

A First Glance at NAIRU in Hawaii

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1. Introduction

At the end of 2002, the unemployment rate of Hawaii was at 3.93 percent. Given the statistical fact that the unemployment rate between 1980 and 2002 averaged 5.04 percent, what do you think about the current rate? Do you consider it as a high or a low rate? If a survey were conducted, we would never get a unanimous response on this question. This is because each person probably thinks of different “proper” level of unemployment rate. So, is there any benchmark of unemployment rate that everyone can rely on? The answer is yes, and such benchmark is called “NAIRU” among macroeconomists.

An awkward word of NAIRU stands for the Non-Accelerating Inflation Rate of Unemployment. It becomes widely known among macroeconomists in the 1990’s, and its role in policymaking is increasingly important in recent years. One can think of it as the “natural rate of unemployment”, a well-known synonym of NAIRU. If the actual unemployment rate falls below the NAIRU, it means that labor is being highly demanded. It is likely that the wage bidding-up spiral will occur, if producers cannot find enough instantly available labor. Pressure on inflation then begins to build up.

Objectives of this paper are to (1) determine the level of constant NAIRU in Hawaii, (2) estimate its variance, and (3) evaluate its stability over time. This paper is separated into

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six sections. This introduction is the first. Section 2 describes the theory of NAIRU and some empirical works. Section 3 briefly illustrates the economics development of Hawaii since 1980's. Methodology is proposed in Section 4, and results are shown in Section 5. Conclusions and suggestions in the last section then complete this paper.

2. NAIRU in Theory and Practice

Since A.W. Phillips (1958) discovered a relationship between wage inflation and unemployment, this so-called "Phillips curve relationship" has been one of the most controversial issues in macroeconomics. Phillips suggested that the wage inflation was negatively related to the unemployment rate. His model could fit the data from the United Kingdom between 1861 and 1957 very well. However, this relationship collapsed in the United States in the late 1960's and the early 1970's. Combinations of high inflation and high unemployment continually emerged during those periods. Friedman (1968) and Phelps (1968) argued that even though the Phillips curve relationship might be true in the short-run, only real forces should be able to determine the level of unemployment in the long run. A new hypothesis, namely the natural-rate hypothesis, was proposed. It states, "There is some normal or natural rate of unemployment, and that monetary policy cannot keep unemployment below this level indefinitely" (Romer, 2001, p.246).

Because Friedman and Phelps did not rule out the possibility of Phillips curve relationship in the short-run, there were efforts to revive the short-run Phillips curve. Quite successfully, they established their arguments on the sluggishness of wages and prices. The sluggishness may occur in many fashions, but all of them would generally lead to a certain level of correlation between real factors and prices. Expected inflation is introduced to this

framework to better capture the expectation made by economic agents. A model can be formulated as

$$\pi_t = \pi_t^e + \beta(u_t - u^*) + \varepsilon_t^s \quad [1]$$

where π_t is the current inflation, π_t^e is the expected inflation, u_t is the unemployment rate, and u^* is the natural rate of unemployment. The supply shock, ε_t^s , is a White noise. The theory suggests that the value of β should be negative, so that when the actual unemployment is below its natural rate, the inflation rate will increase.

The term “natural rate of unemployment” has recently been replaced with the “NAIRU”, the Non-Accelerating Inflation Rate of Unemployment. The term “natural rate” itself may be misleading because it implies that a certain amount of unemployment is acceptable. So, most of the economists prefer to use a “euphemism of NAIRU” (Krugman, 1994). The NAIRU is then defined as “the rate of unemployment consistent with an unchanging inflation rate” (Stiglitz, 1997).

Though the concept of NAIRU is quite concrete, there is still no consensus of how to estimate it. The most common transformation of [1] into an estimable equation involves an assumption of naive expectation. If one believes that people tend to make naive expectation, that is, $\pi_t^e = \pi_{t-1}$, equation [1] can be transformed into the following models.

$$\Delta\pi_t = \beta(u_t - u^*) + \varepsilon_t^s \quad [2]$$

or
$$\Delta\pi = \alpha + \beta(u_t) + \varepsilon_t \quad [3]$$

where $\Delta\pi_t \equiv \pi_t - \pi_{t-1}$ is the first difference of inflation. Equation [3] can give an approximate level of NAIRU, which is equal to $-\alpha/\beta$.

One of the growing areas under this topic is the introduction of Time-Varying NAIRU (TV-NAIRU). Although the theory suggests the existence of the NAIRU, it does not indicate that the NAIRU must be constant over time. In the past, economists generally believed that the NAIRU for the U.S. was around 6 percent. Nevertheless, the stylized fact that the unemployment rate in the U.S. persistently remained below 6 percent during 1994-2001 casts doubts upon this belief. Major explanation for the declining rate is focused on a changing composition of labor force. In practice, techniques used in estimating the TV-NAIRU vary greatly in term of the complication. Ball and Mankiw (2002) utilized a rather simple technique of HP filter, a smoothing method, to extract trend component (or TV-NAIRU) from a modified version of [3]. Sekhon (2001) introduced a complicated Hermite polynomial series of order 6 in place of α in [3], so that the estimated NAIRU would fluctuate with time as well.

In most papers, the estimated NAIRU for the United States ranges from 5.5 to 6.5 percent in the latter half of 1990's. The most recent estimate is from Ball and Mankiw (2002). They revealed that the TV-NAIRU was at 4.9 percent in 2000. This substantiates the general belief that the U.S. NAIRU is falling.

Once we know the point estimate of NAIRU, it is proper to ask how much confident we should put on the estimates. This important empirical question has long been ignored until the work of Staiger, Stock and Watson (1996, 1997). Prior to that, the variance had been assumed rather than estimated. Because the NAIRU is a nonlinear function of α and β , its variance would not come out directly from any statistical package. The study by Staiger et.al. shows that there are two possible techniques to estimate the variance of NAIRU—the delta method and the Fieller's method. This paper makes use of the delta method to estimate

the variance, so the technique will be discussed in detail in Section 4. On the other hand, the Fieller's method, originally proposed by E.C. Fieller (1954), is an iteration technique based on [2]. After the NAIRU is estimated, this procedure repeatedly adds a certain value to the NAIRU and runs regression until there statistically exists a constant term in [2]. Then, the last value is considered as the standard deviation of NAIRU. Staiger et.al. (1997) found that the point estimate of monthly TV-NAIRU ranged from 5.5 to 5.9 percent in 1994, and the tightest of the 95 percent confidence intervals was between 4.3 and 7.3 percent based on the Fieller's method.

Although the estimates of NAIRU are still subject to many statistical arguments, there seems to be considerable supports for the NAIRU as well. For instance, "the theory of NAIRU has been highly successful in tracking inflation over the last 20 years", said Krugman (1996, in Fair, 1999). Alan Blinder, the former vice chairman of the Board of Governors of the Federal Reserve System, also described it as a "clean little secret of macroeconomics" (also in Fair, 1999).

3. Economic Development of Hawaii Since 1980's

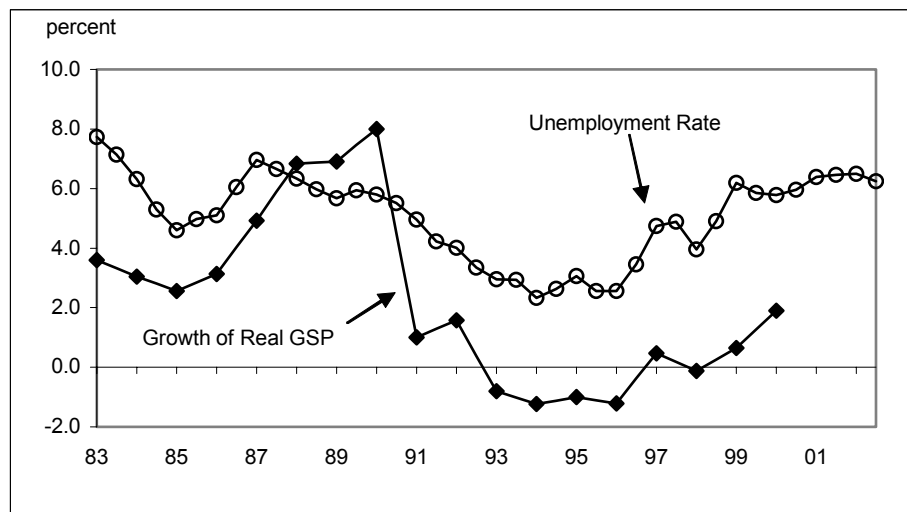
This small section is intended to lay down some important aspects of Hawaii's economic development, so that readers can have a better understanding of the discussing issue². Generally, Hawaii is a very small economy. Since became the fiftieth state of the United States in 1959, Hawaii has faced many ups and downs in its economic development. Slowly but continually, Hawaii evolved from an agricultural-based economy into a service-based one. Non-farm income from service sector, especially tourism, now accounts for

² Readers who are interested in the economic development of Hawaii can also see Grandy (2002) for details on this subject.

slightly more than 50 percent of all non-farm income. The development since 1980's can be easily separated into 2 periods; that is, the bubble period in the 1980's and the slowdown period from the 1990's to the present.

The 1980's seems to be a golden period in Hawaii's economics history. The growth of real Gross State Products (GSP) increased from about 4 percent at the beginning of the decade to 8 percent at the end. It is believed that the economic expansion of Hawaii during this period is a positive spillover effect from the bubbling economy in Japan. Not only did the number of Japanese visitors increase, but the Japanese direct investment in Hawaii also rose considerably. The unemployment rate in Hawaii clearly decreased during the first half of 1980's (*Figure 1*). As a result, inflation steadily climbed up from 2 to 8 percent (*Figure 2*). However, because of the growing prosperity in Hawaii, many workers moved from the mainland to Hawaii to reap the benefits. Growth of labor force increased from about 0 percent in 1985 to 4.9 percent in 1987 (and peaked at 6.2 percent in 1991). This influx of job-searching workers obviously pushed the unemployment rate up during 1985-1987.

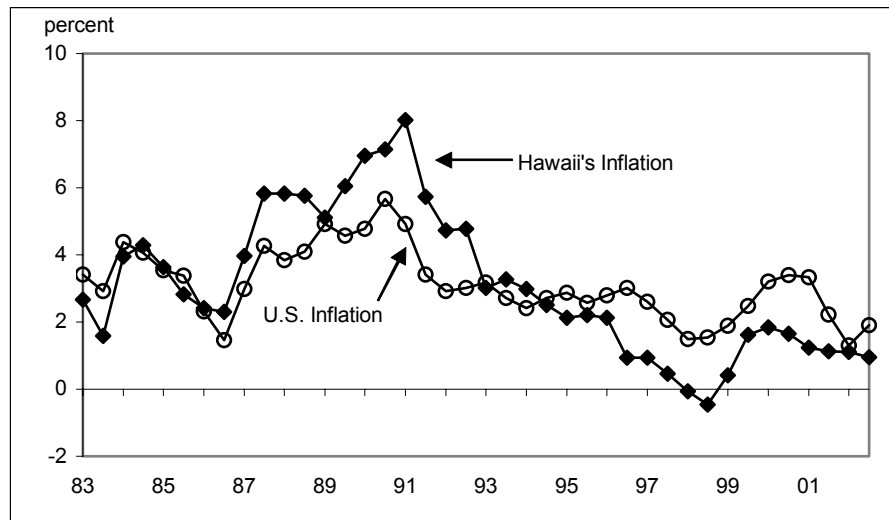
Figure 1 Growth Rate of Real Gross State Products and Unemployment Rate in Hawaii, 1983-2002



Source: Bureau of Labor Statistics and Bureau of Economic Analysis

The voyage of Hawaii during the 1990's took an exactly opposite direction to that in the 1980's. The "malaise of the 1990's" (La Croix, 2002, p.13) began with the outburst of the three "pinpricks" (Grandy, 2002)—the Gulf War in 1991-92, the U.S. recession in 1992-93, and the burst of Japanese bubble in 1991. The growth rate dropped substantially from 8 percent in 1990 to 1 percent in the following year. It became even worse when the growth rate crossed the zero-percent threshold and remained negative between 1993 and 1996. Declining asset prices caused the inflation rate to reverse its course. In 1998, Hawaii joined a small group of nations that faced a rare experience of deflation.

Figure 2 Hawaii's and U.S. Inflation, 1983-2002



Source: Bureau of Labor Statistics

Surprisingly, a large increase in the unemployment was not observed during this malaise period. The unemployment continued to decline until 1996. The rigidity alone may not be enough to explain for such a long period of irresponsiveness to the declining growth. One potential explanation is that workers moved away from Hawaii. Size of the labor force in Hawaii began to grow at a slower rate in 1991, and it actually shrank between 1993 and

1995 (and again between 1999 and 2000). Effects of labor mobility between Hawaii and the mainland might dominate the true effect of unemployment, leaving the unemployment rate declined over the slow period. As a result, the unemployment rate in Hawaii seems to have an unusual procyclical path. This point may prove to be a major problem later in this paper.

4. Methodology

As described in Section 2, researchers regularly estimate the NAIRU based on [3]. However, there are two key weaknesses of any model in this form. First, it is likely (but not always) that the dependent and independent variables would not be integrated of the same order. Then, the problem of spurious regression may arise. Second, when the inflation is differenced, the information about its level does not enter the model. This procedure equally assumes that the economy is at equilibrium in the first period, which is not necessarily true. The amount of disequilibrium at the beginning period will then persist throughout the study period.

A better position to begin with is from [1]. One modification can be made is about how the expectation of inflation is formed. Although the naive expectation seems to be a reasonable assumption at the national level, it is inadequate at the state level. Certainly, Hawaii is geographically remote from the mainland and possibly has a certain level of real-market independence, but its money market does not possess such a self-reliance feature. Hawaii, same as other states, needs to follow the same monetary policy implemented at the national level. Whatever happens in the money market over there must affect the money market (and the whole economy) here as well. It is therefore reasonable to formulate the expectation not only from the previous inflation but also from the inflation on the mainland.

However, it is assumed that when an agent establishes her expected inflation in period t , the information on the U.S. inflation in period t is already available for her. Hawaii is normally considered as a price-taker since most of the goods are shipped from the mainland. Any change in U.S. prices should already be observed at the beginning of each period. Also, because Hawaii is a small state (as its GSP accounts only for 0.43 percent in the U.S. GDP), its inflation should not have a significant reverse effect to the U.S. inflation. Thus, the U.S. inflation can be thought as given even at the macro level.

Mathematically, we can write the expected inflation as $\pi_t^e = \psi \pi_{t-1} + (1-\psi) \Pi_t$, where Π_t is the inflation rate of the United States and ψ is the weight placed on the local inflation. As a result, equation [1] can be transformed into

$$\pi_t = \alpha + \beta(u_t) + \psi(\pi_{t-1}) + \theta(\Pi_t) + \varepsilon_t \quad [4]$$

where the NAIRU is still equal to $-\alpha/\beta$ in this model. This equation can be estimated by the OLS with a restriction that the sum of ψ and θ must be equal to one. This restriction can also be tested for its validity using the standard F-test for a nested model.

After the NAIRU is estimated, the following question is how reliable the point estimate is. As mentioned in Section 2, the NAIRU is clearly a nonlinear function, and it becomes complicated to estimate a variance of such function. Staiger, Stock and Watson (1997) proposed two methods to estimate the variance of NAIRU. This paper utilizes only the delta method in this procedure (see Greene, 2003). In essence, the delta method expands the NAIRU around the two estimated coefficients using the first-order Taylor expansion as shown in [5]. Then, one can take the variance of this approximation to get an estimated variance as in [6]. Only information from the OLS on [4] shall be needed at this stage.

$$f(\alpha, \beta) = f(\hat{\alpha}, \hat{\beta}) + \frac{\partial f(\hat{\alpha}, \hat{\beta})}{\partial \hat{\alpha}} (\hat{\alpha} - \alpha) + \frac{\partial f(\hat{\alpha}, \hat{\beta})}{\partial \hat{\beta}} (\hat{\beta} - \beta) \quad [5]$$

$$\sigma_{NAIRU}^2 = \left[\frac{\partial f(\hat{\alpha}, \hat{\beta})}{\partial \hat{\alpha}} \right]^2 Var(\hat{\alpha}) + \left[\frac{\partial f(\hat{\alpha}, \hat{\beta})}{\partial \hat{\beta}} \right]^2 Var(\hat{\beta}) + 2 \left[\frac{\partial f(\hat{\alpha}, \hat{\beta})}{\partial \hat{\beta}} \cdot \frac{\partial f(\hat{\alpha}, \hat{\beta})}{\partial \hat{\alpha}} \right] Cov(\hat{\alpha}, \hat{\beta}) \quad [6]$$

To see whether the estimated NAIRU is stable over time, we can test for the parameter stability, i.e. the Hansen test, on our estimated parameters. Nonetheless, coping with Time-Varying NAIRU is beyond the objective of this paper, and the instability (if any) will be treated only as a suggestion for other studies. Moreover, since Hawaii in the 1980's is not quite the same as Hawaii in the 1990's as described in Section 3, we can also test for structural break between those periods using the Chow test.

Variables used in this study include the Hawaii's inflation, the Hawaii's unemployment rate, and the U.S. inflation, all of which are retrieved from the Bureau of Labor Statistic. Behavior of these variables is previously explained in Section 3. It should be noted that all inflation rates are calculated from the first difference of logarithm of price indices. The data are semiannually and were collected for 1983-2002 period. Also note that, in running the regression, only the data from the first half of 1983 to the first half of 2002 are used. The last observation on the second half of 2002 is reserved for an analysis on the *ex post* forecast. Finally, this paper employs SHAZAM as the main statistical package.

5. Estimates of NAIRU in Hawaii

5.1. Model Estimation

Before we shall delve ourselves into the OLS results, it is utmost important to test for unit roots and cointegration; otherwise the results may be spurious. The Augmented Dickey-Fuller (ADF) test is used in this paper for this purpose. However, the ADF is known for its

low power of a test. Particularly, the ADF has little power to make a distinction between trend stationary and drifting processes (Enders, 1995). The decision to include a constant or a trend may be awfully vital to the outcome.

A simple 3-step procedure, which is slightly different from that suggested by Enders, is developed in this paper to justify whether or not to include a drift and a trend in the ADF. It is assumed on the outset that all variables follow autoregressive processes. The first step is to estimate the Autocorrelation Function (ACF) to see how many periods the memory of each process statistically remains. This number of lags is then used to estimate the Autoregressive (AR) form in the second step. The AR model includes both drift and time trend. Results from the OLS can indicate if any of them is significant. If, however, none of the ACF in the first step is significant, an *ad hoc* lag of one is still included in the AR model. In the last step, depending on the result from previous step, the ADF is performed with a drift, a drift and a trend, or none of those. The number of lagged endogenous variables in the ADF is determined solely by the Akaike Information Criterion (AIC). Results are shown in Table 1.

Table 1 Summary of Augmented Dickey-Fuller Tests

Variable	Sig. Order of ACF	Autoregressive Form		Augmented Dickey-Fuller			Result
		p-value of trend	p-value of Constant	Number of lag	t-stat	Critical t**	
π	2	0.021*	0.010*	2	-1.120	-3.18	I(1)
$\Delta\pi$	0	0.302	0.961	1	-4.391	-1.61	
Π	1	0.108	0.135	4	-1.039	-1.61	I(1)
$\Delta\Pi$	0	0.433	0.747	4	-3.171	-1.61	
U	2	0.518	0.063*	3	-1.377	-2.58	I(1)
Δu	1	0.238	0.957	2	-3.065	-1.61	

Note: (*) Significant at 10 percent and included in the ADF.

(**) Critical level at 5 percent significance level with 50 observations from Enders (1995).

The null hypothesis of a unit root is that the variable follows a random walk. The t-statistics for all three variables at their levels are -1.120, -1.039, and -1.377, respectively.

Therefore, the null hypotheses cannot be rejected in any of those tests. However, when the variables are in the first difference form, the null hypotheses are rejected in all cases. It can be concluded that all variables are difference stationary processes, or they are integrated of order 1.

In testing for cointegration, this paper adopts the Engle-Granger test. The test relies on [4] without the parameter restriction. Following the OLS estimation, the ADF test with neither constant nor trend is carried out on the error term from the OLS. The result shows that the t-statistic from the ADF is -1.622, which is only slightly but still lower than the critical value of -1.61 at the 5 percent significance level. It means that the inflation, the unemployment rate, and the U.S. inflation are cointegrated. In fact, there is one more evidence showing that the three variables are cointegrated, but it will be discussed later in this section.

Once all variables are cointegrated, the regression can then be meaningful. The OLS is used to estimate coefficients in [4], and results are shown in [7]. The numbers in parentheses are standard deviations.

$$\pi_t = -1.174 + 0.225 u_t + 0.790 \pi_{t-1} + 0.210 \Pi_t + \varepsilon_t ; \quad \text{Adj.R}^2=0.866 \quad [7]$$

$$(0.493) \quad (0.095) \quad (0.087) \quad (0.087)$$

The most striking result is on the goodness of fit of this model. The adjusted R^2 is as high as 86.6 percent. All coefficients are significant, but only two of them have expected signs. Increases in the lagged inflation and the U.S. inflation have positive effects on the Hawaii's inflation. Surprisingly, the unemployment is positively related to the inflation. This equally says that the Hawaii's Phillip curve is positively sloping. As we have seen in Section 3, it is possible that the migration effect dominates the unemployment effect in Hawaii during the bubble of 1980's and the slowdown of 1990's. Omission of relevant

variable is admittedly a major problem and may cause a serious bias on the estimates. However, including the issue of labor mobility is always not an easy task. Given the time constraint of this paper, this issue will be set aside for now. It is strongly suggested that follow-up studies (if any) should pay a great deal of attention on the labor mobility issue.

Of all three variables, the lagged inflation seems to have the strongest impact on the inflation. The standardized coefficient of lagged inflation is equal 0.781, which is much greater than that of the unemployment (0.146) and of the U.S. inflation (0.102). Fortunately, the problem of autocorrelation does not appear in this model. The Durbin-Watson statistic is 1.759 and is not significant. The estimated rho is as low as 0.06.

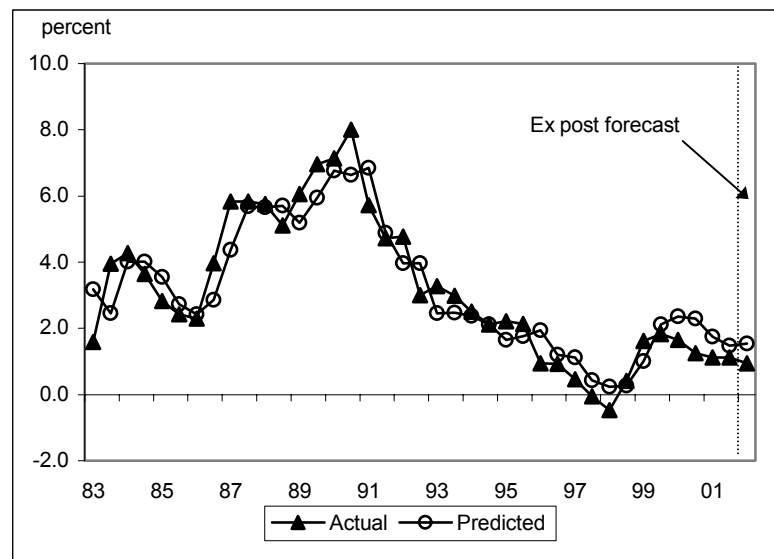
It is also possible to check the validity of the restriction in [4]. This is done by the standard F-test. The result shows that the restriction may not be possible. The value of F-test on the restriction is 3.376, while the critical value is 3.276. The null hypothesis that the sum of coefficients is equal to one has to be rejected. This result certainly calls for a new restriction or, in fact, an alternative assumption on how the expected inflation should be formed. However, since the restriction cannot be rejected at 1-percent significance level, we shall take this ambiguity and proceed as if this restriction is appropriate.

Once all parameters are estimated, the next step is to analyze the ability to forecast of this model. A good model should carry on its power into the forecast process. As mentioned earlier, the last observation—the second half of 2002—is reserved for this stage. Even though the estimation fits very well with the actual data, the forecast does not have such beauty. The forecasted inflation in the last observation is equal to 1.53, while the actual inflation is only 0.95. The root mean square error is 0.76 or only 3.2 percent of the sum square error. The Theil's inequality coefficient is about 0.81, which is not a pleasant result.

If the coefficient is one, it means that the prediction is only as good as the naive expectation (Pindyck and Rubinfeld, 1998). This model is only slightly better than a naive model.

Plots between actual and predicted inflation are shown in Figure 3. It can be seen that, in general, the predicted series follows the actual series nicely. Nonetheless, a few problems with these estimates can be pointed out. First, it misses many turning points such as in 1987, 1989 and 1991. The estimated turning points usually happens a period slower than the actual points. This pattern could be expected as the lagged inflation has the strongest impact among the three independent variables as previously stated. The other problem is that it seems to systematically overestimate inflation in the recent observations, or specifically since 1999.

Figure 3 Actual and Predicted Inflation with Ex-Post Forecast



A short digression from the NAIRU is valuable at this point. When a long-run model like [7] is estimated, it is usual to ask about the short-run adjustment. An error correction model is introduced to capture the short-term dynamics. It takes the similar form as [4], but all variables enter the model as in the first difference form. Lagged residual from [7], ε_{t-1} , is

also included as another independent variable in the short-run model (Mills, 1990). Regression results are shown in [8]. Again, the numbers in parentheses are the standard deviations. The low level of adjusted R^2 is usual in this type of model, and all except unemployment rate are significant.

$$\Delta\pi_t = 0.035 - 0.072 \Delta u_t + 0.698 \Delta\pi_{t-1} + 0.632 \Delta\Pi_t - 0.925 \hat{\varepsilon}_{t-1} + v_t; \quad [8]$$

$$(0.116) \quad (0.233) \quad (0.227) \quad (0.191) \quad (0.304) \quad \text{Adj.}R^2=0.395$$

Two important implications can be derived from this result. First, the coefficient of lagged residual from the long-run equation typically shows the speed of adjustment back to the long-run equilibrium. The value of 0.925 is “the proportion of disequilibrium in (inflation) in one period that is corrected in the next period” (Gujarati, 1995). Inflation adjusts itself back to the equilibrium rapidly. The other important implication is that this result confirms the cointegration between the three variables. It is taken from the fact that error term from the long-run equation is significant in the short-run model. Given that $\Delta\pi_t$ and v_t in [8] are stationary, it follows that ε_{t-1} must also be stationary; therefore, the variables in the long-run model must be cointegrated. This verifies the result from the Engle-Granger test conducted earlier.

5.2 NAIRU Estimation

Given the results from [7], the NAIRU can be directly estimated using the formula derived in Section 4. The result shows that the NAIRU in Hawaii is approximately at 5.10 percent. Even with the problems mentioned in Section 5.1, this 5.10 percent still holds the meaning of “non-accelerating inflation rate of unemployment” as defined by Stiglitz. However, one needs to be careful when analyzing the deviation from the NAIRU. The rates higher and lower than NAIRU now have an opposite meaning to what suggested by the

theory. This is because of the procyclical pattern of unemployment rate in Hawaii. The estimated coefficient of unemployment is positive in this study. It means that if the unemployment rate is lower than the NAIRU, it is possible that the inflation will decline, and vice versa.

Furthermore, the estimated covariance between α and β in [7] is equal to -0.0454. With this piece of inflation, the variance of the NAIRU can be estimated using formula in [6]. The result is that the estimated variance of the NAIRU is 0.577, and the estimated standard deviation is 0.33. This approach yields a 95-percent confidence interval of (4.44%, 5.76%) for the NAIRU. Whenever the actual unemployment falls from this range, it is 95-percent certain that the current unemployment rate actually deviates from the natural rate.

The last objective to be achieved in this paper is the stability of the estimated NAIRU. First, the stability of each parameter is tested using the Hansen test. Unfortunately, both parameters of interest, α and β , do not pass this test. The test-statistic for the α and the β are 0.44 and 0.37 respectively, while the critical value at 10-percent significance level is 0.353 for both parameters. We need to reject the null hypothesis of stable parameter in both cases. Another test implemented is the Chow test in order to analyze the stability of parameters between the 1980's and the 1990's. The observations are separated into two sets of data. The first group contains the data from 1983 to 1989, and the second group is from 1995 to 2002. The middle observations from 1990 to 1994 are excluded, so that the two sets would not be closely related, which may contaminate the result. The calculated F-test is equal to 5.00 and is significant. If the small sample size in each group does not have a great impact on each regression, the result from the Chow test certainly suggests that the parameters take different values between the 2 periods. The problem of parameter instability may probably

point toward the inappropriateness of the constant NAIRU. As stated earlier, estimating the TV-NAIRU is beyond the scope of this paper and will not be done here. Yet, this problem is still beneficial in identifying the needs for the TV-NAIRU.

6. Conclusions and Suggestions

In conclusion, the estimates show that the NAIRU in Hawaii is about 5.10 percent. If the actual rate of unemployment deviates from this level, one can predict a change in the inflation in the near future. The 95-percent confidence interval of the NAIRU can be constructed around 4.44 and 5.76 percent. These figures, however, cannot yet be used extensively in policy-making. A few statistical problems arise during the estimation process. In sum, the assumption about how agents form their expectation on inflation may not be quite appropriate, the Time-Varying NAIRU may be more suitable than our constant NAIRU, and there exists the inverse Phillip curve relationship in Hawaii in the exclusion of labor mobility.

Though Hawaii does not conduct the monetary policy by its own, it is still important to assess the level of NAIRU. Wouldn't it be good to know what will happen with the inflation in the near future? This paper therefore tries to estimate the level of constant NAIRU in Hawaii. To the little knowledge of the author, there has been no study of this kind at the state level, especially in Hawaii. Estimating the Phillip curve at the state level becomes increasingly difficult because workers can move freely between states. The unemployment rates may not reflect the true economic situation of each state. As indicated in the title, this paper is just merely the first glance on this issue. There are still more works to be done on this topic. After all, a man cannot run without taking the first step, and so does the study of NAIRU in Hawaii.

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