A New Method to Estimate Time Variation in the NAIRU

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The non-accelerating inflation rate of unemployment (NAIRU) is frequently employed in fiscal and monetary policy deliberations. The U.S. Congressional Budget office uses estimates of the NAIRU to compute potential GDP that in turn is used to make budget projections that affect decisions about federal spending and taxation. Central banks all consider estimates of the NAIRU to determine the likely course of inflation and what actions they should take to preserve price stability. A problem with the use of the NAIRU in policy formation is that it is thought to change over time (Ball and Mamkiw 2002, Cohen, Dickens and Posen 2001, Gordon 1997&1998). But estimates of the NAIRU and its time variation are remarkably imprecise and are far from robust (Staiger, Stock and Watson 1997, 2001).

NAIRU estimates are obtained from estimates of the Phillips curve – the relationship between the inflation rate on the one hand, and the unemployment rate, measures of inflationary expectations and variables representing supply shocks on the other. Typically, inflationary expectations are proxied with several lags of inflation and the unemployment rate is entered with lags as well. The NAIRU is recovered as the constant in the regression divided by the coefficient on unemployment (or the sum of the coefficient on unemployment and its lags).

The notion that the NAIRU might vary over time goes back at least to Perry (1970) who suggested that changes in the demographic composition of the labor force would change the NAIRU. He adjusted the unemployment rate to account for this. By

1990 several authors (Gordon 1990, Abraham 1987 XXothers?) had suggested that the NAIRU was probably lower in the 1960s than in the 1970s and 1980s. This was initially accommodated by adding dummy variables or splines for certain periods to the Phillips curve regression. However, when it began to appear that the U.S. NAIRU might be coming down in the 1990s, new methods were developed to track its changes. Staiger, Stock and Watson (1997) and Gordon (1997,1998) and Stock and Watson (1999) began to apply time varying coefficient models and structural break models to the estimation of the NAIRU and typically found evidence that it rose in the late 1960s or early 1970s and declined in the 1990s.[1] However, the timing and the magnitudes in the estimated changes differed markedly depending on the specification used, and confidence bounds on the estimated NAIRUs were so large that the estimates had little value for policy.[2]

This paper presents a new approach to estimating time variation in the NAIRU. A major problem with Phillips curve based estimates is that the complicated relationship between inflation, its own lags, supply shocks and unemployment and its lags makes it possible to explain any particular incidence of high or low inflation a number of different ways. This is the root cause of both the lack of robust results and the large confidence intervals around NAIRU estimates derived from Phillips curve estimates. This paper explores an alternative source of information about time variation in the NAIRU. To the extent that such changes are due to changes in the efficiency of the labor market, they are reflected not just in the relationship between inflation and unemployment, but also in the

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[1] In these papers only the constant term, or the NAIRU, was allowed to vary. When Brainard and Perry (2000) estimated Phillips curves allowing all parameters to vary they found that the constant and the coefficient on unemployment were relatively stable (and thus so was the NAIRU). Instead they explained the different behavior of inflation over the decades by variation in the sum of the coefficients on lagged inflation.

[2] See, for example, the results in Staiger, Stock and Watson (1997) or compare figures 3 and 4 in Gordon (1997).

relationship between unemployment and job vacancies. That relationship is much simpler, and consequently much easier to model in a robust fashion. Doing so yields remarkably consistent results for time variation in the NAIRU and entering the NAIRU variable derived from the vacancy-unemployment relationship into the Phillips curve adds notably to the models ability to explain inflation.

The next section provides a brief introduction to the literature on the Beveridge curve – the relationship between unemployment and vacancies – and on how it has shifted over time. It argues that because the Beveridge curve is much simpler and better fitting than the Phillips curve it provides a better basis for discerning shifts in the efficiency of the functioning of the labor market, which appear to be quite significant. The next section develops a theory linking shifts in the Beveridge curve to shifts in the NAIRU. That model motivates the empirical work presented in the next section in which a model of the Beveridge curve is estimated and the results shown to be remarkably robust to changes in specification. The section after that uses the model to derive a number of different estimates of the variation of the NAIRU over the last five decades. It is then shown that variation of the parameters of the model within the ranges allowed by the estimation of the model have very little effect on the time series pattern of variation in the NAIRU. Finally, the NAIRU series generated from the vacancy-unemployment relationship are entered into Phillips curve regressions to test the hypothesis that they are capturing variation in the NAIRU. The results are consistent with that interpretation.

The Beveridge Curve

The Beveridge curve describes a convex relationship between vacancies and unemployment. Like the Phillips curve it entered the literature as an empirical regularity.

Hansen (1970) was the first to propose a formal model to explain the nature and shape of the relationship based on disequilibrium in two labor markets. Blanchard and Diamond (1989) offer an alternative model based on a matching function.

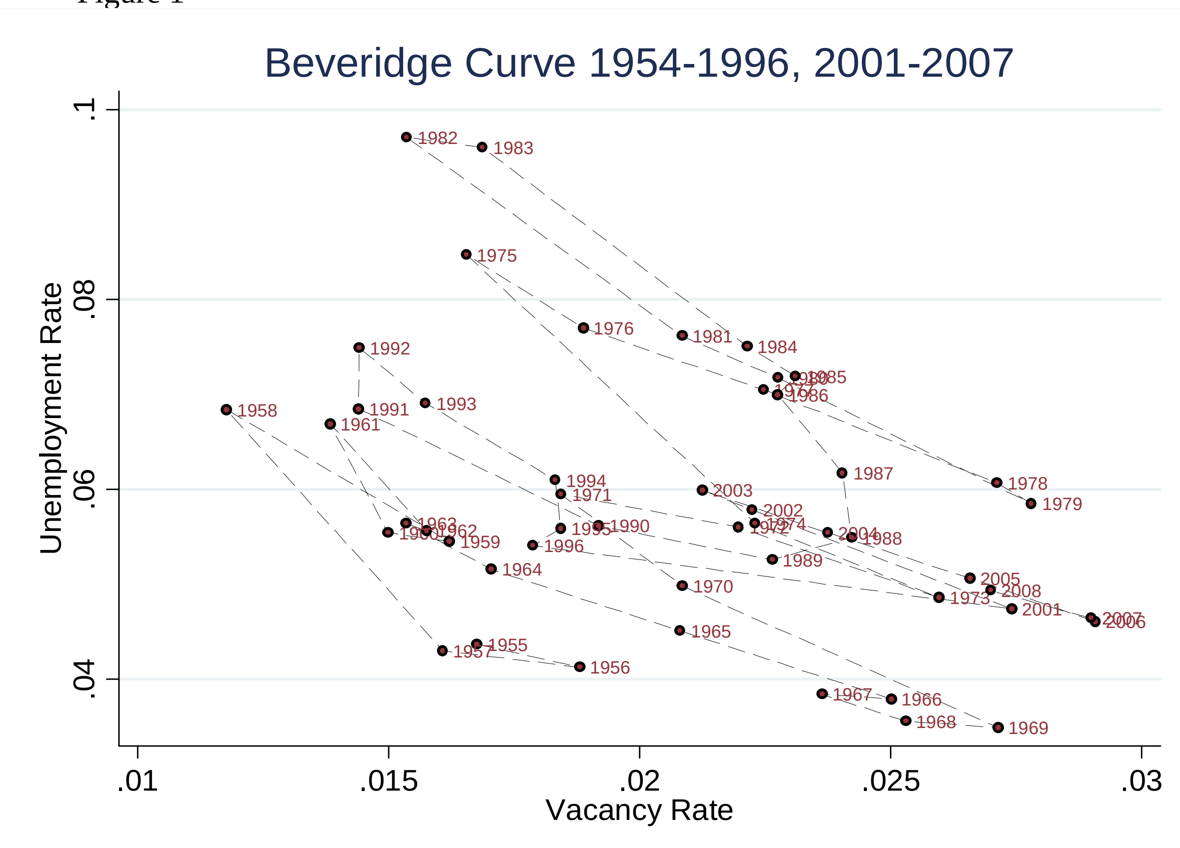
Until recently there was no vacancy data for the U.S., but starting with Abraham (1983) the Conference Board's help wanted index has been used to construct a proxy for the number of vacancies in several studies (Abraham 1983, 1987, Blanchard and Diamond 1989, Bleakley and Fuhrer 1997, Medoff (1983), Valetta 2006). Abraham (1983) argued for several adjustments to the help wanted index to take account of changes in the structure of the newspaper industry and changes in the use of advertising by business in response to equal opportunity laws and regulations. However, Zargorsky (1998) provides convincing evidence that except for an adjustment for scale (due to Konstant and Wingeard, 1968) the help wanted index tracks vacancies well without any adjustment up to 1994.

Sometime after 1994 this relationship falls apart. By the time the Bureau of Labor Statistics began collecting the Job Openings and Labor Turnover Survey (JOLTS) series in December of 2000, measures of the vacancy rate constructed from the help wanted index were running well below the numbers coming out of the JOLTS. This could have been anticipated given the explosive growth of the internet as a way for people to find and apply for jobs. Monster.com started operating in 1994. In December of 1997 it was still only listing 50,000 jobs (XX,XX). Today, it lists over XX million jobs and is only one of many hundreds of sites on which people can post resumes and/or search job listings. There is no doubt that a smaller fraction of jobs are listed in newspaper help wanted advertisements today then were 15 years ago.

In the work that follows the help wanted index is used with only a scale adjustment as suggested by Zargosky (1998). I believe that it remains a reliable measure of vacancies at least up to 1997, but probably not much beyond that. Thus the years 1997-2000 are dropped in most of the work presented here. After 2000 the JOLTS data are used to measure the number of vacancies.

Figure 1 presents a plot of the vacancy rate (vacant jobs over employment plus vacant jobs) versus the unemployment rate from 1954 to 1997 and from 2001 to 2007.

Figure 1



trade-off. The same vacancy rate was associated with a much higher rate of unemployment in the 1980s than in the 1950s and 1960s. The trade off in the 1990s and 2000s seems to have improved notably. Starting with Abraham (1987) several authors have offered theories to explain these movements (Cohen Dickens and Posen 2001, Stock 2001, Valletta 2006).

While the trade-off moves around notably at times, there do appear to be long periods in which the relationship is relatively stable. From 1958 through 1970 the vacancy and unemployment rates move back and forth in a relatively tight band. There is a similar period from about 1975 through 1986 and then another from 1989 to 1997 and then again starting in 2001. The relationship between vacancies and unemployment over these different periods looks remarkably similar. As a result, detecting the magnitude and timing of shifts in the position of the relationship is relatively easy. If these changes do reflect changes in the efficiency of the functioning of the labor market then they should correspond to large changes in the NAIRU. This is the point of departure for the current paper. What is needed is a theory to guide the measurement of the movements in the vacancy-unemployment relationship and to translate it into movements in the NAIRU.

The Model

The model is an extension of Blanchard and Diamond's (1989) simple continuous time labor market model modified to yield a NAIRU. There are K entrepreneurs in the economy each of whom faces a nominal price for the product he might produce at time t the natural log of which is denoted

(1) $$p_i(t) = p(t) + z_i(t)$$

where p(t) is the natural log of the aggregate price level at time t and $z_i(t)$ is the natural log of the real price entrepreneur i faces. While p(t) changes continuously, the values $z_i(t)$

change in jumps that take place at a rate s. When they change, a new $z_i(t)$ is drawn from a uniform distribution with support on the unit interval.

Entrepreneurs know that the natural log of their real costs for production (including the expected amortized cost of capital) will be c (0<c<1), but they do not know the current price level. Thus they do not know the real profits they will be able to make should they choose to produce. Before this information is revealed they must make an irreversible purchase of capital (though they do not have to pay for the capital until it is delivered, and delivery can be delayed till a worker is hired if the entrepreneur is not currently active). Thus both currently active entrepreneurs and inactive entrepreneurs will decide to produce when faced with a new price if

$$(2) \qquad p_i(t) - [p(t) + p^e(t)] = z_i(t) - p^e(t) > c$$

where $p^e(t)$ is the error in their perception of the log of the current price level common to all entrepreneurs and thus the term in brackets is their perception of the log of price level at time t. Active entrepreneurs (those who currently employ a worker) can continue with the same worker once the new capital investment is made. Inactive entrepreneurs must post a vacancy and wait to find a worker before they can begin producing. Thus a fraction

$$(3) \qquad F = (1-c) - P^e$$

of active entrepreneurs facing new prices will choose to continue to operate and a fraction 1-F will cease to operate while a fraction F of inactive entrepreneurs facing new prices will choose to post a vacancy while 1-F choose to remain inactive. Entrepreneurs who choose to operate employ one worker or post one vacancy if they do not already have a worker.

It is assumed that the capital cost is sufficiently large relative to the largest possible error in perception so that true real prices will never be greater than variable costs. Thus entrepreneurs that decide to post a vacancy or operate will continue to do so at least until they receive a new price even if they have over estimated the real price as they are still covering a fraction of the cost of capital.

It is next assumed that unemployed workers are matched with vacant jobs at a rate M(U,V) where U and V are the number of unemployed workers and vacancies respectively. M is assumed to be homogenous degree 1 with dM/dU and dM/dV>0. The labor force contains L workers so that the equations of motion for the vacancy rate and the unemployment rate are given by[3]

(4) $$dV = s(K-V-L+U)F - dP^{e-} - sV(1-F) - M(U,V)$$

(5) $$dU = s(L-U)(1-F) - M(U,V)$$

[3] In a departure from Blanchard and Diamond (1989) quits and layoffs are both assumed to arise from the breakdown of a match which is signified by the arrival of a new price for the entrepreneur.

where dP^{e-} denotes declines in perceived price level (i.e. $dP^{e-} = \max(0, dP^{e})$) which increase vacancies as previously inactive entrepreneurs perceive their potential products to be profitable. New vacancies are also created by previously inactive entrepreneurs (K-V-L+U) who receive new prices that they perceive as profitable (the first term in 4). Vacancies disappear when workers are matched to those vacancies (the last term in equation 4) or when an entrepreneur with a posted vacancy receives a new price that he perceives as being to low to be profitable (term 3 in equation 4). Workers become unemployed when their entrepreneur receives a new price that is perceived to be unprofitable (the second term in (5)) and leave unemployment when matched with a job.

A permanent increase in F will cause a permanent increase in the number of vacancies and a decline in the number of unemployed while a decline will have the opposite effects. Following Blanchard and Diamond this equilibrium locus is defined as the Beveridge curve and the equation that defines it implicitly can be found by setting dV, dU and dP^{e-} to zero and substituting F out of (4) and (5). Doing this and dividing by the number of workers in the labor force (L) yields

(6) $$km = (k - v + u - 1)s\,(1 - u)$$

where lower case letters denote the value of their upper case counter part divided by L. Taking logs, approximating $\ln(1+X)=X$, and taking a first order log linear approximation to the matching function ($\ln(m)=\ln(A)+b\ln(u)+(1-b)\ln(v)$) yields the equation that implicitly defines the Beveridge curve as

(7) $v + \ln(v) = [k-2-\ln(k)+\ln(s)-\ln(A)] + b \ln(v/u)$.

Equation (7) tells us what level of unemployment corresponds to what level of the ratio of vacancies to the labor force for different levels of F. To find the values that will obtain with a particular constant value of F we note from (4) and (5) that if dV, dU and dP^{e-} are equal to zero then moving M to the left hand side, setting the two equations equal to each other and simplifying yields

(8) $Fk = 1 - u + v$

Together equations (7) and (8) will determine the level of unemployment and the ratio of vacancies to the labor force. The natural rate of unemployment can now be defined as the value of u that comes from solving (7) and (8) for u and v given the value of F with no error in the perceived price or $F^* = 1\text{-}c$.

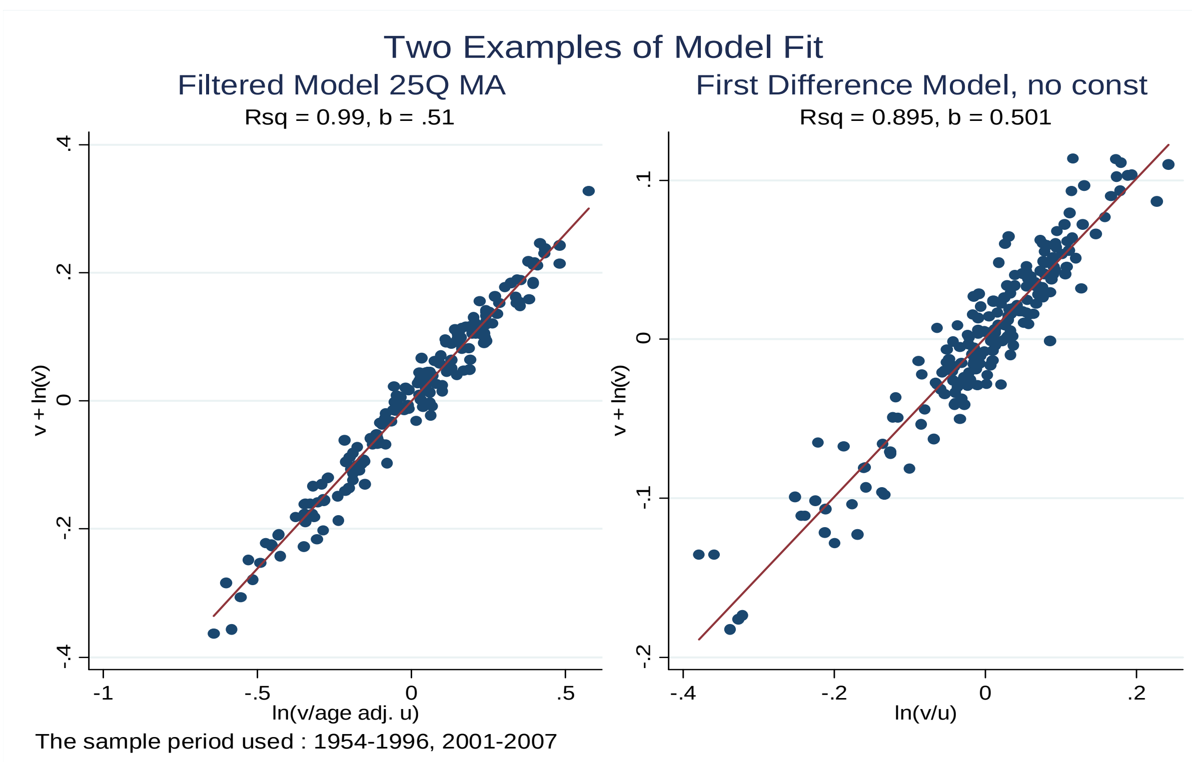
Estimating the Vacancy-Unemployment Relationship

To use the model from the previous section to obtain measures of time variation in the NAIRU two things are needed; an estimate of *b* and the level of the NAIRU at one point in time. We will estimate *b* using quarterly time series data and then we will show that the pattern of time series fluctuations in the NAIRU derived from the model are remarkably robust to what we assume about the level at a particular date.

Although equation (7) specifies a single variable linear relationship between $v+\ln(v)$ and $\ln(v/u)$ we cannot estimate it directly with OLS. The term in square brackets is time varying and from inspection of figure 1 we have good reason to believe that the low frequency variation in that term would be correlated with the v/u ratio biasing our estimates if we treated it as a regression error term. Further, ln(v) is on both sides of the equation so that any measurement error in v, or unique shocks to v, could badly bias our estimate of *b*.

While the low frequency variation in the constant term in (7) is likely correlated with the v/u ratio, there is no reason to expect that higher frequency variation would be. We thus take three approaches to isolating the high frequency variation in order to estimate *b*. First, we estimate equation (7) only on sub-periods where the v-u relationship seems stable. Second, we filter the low frequency variation out of the data and estimate the model only on the filtered data. Finally, we first difference both the left and right-hand sides of (7).

Figure 2



The relationship between the high frequency variation in the left and right-hand sides of equation (7) are remarkably well described by a simple linear relationship as can be seen in figure 2. In the right pane, the differenced data are plotted against each other. In the left pane data that has been passed through a 25 quarter centered moving average filter are plotted against each other. In this case an unemployment rate that has been age adjusted as in Shimmer (1999) is used rather than the total unemployment rate. The R^2s for both regressions are 90 or higher as the observations are tightly packed around a line with a slope of nearly exactly .5.

Nor are these two relationships atypical. Table 1 presents 30 different estimates of *b* using two different measures of unemployment (age adjusted and total) and a number of different methods to remove the low frequency variation. The IV estimates are constructed using four lagged values of the log of unemployment.[4] All of the estimated values of *b* fall in the interval from .44 to .57 and all are precisely estimated. So much so that despite how close they all fall to .5 in exactly half the cases we can reject the hypothesis that they are equal to .5 (alpha statistics for the two tailed test of that hypothesis are provided for each estimate in the table.

[TABLE 1 HERE]

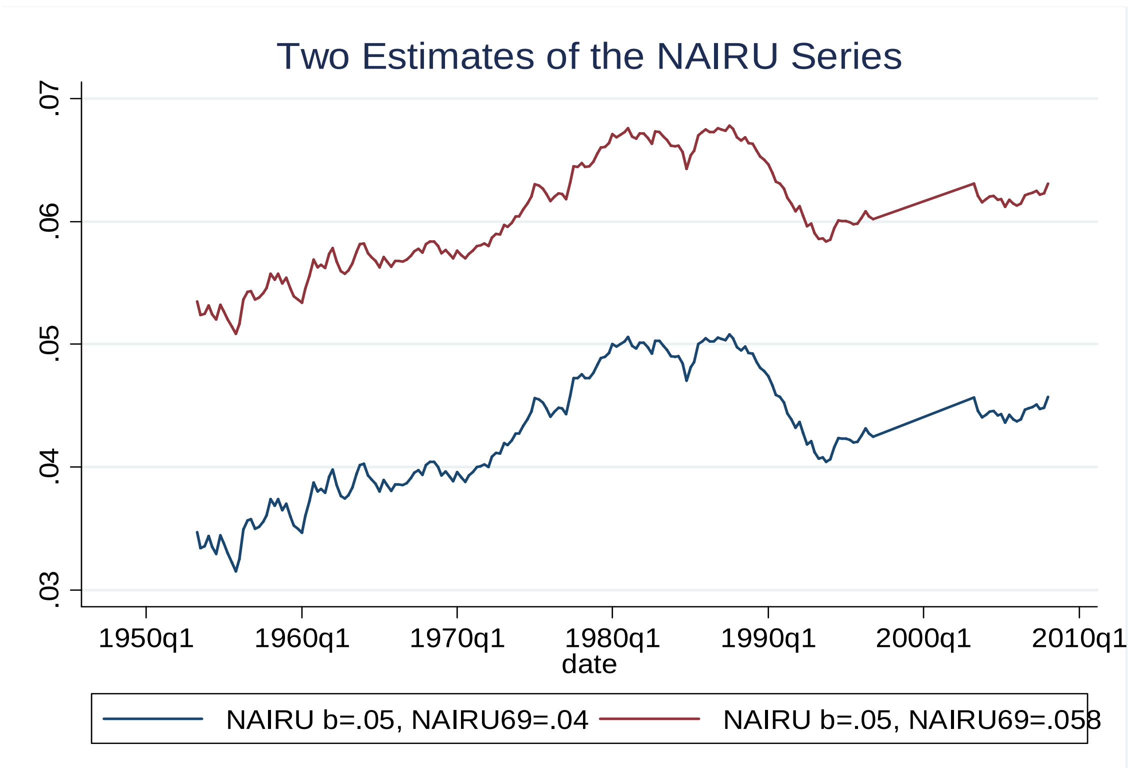
As there is no obvious reason why a vacancy should matter more or less than an unemployed worker in the matching process, a *b* value of .5 seems most plausible, but in the work that follows we experiment with a range of values for *b* from .4 to .6.

[4] Using either the level, the filtered value or first differences corresponding to the treatment of the variables in the specification being estimated.

Constructing the NAIRU Series

Given a value for *b* we can construct the bracketed term in equation (7) using data on unemployment and vacancies. From those numbers we can impute a NAIRU series if we know what the NAIRU was in any one period. Two alternative series presented in figure 3 are constructed using the first quarter of 1969 as the base year. Both series were computed using the unadjusted unemployment rate and a *b* of .5.

Figure 3

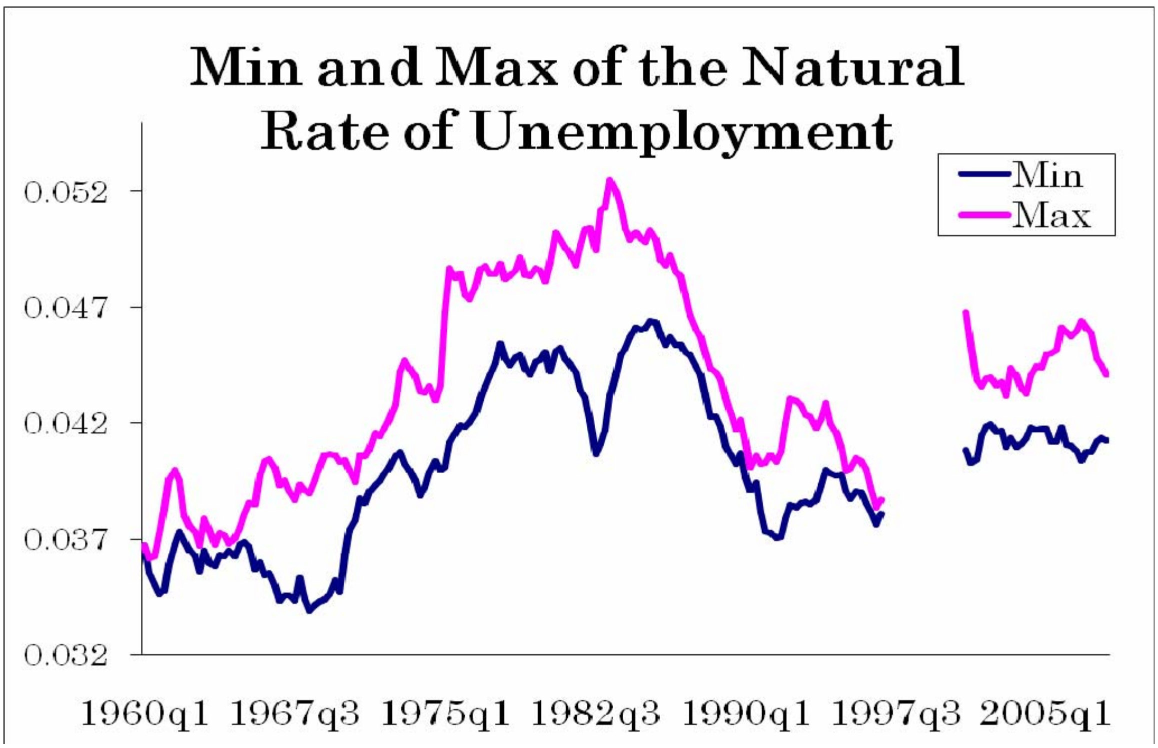


If one takes the NAIRU model seriously – that there is only one level of unemployment at any given time consistent with stable rates of inflation – then it is possible to obtain a very accurate calibration of the NAIRU series. If the NAIRU in the reference period isn't chosen to produce an average value for the NAIRU within a tenth of a percentage point of the average level of unemployment over the sample, then simulations based on that NAIRU will necessarily produce wildly divergent values for inflation. If the average for the NAIRU is only slightly above the average value for the unemployment rate during the period then simulated inflation skyrockets while an average NAIRU slightly below the average rate of unemployment leads to a plummeting rate of deflation. The higher of the two NAIRU series presented in figure 3 is computed assuming that the NAIRU in 1969Q1 was 5.8 percent. That value yields an average NAIRU equal to the average rate of unemployment from 1958Q1 to 1976Q4.

However, it is this extreme sort of behavior of the traditional NAIRU model that most strongly recommends the adaptations proposed by Akerlof, Dickens and Perry (1996, 2001). The traditional NAIRU model demands a time varying rate to accommodate periods such as the last decade in the US, the 1990s in Canada, or the Great Depression. In the ADP models, the lowest sustainable rate of unemployment becomes higher at very low rates of inflation. Those models can accommodate high rates of unemployment at low rates of inflation without requiring movement in the long-run equilibrium locus between inflation and unemployment. Thus they can allow the lowest sustainable rate of unemployment to be less than the average rate of unemployment without causing galloping deflation. Although I have not formally integrated the model presented in this paper with the ADP models, it is the possibility allowed by models like those that motivates the computation of the second set of NAIRU estimates. Those estimates are based on the assumption that the NAIRU in the first quarter of 1969 was 4 percent – what many economists at the time thought of as “full employment.”

One could be forgiven for thinking that the only difference between the two series in figure 3 is a vertical shift. In fact, the choice of the base period NAIRU causes some very subtle differences in the volatility of the series. Further, the choice of *b* also influences the shape of the NAIRU series to some degree. Figure 4 presents the results of a sensitivity analysis. The NAIRU series was recomputed 40 different ways, varying the unemployment rate used (age adjusted or unadjusted), the value of *b* (.4, .45, .5, .55 and .6) and the NAIRU in 1969Q1 (4%, 5%, 5.8% and 6%). Taking out the vertical shift caused by the different values of the base period NAIRU by setting all the series equal in the first quarter of 1961, figure 4 demonstrates the robustness of this method of estimating time variation in the NAIRU to a wide range of model assumptions.

Figure 4



The upper line represents the largest value the NAIRU took in any specification in that quarter while the lower line represents the lowest value taken. All series show essentially the same pattern. After a period of relative stability in the NAIRU in the early 1960s, there is a rapid increase during the late 60s through the mid 1970s. The increase is almost a full percentage point. The NAIRU then remains high through the late 1980s when it drops precipitously through about 1991 when it again becomes fairly constant.

It is unfortunate that there is no overlap between the JOLTS series and the help wanted index during the pre-internet period. If we assume that the JOLTS vacancy numbers are equivalent to those obtained from the scaled help wanted index then it appears that the NAIRU is slightly higher in the 2000s than it was in the 1990s. However, as we will see in the next section, there is some reasons to doubt that they are exactly equivalent.

Comparing these estimates of time variation of the NAIRU to results in Gordon (19997), Stock (2001), or Staiger, Stock and Watson (1997) these tell a much more consistent story. Estimates presented in those papers using different methods tell a somewhat similar story to the estimates presented here, but disagree to a much greater degree as to the timing and the magnitude of the movements. Movements in the vacancy unemployment relationship can be identified with much more precision under a very wide range of assumptions and are thus much more robust than estimates of time variation in the NAIRU derived form the Phillips curve.

The v-u NAIRU and Inflation

Although a strong *a priori* case can be made that variation in the efficiency of the labor market ought to affect the NAIRU, it is possible that if the unemployment rate is only acting as a proxy for the overall level of economic activity. In that case, the efficiency of the labor market might be only weakly related to the level of unemployment below which the rate of inflation accelerates. Thus an important test of this new NAIRU series is whether it can help predict inflation in the context of the standard Phillips curve.

Equation (9) depicts the standard Phillips curve relationship.

$$(9) \qquad \pi_t = \pi_t^e + a\,(u_t^N - u_t) + x_t + e_t$$

The rate of inflation in time period *t* is equal to the expected rate of inflation in that time period plus the difference between the NAIRU and the actual rate of unemployment times a coefficient plus a term for supply shocks (x_t) plus regression error. Inflationary expectations are typically proxied by lagged values of inflation, and a variety of dummies and other variables are used to capture supply shocks. Often lags of unemployment are included in the specification and sometimes contemporaneous unemployment is left out.

If the u-v NAIRU is accurately capturing movements in the NAIRU then if we enter it into the Phillips curve it ought to have a significant positive coefficient that should be equal in magnitude to the additive inverse of the coefficient on the unemployment rate. Finally, if supply shocks have been captured by included variables, then the constant term should be equal to zero as well.

Table 2 presents four Phillips curve estimates drawn at random from the 216 specifications that we estimated.[5] The start date for each regression depends on the available data, but all regressions use data up through 1996Q4 and 2001Q1 through 2007Q3. In all cases the NAIRU variable was included on the right hand side as were a series of dummies for supply shocks in the 1970s and 1980s and a dummy variable for the time period for which the JOLTS vacancy series was used to construct the NAIRU. The inflation measure (CPI, GDP deflator, or wage growth net of trend productivity), the

[5] One chosen randomly each from the four categories noted at the top of table 2. All shown used the NAIRU measure formed by assuming a NAIRU of 4% in 1969Q1.

number of lags of inflation (4, 8 or 12), whether or not the coefficients on lagged inflation were constrained to equal 1, the unemployment measure (age adjusted or not), the NAIRU measure (formed assuming 4% NAIRU in 1969 or formed assuming 5.8% NAIRU in 1969), and the way unemployment was entered into the equation (contemporaneous only, contemporaneous and three lags, or four lags) were all varied.

	Table 2: Representative Phillips Curve Regressions			
	Sum of coefficient on inflation constrained to 1		Sum of inflation coefficients not constrained	
	CPI	GDP deflator	CPI	GDP deflator
Sum of unemployment coefficients	-0.24	-0.52	-0.50	-0.41
se	0.11	0.08	0.15	0.09
Sum of lagged inflation coefficients	1	1	0.89	0.92
se	-	-	0.07	0.05
Sum of NAIRU coefficients	0.01	0.34	0.58	0.42
se	0.44	0.19	0.45	0.22
Post 2000 dummy	-0.001	-0.003	-0.003	-0.004
se	0.004	0.002	0.004	0.003
Constant	0.014	0.016	0.010	0.008
se	0.017	0.007	0.016	0.007
N	149	180	150	184
Number of lags of inflation	4 lags of inflation	12 lags of inflation	12 lags of Inflation	8 lags of inflation
Lags of unemployment and the NAIRU	(t)-(t-3)	(t)	(t)-(t-3)	(t-1)-(t-4)
Unemployment measure	age adjusted	unadjusted	age adjusted	unadjusted

Three of the four coefficients of the NAIRU variable are statistically significant at the .1 level (1 tail test) and two are statistically significant at the .05 level. This is a slightly higher rate than in the 216 specifications for which 61% of the coefficients were statistically significant at the .1 level in a 1 tail test. In no case in table 2 can the hypothesis that the coefficient on unemployment is equal to minus that on the NAIRU variable be rejected. In only 4 of the 216 specifications is it possible to reject this hypothesis. Further, the median of the sum of the coefficients on unemployment plus the coefficients on the NAIRU variable was.08 in the specifications when the NAIRU in 1969Q1 was assumed to be 5.8% and .03 for those specifications where it was assumed to be 4%. In no case in table 2 can the hypothesis that the coefficient on the post 2000 dummy is equal to zero be rejected. In only one case can the hypothesis that the constant is equal to zero be rejected. These results are consistent with what we observe in the 216 specifications [need to tabulate these values for the 216 specifications]. However, the average value of the coefficient on the dummy variable for the post 2000 period is negative suggesting that the NAIRU in that period may be slightly lower relative to that computed using the help wanted index. Overall, it seems quite plausible that the NAIRU variable that has been constructed here provides a good account of movements in the NAIRU.

Conclusion

This paper has presented a new method for estimating time variation in the NAIRU using the vacancy-unemployment relationship. A simple theory of this relationship based on a matching model suggests equations that do an uncannily good job of fitting transformed vacancy and unemployment data. When NAIRU series based on this model are introduced into Phillips curve regressions, they are statistically significant more often that not, and tests fail to reject constraints implied by the model in the overwhelming majority of specifications.

While it seems that this method provides a superior method for judging when changes have taken place in the NAIRU, it has not yet been proven to help in measuring the NAIRU at any one point in time. However, there is some reason to believe that it might. It should be possible to integrate the estimation of the NAIRU model with the estimation of the Phillips curve. To the extent that uncertainty about the NAIRU in Phillips curve models arises from uncertainty about its time variation, the inclusion of the information on the state of the vacancy-unemployment relationship should reduce uncertainty in NAIRU estimates.

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Table 1: Alternative Estimates of The Vacancy-Unemployment Relationship

			First Difference		Filtered (two sided MA)			Stable Time Periods		
			With Constant	No Constant	9Q window	17Q window	25Q window	1958Q3-1968Q4	1975Q2-1985Q4	2001Q1-2007Q2
Age - adjusted Unemployment	OLS	b	0.53	0.53	0.54	0.53	0.53	0.52	0.52	0.47
		se	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01
		b=.515 (alpha)	*0.32*	*0.32*	*0.16*	*0.24*	*0.11*	*0.34*	*0.98*	*0.00*
	IV	b	0.56	0.56	0.54	0.52	0.52	0.53	0.50	0.45
		se	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01
		b=.515 (alpha)	*0.09*	*0.09*	*0.12*	*0.43*	*0.36*	*0.05*	*0.38*	*0.00*
Unemployment	OLS	b	0.54	0.54	0.55	0.53	0.53	0.50	0.50	0.49
		se	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01
		b=.515 (alpha)	*0.12*	*0.12*	*0.03*	*0.25*	*0.22*	*0.23*	*0.21*	*0.01*
	IV	b	0.56	0.56	0.55	0.52	0.52	0.50	0.50	0.49
		se	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01
		b=.515 (alpha)	*0.08*	*0.08*	*0.08*	*0.44*	*0.66*	*0.14*	*0.11*	*0.00*

Note: The regressions using first differenced data use both the JOLTS and the Help-Wanted Index; The regressions using filtered data use only the Help - Wanted Index data from 1955Q1-1996Q4; Stable Time Periods - 1958Q3-1968Q4 and 2001Q1-2007Q2 - Help - Wanted Index, 2001Q1-2007Q2 - JOLTS

The instrumental variables used are 4 lags of the vacancy rate for the Stable Time Period Regressions, 4 lags of the change in the vacancy rate are used for the First Difference regressions and four lags of the filtered vacancy rate for the Filtered regressions.