A Phillips Curve for the Italian Economy? A Comment on Modigliani and Tarantelli *

In this paper we discuss a generalisation of the Phillips-Lipsey curve to a developing country proposed by Modigliani and Tarantelli (MT), and applied by them to the interpretation of wage dynamics in Italy in a study which was published in the March 1977 issue of this *Review*.[1] A major reason of interest in this work is that it seeks to account for some "structural" features of the Italian labour force, while remaining within the boundaries of a widely used — but far from widely accepted — body of theory.

In this direction MT's analysis seeks, in their words, to account for the "fundamental feature of the labour market in a developing country", that is "the strong heterogeneity of the available labour force". To this purpose, they distinguish two major groups within the unemployed: the "trained unemployed", i.e. those who have worked in the past in the industrial sector, and the "untrained unemployed" who have not. The distinction is considered to be relevant as firms are seen to react to a labour shortage by initially trying to hire "trained unemployed" who require low training costs and have an initial higher productivity. The hiring of "untrained unemployed" being more costly to the firm, is seen to take place only as the availability of "trained unemployed" is progressively reduced. A given overall unemployment level is therefore seen to have a larger effect on wage dynamics if the proportion of untrained unemployed on the total is large.

To account for this dual structure of the labour force, MT propose to modify the standard measure of the rate of unemployment:

$$u(t) = \frac{U(t)}{LF(t)} \tag{1}$$

(where U is the total number of unemployed and LF the total labour force, in year t), in a measure for a developing country. Their alternative is:

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[1] See MT(1973) for a detailed description of the model, and its estimation over the period 1952-1968; and MT(1977) for the inclusion of a union militancy variable and an extension to 1973.

$$(2) \qquad u'(t) = \frac{U(t) - \beta U_n(t)}{LF(t) - \beta U_n(t)}$$

where U_n is the number of "untrained unemployed", and β some coefficient such that for $\beta = 0$ the distinction between the two groups of workers disappears and (2) reduces to (1), and that for $\beta = 1$ the "untrained unemployed" group is effectively excluded from the employable labour force.

MT call u'(t) "unemployment rate in efficiency units". This alternative unemployment measure is not directly obtainable from available statistical sources, and MT thus suggest the following approximation procedure. Their first step is to choose a measure for the size of the "untrained unemployed" group, $U_n(t)$; this is approximated, at any year t, by the minimum level of overall unemployment reached in the system in any year preceding t. Next they assume the existence of a constant frictional lower bound for the overall unemployment rate (γ). After some simple manipulations they obtain what they consider to be a satisfactory approximation to (2):

$$(3) \qquad \hat{u}'(t) = \frac{u(t) - \delta - \vartheta\,(u(k) - \delta)}{1 - \vartheta\,(u(k) - \delta)}$$

where k is the year in which the previous unemployment minimum was reached by the system, and ϑ and δ are transformations of β and γ. $\hat{u}'(t)$ is non-linear in the unknown parameters δ, ϑ: in order to be able to use it in a wage equation of the Phillips-Lipsey type, MT choose an arbitrary constant value of 1.5 for δ, and estimate ϑ by scanning over the interval 0,1. This is done by estimating:

$$(4) \qquad \dot{w}(t) = \alpha_0 + \alpha_1[\hat{u}'(\vartheta,t)]^{-1} + \alpha_2\,\dot{p}(t) + \varepsilon(t)$$

(where $\dot{w}$ is the rate of change of industrial money wages, $\dot{p}$ is the rate of change of prices, and $\hat{u}'(\vartheta,t)$ are observations generated by calculating the "unemployment rate in efficiency units", for the various years, at different values of ϑ over the range 0,1). In their first article MT estimate (4) by Ordinary Least Squares (OLS) over the period 1952-1968.

Their preferred equation, after scanning for ϑ, is:

$$(5) \qquad \dot{w} = \underset{(6.2)}{3.7} + \underset{(6.8)}{1.58}\,\frac{1 - 0.54\,\dfrac{u(k) - 1.5}{100}}{u - 1.5 - 0.54(u(k) - 1.5)} + \underset{(3.5)}{0.72}\,\dot{p}$$

$$R^2 = 0.90;\; SE = 1.33;\; d = 2.01.$$

where the symbols have the conventional meaning, and "t-ratios" are shown in parentheses.

By comparing (5) with the estimate of a standard Phillips-Lipsey equation, they remark how their modified wage equation exhibits a lower estimated standard error, a higher R^2, higher significance for the unemployment variable and the constant term, and a price coefficient estimate more in line with *a priori* expectations. Remarking then that the estimate of ϑ at 0.54 implies that "with respect to the effect on wage behaviour an 'untrained unemployed' person counts, as it were, half as much as a trained one" (MT 1973, p. 213), MT conclude that "the evidence strongly supports our generalisation of the Phillips curve for a developing country" (ibidem, p. 215), and proceed to analyse the macroeconomic implications of their result. The same framework is then employed by MT(1977) to extend their analysis to 1973. Their estimated equation, which includes in that case a union militancy variable and seeks to account with a set of dummies for a "structural break" in the labour market in 1969, yields estimates for the constant term (3.1), for ϑ (.5), and for the price coefficient (.8) practically identical to those obtained for the 1952-1968 period.[2]

Instead of following MT in this development of their work, we now turn to a somewhat closer examination of the central feature of their analytical framework: the "unemployment rate in efficiency units". To this aim, we begin by replicating the MT scanning procedure for its construction described above. This shows a surprising feature: the "unemployment rate in efficiency units" takes negative values, with increasing frequency, for values of ϑ above 0.6. This is rather unwelcome because u' (ϑ) is a measure of an unemployment rate, but no discussion of the point is contained in MT's original paper (MT 1973). In their second paper (MT 1977), on the other hand, they state: "in this estimate, as in those that follow, we chose the value of ϑ which minimises the standard error of the regression in the narrower *a priori* acceptable interval $0<\vartheta<.6$ (rather than $0<\vartheta<1$), in that for values of ϑ superior to this latter extreme, $\hat{u}'(t)$ for several years takes by construction negative values which as such do not fall within the *a priori* acceptable interval for the rate of unemployment in efficiency units" (p. 18, fn. 5).

Unfortunately, it is not appropriate to dispose of the problem in so arbitrary a fashion. The number of "trained unemployed" in the MT definition, cannot be larger than the total number of unemployed (trained and untrained). Thus, as can be readily seen from (2) above, the "unemployment rate in efficiency units" can *never* take negative values for any value of ϑ not greater than 1. As the MT approximation does precisely this, it must be that the theoretical concept has been incorrectly approximated.

Although MT do not report any investigation of this issue, it is not difficult to find an economic interpretation of the occurrence of negative values. As we

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[2] See MT(1977) p. 22-24.

saw, MT choose to approximate the number of "untrained unemployed" at any year t by the total number of unemployed at the previous unemployment trough, k. This may be legitimate *when unemployment is rising* since, in such circumstances, a portion of the currently unemployed labour force was previously employed and — presumably — is now "trained" in the MT sense.

This is not, however, legitimate *when unemployment is falling*. At such times, a portion of the labour force which was unemployed at k will now be employed, and U(k) will overestimate $U_n(t)$.

As can be seen from (2), any upward bias in the measure of U_n (t) will give rise to a downward bias in the estimation of the "unemployment rate in efficiency units". Thus, if the above point is correct, we should expect to observe negative values in the MT approximation to $u'(\vartheta)$ *only* in years in which unemployment falls below the previously observed trough. This is, indeed, what we observe comparing the usual measure of unemployment and the MT "unemployment rate in efficiency units".[3] For $\vartheta=1$ this is particularly clear, as we can see from the figure: negative values appear for all years between 1952 and 1963, *except* for 1956 and 1957. *These are the only two years in which unemployment did not fall below its previous minimum.*

Thus the occurrence of negative values for the "unemployment rate in efficiency units" can be given an economic interpretation, and should not be regarded as a *curiosum* — as MT do — to be disposed of by imposing *a priori* restrictions in the estimation process.

The unemployment variable utilised by MT is thus incorrect. As a consequence, the quantitative results they present cannot be considered a valid test of their proposed generalisation of the Phillips curve to a developing economy. A consistent test of the MT model can, on the other hand, be performed once their "unemployment rate in efficiency units" is correctly constructed. This can be easily done along the lines discussed above, by substituting in (3) the *current* unemployment rate u(t) for the *previous* minimum rate u(k) *for all the years in which unemployment fell from the previous minimum*: as it should be expected, in this case, none of the observations is now negative.[4]

Having thus corrected the MT procedure in a way fully consistent with their argument, we are now in the position of undertaking a consistent test of their model. Re-estimation of the wage equation (4) over the period 1952-1968 leads, after scanning for the best value of ϑ, to the following estimate:

$$\dot{w} = \underset{(2.44)}{1.78} + \underset{(6.48)}{0.91}\,\frac{1 - 0.91\,\dfrac{(u(h)-1.5)}{100}}{u - 1.5 - 0.91(u(h)-1.5)} + \underset{(4.62)}{1.00}\,\dot{p} \qquad (6)$$

[3] The detailed results are available, on request.
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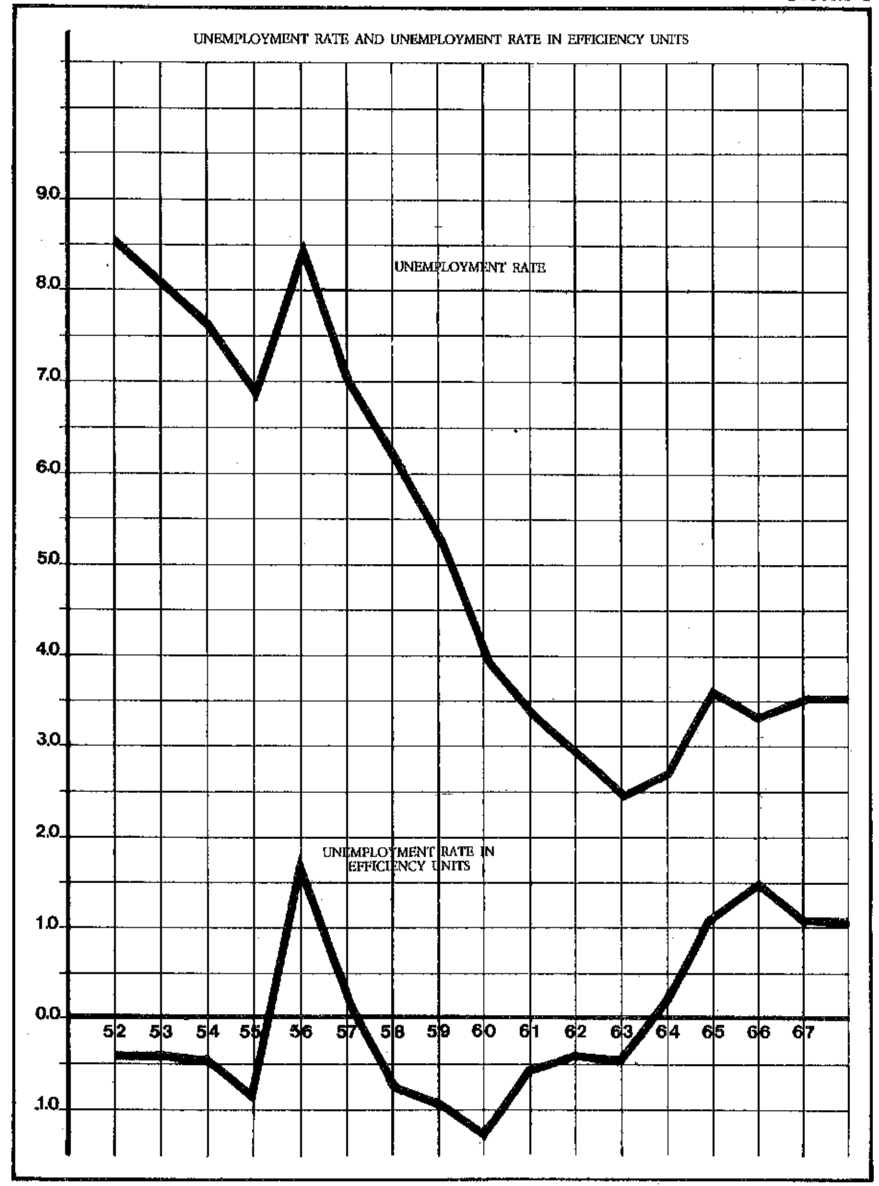
FIGURE 1



$R^2 = .930$; SE $= 1.34$; $d = 2.03$; $z_1\ (3) = 13.59$;

$z_2(3) = .74$; $z_3(3,9) = 3.42$.

In (6) three specification tests are provided in addition to those presented by MT. This was thought necessary for two reasons: first, that in general the crucial problem in applied econometric work is to assess the degree of correct specification of the models employed, so as to minimise the bias arising from the omission of relevant variables, incorrect functional forms and incorrect lag structures. Secondly, that mis-specification may not be detected by the usual Durbin-Watson test if it results in an autoregressive process of order higher than one for the residuals (or, in a number of cases, by *any* test on the randomness of the residuals). Thus, a test for residual correlation up to the third order ($z_2(3)$), and two tests of the post-sample parameter stability of the equation were performed, using the last three observations of the sample as forecasting period ($z_1(3)$ and $z_3(3,9)$).[5]

Turning now to the analysis of our estimated equation (6), we can see how — although the estimated coefficients are all significant, have the sign that the theory would predict, the estimated standard error of the regression is small, and no residual correlation is detectable — two features of the equation point to a serious mis-specification.

First of all, ϑ is now estimated at 0.91. This in the MT words would imply that an "untrained unemployed" worker *counts 9% as much as a "trained" one* with respect to the effect on wage behaviour. As a consequence, it would seem that the "untrained unemployed" are almost unemployable in the short run, and that therefore the dynamics of industrial wages in Italy has been almost entirely determined by the size of the "trained unemployed" group over the period: this seems, however, largely at variance with the Italian experience.

Secondly, the two additional forecasting tests clearly point towards a serious mis-specification of the model showing how, when estimated over the period 1952-1965, the model breaks down over the period 1966-68.

The results obtained so far in this paper may be summarised as follows: Modigliani and Tarantelli construct an incorrect approximation to their "unemployment rate in efficiency units". Their use of an incorrect variable prevents them from consistently testing their model, and thus undermines the significance of the empirical results they present. Once the unemployment variable is correctly approximated, in a fashion fully consistent with their analysis, their model can be seen to be rejected by the data.

Two further problems with the MT model may be worth mentioning here: firstly, as has been shown by Spinelli (1980), the estimates of the coefficients

[5] For a description of the tests, see DAVIDSON *et al.* (1978), HENDRY (1979) and HENDRY (1980).

of the model are extremely sensitive to (and thus conditional upon) the value of the lower bound of the unemployment rate (δ); since a value for this parameter is chosen by MT entirely on *a priori* grounds, this makes their model depend on a crucial, *but never tested,* maintained hypothesis.

Secondly, MT do not devote sufficient attention to the possible existence of a simultaneous equations bias, arising from the existence of a second structural equation linking price changes to wage changes via unit costs, nor fully realise the consequences of this problem for their argument. Re-estimating (5) with a two-stage technique (while keeping ϑ at its OLS estimate of .54), they indeed observe changes in the estimated coefficients as large as 40% but hastily dismiss the issue:[6] they do not seem to be aware of the fact that a simultaneity bias will generate incorrect estimates of the standard error of the equation. As their method for the estimation of ϑ relies precisely on the comparison of estimated standard errors corresponding to different values of ϑ over the scanning interval, simultaneity will be likely to yield biased and inconsistent estimates for ϑ: their procedure of testing for simultaneity bias *while keeping* ϑ *at its OLS estimated value* is, therefore, incorrect.

Thus, as a general conclusion about the MT results, we may say that they are obtained by making use of an incorrectly approximated unemployment variable; they are conditional upon a non-tested hypothesis about the lower bound of the unemployment rate; they potentially suffer from a serious simultaneous equations bias.

The theoretical foundations of the Phillips curve, after more than twenty years from its proposition, are still far from being satisfactorily settled. The Phillips curve maintains, therefore, its original character of an essentially empirical relationship, obtained as a result of econometric estimation. It would seem advisable that, for this reason, any applied work in the area, and especially any attempt to "generalise" it, paid the greatest attention to the appropriateness and modernity of the econometric procedures employed.

Bologna

LUIGI PROSPERETTI

[6] See MT (1973) p. 215 fn. 1.

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