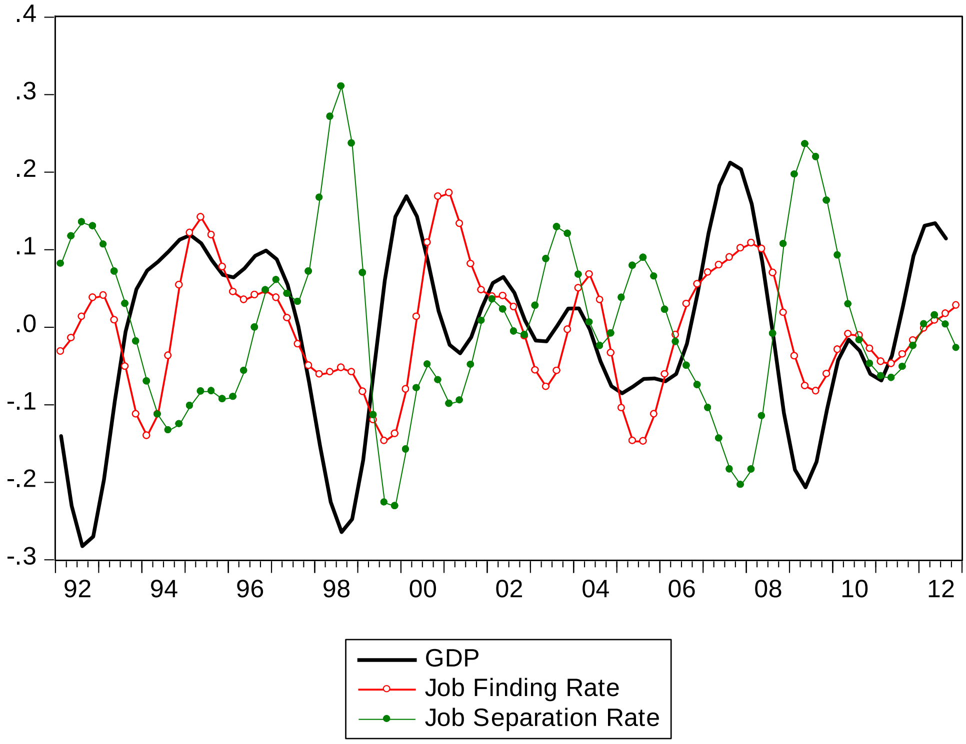


Figure 17

The Beveridge Curve

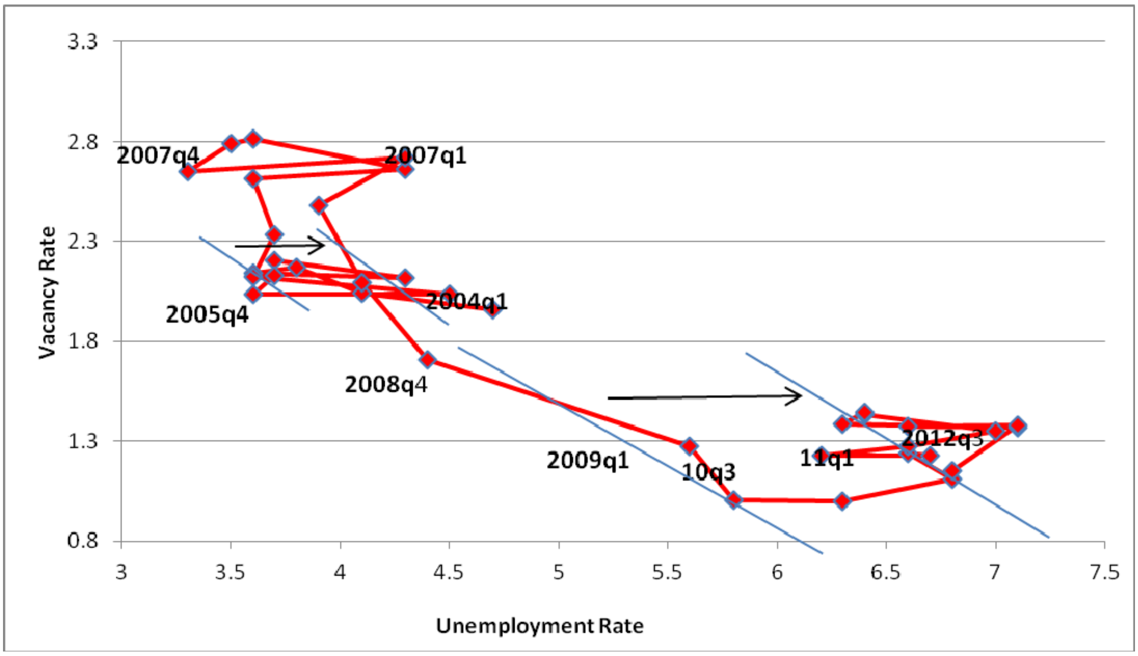


Figure 18

Counter-clockwise adjustment

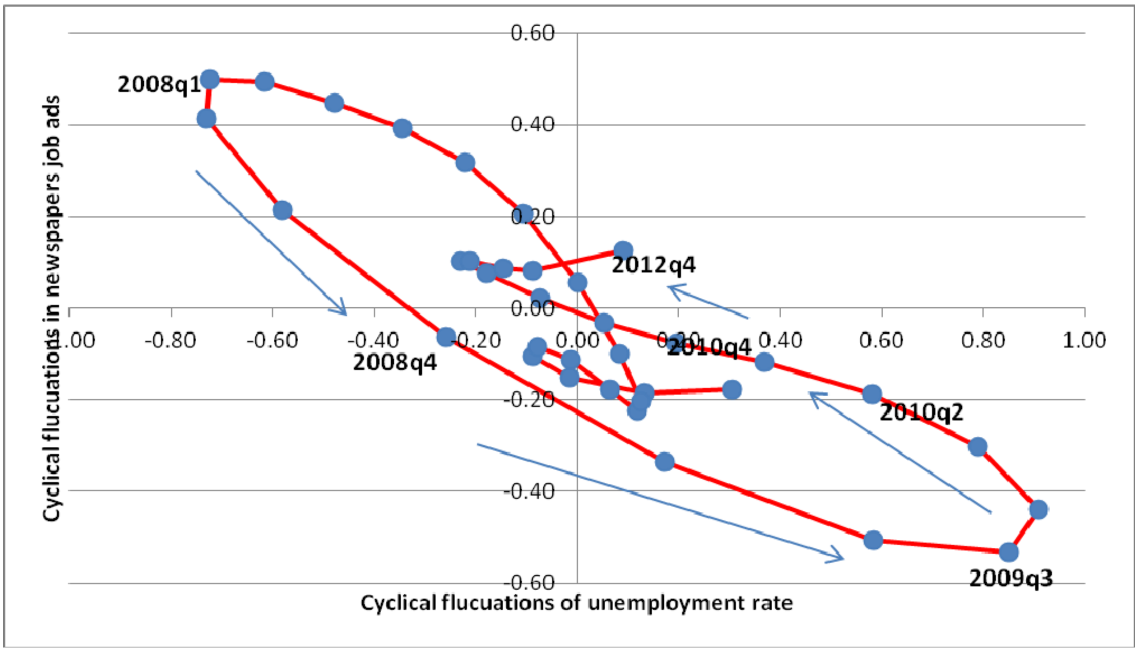
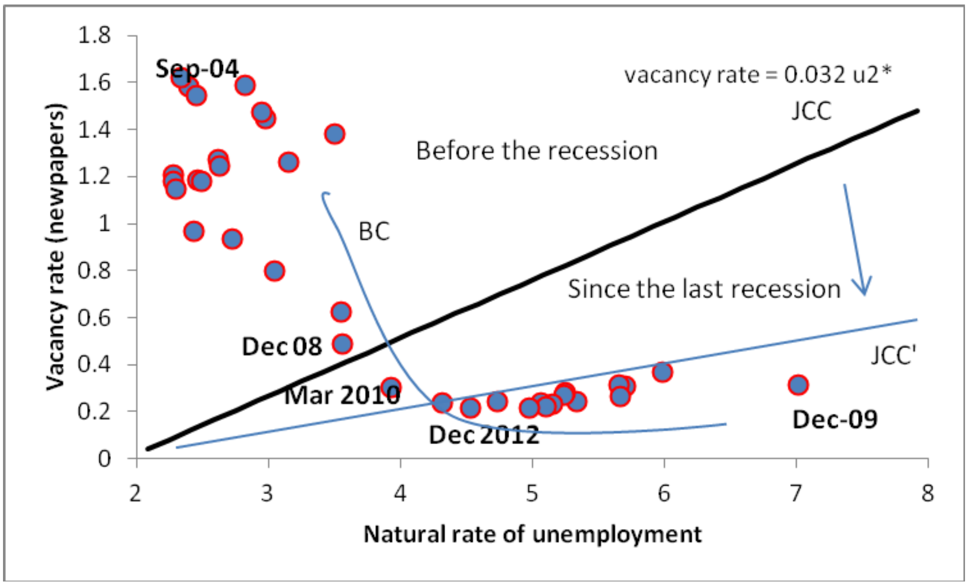


Figure 19

The New Zealand Long – Run Job Creation Curve



At a point such as Dec 2012, the Beveridge curve shifts down and JCC shifts down to the right.

Data Appendix

u_t	The unemployment rate	Household Labour Force Survey, Statistics New Zealand.
U	The pool of unemployed workers	Gross flows, Stats NZ.
E	The pool of employed workers	Gross flows, Stats NZ.
N	The pool of workers not in the labour force	Gross flows, Stats NZ.
L	Labour force	Gross flows, Stats NZ.
i	90-day interest rate	Reserve Bank
π_t	Inflation rate	Reserve Bank
G_t	Government expenditures	Reserve Bank
y_t	Real GDP	Reserve Bank
WAP	Working age population (15-64), as a measure of labour in the production function.	Statistics NZ
I	Is fixed capital formation used to compute the stock of capital	Statistics NZ
v	Vacancy rate usually measures job ads in newspaper and the Internet.	ANZ, Stats NZ.