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THE PHILLIPS CURVE NOW AND THEN

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ABSTRACT

This paper describes the development of the "triangle" model of inflation, which holds that the rate of inflation depends on inertia, demand, and supply. This model differs from most other versions of the Phillips curve by relating inflation directly to the level and rate of change of detrended real output, and by excluding wages, the unemployment rate, and any mention of "expectations." The model identifies the ultimate source of inflation as nominal GNP growth in excess of potential real output growth and implies that a policy rule that targets excess nominal GNP growth is an essential precondition to avoiding an acceleration of inflation. Any residual instability of inflation then depends on the severity of supply shocks.

The textbook and econometric versions of the triangle model were developed simultaneously in the mid-1970s. Since then there have been two empirical validations for the U. S. of the model as estimated a decade ago. First, the "sacrifice" ratio of cumulative output loss relative to the decline in inflation during the business slump of the early 1980s was predicted accurately in advance. Second, the natural unemployment rate implied by the model's estimates predicted in advance the slow acceleration of inflation that occurred in began in 1987, when the unemployment rate fell below 6 percent.

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Almost thirty years ago Paul Samuelson and Bob Solow coined the term Phillips curve at the 1959 AEA meetings, reacting promptly to the publication of Phillips' (1958) article. For many years afterwards Solow thought and wrote about the Phillips curve and many of the unsettled research puzzles that economists had struggled to resolve under that general heading. As Olivier Blanchard and Peter Diamond (1989) remind us, the Samuelson-Solow AEA paper (1960) was farseeing, anticipating many of the major issues that arose later when the Phillips curve started shifting. So it is fitting to take a look at the current state of the Phillips curve in economic research and its evolution since the seminal Phillips and Samuelson-Solow papers.

The Phillips Curve Now

To determine the difference between present views and those of the 1960s, and to highlight remaining puzzles, I take as my point of departure the current mainstream view of the U. S. inflation process.[1] To find this mainstream view, you can look it up in any of the three best-selling intermediate macroeconomics textbooks. Here we find what I call the "triangle" model of inflation -- inflation depends on three basic sets of factors – demand, supply, and inertia.

Formally, this model consists of two equations, the modern Phillips curve and a second equation which, at least in my version, is a pure identity splitting the rate of nominal GNP growth in excess of potential output growth (this is "excess nominal GNP growth") between inflation and changes in the output gap (i.e., in the log ratio of actual to potential output). In fact, some French authors have dubbed this model of the Phillips curve plus

an identity as the "split" model. The first equation, the modern Phillips curve, is where the triangle appears. Inflation is explained by three sets of variables, demand, supply, and inertia. Demand enters through the level and change of the output gap, or, equivalently, the level and change of the unemployment gap. Supply enters through one or more exogenous shift variables to convey the effect of supply disturbances like oil shocks, import prices, and price controls. Inertia enters through a set of lagged inflation variables. In the textbook version the lagged inflation coefficients are *assumed* to sum to unity, and in the econometric version they *actually do* sum to unity. When the two equations are solved simultaneously, they determine inflation and the output gap, for any given history of inflation, any set of supply shocks, and any rate of excess nominal GNP growth.

Taking excess nominal GNP growth as exogenous admittedly sweeps two-thirds of macroeconomics under the rug, but this is the kind of assumption that Solow might endorse, since it makes the model simple enough to focus attention on the basic determinants of inflation and to allow side issues to be ignored. This assumption imposes a kind of dichotomy on macroeconomic discourse. Under this dichotomy one group of economists is assigned the task of understanding how excess nominal GNP growth is determined by monetary and fiscal policy, by the dynamics of investment and inventory behavior, by the demand for alternative types of assets, and other factors. Then another group of economnists is assigned the task of understanding how excess nominal GNP growth is split between inflation and changes in the output gap. Among the members of this second group are practitioners of the "New Keynesian Economics," the current attempt to build the microeconomic foundations of price stickiness; in this context price stickiness can be

interpreted simply as the failure of price changes to mimic excess nominal GNP growth.

The dichotomy admittedly ignores channels by which inflation feeds back into the determination of nominal GNP, which may cause econometric bias in versions in which nominal GNP appears directly as an explanatory variable. This raises the question as to whether the triangle equation should be estimated with nominal GNP appearing directly as an explanatory variable, as I have done in some papers focussing on century-long annual data, or in an alternative version with real GNP or unemployment as an explanatory variable and with nominal GNP omitted (using the identity). As a general proposition, in the presence of contemporaneous feedback from inflation to nominal GNP and of supply shocks which are imperfectly measured, estimates of the triangle-type inflation equation will yield a coefficient on nominal GNP which is biassed away from zero and on real GNP or unemployment which is biassed toward zero. The bias in the latter case, which applies to most published estimates for quarterly data, is likely to be small when a full set of supply-shock variables is included.

It should be emphasized that the triangle approach does not require imposing the dichotomy. In fact it is possible to build large and complex econometric models that simultaneously express relationships among a large number of common variables, and which allow for two-way feedback between nominal GNP growth and inflation. The purpose of the dichotomy, and the simple two-equation inflation model that it makes possible, is both to facilitate exposition and to allow us to understand historical events in a simpler and clearer way than is possible with the large models.

Once this dichotomy is accepted, the mainstream triangle model has at least five clear implications.

(1) In the long run inflation is "always and everywhere an excess nominal GNP phenomenon." To control inflation, policy needs a nominal anchor. Correspondingly, there has been growing support for a policy of nominal GNP growth as the core target of monetary policy by economists as diverse as Robert Hall, Bennett McCallum, John Taylor, James Tobin, and myself. Because of inertia, the model instructs the Fed to start targeting nominal GNP growth when the economy has a zero output gap (which I estimate to have occurred in the third quarter of 1987), and to choose a number for nominal GNP growth equal to potential output growth plus inherited inertial ("core") inflation. The choice of any other number will lead to output fluctuations as the economy overshoots in its struggle to establish a new core rate of inflation. Adopted in late 1987, this approach would have chosen a growth rate of 6.5 percent for nominal GNP (2.5 percent for potential output growth and 4.0 percent for the inherited "core" inflation rate at that time). Achieving that target would have required somewhat tighter monetary policy in 1988 and 1989 than has occurred, given the fact that actual nominal GNP growth between 1987:Q3 and 1989:Q2 has turned out to be 7.5 percent at an annual rate.

(2) There is no special connection between growth in the money supply and inflation; any effect of money on inflation is shared by a similar effect of velocity on inflation. Stated another way, a change in the money supply must induce a change in nominal GNP if it is to affect inflation, while if that change in the money supply is offset by a movement of velocity in the opposite direction (as in 1985-86 for M1), there will be

no response of inflation.

(3) In the short run, fluctuations in excess nominal GNP growth lead to counterclockwise loops on a diagram plotting inflation against the output gap. The loops come from inertia. An acceleration of excess nominal GNP growth causes a loop on the diagram from 6 o'clock to 3 o'clock to 12 o'clock, with a low-inflation boom followed by stagflation. This happened in 1964-71 and a milder version is in progress today. A deceleration of excess nominal GNP growth causes a loop from 12 o'clock to 9 o'clock to 6 o'clock, with a recession followed by an expansion in which inflation may decelerate. This happened between 1981 and 1986.

(4) Supply shocks cause other patterns. An adverse oil shock can cause the economy to shoot off to the northwest, as in 1974-75. Price controls or a beneficial oil shock or price controls can push the economy to the southeast, as in 1971-72 or 1986-87. The point on the compass depends not just on the nature of the supply shocks, but also on the policy response. The northwest movement following an adverse supply shock assumes that policymakers hold excess nominal GNP growth fixed. A restrictive policy response would tilt the economy's movement toward the west and an accommodative response would lead the economy's movement to be more northward than westward.

(5) The triangle model is resolutely Keynesian. Prices are prevented from mimicking changes in nominal GNP growth both by inertia -- the presence of lagged inflation -- and by the finite Phillips curve adjustment coefficient, that is, the coefficient on the output gap variable. With excess nominal GNP growth treated as exogenous, the output gap is determined as a residual. One can use the second equation – that is, the

identity – to write an equation for the output gap that is the dual to the Phillips curve, showing that changes in output depend positively on excess nominal GNP growth and negatively on lagged inflation. The negative effect of inflation inertia on output is the identifying restriction that allows this model of output to be distinguished from the Lucas supply equation approach.

What theoretical story is consistent with the mainstream triangle model? Agents implicitly are price setters and demand takers. While the Patinkin-Clower-Barro-Grossman disequilibrium framework has no model of price setting, it is the right model of quantity determination given whatever sources of inertia and finite Phillips slopes prevent prices from clearing markets. Agents are pushed off notional supply and demand curves by constraints that spill over from rationed markets. Today's macroeconomists who write survey papers tend routinely to brush off the disequilibrium framework, because it has no theory of price determination, while forgetting that it has the right theory of output determination. When these economists say things like "long-lasting effects of money require flat supply curves for goods and labor," they forget that output and employment are not choice variables and that their movements cannot be interpreted as responses of economic agents along supply curves.[2]

Origins and Performance of the Mainstream Textbook Model

In the history of economic models, the triangle model may be unique in that its textbook version came first, and the econometrics and theory came after that. The textbooks were published in 1978; the basic equations were set out in 1976;[3] and the

diagrammatic version originated in a classroom handout which Rudi Dornbusch developed at the Chicago Business School in early 1975. Both my version and that of Dornbusch combined the Friedman-Phelps Phillips curve and a nominal GNP-type identity with Okun's insight that supply shocks have macroeconomic externalities.[4]

In contrast to empirical work on Phillips curves in the 1960s and early 1970s, when every year there was a paper explaining why last year's paper had underpredicted the inflation rate, the triangle framework has remained stable for almost 15 years. The textbook version survives totally intact. The econometric version, developed and refined in the late 1970s, has been validated in the 1980s. The cumulative output gain or loss caused by a permanent acceleration or deceleration of nominal GNP depends on two sets of parameters in the Phillips curve equation, the demand coefficient (that is, the Phillips curve slope) and the inertia coefficients on one or more lags of inflation. A widely used summary statistic that combines the effects of the demand and inertia coefficients is the "sacrifice ratio," i.e., the ratio of the cumulative output gain or loss to the permanent increase or decrease in the inflation rate. The predictive power of the mainstream model was demonstrated in 1981-87, when the actual sacrifice ratio (roughly six) turned out to be almost exactly what had been predicted in advance on the basis of parameters estimated through the end of 1980.[5]

More recently there has been another empirical validation. We only learn the value of potential or natural output, and of the constant-inflation rate of unemployment, by inverting the empirical Phillips curve. This told us in 1985 and 1986 that inflation was not decelerating fast enough to be consistent with a constant-inflation unemployment rate below

6 percent. And, low and behold, when unemployment did go below 6 percent in late 1987, price inflation started to accelerate, and in 1988 wages joined in. Thus the triangle model would appear to have enough empirical support to warrant rejecting Arthur Okun's skeptical view, expressed a decade ago, that "since 1970 the Phillips curve has become an unidentified flying object."[6]

This history of the triangle model reveals a wonderful irony. A central point of departure for Lucas' new classical revolution was the failure of the 1960s Phillips curve. We all remember the flowery language of Lucas and Sargent (1978), "That these predictions were wildly incorrect, and that the doctrine on which they were based is fundamentally flawed, are now simple matters of fact. . . the task which faces contemporary students of the business cycle [is] that of sorting through the wreckage . . . of that remarkable intellectual event called the Keynesian Revolution." The irony is that the triangle model was in print in its present form before Lucas and Sargent spoke these lines. It has survived and thrived, while the wreckage consists of the empirical attempts by Robert Barro and others to validate the new classical policy ineffectiveness proposition, which ran aground on the bedrock of inflation inertia. In fact, the Lucas imperfect information version of new-classical macroeconomics has even been abandoned in print by one of its most prominent developers.[7]

The Triangle Model from an Earlier Perspective: Omitting Expectations, Unemployment, and Wages

Viewed from the perspective of the triangle model, much of the pre-1974 empirical work on the Phillips curve seems quaint and anachronistic. We can't blame our own

youthful transgressions for neglecting supply shocks, since there had been no prior oil shocks of any importance; and in fact there was ample attention to Kennedy-Johnson guideposts and Nixon price controls as variables which could shift the Phillips curve down in just the same way as oil shocks later shifted it up.

But there are other major differences between the earlier writing and the triangle model. The original Phillips article was, after all, about the relationship between wage changes and unemployment. Later expected inflation was added, and we had the expectational Phillips curve. But the triangle model as summarized here has no expectations, no wages, and no unemployment. These are issues of substantive significance.

The omission of expectations is deliberate. Much time was wasted and ink spilled in the late 1960s and early 1970s trying to interpret the lagged effect of prices on wages as reflecting adaptive lags in the formation of expectations. But if we've learned anything from the new Keynesian economics of Fischer, Taylor, Blanchard, and their younger followers, it is that price and wage inertia is compatible with rational expectations. The speed of price adjustment and the speed of expectation formation are two totally different issues. Price adjustment can be delayed by wage and price contracts, and by the time needed for cost increases to percolate through the input-output table, and yet everyone can have form expectations promptly and rationally based on full information about the aggregate price level.

The omission of unemployment at one level is trivial; it allows us to write the model as two equations. To include unemployment requires the addition of a third "Okun's law" equation to link the output and unemployment gaps. But at a more profound level the

omission of unemployment is desirable, for the unemployment rate is a bad cyclical indicator. This is one of the main points of Blanchard and Diamond (1989). The raw unemployment rate mixes up what they call aggregate activity and reallocation shocks, and one needs a careful econometric study like theirs to achieve the needed decomposition of unemployment into its cyclical and structural components. George Perry (1970) taught us that you can't take the raw unemployment rate off the shelf and stick it into a Phillips curve; you need a demographic adjustment. But the events of the last decade have taught us that the demographic adjustment isn't enough either; the natural unemployment rate has not fallen in response to the demographic reversal of the 1980s. By leaving unemployment out of the triangle model, we avoid having to deal with all that. The output gap will do just fine, and if you want a variable that can be taken off the shelf from the government statisticians without any fine tuning, the Fed's capacity utilization rate captures the impact of the business cycle on the inflation process without the need for any adjustment or decomposition at all.[8]

More important than the omission of unemployment is the omission of wages in the triangle model. We now realize that the earlier fixation on wages was a mistake. Back in the bad old days, all the Phillips curve action was assumed to take place in the wage equation, which was assumed to represent a structural relationship in the labor market. Prices were determined by a markup equation, which was generally assumed to tell us something about the product market and to be a sideshow to the main arena, the labor market. The mistake was to assume that the markup fraction, while allowed to vary over the business cycle, was stable on average across cycles. If the markup of prices over

unit labor cost was stable across cycle averages, then so by definition was labor's income share. But this turned out to be incorrect. When we cumulate the wage, price, and productivity data that we have all used in Phillips curve estimation, we see that labor's income share exhibits a strong upward secular movement between the mid 1960s and late 1970s, and a strong downward movement since then.[9] The Federal Reserve's goal is to control inflation, not wage growth, so these changes in labor's income share across business cycles imply that wage equations are useless in explaining inflation if they are combined with price mark-up equations that assume a constant markup across business cycles. As I wrote last year (1988) in an overstatement intended to dramatize this issue, "The markup hypothesis is dead."

It appears in retrospect that those large increases in wages in 1969-1971, that forced us to write new articles on the Phillips curve every year, reflected in substantial part the secular upswing in labor's share. And it appears that those small increases in wages in the last five years, when wages by some measures have actually increased less than inflation despite positive growth in productivity, are part of the secular reversal of the previous upswing in labor's share. This is important, because every economist who reached the misguided conclusion that the natural rate of unemployment fell below 6 percent in the mid-1980s did so on the basis of a wage equation; such a conclusion cannot be reached from evidence on price behavior and hence is of little interest to the Federal Reserve.

I credit Christopher Sims with the major role in purging wages from the triangle model. His contribution came not just from his invention of the VAR format for estimation, which puts a premium on pruning the list of variables, but also from his

consistent position as a critic at the Brookings Panel, where he steadfastly refused to accept any structural interpretations of wage and price equations and insisted that a price equation is a wage equation stood on its head, and vice versa.[10] To their credit, Samuelson and Solow in their original paper presented their famous stylized Phillips curve in the price, unemployment quadrant. The earliest credit for ignoring wages is claimed by Irving Fisher, whose neglected article (1926) discovered the Phillips curve in the form of a relationship between the unemployment rate and price changes, not wage changes.

The Place of the Phillips Curve in Macroeconomics

Despite its success with postwar U. S. data, the triangle model does not settle everything. There are still big puzzles to be explained through history and across countries, especially the hysteresis-like disappearance of the Phillips curve in the interwar U. S. and U. K. and in most of Europe over the last decade.[11] Nevertheless, the postwar U. S. success is there, and the econometric version of the triangle model is absolutely central to any current U. S. discussion of inflation, unemployment, or monetary policy. This then leads me to ask, as my last issue, why has the Phillips curve become the black sheep of macroeconomics? Economists under the age of 40 seem afraid to touch it, and as a result miss the chance to tackle the big remaining puzzles. Why?

The answer, I believe, is that the young are irresistably drawn to models of maximizing behavior. This is nothing new. In our childhood term papers, some of which became part of the MPS model, we M.I.T. graduate students followed Jorgenson and others by starting from a marginal condition for an individual agent and then jumping to aggregate

data to which we attached a structural interpretation. Today this fixation on the representative agent leads not just Minnesota graduates but even a few from M.I.T. to develop equilibrium business cycle models that are in fundamental conflict with the non-market-clearing implications of price inertia.

I think we should just face the fact that we will probably never have an adequate theory of the Phillips curve slope at the level of the representative agent. As Bob Solow said in his "Gun and Camera" paper, "it did not occur to me then that the Phillips curve . . . needed any subtle theoretical justification. It seemed reasonable in a commonsense way. . ." (1976). The commonsense Phillips curve slope comes from aggregation over millions of decision makers, looking forward and backward in the input-output table at both costs and demand, trying to anticipate aggregate events without letting prices get out of line with slowly adjusting costs.

Representative agent theorists, if they want to expose themselves briefly to the real world, might benefit from a recent case study in the *Wall Street Journal* (Wessel, 1989). One of the examples in the article goes as follows: a paper box company plans to raise prices on January 1, but in fact it doesn't because it learns competitors won't follow. One month later on Frebruary 1 it tries again; this time the increase sticks, but at 7.3 percent rather than the 9.7 percent originally planned for January 1. Try to model that, and then try to aggregate it.

We would all be better off if we recognized with Solow that it is commonsense that demand matters, and that the Phillips curve should have a slope, but that the exact value of that slope depends on aggregation over millions of decisions each of which is based on

a set of complex criteria. Any apparent stability of that slope tells us more about the law of large numbers than about microeconomic behavior. With luck the law of large numbers may help us escape the bite of the Lucas critique and use the triangle model for policy, but we will always need to be vigilant, because our luck could run out, as it did in the Great Depression, and as it has in Europe more recently.

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FOOTNOTES

1. Here the adjective "U. S." must be emphasized, as nature of the inflation process in Europe is currently the subject of controversy that does not apply to the U. S.

2. The quote is from Blanchard (1987).

3. Gordon (1977). This paper was presented at the AEA meetings in October, 1976.

4. The only difference is that I took excess nominal GNP growth as exogenous and Dornbusch took excess monetary growth. My version eliminates the unnecessary (and inaccurate for the 1980s) step of assuming that velocity growth is constant.

5. Using the series for the output ratio given in my textbook (fifth edition, Appendix A), the cumulative deviation of actual from potential output during the period 1980-87 was 26.2 percent. While many different measures could be chosen for the "permanent" reduction of inflation during this period, I prefer to take the average annual rate of change of the fixed-weight consumption deflator in 1979-80 (8.25 percent) minus the average for 1985-86 (4.15 percent), for a reduction of 4.1 percent and a sacrifice ratio of 6.4 percent. This is remarkably close to the sacrifice ratio of 6.2 estimated by Gordon-King (1982) on the basis of data for 1954-80 (this is the undiscounted sacrifice ratio from Table 5, line 3, where the reasons for preferring line 3 are given on p. 237).

6. See Okun (1980), p. 166.

7. Recently Barro has written, "The new classical macroeconomics began at about that time [the 1970s], and focused initially on the apparent real effects of monetary disturbances. Despite initial successes, this analysis ultimately was unsatisfactory as an explanation for an important role of money in business fluctuations" (1989, abstract page).

8. See the estimated equations in my comment on Shapiro (1989).

9. The data are plotted in Gordon (1988).

10. See Sims' comments on my paper in *Brookings Papers on Economic Activity*, 1977, no. 1, and on Blanchard's paper in 1987, no. 1.

11. Samuelson and Solow (1960, p. 188) spotted the disappearance of the Phillips relation during the Great Depression and dismissed the 1933-41 observations as "*sui generis*."