On the Death of the Resurrected Short-Run Phillips Curve: A Further Investigation

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In a recent issue of this journal, Richard Reichel (2004) takes issue with the resurrected Phillips curve (PC) in William Niskanen's (2002) article. Accordingly, Niskanen's reformulation of the PC provides empirical evidence for a weak, but statistically significant, short-run (in the same year) tradeoff between inflation and unemployment rates in the United States. Furthermore, the unemployment rate is directly and significantly determined by the one-period lagged value of the inflation rate, which implies an upward sloping PC, consistent with the type of PC explicated by Milton Friedman (1987). Reichel's main point of contention is that the variables in the reformulated version of PC are nonstationary, meaning that statistical properties (such as conditional mean and variance) vary with time. Thus, Niskanen's findings are spurious.

However, variables with the same order of integration, though nonstationary in level, can share a linear trend in the long run—that is, they are cointegrated. If cointegration is confirmed, then the implied error correction model (ECM) is capable of depicting long-run equilibrium along with short-term dynamic adjustments. In that spirit, Reichel examines inflation and unemployment data for the 1960–2001 period in the United States as well as in 15 industrialized

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nations for integration, cointegration, and error corrections. His overall findings suggest that there appears to be no evidence of cointegration between inflation and unemployment rates, although the short-term PC is observed in Italy and the United States. Most notably, the United States is the only nation in which the short-run PC has also been confirmed in the context of the implied ECM utilized by Reichel. Consequently, he concludes that the U.S. case is an exception to the rule, and that for all practical purposes the PC phenomenon appears to have been dead in the rest of the world.

This article addresses a number of issues both theoretically and empirically associated with the above studies that deserve further consideration. First, the proposed autoregressive distributed lag (ARDL) model reformulated by Niskanen is subject to a specification error in that it lacks the demand pressure mechanism that is necessary for a meaningful test of the contemporary PC.[1] Second, the empirical findings of the ARDL model have been heavily affected by the apparent structural changes. Indeed, when the ARDL model is adjusted for these changes (e.g., adverse supply shocks in the 1970s), the significant short-term PC disappears quickly. Third, the estimated value of the so-called nonaccelerating inflation rate of unemployment (NAIRU) is understated. Fourth, a reliable integration test should take into account the structural breakpoints (temporary or permanent) within the sample period. In fact, when the aforementioned breakpoints are incorporated into Niskanen's model, the variables appear to be stationary—that is, integrated of order zero. Hence, Reichel's main argument regarding integration, cointegration, and the ECM does not hold at least for the United States. Finally, assuming that Reichel's nonstationarity proposition holds for the other 15 nations considered, the implied ECM depicts only linear dynamic adjustments. As is well known, the notion of the PC in its oldest format as prescribed by Phillips (1958) is inherently nonlinear: the unemployment rate is not, except by chance, equal to the inverse of the inflation rate. Thus, the commonly used linear ECM may not be

[1]The demand pressure mechanism is the impact of aggregate demand on the output gap measured by the discrepancy between the one-period lagged value of gross domestic product (GDP) and full employment GDP. In the PC framework, an increase in aggregate demand (demand pressure) results in an increase in the price level. Thus, the lagged output is above its full employment level. The expansionary gap also implies that the unemployment rate is below its natural level and that there are short-run tradeoffs between unemployment and inflation rates.

appropriately specified.[2] Toward that end, we re-estimate Niskanen's model and demonstrate the embedded residuals anomaly along with the findings of the corrected model. We next present and estimate a more appropriate version of Niskanen's model and conclude with some implications for monetary policy.

Niskanen's Model

With minor modifications, we can present Niskanen's model as the first difference version of the PC, which can easily be transformed into an ECM (see Greene 2003: 579):

(1) $U_t = a + b\ U_{t-1} - c\ I_t + d\ I_{t-1} + e_t$,

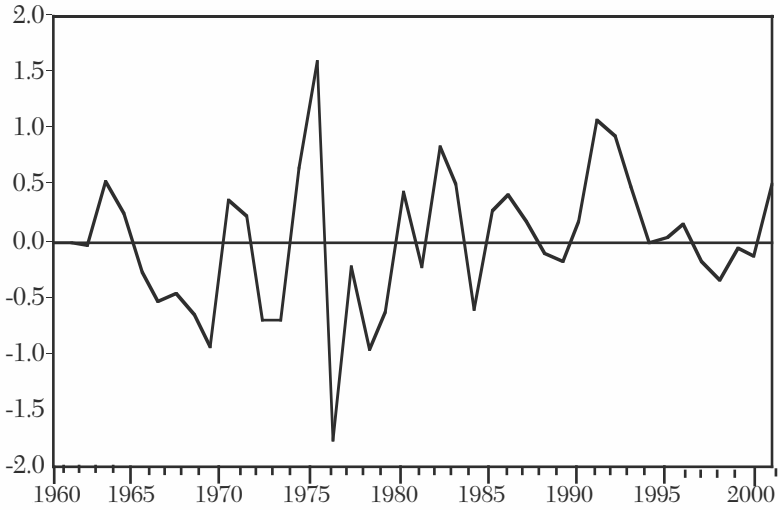
where U_t is the unemployment rate; I_t is the inflation rate; a is the intercept; b, c, and d are regression coefficients; and e_t is a stochastic error term. In equation 1 (Niskanen's estimated ARDL model), a/(1-b) is a measure of the so-called NAIRU, c is a measure of the short-term PC, and d depicts a change in U_t due to a change in the one-period lagged value of I_t (see Niskanen 2002: 197, equations 1–3). Utilizing annual data for the 1960–2001 period, Niskanen reports significant regression coefficients, with the estimated NAIRU at 3.7 percent, and a good measure of the overall fit.

Using the same data and sample period (Ut = civilian unemployment rate, 16 years and older in percent, and It = the percentage rate of growth of the GDP chain price index, with the base year of 2000), the findings are similar to those reported by Niskanen.3 However, an examination of the residuals (the discrepancy between actual and estimated Ut in equation 1) indicates a significant volatility in the mid-1970s (Figure 1).[4]

As can be seen, there is a noticeable residuals spike in 1975 (a by-product of adverse supply shocks resulting in a high stagflation rate) that has not been picked up by Niskanen's simple ordinary least

[2]An empirical investigation of the nonlinear ECM is beyond the scope of this article.
[3]The data have been taken from the Haver Analytics: U.S. Economic Statistics, 2004.
[4]Niskanen's claim that the estimated ARDL model appears to have been stable over time is doubtful in the presence of the apparent residuals gyration. Also, the inappropriately reported Durbin Watson statistics by Niskanen (equation 4) and Reichel (equation 5) cannot measure autocorrelation in the residuals because of the lagged dependent variable (U_{t-1}) in the model (see Johnston and DiNardo 1997: 182).

FIGURE 1
The Estimated Residuals of Niskanen's Model, 1960–2001



squares (OLS) estimation. As such, Niskanen's empirical findings are plagued with a profound anomaly embedded in equation (1).

To account for the apparent structural breaks in 1975, dummy variables would have to be incorporated in the Niskanen model, and the corrected model would have to be estimated with OLS. To ensure that the OLS findings are not spurious, we have subjected the variables to the integration test proposed by Pierre Perron (1989). The Perron test is specifically designed to detect nonstationarity in the presence of structural breaks in the model.[5] Without delving into the details of Perron's test, it incorporates dummy variables for temporary or pulse changes (DP), as well as for permanent or level changes (DL) in the

[5]In using Perron's test, care should be exercised because the date of the structural break is thought to be known a priori. Furthermore, a number of researchers have argued that the exogenous breakpoints in Perron's procedure may favor over-rejection of the unit-root hypothesis. See for example, Banerjee et al. (1992), Zivot and Andrews (1992), and Perron (1997). Indeed, the July 1992 issue of *Journal of Business and Economic Statistics* is entirely devoted to breakpoints and integration in time series econometrics.

augmented Dickey-Fuller (ADF) integration test.[6] The results of Perron's test resoundingly reject nonstationarity for both unemployment and inflation rates within the sample period.[7]

The OLS re-estimation of Niskanen's model with intercept and slope dummies (DUM and DUM1, respectively such that DUM = 0 in 1960–75 and 1 otherwise) are reported below:

$$(2)\ U_t = 0.77 + 0.61\ U_{t-1} - 0.09\ I_t + 0.45\ I_{t-1} + 0.80\ DUM - 0.18\ DUM1$$
$$(1.35)\ (6.75)\quad (-0.83)\quad (4.23)\quad (1.95)\quad (-2.13)$$

Adjusted R-squared = 0.83 Ljung-Box Q-statistic = 1.41 (probability = 0.49, optimum lag-length based on the Schwartz Bayesian criterion = 2)

where numbers in the parentheses are t-statistics, and the Q-statistic (distributed as a chi-squared with 2-degrees of freedom) is an appropriate measure of the residuals autocorrelation.[8] There is no evidence of a short-term PC, the two dummy variables are significant at the 5 percent level, and the residuals are nearly "white noise." The regression coefficient of the lagged inflation rate is positive and highly significant as expected. Moreover, the estimated NAIRU = (0.77 + 0.80)/(1 – 0.61) = 4 percent, which is larger than that reported by Niskanen.[9]

The Augmented Phillips Curve

Among different versions of the PC suggested, the Ed Phelps (1967) and Milton Friedman (1968) versions have been widely cited in the literature. Given the wage price spiral and incomplete information, workers are incapable of recognizing the difference between changes in real and nominal wages in the short run. As such, an

[6]Reichel (2004) has used the ADF-test and different variants of it, but the results for the United States are misleading because the underlying variables are stationary when the structural breakpoints (in the data) have been taken into consideration.

[7]A general version of the Perron equation is $Z_t = a1 + b1\ Z_{t-1} + c1\ T + d1\ DP + f1\ DL + g1_i\ cZ_{t-i} + e1_t$, where Z is the variable to be tested for nonstationarity (U_t or I_t), a1 is the intercept, T is a linear time trend, b1–g1 are regression coefficients, e1 is the error term, and i = 1, 2,..., n. The estimated t-statistics associated with Z_{t-1} (8.12 for U_{t-1} and 4.8 for I_{t-1}) are larger than the Perron nonstandard critical values at the 5 percent level (4.17 and 4.22 in absolute value, respectively). See Perron (1989: 1377). Consequently, the null hypothesis of a unit root is rejected. The detailed findings are available from the authors.

[8]This test is quite potent even with the lagged dependent variable in the model.

[9]The average NAIRU in 1960–2001 was about 6 percent.

increase in I_t results in higher wages, which in turn increases production (decreases U_t), resulting in a short run tradeoff between I_t and U_t. In this formulation, I_t is determined by its expected value (EI_t) and the output gap $(Y_{t-1}-Y^*)/Y^*$, where Y is GDP and Y^* is full employment GDP.[10] The output gap depicts the market pressure on aggregate demand, which eventually creates inflationary pressure in the macroeconomy. Accordingly, I_t and the gap are directly related and the size of the regression coefficient is a measure of the short-run PC. Before estimation with OLS, one needs to check Y for non-stationarity using the Perron test. As was the case for inflation and unemployment rates, the Y time series is also stationary. The OLS results follow:

$$(3)\ I_t = 0.011 + 0.83\ EI_{t-1} - 0.000108\ (Y_{t-1} - Y^*/Y^*)$$
$$(2.20)\ (10.54)\qquad (-1.57)$$
Adjusted R-squared = 0.79

The PC coefficient is negligible, statistically insignificant, and has the wrong sign. It implies that whenever the output gap is positive ($Y_{t-1} > Y^*$) and the actual unemployment rate is below its natural level, the inflation rate falls—a finding quite at odds with the existence of the short-run PC in the United States. Indeed, the negative coefficient confirms an (insignificant) upward sloping PC—a finding in concert with the Friedman-Phelps suggestion nearly four decades ago.

Conclusion

The empirical findings of this article suggest that Niskanen's resurrected short-term PC for the United States needs to be buried in the same place as its predecessor. In like manner, Reichel's findings (at least for the United States) also would have to be buried. His integration test and the implied ECM do not take into account major structural breaks in the mid-1970s and, thus, suffer from specification errors. However, there appears to be weak evidence of an upward sloping PC in the 1960–2001 sample period. The anemic policy implication is that if inflation is finally adopted as a target by the monetary authority (the Fed), it can also subtly be viewed as a target for unemployment and output (GDP).

[10]There are several different ways of generating data on EI_t, the most common of which is to use the lagged value of I_t as a proxy for EI_t (see Hall and Taylor (1997: 212–14).

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