Employment functions for industry groups

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For all transportable goods industries as a whole, O Herlihy has studied both short run and long run responses of employment to the output level [3]. His findings with regard to long term changes are that employment tends to rise by about 6% for every 10% increase in industrial output; minus a 1.2% reduction per annum which reflects autonomous labour productivity gains.

It is of some interest to ascertain whether similar relationships to that developed on a global level apply to individual industry groups. For this purpose, recently published annual index numbers of production and data for persons engaged in industry [1] each year for 1953 to 1964 have now been analysed.

The data were converted into first differences of logarithms, and initially separate employment functions were estimated for each industry group. All equations were of the form

$$\Delta \log_e L = a + b_1 \Delta \log_e P + b_2 \Delta \log_e P_{-1}$$

where L indicates employment and P output. Thus the more immediate and the further delayed effects of output changes on employment changes were separately estimated; a finer lag structure could of course not be ascertained with annual data. It seemed reasonable to assume that any adjustment to changes in production levels would be completed a year later on. The results were as follows, using the year-to-year changes from 1954-5 to 1964-5, and 1953-4 for the lagged variable.

Table 1. Coefficients in employment functions for each industry group, 1954-5 to 1963-4

Industry group	a (constant)	b_1 ($\Delta \log_e P$)	b_2 ($\Delta \log_e P_{-1}$)	R^2
Food	-.00042	.4154 (.1388)	.1053 (.0983)	.704
Drink and tobacco	-.00518	.2971 (.1632)	.1069 (.1642)	.406
Textiles	-.01592	.4993 (.1422)	.0726 (.1443)	.665
Clothing and footwear	-.01148	.3798 (.0682)	.0104 (.0617)	.858
Wood and furniture	-.02681	.5634 (.1490)	.0869 (.1470)	.767
Paper and printing	-.01883	.1769 (.1444)	.3752 (.1239)	.672
Chemicals	-.01348	.3798 (.1400)	.2333 (.1404)	.557
Structural clay and cement	-.02304	.4625 (.0797)	.2583 (.0826)	.895
Metals and engineering	-.00950	.4920 (.0941)	.1810 (.0825)	.862
Other manufacturing	-.00596	.3786 (.0904)	.0904 (.0917)	.771
Mining and turf	.00156	.1352 (.1022)	.0993 (.1017)	.201

It is immediately evident that the relationship for mining and turf is quite different in character from those for the manufacturing industry groups; there is a small autonomous loss in labour productivity instead of a gain, changes in output have only a slight effect upon employment and explain only one-fifth of the variation in relative employment changes instead of anything between 40% and 90%. Variations in the supply of turf which are not planned but brought about by climatic conditions are probably largely responsible for this state of affairs. For this reason, mining and turf has been excluded from further analysis, which thus refers to manufacturing industries above.

One would expect current changes in output to have a greater effect upon employment than changes in the past year; and this in fact appears to be borne out by the results for all but one industry group. However, with only 7 degrees of freedom available for each group, the regression coefficients cannot be accurately estimated. More reliable results can be obtained if pooling of the observation is permissible.

An analysis of variance which was carried out shows that the regression coefficient for the 10 industry groups do indeed not differ significantly, the relevant F ratio being only .70. Regarding the differences between constant terms, we find that F = 1.74, which is just significant at the 10% level. Thus a single equation may be considered, but a set of parallel equations seems theoretically quite plausible and may well be given preference.. The results obtained follow.

$$\Delta \log_e L = -.01351 + \underset{(.0324)}{.4343} \Delta \log_e P + \underset{(.0308)}{.1544} \Delta \log_e P_{-1}$$

or:

$$\Delta \log_e L = a + \underset{(.0325)}{.4396} \Delta \log_e P + \underset{(.0312)}{.1614} \Delta \log_e P_{-1}$$

where a assumes the following values:

Food	-.00166
Drink and tobacco	-.00682
Textiles	-.01771
Clothing and footwear	-.01853
Wood and furniture	-.02582
Paper and printing	-.01964
Chemicals	-.01251
Structural clay and cement	-.01571
Metals and engineering	-.00445
Other manufacturing	-.01850
Mean	-.01414

For the single equation, $R^2 = .769$. For the parallel equations, $R^2 = .764$, or $R^2 = .804$ if calculated on the basis of deviations from industry group means.

Thus the analysis confirms the earlier result that a 10% change in industrial output tends to be accompanied by a 6% change in employment in the same direction, about three-quarters of the adjustment taking place in the current and one-quarter in the following year. The gains in labour productivity which are not associated with industrial growth appear to lie within the range of 1 - 2% per annum for most industry groups, though less for food, for drink and tobacco, and for metals and engineering, but more for wood and furniture.

As a check on the validity of the employment function, a further regression has been computed, using cross section data for 41 individual industries for which data referring to 1953 and 1964 are available. Denoting here by P the volume of production in 1964 divided by 100 and by L the employment in 1964 divided by employment in 1953, the resulting equation is

$$\log_e L = \underset{(.0461)}{-.0708} + \underset{(.0690)}{.5765} \log_e P \qquad (R^2 = .641)$$

Thus, the long-run elasticity of employment with regard to output is again estimated to be in the neighbourhood of 0.6. Since the constant term reflects the total trend effect of the 11 year period, the average annual autonomous gain in labour productivity is now estimated to be about 0.6% or 0.7% instead of 1.4%. However, the trend is not accurately estimated by this method which compares industries of very diverse size and experience. The employment functions derived for industry groups should be the more reliable and useful ones.

The equations may be used to check the N.I.E.C. industrial employment forecasts for 1970 [2]. On the basis of the estimated volume of output changes between 1964 and 1970 and those between 1963 and 1969, using 1969 figures obtained by geometric interpolation between 1967 and 1970, employment changes may be estimated and converted into actual numbers in 1970. The results are as follows:

Table 2. Estimated employment in manufacturing industry groups, 1970

Industry group	Employment (000)			
	1964	1970		
		Single equation	parallel equations	N.I.E.C. estimate
Food	38.8	42.5	45.9	43.9
Drink and tobacco	10.2	10.3	10.8	10.7
Textiles	22.3	24.9	24.4	23.2
Clothing and footwear	22.7	23.3	22.7	23.5
Wood and furniture	7.8	9.5	8.9	9.6
Paper and printing	14.8	15.4	14.8	16.0
Chemicals	5.9	8.2	8.3	7.9
Structural clay and cement	7.2	8.8	8.8	8.8
Metals and engineering	31.9	39.0	41.4	40.1
Other manufacturing	10.2	13.0	12.4	14.3
All manufacturing	171.8	194.9	198.4	198.0

Thus according to whether the trend effect is assumed to be the same for all industry groups or to vary between industries, total manufacturing employment is expected to increase by about 13½% or by about 15½% between 1964 and 1970. The forecast on the basis of variable autonomous labour productivity increases practically coincides with the N.I.E.C. estimate as far as total manufacturing employment is concerned, though there are discrepancies for individual industry groups, notably food, textiles, paper and printing, metals and engineering, and all manufacturing.

Time will show which of the estimates proves more accurate. Of course, the accuracy of all forecasts depends on to what extent output targets will be reached.

REFERENCES

[1] Central Statistics Office, Irish Statistical Bulletin, September 1966.

[2] National Industrial Economic Council, Report on Review of Industrial Progress 1966. Report No. 19.

[3] O Herlihy, C. St. J. A Statistical study of wages, prices and employment in the Irish manufacturing sector, E. S. R. I. Paper No. 29.