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The Samuelson-Solow "Phillips Curve" and the Great Inflation

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Abstract

The notion of the Phillips curve as a policy tool was first advanced in 1960 by Paul Samuelson
and Robert Solow. Despite their pointing out features of the curve that would later become
prominent, (i.e., that the curve could shift), it helped create the environment that allowed
inflation in the United States to accelerate during the 1960s. Ironically, Samuelson and Solow
never estimated their Phillips curve, but instead hand drew it to fit the data for the twenty-five
year period from 1934 to 1958. Using the data and econometric techniques available to them at
the time, we estimate the Samuelson-Solow Phillips curve, find that it bears little resemblance
to their hand-drawn curve, and discuss the policy implications of the two curves.

1.   **INTRODUCTION**

The Great Inflation that occurred in the United States during the 1960s and 1970s was one of the major economic events of the post-World War II era. Indeed, Allan Meltzer (2005, 145), the historian of the Federal Reserve System, describes it as "the central monetary event of the latter half of the 20th century." Following a period of relatively stable prices in the 1950s, the annual rate of inflation (as measured by the Consumer Price Index, CPI-U) rose from 1.2% in 1962 to 5.84% by 1970 to 13.5% by 1980. Another popular economic indicator at the time was the 'misery' index, which is the sum of the unemployment rate and the annual rate of inflation.[1] It rose from 6.8% in 1962 to 10.8% by 1970, ultimately reaching an historic high of 20.8% by 1980.

While controversy still exists over the factors that caused the Great Inflation to persist for some twenty years,[2] there is general agreement that the Phillips curve notion of a permanent tradeoff between inflation and unemployment which held sway in macroeconomic policy circles during the 1960s helped create the climate that allowed inflation to accelerate. This change in attitude away from "…the widely-held proposition that ongoing inflation would produce unemployment" (Robert Leeson, 1997b, 447) to the view that inflation could generate economic benefits began in the 1950s. In particular, the influential Keynesian, Alvin H. Hansen, and the equally influential Sumner H. Slichter disavowed their earlier opposition to inflation which helped create a more tolerant view of the potential benefits of inflation.[3] The actual *benefits* of inflation were then *quantified* by Paul Samuelson and Robert Solow (1960) in a classic paper published in the *American Economic Review Papers and Proceedings* in which they presented the results of a Phillips-type relationship for the United States. Coming as it did during the 1960-1961 recession, the Samuelson-Solow Phillips curve presented policymakers with the attractive (and politically popular) option of pursuing expansionary monetary and fiscal policies which

would raise inflation, but not to levels high enough to become painful, in exchange for a lower unemployment rate.

As is well known, the Phillips curve is named after the economist A.W. Phillips who in a 1958 paper presented evidence of a negative relationship between the unemployment rate and the rate of change in nominal wages in the United Kingdom. Phillips himself never claimed that his results had significant policy implications, particularly policies designed to reduce unemployment.[4] Instead, it was Samuelson and Solow who first championed the Phillips curve as a policy tool. Rather than focus on the relation between the rate of change in nominal wages and the unemployment rate as Phillips did, they *estimated* the relationship between the rate of inflation and the unemployment rate for the twenty-five year period from 1934 to 1958.[5] This relationship, reproduced here in Figure 1, looks much like the one Phillips reported for the 1861-1913 and 1948-1957 periods, downward sloping and nonlinear. Samuelson and Solow called it the Phillips curve.[6]

Figure 1
The Samuelson-Solow Phillips Curve: 1934-1958
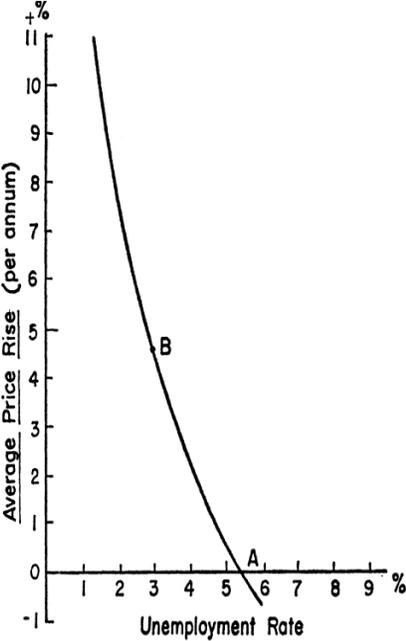
Samuelson and Solow interpreted their statistical Phillips curve as a structural relationship that had the potential of offering a menu of exploitable tradeoffs between inflation and unemployment. And while they warned that the tradeoff may not be sustainable (i.e., warned that the Phillips curve might shift), this message seemed to have been quickly lost on all but a few.[7] In 1961, Paul Samuelson (1961, 383) incorporated the Phillips curve into the 5th edition of his *Economics* text, introducing the notion of an inflation-unemployment tradeoff to a whole generation of students and faculty. And, as reported by Leeson (1997a) in an interview, in the mid-1960s Samuelson and Solow themselves seemed to downplay the possibility of an unstable Phillips curve. In the interview, Robert Solow said "Paul Samuelson asked me when we were looking at these diagrams (of inflation and unemployment) for the first time, 'Does that look like a reversible relation to you?' What he meant was 'Do you really think the economy can move back and forth along a curve like that?' And I answered 'Yeah I'm inclined to believe it,' and Paul said 'Me too'" (Leeson, 1997a, 145).[8]

The notion of the Phillips curve as a menu of choices from which policymakers could choose quickly became an important consideration in economic policy. In 1962, the Council of Economic Advisers officially embraced the notion of a tradeoff when, in the *Economic Report of the President*, they argued that "…the target for stabilization policy is to eliminate the unemployment which results from inadequate aggregate demand without creating a demand-induced inflation" (1962, 46). At the same time, they argued that "an unemployment rate of about 4% is a reasonable and prudent full employment target for stabilization policy" (*Economic Report of the President*, 1962, 46).[9] In an effort to lower unemployment, monetary and fiscal policy shifted to expansion in the early 1960s which, in turn, led to a 4.8-fold increase in inflation (as measured by the CPI-U) from 1962 to 1970.[10]

The curve also met with great political and popular appeal, both in the US and Great Britain.[11] Indeed, Allan Meltzer (2009) argues that it was this political-popular appeal of the Phillips curve that caused inflationary policies to persist into the 1970s:

> The Great Inflation resulted from policy choices that placed much more weight on maintaining high or full employment than on preventing or reducing inflation. For much of the period, this choice reflected both political pressures and popular opinion as expressed in the polls. Many accepted James Tobin's view that inflation would increase before the economy reached full employment, or they claimed that eliminating inflation required an unacceptable increase in unemployment. (Meltzer, 864.)

It turns out, however, that the Samuelson-Solow Phillips curve was neither *statistical* nor structural. Samuelson and Solow provided no empirical estimates of the Phillips curve in their celebrated 1960 paper. Instead, they simply hand-drew a line they believed fit the data for the twenty-five year period from 1934 to 1958.

This paper presents estimates of the Samuelson-Solow Phillips curve. More specifically, using the data available to Samuelson and Solow, and the econometric techniques commonly employed at that time, we estimate the Phillips curve emphasized in their 1960 paper. As it turns out, the estimated Phillips curve bears small resemblance to their hand-drawn curve. Moreover, and in stark contrast to the policy recommendations of Samuelson and Solow, the estimated Phillips curve provides little support for a menu of lower unemployment-higher inflation tradeoffs.

2.   AN ESTIMATED PHILLIPS CURVE

Robert Solow's recollection is that they used the consumer price index (CPI) or the wholesale price index (WPI) as the price measure, and the Lebergott unemployment series spliced to the BLS series as reported in the *Economic Report to the President*.[12] Accordingly, data are from the 1959 *Economic Report of the President* which was available to Samuelson and

Solow.[13] Figures 2 and 3 show the scatter diagrams of unemployment with the CPI and WPI measures of inflation for the 1934-1958 period.

Figure 2
Scatter of Unemployment and the CPI

Figure 3
Scatter of Unemployment and the WPI
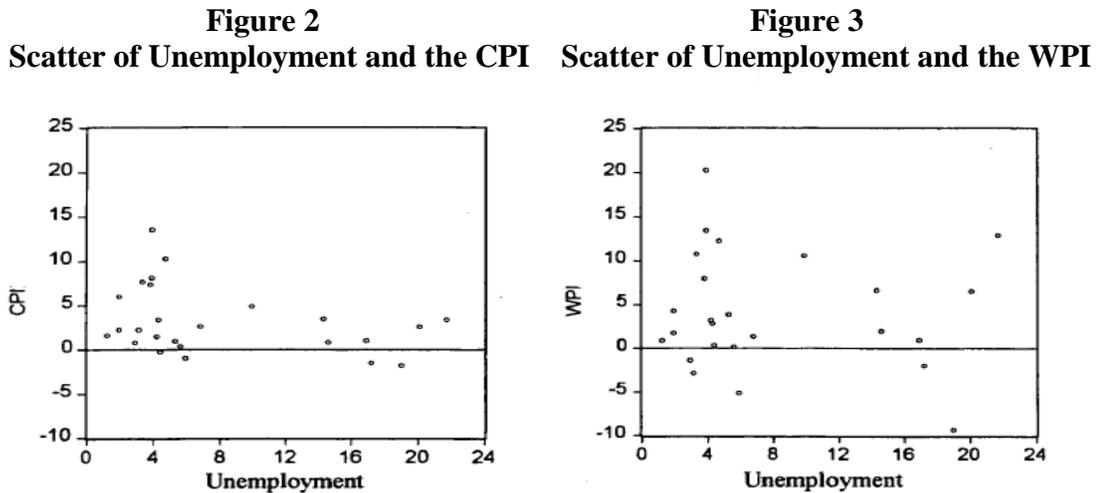
The equation we use to estimate the (non-linear) 1934-1958 relationship between inflation and unemployment fitted by Samuelson and Solow is:

$$p_t = b_0 + b_1 (1/U)_t + b_2 (1/U^2)_t + e_t$$

where p is the inflation rate measured as either the annual percent change in consumer prices or wholesale prices, U is the unemployment rate, e is a random error term, and t represents the time subscripts. We use this particular estimation form for two reasons. One, it is the specification used by Richard Lipsey (1960) that got the Phillips curve econometric industry started. Two, and more importantly, Lipsey's estimates using Phillips' 1862-1913 data were virtually identical with Phillips'(1958, 286) famous Figure 1 curve, and as reported by C. Gilbert (1976) also had similar test statistics.

Ordinary least squares applied to the basic equation when CPI inflation is the dependent variable yields (t-stats in parentheses):

$$p_t = 0.0044 + 24.27 (1/U)_t - 27.76 (1/U^2)_t$$
$$(0.0025) \quad (2.05) \quad\quad (-1.88)$$
$$R^2 = .162 \quad\quad SEE = 3.61 \quad F = 2.12 \quad\quad\quad\quad DW = 1.20$$

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The results with WPI inflation as the dependent variable are:

$$p_t = 2.12 + 17.78 \ (1/U)_t - 24.81 \ (1/U^2)_t$$
$$\quad (0.65) \quad (0.80) \quad\quad\quad (-0.89)$$
$$R^2 = .03 \quad\quad SEE = 6.80 \quad F = .40 \quad\quad\quad\quad DW = 1.34$$

There are obvious serial correlation problems with both sets of estimates. In the 1960s serial correlation was often acknowledged as a potential problem, but corrected estimates typically were not calculated because the computation costs were large. Nevertheless, we ran corrected versions of both equations, and adjusting for first order autocorrelation did not substantively change the estimated parameters.[14]

3. COMPARING THE PHILLIPS CURVES

How does the estimated Phillips curve compare to the Samuelson-Solow Phillips curve? Figures 4 and 5 pair the fitted Phillips curves with the curve reported by Samuelson and Solow in their 1960 paper. Figure 4 is the fitted Phillips curve using the CPI, Figure 5 the fitted curve using the WPI.

While the estimated curves are similar to the Samuelson-Solow Phillips curve in one regard--namely, each is negatively sloped over a large range of unemployment rates--all similarity stops there.[15] The estimated Phillips curves each have a hump-shaped portion, each is considerably flatter than the one drawn by Samuelson and Solow, and over a wide range of unemployment rates none are associated with a zero rate of inflation. In addition, the upward sloping portion of the estimated curve suggests that when unemployment is low it can be lowered further by reducing inflation.

Needless to say, the estimated Phillips curves tell a different story than the one suggested by Samuelson and Solow. In a very high unemployment economy, with rates of 10% or more, raising inflation does lower unemployment, and lowers it a great deal. By contrast,

Figure 4
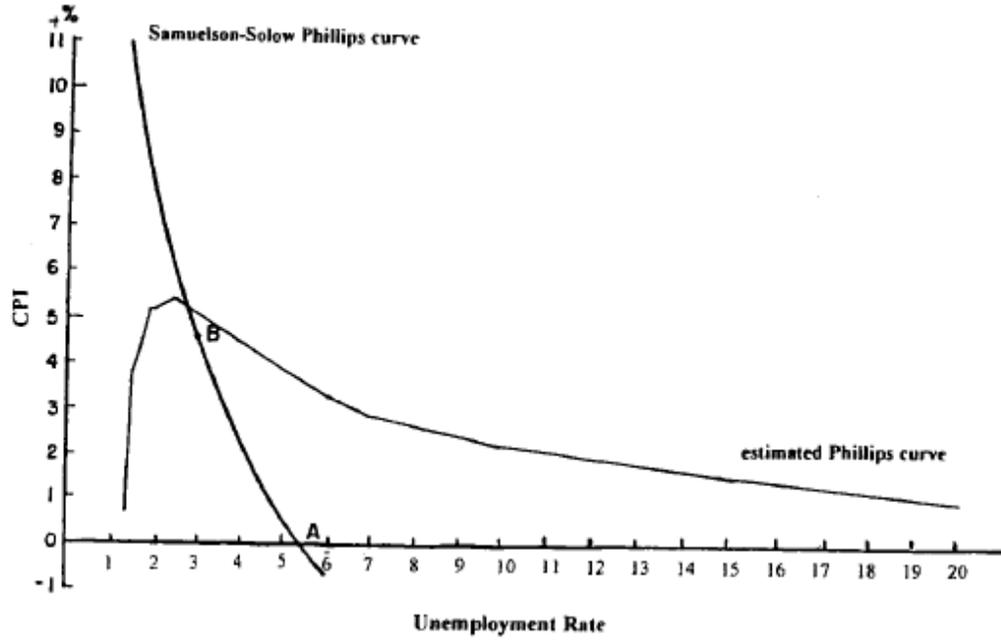**Estimated Phillips Curve vs. Samuelson-Solow Phillips Curve, 1934-58: CPI**

Figure 5
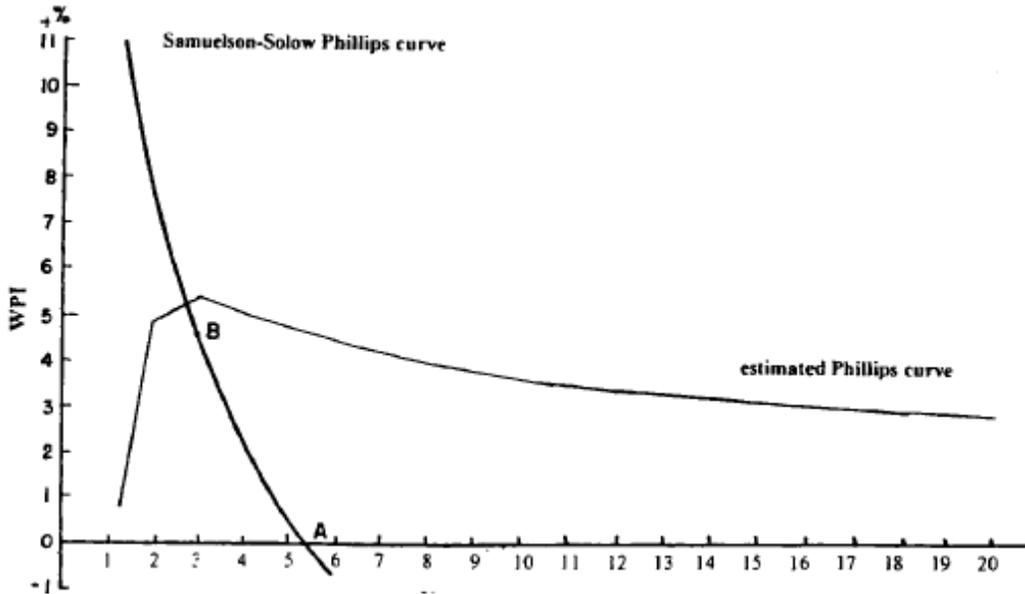**Estimated Phillips Curve vs. Samuelson-Solow Phillips Curve, 1934-58: WPI**

unemployment in the 5.0 to 6.0 percent range, which yields a zero (or close to zero) rate of inflation in the Samuelson-Solow Phillips curve, results in a 3.0-5.0 percent inflation rate in the estimated Phillips curve. Thus, while a reduction in unemployment from 5.5% to 'full employment' of 4% is accompanied by only ½ to ¾% rise in inflation in the estimated Phillips curve (as opposed to a 2½ -3% rise in the Samuelson-Solow Phillips curve), the level of inflation is, as mentioned above, much higher, and in the range that economists considered unacceptable at the time. Finally, in a low unemployment economy, an unemployment rate of around 2.5% for the CPI and about 3% for the WPI, lowering the rate of inflation actually reduces unemployment.[16]

In light of the differences between the estimated Phillips curve and their hand-drawn curve, one has to wonder if the path of macroeconomic policy in the United States during the 1960s might have evolved differently had Samuelson and Solow, like A.W. Phillips (1958) and Richard Lipsey (1960) before them, statistically estimated the curve. Would they have still argued for the existence of an exploitable tradeoff?

Given that Samuelson was the consummate theoretician--he did no empirical work during his brilliant career--it is perhaps not surprising that Samuelson and Solow did not estimate their Phillips curve. One still must wonder, however, why the Council of Economic Advisers (CEA) and the majority of the economics profession were so quick to buy into their policy prescriptions when many surely knew that the curve from which those prescriptions were derived was not based on regression analysis. Several reasons may help explain why. Most obvious was the enormous prestige that Samuelson and Solow held in the profession. Couple this with a CEA whose members (Walter Heller and James Tobin, in particular) were already favorably disposed toward activist policies, and it is likely that any misgivings the CEA may

have had about the Samuelson-Solow method of analysis were quickly overshadowed by their activist policy prescription which served to confirm their (i.e., the CEA's) priors.[17] Robert Solow was on the staff of the CEA at the time too, so he was available to help assuage any concerns that may have arisen there.

4.   CONCLUSION

The Samuelson-Solow Phillips curve provided the economic rationale for expansionary government policies in the 1960s—namely, that the unemployment rate could be lowered with a small rise in inflation---and played an important role in the Great Inflation that occurred in the US during the 1960s and 1970s. The empirical results presented in this paper challenge the results as well as the policy implications of the Samuelson-Solow Phillips curve.

While clinical in nature, our analysis raises two interesting historical questions. First, would economic events during the 1960s and 1970s have turned out differently had Samuelson and Solow not weighed in with their Phillips curve? Second, would economic events have turned out differently had Samuelson and Solow presented an empirically estimated Phillips curve like the curves in Figure 3 or 4 that show high inflation over a large range of unemployment and, for inflation measured by the CPI, a high cost to lower unemployment over the range from 6% to 3%?

With regard to the first question, economic events likely would have turned out about the same had Samuelson and Solow not weighed in. The 1960s seemed destined to be an expansionary (inflationary) decade--Presidents Kennedy and Johnson pushed major social legislation (the Great Society in particular), the US was engaged in the Vietnam War, and, as mentioned earlier, the Council of Economic Advisers (CEA) to both Presidents were favorably disposed towards expansionary policies. More importantly, the Federal Reserve agreed to

"…coordinate its actions with the administration's fiscal policy" (Metzler, 2009, 485). In practice, this agreement meant the Federal Reserve altered money growth (hence inflation) to keep interest rates relatively constant. Richard Nixon became President in 1969. His reputation as an inflation hawk notwithstanding,[18] he too allowed inflation to rise in the early 1970s even though members of his CEA accepted Milton Friedman's (1966, 1968) natural-rate hypothesis.

By contrast, had Samuelson and Solow reported an empirically estimated Phillips curve, economic events might have turned out differently. And it might have been for better or worse. Given the high cost associated with reducing unemployment from 6% to 3%, especially when inflation is measured by the CPI, the Kennedy and Johnson CEA's as well as the Federal Reserve might have argued for more caution in pursuing expansionary policies, caution that could have led to a slower pace of expansion. In this case, the Samuelson-Solow Phillips curve would have been an agent for policy moderation and lower inflation. Alternatively, the high inflation that exists over a wide range of unemployment rates in Figure 4 and Figure 5 raises the specter that had Samuelson and Solow estimated their Phillips curve they might have helped usher in wage-price controls in the 1960s rather than in 1971 under President Nixon. As an economic adviser to John Kennedy prior to the 1960 presidential election John K.Galbraith argued for wage-price controls (see Leeson, 1997a). Given high inflation over a wide range of unemployment rates in the estimated Phillips curve, the Kennedy-Johnson CEA might have accepted Galbraith's argument and endorsed wage-price controls as the preferred vehicle to "control" inflation in the face of expansionary policies.

Would the Great Inflation in the United States have evolved differently had Samuelson and Solow presented an estimated Phillips curve? While this question can never be answered

definitively, it is likely that macroeconomic policy would have evolved along a different path.

Whether or not this 'different path' would have been beneficial or not is impossible to determine.

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NOTES

[1] Invented by Arthur Okun at the Brookings Institution in the 1970s, the misery index became an oft-used instrument in the 1976 and 1980 U.S. Presidential elections.

[2] The competing views on why inflation persisted fall into two broad camps. One is that monetary policy mistakes were largely driven by 'politics'. This is the view held by Meltzer (2005, 2009). The other, which is held by a number of economists (Mayer (1999), Sargent (1999), Romer and Romer (2002, 2004), and Nelson (2004) to mention but a few), is that policy mistakes were primarily the result of mistaken 'ideas' about how the macro economy works. See Romer (2005) for a good discussion of the two competing points of view. For a detailed discussion of the history of the Phillips Curve as it evolved in the United States, see Gordon (2008).

[3] See Leeson (1997b) for a discussion of the transformation away from the goal of zero inflation.

[4] Phillips, like Friedman (1968, 1977) and Phelps (1967), never accepted the proposition that lower unemployment could be sustained by higher inflation. Nonetheless, his work "came to be confidently misinterpreted as a series of trade-off equilibrium points, a menu of choice from which policymakers can choose" (Leeson, 1997c, 156).

[5] Samuelson and Solow say (1960, 192) that their curve is "roughly estimated from [the] last twenty-years." We take this to be the period 1934 to 1958 since the annual observation for 1959 would not have been available when they presented their paper at the AEA meetings in December 1959.

[6] The backdrop to the Samuelson-Solow Phillips curve, and the only other diagram in their paper, was a scatter plot of the annual change in wages, using Albert Rees' (1959) wage data, against unemployment over what appears to be a 50 to 60-year period.

[7] The diagrams for the sub periods in Phillips' paper might also have alerted Samuelson and Solow to the fact that the Phillips curve relation only seemed to be stable under fixed exchange rates which helped to anchor inflation expectations. During the twenty-five year period that Samuelson and Solow chose for their Phillips curve, the world did not operate under a continuous system of fixed exchange rates.

[8] In the 10th edition of his Principles text, Samuelson (1976) still dismissed the arguments of those who believed in a long-run vertical Phillips curve. Mayer (1999, p. 96) argues that the lack of empirical support for the long-run vertical Phillips curve helped to explain why "…the feasibility of an unemployment-inflation tradeoff was [still] taken seriously… eight years after the publication of Friedman's presidential address."

[9] The 1962 Council of Economic Advisers was not the first to set a quantitative 'target' for full employment. In the 1942 Beveridge Report, the British economist William Beveridge defined a 3% unemployment rate as the post-WWII target for full employment for Great Britain.

[10] Despite accelerating inflation through the 1960s and into the 1970s, both the Federal Reserve and the CEA continued (until 1976) to define full employment as a 4% unemployment rate.

[11] See Wulwick (1987), Leeson (1994), and Sleeman (2011).

[12] Letter to one of the authors dated January 11, 2007.

[13] We use the unemployment series identified as the "new" series because the "old" series ends in 1957.

[14] Results for the autocorrelation corrected version are as follows (t stats in parenthesis). For CPI inflation:

$$p_t = 0.55 + 21.65 \ (1/U)_t - 25.83 \ (1/U^2)_t$$
$$\qquad (0.23) \qquad (1.53) \qquad\qquad (-1.63)$$
$$R^2 = .245 \quad SEE = 3.50 \qquad F = 2.33 \qquad DW = 1.53$$

For WPI inflation:

$$p_t = 2.37 + 16.32 \ (1/U)_t - 23.98 \ (1/U^2)_t$$
$$\qquad (0.57) \quad (0.63) \qquad\quad (-0.80)$$
$$R^2 = .10 \qquad SEE = 6.71 \qquad F = .82 \quad DW = 1.72.$$

[15] Inspection of Figures 2 and 3 suggests that the fitted relationship, regardless of the form of the estimated equation, would not in all likelihood have yielded a Phillips curve resembling the one drawn by Samuelson and Solow. Indeed, we estimated the relation using several different specifications (i.e., higher orders of u as additional independent variables and, separately, the natural log of u as the independent variable) and the fitted Phillips curves were not unlike the ones shown in Figures 4 and 5.

[16] As previously mentioned, there are only two figures in the Samuelson and Solow paper. Figure 1 is a scatter plot of the annual change in wages against the unemployment rate for a 50 to 60-year period, Figure 2 is their hand drawn Phillips curve with the caption "roughly estimated from last twenty-five years." In Figure 1, Samuelson and Solow circle twelve or thirteen observations,

stating in the caption that these points are from "recent years." One anonymous referee suggested that instead of twenty five years Samuelson and Solow meant twelve or thirteen years, the circled years in Figure 1, as the 'estimation' period for their hand drawn Phillips curve. This suggestion strikes us as improbable. Had Samuelson and Solow meant "recent years" as the 'estimation' period it is difficult to imagine that they would not have noticed the error in the caption to Figure 1. More importantly, their paper was "...widely read and discussed"(Gordon, 2008, 5) when it was published and, to this day, remains one of the most widely read and cited papers of all time. It is implausible that a paper of this status could have contained such an error for so long without someone having noticed. Having said this, we nonetheless (re)estimated the Phillips curve relation for the 1947-1958 period to see if it 'fit' the Samuelson-Solow hand drawn curve (as the anonymous referee implied to be the case). It did not fit. For the CPI, the 1947-58 Phillips curve was also hump shaped--as the unemployment rate rises from 4% to 5% to 6%, the rate of inflation falls from 5.1% to 0.5% to -1.9%, but as the unemployment rate falls from 4% to 3% to 2%, the rate of inflation *falls* from 5.1% to 3.4% to -19%. So, while the 1947-58 Phillips curve is closer to the Samuelson-Solow hand drawn Phillips curve for unemployment rates above 4%, it yields nonsensical predictions as unemployment falls below 4%. Additionally, the 5.1% rate of inflation at the "full employment" unemployment rate of 4% is well above the 2% rate of inflation at 4% unemployment in the Samuelson-Solow hand drawn curve. Similar results obtain for the WPI.

[17] In a fascinating paper, Leeson (1997a) discusses the role the political environment--the run up to the 1960 Presidential elections--played in the development of the Phillips curve as a policy tool in the United States.

[18] In his 1960 Presidential campaign against John Kennedy, Nixon argued that the economic policies being proposed by Kennedy would cause an unacceptable rise in prices (see Leeson, 1997a).

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