*The Appropriate Measure of Unemployment in an Irish Phillips Curve**

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Précis: A generalisation of the Phillips curve for a developing country, recently proposed by Modigliani and Tarentelli (1973), is modified and applied to the Irish economy for the period 1953–1972, using annual data. The results indicate that a redefinition of the unemployment variable to allow for the structural characteristics of the Irish labour force fails to improve the overall fit of the Phillips relationship or the significance of the unemployment term itself. In addition, the results using unadjusted unemployment variables revealed both a small and rather weak relationship between unemployment and wage inflation, a result similar to that found by Geary and McCarthy (1975). To the extent that the rate of unemployment reflects domestic excess demand, this result provides little support for the view that Irish wage inflation is largely determined by domestic excess demand. In the context of a small open economy, this outcome is hardly surprising. The results also indicate that price expectations exercise a dominant rôle in determining the rate of wage inflation in Ireland; whether quarterly or monthly data would produce a more significant rôle for domestic factors such as the structure of the labour force is open to question.

1 *Introduction*

In a recent paper, Modigliani and Tarentelli (1973) proposed a generalisation of the Phillips curve to account for the labour market characteristics of developing economies. They viewed the rate of unemployment as an inadequate proxy for the level of excess demand in the industrial labour market of such economies, which tend to be characterised by initially large but declining volumes of structural unemployment. Their generalisation involved a redefinition of the

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unemployment variable and it is discussed below. It was supported by Italian data for the post-war period; this suggests that it might be applicable to Ireland since the Irish and Italian economies have some relevant characteristics in common. In particular, in the post-war period, each has experienced significant growth in the share of its industrial sector in both GNP and employment, with an accompanying decline in the share of agriculture. A study of *non-agricultural* unemployment in Ireland by Walsh (1974) while questioning the extent to which its high level is due to structural factors, accepted the existence of "serious labour market imbalances between various regional, occupation and demographic groups in Ireland" (p. 72). When total unemployment is considered, the rôle of structural factors is presumably strengthened.

The behaviour of measured unemployment and the labour force in the two economies differed, however. The Italian unemployment rate fell up to 1963, from 9 per cent to 2·5 per cent of the labour force and then rose to average 3·5 per cent in the mid-1960s, while in Ireland, the rate fell to around 5 per cent in 1965, and then rose gradually. At no time did the Irish unemployment rate, however measured (see below), approach the low level experienced in Italy. The Irish labour force declined until the early 1960s, largely because of the emigration of the 1950s and since then it has risen slightly; Italian emigration did not lead to a declining labour force.

The purpose of this paper is to apply the Modigliani-Tarentelli model, appropriately modified, to the Irish economy. It is assumed that only the level of unemployment is relevant to the process of wage inflation, thus excluding its rate of change and variables such as net migration, which were discussed by Geary and McCarthy (1975). In Section 2, the model is presented and some criticisms of it are offered. This is followed by a discussion of the Irish data and the specific measures of unemployment to be used to estimate the model. The results of estimating the generalised Phillips curve are presented in Section 4, and the paper concludes with an evaluation of the implications of the results.

2. *Modification of the Modigliani-Tarentelli generalisation*

Modigliani and Tarentelli divided the labour market into three sectors, the employed, the trained unemployed and the untrained unemployed. The first is defined as the proportion of the labour force *currently employed in industry*, the second as that part of the pool of unemployed workers with industrial experience and the third as "that fraction of the labour force which lacks previous experience in the industrial sector" (p. 206). Denoting the untrained unemployed by *Un* they argued that the measured unemployment rate $u = U/LF$, where U is the number unemployed and LF is the labour force, should be replaced, in a developing economy, by the following measure of labour availability

$$u' = \frac{U - \beta Un}{LF - \beta Un} \qquad 0 < \beta < 1 \qquad (1)$$

on the following grounds. The probability of a firm filling a vacancy increases with the number of trained unemployed. However, it is much less responsive to the size of the pool of *untrained* unemployed, since hiring untrained workers imposes extra costs on firms. In the extreme case of the untrained unemployed being unemployable, they should be completely excluded from the measure of labour availability, i.e. $\beta = 1$. The other extreme ($\beta = 0$) implies no distinction between the untrained and trained unemployed; hence the restriction $0 < \beta < 1$.[1]

Lacking a direct measure of the untrained unemployed, Modigliani and Tarentelli suggested as a reasonable proxy, the difference between the total labour force and the previous highest level of employment achieved in the economy, denoted by E_m:

$$Un(t) = LF(t) - E_m(t) \tag{2}$$

A number of modifications to this formulation were proposed but they do not alter its basic properties.

Incorporating u' in the Phillips curve of a developing country implies that there is not a unique relationship between money wage inflation and the level of unemployment even in the short run, as a standard Phillips curve would imply. This is because the effect on money wages of a given unemployment rate depends on the composition of unemployment, i.e., on the proportions of trained and untrained unemployed. If the latter form a large proportion of total unemployment, then by (1) the relevant unemployment rate u' is much less than u, hence the greater the pressure on money wages to rise. As the economy develops and the trained labour force grows relative to the total, the significance of the untrained declines and u' is closer to u; the pressure on money wages to rise is less. Thus the developing economy is seen to have a *family* of Phillips curves, whose parameter is the composition of unemployment; as it develops, the economy moves on to lower curves and approaches the developed countries Phillips curve, where the whole labour force is trained.

An aspect of the Modigliani-Tarentelli model which requires elaboration is the definition of u' and the treatment of the agricultural labour force.[2] The untrained unemployed, as defined, are the difference between the total and the trained labour force. This would appear to include the entire agricultural labour force, employed and unemployed. Subsequent discussion (p. 210), however, casts doubt on this interpretation and suggests that of the agricultural labour force, only the unemployed form part of *Un*. The meaning of u' is obscure under the first interpretation. Its numerator involves the difference between total unemployment and a fraction of the untrained *labour force*. This is a meaningful measure of the number of available workers only if the untrained employed are regarded as

1. Clearly, measures of labour availability such as u' may be applied in any labour market in which groups of workers are imperfectly substitutable, for example, where there is discrimination between groups of workers or where there is geographical immobility.

2. The rest of this section is based on Geary (1975).

available for industrial work. But then, instead of $U-\beta Un$, the numerator should be

$$U+En-\beta(U\hat{n}+En) = U+En-\beta LFn \tag{3}$$

where En is the number of untrained employed (effectively, those employed in agriculture), $U\hat{n}$ is the number of untrained workers out of work and $LFn = U\hat{n}+En$ is the untrained labour force. Interpreting Un as LFn and leaving the denominator unaltered,

$$u'' = \frac{U+En-\beta LFn}{LF-\beta LFn} \tag{4}$$

measures labour availability with the implication that the untrained labour force is imperfectly substitutable for the trained labour force.

Under the second interpretation, the number of available workers is not assumed to include the untrained employed, but they are part of the labour force and thus enter the denominator, Where they are treated as indistinguishable from the trained labour force. This is a rather anomalous situation: in the denominator, the untrained employed are regarded as perfectly substitutable for the trained labour force but in the numerator they are regarded as unsubstitutable for them. Further, when unemployed, untrained Workers are regarded as imperfect substitutes for trained workers. In the Modigliani-Tarentelli discussion, of course, the untrained employed are not specifically recognised as a category, since it is assumed that when hired, the untrained become trained. However, in a developing economy with a sizeable agricultural sector and/or unskilled underemployment in cities, they may constitute a significant proportion of the labour force. If so, the seconds interpretation is also inappropriate.

An alternative measure of labour availability would be one which excludes part of the untrained unemployed from the numerator but part of the untrained labour force from the denominator, i.e.,

$$u''' = \frac{U-\beta Un}{LF-\beta LFn} \tag{5}$$

This avoids some of the drawbacks of the previous measure. In the case of $\beta = 1$, for example, it states that untrained workers are irrelevant to industrial labour availability; for $0<\beta<1$ the degree of substitutability of untrained for trained workers is the same among the unemployed as among the labour force as a whole. Thus the substitutability of untrained for trained labour is independent of its employment status.

Modigliani and Tarentelli also used one definition of unemployment which

completely excluded the agricultural unemployed and labour force, i.e., starting from the non-agricultural unemployment rate, they made adjustments for the presence of untrained non-agricultural workers. The points made above still apply to this formulation, although with less force.

The foregoing discussion implies that the basic definition of u' used by Modigliani and Tarentelli (see equation (1)), is not the most appropriate to the Irish economy, which still has 23 per cent of its labour force employed in the agricultural sector. Their alternative definition, based on the non-agricultural unemployment rate, is more appropriate but still subject to the drawbacks outlined above. The preferred definitions are those given by equations (4) and (5).

3. *Application to the Irish economy*

3.1. *The Data*

The extent and deficiencies of Irish unemployment data have been described elsewhere; see Walsh (1974), Geary and Hughes (1970). The Live Register provides an occupational classification which allows the measurement of untrained unemployment (in the sense of $U\hat{n}$). This could be taken as those on the Live Register from agricultural occupations, or in addition, those from unskilled occupations, such as unskilled building workers. Live Register data on agricultural unemployment, however, are of questionable usefulness due to changes in the law—"notably, the liberalisation of the qualification rules and the redefinition of the Register in 1966, the introduction of Employment Period Orders, etc." (Walsh (1974,) p. 19). In measuring the percentage of unemployment, the number on the Live Register is expressed as a percentage of the insured labour force. For the period for which data are available, the insured labour force was not equivalent to the total labour force; the difference is explained in the Trend of Employment and Unemployment, published annually. Unfortunately, these data do not allow adequate measurement of the untrained labour force. There is no occupational breakdown of the insured population published, only an industrial breakdown. Thus the agricultural and non-agricultural insured labour forces can be separated, but there are no data on the skill composition of the latter. Furthermore, the problems that arise in using Live Register data on agricultural unemployment also affect the data on the insured agricultural labour force. In principle, then, unemployment definitions such as (1) can be measured directly but the definitions given by (4) and (5) cannot, and require a proxy measure for *LFn*. Data quality considerations, however, cast particularly strong doubts on the latter. The version of (1) based on non-agricultural unemployment can also be measured directly; those based on (4) and (5) again require a proxy for *LFn*.

The alternative source of data is based on Census of Population returns, together with estimates for non-Census years; it is published annually in TEU. The data consist of estimates of the total labour force, the number out of work and an industrial classification of those at work. The "out-of-work" are not classified.

Measures of unemployment based on (1), (4) and (5) clearly cannot be calculated directly from this source; proxy measures must be found for both the unskilled unemployed and labour force. The data have the advantage, however, of being less susceptible to the biases introduced into Live Register data by changing social security provisions.

3.2. *Measures of unemployment*

As already noted, proxy measures of the untrained labour force and unemployed are required to operationalise some of the definitions of unemployment discussed above. Using the Census based data, the following proxies are calculated.

(i) The untrained labour force, *LFn*, at any time *t*, is measured as the difference between the total labour force at time *t*, and the previous highest level of non-agricultural employment achieved by the economy in any period preceding *t*, denoted by $E_m(t)$, i.e.,

$$LFn(t) = LF(t) - E_m(t) \tag{6}$$

This is very similar to the first interpretation of the Modigliani-Tarentelli definition of *Un*, discussed in Section 2 and given by (2); *Un* here includes the agricultural labour force.

(ii) The untrained unemployed denoted by $U\hat{n}$ (as distinct from *Un*), are measured as the difference between the untrained labour force and the number at work in agriculture, denoted by *Ea*.

$$U\hat{n}(t) = LFn(t) - Ea(t) \tag{7}$$

This corresponds to the second interpretation of *Un*, that actually used in the empirical section of the Modigliani-Tarentelli study.

(iii) The untrained employed are simply the difference between *LFn* and $U\hat{n}$; and are thus the number at work in agriculture:

$$En(t) = LFn(t) - U\hat{n}(t) = Ea \tag{8}$$

Data do not allow the untrained employed in non-agricultural occupations to be estimated.

These proxies allow the definitions of unemployment u'' given by (4) and u''' given by (5) to be calculated. The results of incorporating them into the Irish Phillips curve are presented below.

The calculation of a proxy variable for *LFn* from Live Register data is not undertaken because of the inadequacies of the data relating to the agricultural

sector. In principle *LFn* can be estimated from data on the non-agricultural insured labour force and Live Register in the manner given by (6). However, because of the high rate of emigration in the 1950s the insured labour force fell, thus making the estimate of *LFn* negative. The formulation of alternative proxies to meet this case is not pursued here, but the special case of $\beta = 0$, i.e. where unemployment is measured by the non-agricultural unemployment rate can be estimated and the results are presented in Section 4.

4. *The Results*

Generalised Phillips curves, of the form

$$\dot{W}_t = a_o + a_1 u_t + a_2 \dot{p}^e_t \qquad a_1 < 0,\ a_2 > 0. \quad (9)$$

where $\dot{W}$ is the hourly earnings rate in industry, u is the rate of unemployment variously defined, $\dot{p}^e$ is an index of expected consumer prices and a dot on a variable denotes a proportionate first difference, were estimated by two stage least squares. It was assumed, on the basis of the findings of Geary and McCarthy (1975), that $\dot{p}^e = \dot{p}$, i.e., there are stationary expectations. Since annual data were used in the estimation, this assumption is unexceptionable. The first stage estimate of $\dot{p}$ was obtained by specifying a standard price equation of the type

$$\dot{p}_t = b_o + b_1 \dot{W}_t + b_2 p_f + b_3 Z \quad (10)$$

where p_f is an index of consumer prices in Britain (the Retail Price Index) and Z is an index of industrial output per head. (The appropriate measure of foreign prices in a wage-price model of Irish inflation will be discussed elsewhere.)

The measures of unemployment given by u'' and u''' contain the parameter β, whose range is the interval (0,1). The model was estimated for alternative values of β. The results, together with that for the Live Register non-agricultural unemployment rate ($\bar{u}$), are summarised in Table 1, where the subscripts on the unemployment variable denote the values of β and the t-statistics are in parentheses. The results for β values of 0, 0·1 and 0·5 are reported; the complete results, with β values chosen at intervals of 0·1, in no way alter the impression given by the table. The results were also insensitive to the use of the inverse of the unemployment variable, rather than its level.

The effect of varying β is similar for u'' and u'''. In each case, increasing its value from 0 leads to a reduction in both the t-statistic of the unemployment variable and the overall goodness of fit of the wage equation. No support is provided for the generalisation of the Phillips curve implicit in u'' and u''' for increasing values of β. This is in marked contrast to the results of Modigliani and Tarentelli although the formulations tested are not identical; tests with identical formulations whose interpretation was discussed above produced similar results.

Table 1

(a)	$\dot{w}=$	19·34	−0·40	u''_0	+0·87$\dot{p}$	$\bar{R}^2=0.68$
		(1·85)	(1·65)		(2·02)	D.W.=1·62
(b)	$\dot{w}=$	18·02	−0·39	$u''_{0.1}$	+0·88$\dot{p}$	$\bar{R}^2=0.67$
		(1·76)	(1·55)		(2·01)	D.W.=2·55
(c)	$\dot{w}=$	10·43	−0·28	$u''_{0.5}$	+1·03$\dot{p}$	$\bar{R}^2=0.58$
		(1·17)	(0·90)		(2·10)	D.W.=2·08
(d)	$\dot{w}=$	9·21	−1·24	u'''_0	+1·38$\dot{p}$	$\bar{R}^2=0.49$
		(1·43)	(1·04)		(4·33)	D.W.=1·72
(e)	$\dot{w}=$	6·05	−0·65	$u'''_{0.1}$	+1·34$\dot{p}$	$\bar{R}^2=0.47$
		(1·00)	(0·58)		(4·16)	D.W.=1·66
(f)	$\dot{w}=$	1·01	+0·33	$u'''_{0.5}$	+1·43$\dot{p}$	$\bar{R}^2=0.46$
		(0·31)	(0·61)		(3·97)	D.W.=1·59
(g)	$\dot{w}=$	9·56	−0·97	$\bar{u}$	+1·29$\dot{p}$	$\bar{R}^2=0.50$
		(1·99)	(1·46)		(4·28)	D.W.=1·81

When $\beta = 0$, u'' is the sum of those out of work and those employed in agriculture as a percentage of the total labour force, while u''' is simply the percentage of the total labour force out of work. Equations (*a*) (*d*) and (*g*) (and the remaining equations) have the following characteristic in common. The coefficients of $\dot{p}$ are statistically significant at the 5 per cent level; the coefficients of the unemployment variable are not significant at this level. The coefficients of $\dot{p}$ are not statistically different from unity at the 1 per cent level. The estimated equations differ in the magnitude of their intercepts, that in (*a*) being much larger than the other two for obvious reasons; the coefficient of $\dot{p}$ in (*a*) is both smaller in magnitude and statistically less significant than that in (*d*) and (*g*). Furthermore, the coefficient of the unemployment variable is smaller in magnitude and statistically more significant than that in (*d*)and (*g*),while the $\bar{R}^2$ in (*a*) is appreciably higher than that in the other two equations. The explanation of the latter differences lies in the behaviour of the variable u'' when $\beta = 0$. It is dominated by the decline in the agricultural labour force, which causes u'' to fall steadily from 1957. A measure of unemployment alone, such as $\bar{u}$, fluctuates much more, declining to the mid-1960s and then gradually rising.

The implications of these results are considered in Section 5.

5. *Implications*

The results indicate that a redefinition of the unemployment variable to allow for the structural characteristics of the Irish labour force fails to improve the overall fit of the Phillips relationship or the significance of the unemployment term itself. In addition, the results using unadjusted unemployment variables revealed both a small and rather weak relationship between unemployment and

wage inflation, a result similar to that found by Geary and McCarthy (1975). Equation (*g*), for example, suggests that a one point increase in Irish unemployment would be associated with only a one point decrease in the rate of wage inflation, *cet. par.* To the extent that the rate of unemployment reflects domestic excess demand, this result provides little support for the view that Irish wage inflation is largely determined by domestic excess demand, while the same can be said of foreign demand. In the context of a small open economy, of course, this outcome is hardly surprising. If such an economy is a price taker in trade, domestic excess demand will largely be met at existing prices by imports while domestic excess supply will be absorbed by exports. In other words, the more open an economy, the less meaningful a concept is its excess demand. Furthermore, in this study, annual data are employed, which makes the result even less surprising; whether quarterly or monthly data would produce a more significant rôle for domestic factors such as the structure of the labour force is open to question.

Price expectations clearly exercise a dominant rôle in determining the rate of wage inflation in Ireland, on the basis of the evidence in Table 1. Further, the values of the coefficients of the price terms are consistent with the Friedman-Phelps hypothesis of zero money illusion in the labour market (see for example, Friedman (1968)), since they are not significantly different from unity, a finding which again agrees with that of Geary and McCarthy. Some of the $\dot{p}$ coefficients are rather large, however; this is a result which, if it were well established, would imply a *positive* long-run relationship between inflation and unemployment.

This study has concentrated on the wage equation of the wage-price model, i.e., the Phillips curve, it has said nothing of the rôle of such factors as foreign prices in determining the rate of price inflation nor of the interrelationship between wage and price inflation. Neither has it ruled out the possibility that alternative output-based measures of excess demand would lead to modifications of the conclusions of this study. These topics are the subject of separate studies.

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