World Prices and the Inflationary Process in a Small Open Economy — the Case of Ireland

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Précis: The standard wage-price model of inflation and a variant of Parkin's (1973) inflation model, both directly incorporating world prices, are applied to the Irish economy for the period 1953–74. This approach does not allow the inflationary transmission mechanism to be investigated in detail; it restricts attention to the proximate role of world prices as a determinant of Irish inflation. The models are estimated using annual data and the coefficient restrictions implied by the theory of small open economy inflation are tested. When world prices are measured by the UK Retail Price Index, these restrictions are satisfied although the individual coefficients raise some questions. The Personal Consumption Deflator of the OECD yields less satisfactory results. The weak relationship between unemployment and wage and price inflation, a feature of other studies of Irish inflation, is also found in this study.

I. *Introduction*

THIS paper is concerned with the role of world prices in the inflationary process of a small open economy. It applies both a wage-price model and single equation approaches to the Irish economy, which is both very small and extremely open. The ratio of exports or imports to GNP is about 40 per cent, factor mobility between Ireland and Britain has been almost unhindered and a fixed exchange rate relationship has been maintained between the Irish and British currencies. In adopting this approach, it is necessarily concerned with the proximate role of

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world prices, since the long run rate of inflation in a small open economy is, under fixed exchange rates, effectively determined by the appropriately defined world rate. Thus the transmission mechanisms are not fully dealt with.

Part II of the paper presents a modification of the wage-price model of inflation to include world influences and considers its interpretation in the open economy context. Alternative single equation formulations of the type considered by Parkin (1973) are presented and interpreted. The question of the appropriate definition of world prices is briefly examined. In Part III, the results of estimating the models using annual data for the Irish economy are presented and their implications are discussed in Part IV.

II. *Models of Wage and Price Inflation*

The standard wage-price model of inflation, as formulated, for example, by Lipsey and Parkin (1970) may be written

$$\dot{W} = W(U, \dot{P}) \tag{1}$$

$$\dot{P} = P(\dot{W}, \dot{P}_m, \dot{Z}) \tag{2}$$

where W is the wage or earnings rate, U is the rate of unemployment, P is an index of prices, P_m is an index of import prices, Z is an index of productivity and a dot on a variable denotes its proportionate rate of change. $\dot{P}$ in equation (1) is often replaced by $\dot{P}^e$, the expected rate of inflation, and a further equation relating $\dot{P}^e$ to current and past price inflation added, in the absence of directly observed values for $\dot{P}^e$. It is assumed here that $\dot{P}^e = \dot{P}$; as is noted in Part III below, annual data are employed in the estimation, so that this assumption is not implausible. It is also commonly assumed that the $\dot{W}$ and $\dot{Z}$ terms should be combined to form a unit labour cost variable $(\dot{W}-\dot{Z})$; in the linear form of (2) this restricts the $\dot{W}$ and $\dot{Z}$ coefficients to be equal in magnitude and of opposite sign. This model involves a limited concept of openness, import prices being the only external influence directly included. They give the price equation a simple mark-up interpretation, which is forfeited in alternative specifications such as those which include export as well as import prices.

The theory of small open economy inflation suggests a more general relationship between domestic and foreign inflation. Not merely is foreign inflation transmitted through the prices of internationally traded goods, but also through the effects of exports, imports and factor flows on domestic income and the money supply and on the domestic responses they invoke under fixed exchange rates. Since changes in world inflation induce such general responses, it is appropriate explicitly to include a world price variable as a determinant of domestic inflation (see Jonson *et al* (1974) and Parkin (1973)).

This may be achieved in the context of the wage-price model by employing a world price term, denoted by $\dot{P}_w$, instead of the import price term in equation (2).

The role of $\dot{P}_w$ may be interpreted in a number of ways. It might be regarded as reflecting, in part, the "cost push" influences of increases in import prices, and in part, the influence of world demand on the assumption of price-taking behaviour by firms. This is an *ad hoc* interpretation which imposes no particular constraint on the coefficient of $\dot{P}_w$ other than that it exceed zero. However, the model might be given a "long run" interpretation, which would mean that the complete effects of a change in world on domestic inflation rates would occur in a single period. Where the period is a quarter, this would be untenable; where it is a year, it is much less so. Such an interpretation implies restrictions on the values of the coefficients of equation (2). Rewriting the model in linear form,

$$\dot{W} = a_0 + a_1 U + a_2 \dot{P}, \qquad a_1 < 0,\ a_2 > 0 \tag{1'}$$

$$\dot{P} = b_0 + b_1 \dot{W} + b_2 \dot{Z} + b_3 \dot{P}_w, \qquad b_1,\ b_3 > 0,\ b_2 < 0 \tag{2'}$$

it follows that the domestic inflation—world inflation multiplier is $b_3/(1-a_2 b_1)$. By the theory of small open economy inflation, (see, for example, Caves (1973)), we have

$$b_3/(1-a_2 b_1) = 1 \tag{3}$$

in the long run. If there is no money illusion in the labour market, and money wages adjust to price changes in a single period, a_2 is unity. If, in addition, b_1 and b_3 are assumed to be positive, then

$$b_1 + b_3 = 1, \qquad 0 < b_1,\ b_3 < 1 \tag{4}$$

i.e., the coefficients of the wage and world price terms should add to one. When $a_2 \neq 1$, (4) becomes

$$b_1 + b_3 \gtreqless 1 \quad \text{as} \quad a_2 \gtreqless 1 \tag{4'}$$

In addition, the restriction that $b_1 = -b_2$ may be imposed.

Parkin's (1973) wage inflation model, which utilises the distinction between internationally tradeable and non-tradeable goods, may be modified to yield a price equation similar to (2'). Let

$$\dot{P} = c_1 \dot{X} + c_2 \dot{P}^e, \qquad c_1 > 0,\ c_2 > 0 \tag{5}$$

$$\dot{P}^e = g_1 \dot{P}_w{}^e + g_2 \dot{P}_d{}^e, \qquad g_1, g_2 > 0,\ g_1 + g_2 = 1 \tag{6}$$

$$\dot{P}_d{}^e = h_1 \dot{W}^e + h_2 \dot{Z}^e + h_3 \dot{P}_w{}^e; \qquad h_1 = -h_2,\ h_2 < 0,\ h_1 + h_3 = 1 \tag{7}$$

where P_w is the price of internationally tradeable goods, P_d is the price of domestic non-tradeable goods, X is a measure of excess demand and superscript ^{e} denotes expectations. Equation (5) is an expectations-augmented Phillips curve in prices and (6) is a definition. The full derivation of (7) may be found in Parkin (1973). He posits an excess demand function for labour whose arguments are earnings, productivity and the prices of internationally tradeable and non-tradeable goods; the assumption of long run equilibrium, i.e., $\dot{X} = 0$, yields (7). The three equations yield

$$\dot{P} = c_1 X + k_1 \dot{W}^e + k_2 \dot{Z}^e + k_3 \dot{P}_w{}^e \tag{8}$$

where $k_1 = c_2 g_2 h_1$, $k_2 = -k_1$ and $k_3 = c_2 - k_1$. The similarity of (8) and (2′) is clear, the differences being the presence of expected rather than actual values of some of the variables in (8) and the absence of the excess demand term in (2′). In deriving long run trade-offs, Parkin assumes that $\dot{P}_w{}^e = \dot{P}_d{}^e = (\dot{W} - \dot{Z})$, which in this model has the long run implication that, for $c_2 = 1$, $\delta \dot{P} / \delta \dot{P}_w{}^e$ is unity.

III. *Estimation and Results*

The absence of directly measured expectations variables necessitates the use of proxies in the estimation of (8). Studies based on quarterly data usually employ weighted sums of lagged values of the variables to proxy expectations, but with annual data the use of more than a single lag would imply a rather slow rate of adjustment of expectations. Nordhaus (1972) has argued the position that adjustment of price expectations is slow but the experience of the current inflation suggests that at high inflation rates adjustment is quite rapid. The assumption of complete adjustment in a single period allows the replacement of expected by actual rates of change; it is made in estimating equations (1) and (8), using annual data. This has the effect of making equations (2′) and (8) differ only with respect to the presence of the excess demand in (8). The estimation of equation (8) is also undertaken using single period lags in the unit labour cost and world price terms.

The wage-price model is estimated by two stage least squares, while equation (8) is estimated by instrumental variables, due to the presence of actual $\dot{P}$ and $\dot{W}$. The instrument for $\dot{W}$ is obtained from the reduced form estimate of $\dot{W}$ in the wage-price model. The restrictions that the $\dot{P}$ coefficient in the $\dot{W}$ equation be unity and that the sum of the $\dot{W}$ and $\dot{P}_w$ coefficients in the price equations sum to unity are not imposed but the unit labour cost formulation is employed in some of the price equation estimates. In estimating the lagged version of (8), ordinary least squares are employed.

The question of how to measure world prices is now considered. There is a number of possible measures. One is a British price index, such as the Retail Price Index, since Ireland has maintained a fixed exchange rate with Britain for more than a century and a half and there is substantial factor and goods mobility

Table 1: P_w=*UK Retail price index*, P=*Irish consumer price index*

			Regressors								
Eqn	*Dependent Variable*	*Const.*	(1) U	(2) $\dot{P}$	(3) $\dot{W}$	(4) $\dot{Z}$	(5) $(\dot{W}-\dot{Z})$	(6) $\dot{P}_w$	$\bar{R}^2$	DW	*Sum of* $\dot{W}$, $\dot{P}_w$ *coeffs.*
(*a*)	$\dot{W}$	9·210	−0·867	1·274					0·622	2·02	
		(1·699)	(1·091)	(5·768)							
(*b*)	$\dot{P}$	−0·117			−0·381	0·353		1·547	0·874	1·61	1·166
		(0·125)			(0·629)	(0·795)		(1·981)			
(*c*)	$\dot{P}$				−0·341	0·337		1·501	0·881	1·64	1·160
					(0·683)	(0·819)		(2·243)			
(*d*)	$\dot{P}$	0·031					−0·326	1·476	0·881	1·63	1·150
		(0·056)					(0·899)	(3·148)			
(*e*)	$\dot{P}$	−0·234	0·040				−0·304	1·447	0·874	1·61	1·143
		(0·098)	(0·115)				(0·732)	(2·646)			
			(1) U	(2) $(\dot{W}-\dot{Z})_{-1}$	(3) $\dot{P}_w$	(4) $\dot{P}_{w-1}$					
(*f*)	$\dot{P}$	−0·355	0·041	0·108	0·998				0·874	1·57	1.106
		(0·159)	(0·119)	(0·729)	(8·301)						
(*g*)	$\dot{P}$	0·741		0·290		0·749			0·556	1·99	1·039
		(0·593)		(1·541)		(1·954)					

t-statistics in parentheses.

between the two countries. This definition is adopted, with domestic prices measured by its Irish counterpart, the Consumer Price Index. A more general measure of world prices is the personal consumption deflator of the OECD, where the weights are the real consumption levels of member countries. This index is calculated at constant (1963) exchange rates and is also employed in the estimation, together with the Irish personal consumption deflator. Other measures include the GDP deflator of the OECD and both consumption and GDP deflators weighted by the shares of OECD countries in Irish exports or imports, i.e., trade weighted deflators. There are no straightforward theoretical grounds for choosing between these alternatives, since they differ principally in terms of the lags they imply in the inflationary transmission process. One would expect, however, that the Retail Price Index would give better results in the case where current and expected world inflation rates are assumed to be equal. A comparison of the empirical results of using all these alternatives is beyond the scope of this study, and will be dealt with in a subsequent paper. The results of using the Retail Price Index and the OECD personal consumption deflator are presented in Tables 1 and 2. The definitions of the variables are given in an Appendix; the data periods are 1953–74 in Table 1 and 1953–73 in Table 2.

The first four equations in Table 1 give the TSLS estimates of the wage-price model (equations (1′) and (2′)) where the Retail Price Index is used to measure world prices. The wage equation has a very large intercept and a small and insignificant U coefficient. The price coefficient is highly significant and not significantly different from unity. In the price equations, the coefficients of the $\dot{W}$, $\dot{Z}$ and $(\dot{W}-\dot{Z})$ terms have the wrong signs and they are statistically insignificant. The world price term is significant at the 0·05 level in (*b*) and (*c*) and at the 0·01 level in (*d*) and is above unity in all cases; the sum of the wage and world price coefficients is approximately 1·16 in each equation. Equation (*c*) is the homogeneous version of (*b*); the homogeneous versions of (*d*)–(*g*) are not reported but are very similar to the results in the table. The hypothesis that these coefficients add to one was tested (see, Johnson (1972), p. 155–156). It was not rejected in each case, even at a significance level of 0·40.

Equation (*e*) is an estimate of (8) where actual and expected values of the variables are assumed equal. The addition of the unemployment term as a measure of excess demand lowers the adjusted R^2 and leaves the remaining coefficients unchanged. In (f) and (*g*) lags are introduced on the wage and world price terms, U being deleted from the latter; in both, the $(\dot{W}-\dot{Z})$ term is no longer negative, but it remains insignificant. The introduction of the lagged world price term in (*g*) leads to a sharp fall in the value of $\bar{R}^2$. The sum of the $(\dot{W}-\dot{Z})$ and $\dot{P}_w$ coefficients in these equations averages 1·07; the hypothesis that they add to one was, again, not rejected in each case at the 0·40 level of significance.

The same specifications were estimated using the OECD personal consumption deflator to measure world prices and the equivalent price index to measure domestic prices and the results are presented in Table 2. They are clearly distinguishable from those in Table 1. In the wage equation, the coefficient of $\dot{P}$ is

Table 2: P_w = *OECD personal consumption deflator,* P = *Irish personal consumption deflator*

			Regressors								
Eqn	*Dependent variable*	*Const.*	(1) U	(2) $\dot{P}$	(3) $\dot{W}$	(4) $\dot{Z}$	(5) $(\dot{W}-\dot{Z})$	(6) $\dot{P}_w$	$\bar{R}^2$	DW	*Sum of* $\dot{W}$, $\dot{P}_w$ *coeffs.*
(*a*)	$\dot{W}$	6·665	−0·855	1·818					0·695	1·95	
		(1·419)	(1·277)	(6·535)							
(*b*)	$\dot{P}$	−0·685			0·400	−0·148		0·724	0·696	1·69	1·124
		(0·517)			(2·157)	(0·718)		(1·091)			
(*c*)	$\dot{P}$				0·440	−0·209		0·486	0·710	1·64	0·926
					(2·661)	(1·258)		(1·041)			
(*d*)	$\dot{P}$	0·283					0·305	1·088	0·680	1·80	1·393
		(0·213)					(1·730)	(1·745)			
(*e*)	$\dot{P}$	3·480	−0·884				0·009	2·320	0·696	1·69	2·329
		(1·140)	(1·361)				(0·033)	(2·129)			
			(1) U	(2) $(\dot{W}-\dot{Z})_{-1}$	(3) $\dot{P}_w$	(4) $\dot{P}_{w-1}$					
(*f*)	$\dot{P}$	3·586	−0·866	0·078	2·144				0·704	1·61	2·222
		(1·444)	(2·157)	(0·632)	(4·444)						
(*g*)	$\dot{P}$	0·393		0·136		1·277			0·363	1·84	1·413
		(0·250)		(0·823)		(2·039)					

t-statistics in parentheses.

extremely large and significantly different from one at the 0·05 level. In the price equations, the coefficients are more volatile, especially with respect to the inclusion of the unemployment variable, while the $\bar{R}^2$ varies only slightly. The sum of the wage and world price coefficients in (*b*), (*c*), (*d*) range from 0·926 to 1·393 but in (*e*) they sum to 2·329. The effect of the inclusion of lags on the $(\dot{W}-\dot{Z})$ term may be seen in (*f*) and on both $(\dot{W}-\dot{Z})$ and $\dot{P}_w$ may be seen in (*g*); the sum of the two coefficients is 2·222 in (*f*) and 1·413 in (*g*). As above, the inclusion of a lagged world price term in (*g*) led to a sharp fall in the value of $\bar{R}^2$.

Tests of the hypothesis on the sum of the wage and world price coefficients produced more variable results than was the case with the coefficients in Table 1. In equations (*b*) (*c*) (*d*) and (*g*), the hypothesis was not rejected at the 0·10 level; in equation (*e*) it was not rejected at the 0·20 significance, but in (*f*) it *was* rejected at the 0·02 level.

IV. *Implications*

The "long run" equilibrium restrictions on the sums of the coefficients in the models outlined in Part II are effectively satisfied when the UK Retail Price Index is used as a measure of world prices. A striking feature of Table 1 is the uniformity of the sum of the wage and world price coefficients at about 1·10. On the assumption that the price expectations coefficient in the wage equation is unity, the coefficients should add to one; when the estimated value is incorporated in (3), they should add to 1·08. The restrictions on the coefficients in (8) are similarly satisfied. These results, together with the absence of lags in the wage-price model and the use of actual to measure expected values in (8), suggest a rapid adjustment of Irish to British inflation rates. However, while the sum of the wage and world price coefficients conforms to the restrictions of the models, questions are raised by the estimates of the individual coefficients.

The statistically insignificant wage coefficient is at first sight somewhat surprising, but it is consistent with an extreme, recursive version of the wage-price model in which the price equation reduces to

$$\dot{P} = b_0 + b_3\dot{P}_w, \qquad b_3 = 1. \qquad (2'')$$

In this model, world inflation *directly* determines domestic price inflation, rather than working in part through the labour market; wage inflation simply *adjusts* to price inflation, given the level of excess demand. If all goods in the economy were internationally tradeable, this outcome would not be surprising. It is noted that equation (8) would reduce to equation (2″) in the absence of non-tradeable goods. This suggests that a more disaggregated model, invoking the tradeable—non-tradeable goods distinction (and perhaps employing a quarterly rather than annual time period) would repay investigation.

Another noteworthy feature of the results in Table 1 is the size and lack of

statistical significance of the unemployment term in both the wage and price equations. This finding is common to a number of studies of Irish inflation; see, for example, Geary and Jones (1975) where adjustments to the unemployment variable to allow for the structural characteristics of the Irish labour force left the finding intact. It may be rationalised in the small open economy context on the grounds that the more open an economy is, the less clearcut a concept is its excess demand; *à fortiori* is this the case the longer the time period of the model (i.e., if it is annual rather than quarterly). Correspondingly, the concept of the natural rate of unemployment becomes more vague, so that the implications of the very high value implicit in the estimated wage equation are not so clear.

The differences between Tables 1 and 2 suggest a considerable sensitivity of the results to the choice of world price index, since the Irish Consumer Price Index and consumption deflator are very similar. Allowing for the size of the price coefficient in the wage equation, which is significantly different from one, equilibrium in the wage-price model requires that the wage and world price coefficients sum to about 0·7. This restriction is closest to being satisfied in (*c*); when the restriction that the wage and productivity terms be equal but if opposite sign is imposed the coefficient sum is 1. The lack of uniformity of this coefficient sum is emphasised in the estimates of equation (8), given by (*e*) (*f*) and (*g*).

While the results from using the OECD deflator as the measure of world prices do not in general raise the questions posed by the insignificant wage coefficients in Table 1, they conform less closely to the *a priori* restrictions of the models than do the results from using the UK Retail Price Index; the latter also performs better in terms of the goodness of fit of the price equations. The tendency of the coefficient sums in Table 2 to exceed the level implied by the restrictions is consistent with a longer adjustment period of domestic to the OECD average inflation rate than to the British rate, but the use of, admittedly, very simple lags in the price equation shed little light on this question. Thus, within the framework of the models presented above, the RPI appears to be the better measure of "world" prices, a conclusion which would have been expected. However, a number of issues remains unresolved and it may well be the case that a more detailed framework is needed to resolve them.

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APPENDIX

Definitions of Variables

W = Hourly Earnings in Transportable Goods Industries, persons 18 years and over, from *Irish Statistical Bulletin* (ISB), various issues, Stationery Office, Dublin.

U = Percentage of Insured Persons in the Non-agricultural Live Register, from *Trend in Employment and Unemployment,* various issues, Stationery Office, Dublin.

P = Consumer Price Index, from (ISB), various issues.
Implicit Deflator of Consumers' Expenditure, calculated from *National Income and Expenditure* (NIE), various issues.

P_w = Retail Price Index of the United Kingdom, from *Monthly Digest of Statistics,* HMSO London, various issues.
OECD Personal Consumption Deflator, calculated at constant (1963) exchange rates, from *National Accounts of OECD Countries,* OECD Paris.

Z = Index of Output per Man-hour in Transportable Goods Industries, from *ISB,* various issues.