An Austrian Rehabilitation of the Phillips Curve

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William Niskanen (2002) estimated a Phillips curve for the United States using annual 1960–2000 data. By adding one-year-lagged terms in unemployment and inflation, he was able to show that this familiar equation is misspecified. In his improved specification, Niskanen found that the immediate impact of inflation is to reduce unemployment, confirming the traditional understanding of the Phillips-curve relationship, but also finding that after an interval as short as one year inflation has generally been followed by increased unemployment. Though Niskanen was perhaps unaware of it, his results lend strong support to the Austrian model of the business cycle. In that model, credit expansion results in a temporary but unsustainable expansion. Unemployment is lowered in the short run, but once the policy-induced malinvestment is recognized, total output and income will be permanently reduced, and unemployment will increase.

Beyond reinterpreting Niskanen's results, this article estimates a similar model using an expanded monthly 1948–2009 dataset. In particular, the article presents an improved specification with a statistically better-motivated and more-encompassing lag structure. Insights and cautions suggested by Reichel (2004), who estimated vector-error-correction (VEC) models for a variety of different

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countries, and by Moghaddam and Jenson (2008), who estimated a respecified error-correction-model (ECM), are also addressed.

Background

The Phillips curve is the purported relationship between inflation and unemployment. In his study of U.K. wage inflation and unemployment, A.W.H. Phillips (1958) found a consistent inverse relationship between unemployment and wage inflation—when unemployment was high, wages increased slowly; when unemployment was low, wages rose rapidly. Phillips conjectured that the lower the unemployment rate, the more firms needed to raise wages to attract scarce labor.

At the height of the Phillips curve's popularity as a guide to policy, Edmund Phelps (1967) and Milton Friedman (1968) independently challenged its theoretical foundations. They argued that nominal wages were largely irrelevant, and that worker behavior responded only to real—that is, inflation-adjusted—wages. In their view, real wages would adjust to make the quantity supplied of labor equal to the quantity demanded, and the unemployment rate would then stand at a level uniquely associated with that real wage—the "natural rate" of unemployment, often also called the "non-accelerating inflation rate of unemployment" or NAIRU.

In the expectations-augmented Phillips curve proposed by Friedman and Phelps, unanticipated inflation results in a temporary depression of the real wage, making labor a relatively cheap factor of production, and facilitating lowered unemployment. This short-run tradeoff between inflation and unemployment disappears as soon as workers learn to expect the prevailing rate of price inflation and start demanding higher nominal wages. When workers thus restore the real wage to its pre-inflation level, labor ceases to be an especially cheap resource, and unemployment rises back to its natural rate.

The Friedman-Phelps critiques of the Phillips curve failed to consider the impact of "Cantillon effects" of expansionary policy. Monetary expansion, or expansionary fiscal policy such as public works programmes, both increase demand for output, and therefore demand for labor, in particular sectors at the expense of others. The higher real wage in the initially favored sectors accompanies a reallocation of resources, including labor, to those sectors. The higher real wage is spread out throughout the economy as those workers boost demand in consumption sectors, often geographically near the location of the industries that first benefit from the Cantillon effect. At each successive wave of spending, the increase in the real wage is dissipated, until it is overcome by the general increase in prices, which rise to meet it throughout the economy, and eventually rise beyond the average increase in nominal wages introduced by the expansionary policy.

During the 1970s, the Phillips curve became badly discredited as a policy guide, as the experience of protracted stagflation unambiguously gave the lie to government attempts to exploit this supposed trade-off between inflation and unemployment, leading to more of both. It is thus somewhat curious that that under the guise of the so-called Keynesian resurgence, the Phillips curve is again being invoked to justify expansionary monetary and fiscal policy.

Niskanen's Auto Regression Distributed Lag (ARDL) Specification

Niskanen (2002) suggests equilibrium unemployment (U^*) should be rendered as a positive function of lagged inflation:

(1) $U^* = a - bI + cI_{-1} + u.$

This becomes the natural rate of unemployment or NAIRU if the coefficients b and c are equal. Then note that the rate of change of the unemployment rate should be a linear function of the difference between the equilibrium rate of unemployment and the unemployment rate of the previous time period:

(2) $(U - U_{-1}) = d(U^* - U_{-1}) + v.$

By substituting equation (1) in equation (2) and solving for U, these two relations yield a reduced form:

(3) $U = ad - bdI + cdI_{-1} + (1 - d)U_{-1} + (du + v).$

Niskanen found that annual 1960–2001 data yielded the following estimate of equation (3), with standard errors in parentheses:

(4) $$\underset{(0.450)}{U = 1.487} - \underset{(0.086)}{0.229I} + \underset{(0.091)}{0.464I_{-1}} + \underset{(0.077)}{0.594U_{-1}} + (du + v).$$

Adj R-square = 0.814
SE Regression = 0.642
DW =1.955

This yields the following estimate of equation (1):

(5) $U^* = 3.672 - 0.564I + 1.144I_{-1} + u.$

This estimate demonstrates that the NAIRU has been stable over this period at 3.7 percent, and the only steady-state inflation rate consistent with this level of unemployment is zero.

Niskanen concluded that there was no trade-off between unemployment and inflation except in the same year. This result is consistent with the Mises-Hayek model of the business cycle, which predicts that credit expansion depresses the market interest rate below the general rate of time preference, driving a wedge between saving and investment, thus resulting in simultaneous, and unsustainable, increases in demand for both producer and consumer goods. Niskanen also found that over the long term, unemployment is an *increasing* function of the inflation rate, exactly as Austrian business cycle theory predicts. Finally, Niskanen concluded that the minimum sustainable unemployment rate is about 3.7 percent, and can be achieved only with a zero steady-state rate of inflation. My findings are consistent with that conclusion.

An Improved ARDL Specification for Monthly Data

Equilibrium unemployment (U^*) is modeled as a positive function of lagged inflation:

(6) $U_t^* = a - bI_t + \sum_{i=j,n} c_j I_{t-i} + u_t.$

This is the same as Niskanen's equation (1), but for monthly data, it is augmented with additional lagged monthly inflation rates to reflect the potentially more complex relationship between lagged inflation and unemployment. This equilibrium unemployment level becomes the non-accelerating inflation rate of unemployment (NAIRU) if the c coefficients sum to equal b. Then the rate of change of the unemployment rate should be a linear function of the difference between the equilibrium rate of unemployment and the unemployment rate of the previous time period:

(7) $(U_t - U_{t-1}) = d(U_t^* - U_{t-1}) + v_t.$

By substituting equation (6) in equation (7) and solving for U, these two relations yield a reduced form:

(8) $U_t = ad - bdI_t + d\sum_{i=j,n} c_j I_{t-i} + (1 - d)U_{t-1} + (du_t + v_t).$

Are Unemployment and Inflation Stationary?

Richard Reichel (2004) criticized and expanded Niskanen's work on two grounds. First, Niskanen examined the Phillips curve only for the United States, and the behavior of unemployment and inflation may be different in other countries. The present article uses only U.S. data, so it is admittedly subject to the same criticism. The dataset extends from 1947–2009, slightly more than 50 percent longer than Niskanen's original 1960–2000 dataset. Use of monthly rather than annual data provides 12 times as many observations per year.

Reichel's second major criticism was that Niskanen's ARDL was misspecified because inflation and unemployment are non-stationary or first-order-integrated (I(1)) series. The ordinary least-squares estimate Niskanen performed is most appropriate when classical regression assumptions, including stationarity of the data, are satisfied. Stationary time series have constant means and variances. Steadily growing time series, like GDP for example, have to be first-differenced and in some cases second-differenced, to be made stationary, with the number of times differencing is necessary to impose stationarity referred to as the order of integration of the series. Reichel employed statistical tests to show that inflation and unemployment are I(1) rather than I(0), and in some cases Reichel found unemployment was I(2) for certain countries. Because of their belief that unemployment and inflation were I(1) but cointegrated, i.e., share a stable, long-term relationship, Reichel (2004) and Moghaddam and Jenson (2008) estimated error-correction models. The longer dataset used in this article lessens the possibility of spurious rejections of stationarity. From theoretical considerations, unemployment can safely be treated as stationary over a sufficiently long time frame, as can inflation, at least in the absence of hyperinflation, which cannot persist for more than a brief episode. Phillips-Perron (1988) tests for unit roots yield test statistics of –14.344 for inflation and –52.158 for first-differenced-inflation, compared with a 1 percent critical value of –3.1448, in both cases rejecting the null hypothesis of a unit root. The same test yields test statistics of –2.443 for unemployment and –25.915 for first-differenced unemployment, with the same critical values, suggesting unemployment has a unit root. Nevertheless, it is clear that unemployment cannot grow without limit, at least not without the impetus of spectacularly poor public policy.

An Unrestricted Vector Autoregression

An exploratory vector autoregression (VAR) was estimated to determine optimal lag length for inflation. Inflation influences unemployment, but with a lag, so the impact of past innovations in inflation is much stronger than the immediate impact of current innovations. Shocks to current inflation do not affect resource employment immediately. Recall that Niskanen used annual data lagged one year. His practice is validated by both Akaike (AIC) and Schwarz (SBIC) information criteria, which indicate 13 months as the optimal lag length. Two models are presented below with 13 months of lagged data, an unrestricted vector autoregression in unemployment and inflation, and a variety of reduced-form ARDL models (equation 8) similar to Niskanen's equations (3) and (4).

The 13-month-lagged unrestricted VAR was estimated in unemployment and inflation. Coefficients typically alternate in sign, indicating the necessity of relying on impulse response and variance decomposition functions in interpreting the VAR estimate. Table 1 presents Granger causality tests indicating that unemployment and inflation are mutually endogenous.

Accumulated impulse response functions for the unrestricted VAR indicate a one-standard-deviation innovation in inflation results in a permanent increase in unemployment of greater than four percent after 48 months—extremely strong evidence in support of the Austrian business cycle (ABC) theory expectation that inflation causes unemployment over the long run. The impulse response of inflation to a one-standard-deviation innovation in unemployment is that unemployment lowers *inflation* by approximately 6 percent after 48 months, a result that seems inconsistent with any success-

TABLE 1
VAR Pairwise Granger Causality/
Block Exogeneity Wald Tests

Exclude	Chi-square	d.f.	Prob (chi-sq)
I	23.61	13	**0.0349
U	27.95	13	***0.0092

Notes: Sample range = 1949:01–2008:10; N = 705.
*** indicates 1 percent significance; ** indicates 5 percent significance.

ful attempt to systematically exploit the Phillips curve relationship. If policymakers generally responded to increases in unemployment by increasing inflation, and if this generally resulted in lower unemployment, one would expect to see a positive relationship.

Variance decomposition functions provide further support for ABC theory. After 48 months, almost 40 percent of the variance in unemployment is due to variation in inflation, and this percentage continues to increase at longer time horizons. After 48 months, only about 15 percent of the variance in inflation is due to unemployment, and this amount is decreasing slowly but steadily after about 20 months.

Improved ARDL Estimates

Next, we estimate the ARDL specification in monthly data of equation (8), which is directly comparable to Niskanen's estimate with annual data. This has as explanatory variables, one-period (one-month) lagged unemployment, current inflation, and inflation lagged 12 months (Table 2). The negative and statistically significant coefficient on current inflation helps explain the persistent and widespread belief in the traditional Phillips curve relationship, but the positive coefficient on one-year-lagged inflation indicates that any immediate reduction in unemployment which results from inflation, is more than offset by a three-fold greater increase

TABLE 2
Parsimonious ARDL for Unemployment, 1949–2008

Variable	Coefficient	Std. Error	t-Statistic	Prob (t)
C	0.055	0.031	1.778	0.0757
INF	–0.003	0.002	–1.772	0.0768
U(–1)	0.987	0.005	181.582	0.0000
INF(–12)	0.010	0.002	4.818	0.0000
Adj. R-square	0.980	Akaike info. crit.		–0.245
S.E. of regression	0.213	Schwarz criterion		–0.220
Log likelihood	93.301	F-statistic		12029
Durbin-Watson	1.811	Prob(F-statistic)		0.000

Notes: Sample range = Jan 1949–Aug 2009; N = 728.

in unemployment, which is permanent. Any jobs created through monetary expansion result in a permanent loss of three jobs after an impact period as brief as one year. This estimate yields a NAIRU of 4.35 percent, consistent with Niskanen's estimate of 3.7 percent. The two estimates lie within their standard errors. Ramsey (1969) regression specification error tests (RESET) indicate the ARDL is properly specified—no important variables have been omitted; variables have been properly specified as logarithms, powers, reciprocals, etc.; and potential measurement error, simultaneity bias, lagged unemployment on the right-hand side, and serially correlated disturbances, do not introduce observable bias.

This specification can be improved slightly as shown in Table 3, which yields a NAIRU of 4.14 percent, and also passes the Ramsey RESET test.

The estimate of the ARDL specification best supported by the 1947–2009 monthly data, is shown in Table 4, which indicates that any temporary gain in lowered unemployment is completely undone after as little as six months, and that any increase in inflation continues to boost unemployment after 12 and 18 months. This most-definitive ARDL specification yields a NAIRU unemployment rate of only 3.30 percent. Ramsey RESET tests indicate this equation is properly specified.

TABLE 3
Less Parsimonious ARDL for Unemployment Explained by Inflation, 1949–2009

Variable	Coefficient	Std. Error	t-Statistic	Prob (t)
C	0.059	0.031	1.889	0.0593
INF	–0.005	0.002	–2.379	0.0176
U(–1)	0.986	0.005	180.358	0.0000
INF(–11)	0.005	0.003	2.158	0.0312
INF(–12)	0.007	0.002	2.986	0.0029
Adj. R-square	0.980	Akaike info crit.		–0.249
S.E. of regression	0.213	Schwarz criterion		–0.217
Log likelihood	95.638	F-statistic		9068
Durbin-Watson	1.814	Prob(F-statistic)		0.000

Notes: Sample range = Jan 1949–Aug 2009; N = 728.

TABLE 4
Fully Specified ARDL for Unemployment Explained by Inflation, 1949–2009

Variable	Coefficient	Std. Error	t-Statistic	Prob. (t)
C	0.052	0.031	1.681	0.0933
INF	–0.005	0.002	–2.33	0.0198
U(–1)	0.984	0.006	174.821	0.0000
INF(– 6)	0.005	0.002	2.078	0.0381
INF(– 12)	0.006	0.002	2.678	0.0076
INF(–18)	0.005	0.002	2.458	0.0142
Adj. R-square	0.981	Akaike info. Crit.		–0.273
S.E. of regression	0.210	Schwarz criterion		–0.235
Log likelihood	104.550	F-statistic		7429.283
Durbin-Watson	1.829	Prob(F-statistic)		0.000

Notes: Sample range = Jun 1949–Aug 2009; N = 722.

It is especially noteworthy that positive and statistically significant coefficients on lagged inflation are robust to a variety of lag specifications, as is the estimate of approximately 3 to 4 percent as the NAIRU rate of unemployment, consistent with Niskanen's original finding. All these ARDL estimates are statistically well-specified according to Ramsey RESET tests.

A Superconsistent Estimate with Non-Stationary Data

Since inflation is caused by increases in the money supply, it is also attractive to examine the relationship between total civilian employment and the monetary aggregates. Non-stationary time series with obvious trend violate the classical regression assumption of stationarity, but it has been found that regressions with such data exhibit the desirable property of superconsistency, that is coefficient estimates converge to their true population values more rapidly than for regressions with stationary data (Banerjee et al. 1986, 1993).

Table 5 reports estimates of an ARDL where civilian employment in thousands is explained by one-month-lagged employment and the Austrian Money Supply (AMS) in billions of dollars, lagged

TABLE 5
ARDL of U.S. Civilian Employment Explained by Austrian Money Supply (AMS), 1960–2009

Variable	Coefficient	Std. Error	t-Statistic	Prob (t)
C	–77.393	92.801	–0.834	0.4046
CIVEMP(– 1)	1.003	0.001	871.922	0.0000
AMS(– 6)	0.284	0.107	2.660	0.0080
AMS(– 18)	–0.377	0.113	–3.342	0.0009

Adj. R-square	0.9998	Akaike info criterion	14.252
S.E. of regression	299.925	Schwarz criterion	14.281
Log likelihood	–4200.25	F-statistic	1399130
Durbin-Watson	2.001	Prob(F-statistic)	0.0000

Notes: Sample range = Jan 1960–Aug 1960; N = 590.

6 and 18 months. The Austrian Money Supply (AMS), defined by Salerno (1987) and Shostack (2000), is the sum of the currency in circulation, checkable deposits, savings deposits, U.S. government demand deposits and note balances, demand deposits due to foreign commercial banks, and demand deposits due to foreign official institutions. This captures money available to fund transactions that are redeemable at par on demand (like MZM), but do not require the sale of assets for redemption. The six-month lag on AMS proxies the delayed impact that changes in monetary aggregates have on components of the price index. Ramsey RESET tests indicate this regression is properly specified with no omitted or improperly transformed variables.

The positive coefficient on six-month-lagged AMS indicates that increases in the money supply result in short-term increases in civilian employment, but the negative coefficient on 18-month-lagged AMS indicates that this results in larger permanent decreases in employment. Every one-billion-dollar increase in the money stock creates a mere 284 new jobs after six months—at an average of $3,521,126.76 per job created, horrendously inefficient even by the standards of government intervention. However, after 18 months, each billion dollars of monetary expansion has wiped out an average of 377 jobs, for a permanent net loss of 93 jobs. Because the AMS is not a stationary process, the estimated coefficients only give the average impact over the whole (1960–2009) half-century. Given the size of the money supply today, it requires an increase of $3.48 billion to create an equivalent number of jobs—today actually a staggering $12,262,654.15 per job that on net will be wiped out, with interest, within 18 months.

Conclusion

The Phillips curve need not be abandoned either as a theoretical construct or as a tool for policy formulation. In reality, however, the true relationship between unemployment and inflation is exactly the opposite of what has been widely believed. It is essential that both policy and theory be guided by improved and accurate estimates of appropriate and theoretically better-motivated specifications. Austrian business cycle theory should inform public policy—in clear and loud tones—that in the long-run there is a *positive* relationship between inflation and unemployment, as documented in this article. The sooner policymakers embrace a goal of zero inflation as the road to lower unemployment, the better.

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