

Manufacturing Productivity in Northern Ireland: A Re-Examination

STEPHEN ROPER*

Northern Ireland Economic Research Centre, Belfast

Abstract: This paper considers the influence of plant-level productivity and industry-mix/plant-size structure on manufacturing productivity in Northern Ireland. It demonstrates that from 1981-91 around two-thirds of the productivity gap between the UK and Northern Ireland was due to the region's structural weakness rather than shortfalls in the productivity performance of individual plants. To maintain or increase the wealth creating potential of Northern Ireland manufacturing, future policy will need to address both firms' competitive position and the region's structural disadvantage.

1 INTRODUCTION

This paper considers the influence of the productivity of individual plants and industrial structure on the ability of Northern Ireland manufacturing to create wealth. Past studies, noting that manufacturing productivity (value added per employee) in Northern Ireland was significantly below the UK average, have inferred that individual Northern Ireland plants were less cost efficient than their UK counterparts (Hitchens, Wagner and Birnie, 1990; Roper, 1993; Harris, 1991; Gudgin and O'Shea, 1993). It is demonstrated here, however, that this belief was misplaced and that from 1981-91 the productivity gap between Northern Ireland and the UK was due primarily to a structural disadvantage related to industry-mix and plant size structure.

Section II of the paper outlines the background to the comparisons and describes the methodology to be used. Section III discusses the data and

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summarises the main empirical findings. Section IV concludes with some brief comments on the implications of the results for industrial development policy in Northern Ireland.

II MAKING PRODUCTIVITY COMPARISONS

Value added, the difference between turnover and purchases, measures a firm or plant's ability to create wealth. Value added per employee, or labour productivity, has therefore been used extensively to examine differences in wealth creation between plants, firms, regions and national economies.¹ At a regional or national level the simplest form of comparison relates economy-wide average productivity in one area to that in another. For example, if e_{ij} is employment in industry i ($i=1, \dots, m$), plant size-band j ($j=1, \dots, n$) in the UK and v_{ij} is total value added in the same industry/plant size-band, then average productivity in Northern Ireland might be compared to average productivity in the UK, i.e.,

$$X_1 = \frac{\sum_i \sum_j e_{ij} (v_{ij} / e_{ij})}{\sum_i \sum_j e_{ij}} = \sum_i \sum_j n_{ij} p_{ij}$$

where, $n_{ij} = e_{ij} / \sum_i \sum_j e_{ij}$ and $p_{ij} = v_{ij} / e_{ij}$. Such economy-wide comparisons provide a useful guide to the relative level of wealth creation in each economy. However, they reflect both the underlying difference between individual plants' productivity and the effects of industry-mix and plant size structure. Productivity differences between industries are pronounced. In 1991 the UK Census of Production indicated that value added per employee ranged from a low of £11,700 in the clothing sector to £39,500 in plants manufacturing chemicals. Similarly, value added per employee differed significantly between manufacturing plants of different sizes. Excepting non-metallic minerals and textiles, productivity was positively linked to plant size in each UK manufacturing sector. This accords with evidence from Italy (Invernizzi and Revelli, 1986) and Japan (Sasaki, 1981), but contrasts with the situation in Austria where productivity appears higher in smaller plants (Aiginger and Tichy, 1984 and 1991; Bartel, 1990; Schneider, 1991; Schneider and Lenzenbauer, 1993).² The implication is that if the areas being compared

1. For some interesting comparisons of value added at firm level see Kay (1993), and the references cited there. At national level see, for example, papers by Van Ark (1990) and (1990a).

2. Similar variation is found in studies of the relationship between operating surplus and plant size. Measured relative to employment or assets, operating surplus appears higher in small plants in Austria (Aiginger and Tichy, 1984), West Germany (Irsch, 1988) and the US (Reinganum and Smith, 1983), but lower in the UK (Burns and Dewhurst, 1986; Storey *et al.*, 1987).

have significantly different industrial structures, or distributions of plant sizes, then although economy-wide productivity comparisons provide a valid guide to wealth creation they cannot be interpreted as indicative of the relative productivity of individual plants.

Attempts to disentangle the structural and plant level elements of economy-wide productivity differences have typically involved either industry-by-industry comparisons or economy-wide comparisons adjusted to take account of differences in industrial structure. A recent example of industry-by-industry productivity comparisons is the study by Hitchens, Wagner and Birnie (1990), who used Census of Production data to compare labour productivity in over 80 Northern Ireland industries to their GB equivalents in 1979 and 1984. The alternative approach has been to make economy-wide comparisons based on industry-by-industry productivity and a common industrial structure. For example, Roper (1993a) compared Northern Ireland manufacturing productivity to a UK figure constructed by weighting UK productivity in each (4-digit) industry by employment in Northern Ireland in that industry, i.e.:

$$X_2 = \frac{\sum_i \left(\sum_j E_{ij} \right) \left(\sum_j v_{ij} / \sum_j e_{ij} \right)}{\sum_i \sum_j E_{ij}} = \sum_i \left[\frac{\sum_j N_{ij}}{\sum_j n_{ij}} \sum_j p_{ij} n_{ij} \right]$$

Where E_{ij} is employment in industry i , plant size-band j in Northern Ireland and $N_{ij} = E_{ij} / \sum_i \sum_j E_{ij}$. Along similar lines it is possible to construct a UK comparator which weights UK productivity in each plant size-band by employment in the same plant size-band in Northern Ireland. In this case, actual average productivity in Northern Ireland would be compared to:

$$X_3 = \frac{\sum_j \left(\sum_i E_{ij} \right) \left(\sum_i v_{ij} / \sum_i e_{ij} \right)}{\sum_i \sum_j E_{ij}} = \sum_j \left[\frac{\sum_i N_{ij}}{\sum_i n_{ij}} \sum_i p_{ij} n_{ij} \right]$$

However, a more comprehensive structural adjustment is possible taking into account differences in both industry-mix and the distribution of plant sizes. Here, actual productivity in Northern Ireland is compared to productivity in each industry/plant size-band in the UK weighted by industry/plant size-band employment in Northern Ireland, or

$$X_4 = \frac{\sum_i \sum_j E_{ij} (v_{ij} / e_{ij})}{\sum_i \sum_j E_{ij}} = \sum_i \sum_j N_{ij} p_{ij}$$

It can easily be seen that the four UK comparators are identical if the proportional distribution of employment between industries and size-bands is identical in Northern Ireland and the UK (i.e., if $N_{ij} = n_{ij}$ for all i and j). Moreover, if there was the same distribution of employment between plant size-bands in Northern Ireland and the UK ($\sum_j N_{ij} = \sum_j n_{ij}$), then the plant size-band adjusted comparator (X_3) would be equal to the unadjusted measure (X_1). Similarly, if employment was evenly distributed between industries in the two areas (i.e., $\sum_i N_{ij} = \sum_i n_{ij}$), then the industry adjusted index (X_2) would equal the unadjusted measure (X_1). The adjusted indices, X_2 and X_3 , may also equal the unadjusted index X_1 , when $\sum_i N_{ij} \neq \sum_i n_{ij}$ and $\sum_i N_{ij} \neq \sum_i n_{ij}$ if productivity differs between size-bands within each industry or between industries within the same size-band.

III THE EMPIRICAL EVIDENCE

The relative productivity indices are the ratio of actual values for Northern Ireland to each of the four UK comparators. Actual values for each year were obtained directly from the UK Census of Production Summary Reports, and relate to all manufacturing plants.³ Construction of the UK comparators was more complex, combining UK productivity and wage cost per employee in each industry/plant size-band with Northern Ireland employment weights for each plant size-band and industry. Data limitations meant that the only feasible industry breakdown was at the 18 industry, two-digit level, and that only three plant size-bands could be distinguished (1-99 employees, 100-499 employees, 500 plus employees).⁴ Per employee productivity and wage cost information for the UK was taken from the Census of Production,⁵ while data

3. The analysis for Northern Ireland covers all manufacturing excluding the manufacture of other transport equipment (SIC 80 36). This was excluded to remove the influence of two large companies which were publicly owned throughout the 1980s (Harland and Wolff and Short Brothers).

4. Ideally a finer industry and size-band adjustment would have been made. However, it is reassuring that the indices presented here based on a 2-digit industry adjustment closely reflect those reported elsewhere which use a finer 4-digit framework (see Roper, 1993).

5. In the published analysis no value added information is given for plants in the 1-99 size-band, with the information being aggregated into the next size-band (usually 100-200 employees). In each UK industry, value added per employee in the 100-200 employees size-band was therefore assumed to apply also to establishments with 1-99 employees. As value added per employee in the UK typically increases with establishment size, this assumption is likely to overestimate the productivity of smaller production units, and depress apparent relative productivity in Northern Ireland.

for the size-band/industry structure of employment in Northern Ireland was collected from the Size Analysis of UK Businesses. Confidentiality restrictions meant that since 1985, 15.2 per cent of cell values in the industry/plant size-band employment breakdown have been suppressed.⁶ In most cases, however, although data may have been absent for a particular industry/plant size-band cell for one year, values were typically available for the same industry/plant size-band in the previous and subsequent year. This allowed missing data values to be interpolated with a degree of confidence.⁷

Using this data the four UK comparators were constructed for value added per employee and wage cost. Comparators were also derived for the non-wage element of value added, which we denote operating surplus. If the UK comparators adjusted for Northern Ireland's employment structure were greater than the unadjusted comparator, a positive structural effect would have been implied. In fact, each of the adjusted comparators was less than the unadjusted measure throughout the 1981-91 period (Table 1). This implies that Northern Ireland had a greater concentration of employment in low productivity industries and plant size-bands than the UK. It also means that even if all Northern Ireland plants had had UK average productivity, regional productivity would have been significantly below the UK average.

The scale of this structural disadvantage is evident when actual productivity, wage cost and operating surplus in Northern Ireland are compared to the four UK comparators (Table 2).⁸ For each variable, and throughout the 1981-91 period, the structurally adjusted comparisons suggest significantly smaller productivity, wage cost and operating surplus shortfalls than the unadjusted measures. For productivity, an unadjusted comparison suggests that Northern Ireland lagged behind the UK by an average of 14.2 percentage points from 1981-91. However, once the effect of plant size and industry-mix is removed the shortfall is reduced to an average of 4.2 percentage points.

6. The percentage of data values in Northern Ireland which were suppressed were as follows: 1982, 38.9; 1983, 37.0; 1984, 29.6; 1985, 14.4; 1986, 13.3; 1987, 14.4; 1988, 21.1; 1989, 15.6, 1990, 8.9 and 1991, 18.9.

7. The industry/size-band information prior to 1984 also suffers from two other limitations. First, no information exists for 1981, and so in estimating the UK comparators for 1981 we use the 1982 employment structure. Also, the employment information which does exist for 1982-84 relates only to companies with more than 20 employees. This is pro-rated up using 1985 proportions to give an estimate of total employment in Northern Ireland in 1982-84.

8. To ensure comparability between the results presented here and unadjusted values derived directly from the Census of Production Summary Report the actual values for Northern Ireland are scaled. This is necessary because slight differences exist in the UK employment structure implicit in the actual figures (taken directly from the Census of Production Summary Report) and the UK comparators (based on industry/size-band productivity from the Census of Production Summary Report and employment structure from the Size-Band Analysis of UK Businesses). The scaling factor is 1.2 per cent, and is applied equally to each of the four relative productivity indices.

Table 1: *UK Comparators Adjusted for Northern Ireland Employment Structure as a Percentage of the Unadjusted Comparator*

	1981	1983	1985	1987	1989	1991
<i>Value Added</i>						
Unadjusted	100.0	100.0	100.0	100.0	100.0	100.0
Industry Adjusted	91.4	93.6	90.8	90.5	88.2	91.7
Size-band Adjusted	96.8	96.4	96.9	96.3	96.0	96.9
Industry and Size Adjusted	90.4	92.8	90.1	89.4	85.2	89.1
<i>Wage Cost</i>						
Unadjusted	100.0	100.0	100.0	100.0	100.0	100.0
Industry Adjusted	86.9	90.8	89.7	89.3	88.9	89.8
Size-band Adjusted	96.7	97.0	97.1	97.5	97.7	97.5
Industry and Size Adjusted	85.6	89.7	88.7	87.5	86.8	88.1
<i>Operating Surplus</i>						
Unadjusted	100.0	100.0	100.0	100.0	100.0	100.0
Industry Adjusted	98.0	97.0	92.1	91.6	87.4	94.4
Size-band Adjusted	97.0	95.7	96.7	95.1	94.2	96.0
Industry and Size Adjusted	97.4	96.6	91.8	91.3	83.5	90.5

Source: Census of Production Summary Reports, Size Distribution of UK Manufacturing Businesses.

Table 2: *Value Added Per Employee Wage Cost and Operating Surplus in Northern Ireland as a Percentage of the UK*

	1981	1983	1985	1987	1989	1991
<i>Value Added</i>						
Unadjusted	95.3	90.0	85.2	83.1	82.4	87.9
Industry Adjusted	104.2	96.1	93.8	91.9	93.5	95.8
Size-band Adjusted	98.4	93.3	87.9	86.3	85.8	90.7
Industry and Size Adjusted	105.4	96.9	94.6	93.0	96.8	98.6
<i>Wage Cost</i>						
Unadjusted	90.9	87.2	84.6	82.9	81.2	78.7
Industry Adjusted	104.7	96.1	94.3	92.8	91.2	87.7
Size-band Adjusted	94.0	89.9	87.1	85.1	83.0	80.7
Industry and Size Adjusted	106.3	97.2	95.4	94.8	93.5	89.4
<i>Operating Surplus</i>						
Unadjusted	101.3	93.4	86.0	83.3	83.8	100.2
Industry Adjusted	103.4	96.3	93.3	90.9	95.8	106.1
Size-band Adjusted	104.5	97.5	88.9	87.6	88.9	104.3
Industry and Size Adjusted	104.1	96.7	93.6	91.2	100.4	110.7

Source: Census of Production Summary Reports, Size Distribution of UK Manufacturing Businesses.

This suggests that two-thirds of Northern Ireland's productivity shortfall relative to the UK during this period was due to a structural disadvantage, with the remaining third attributable to plant level differences. Similar observations could be made regarding wage costs and operating surplus per employee.

IV CONCLUSION

Past analyses of Northern Ireland manufacturing productivity, based on economy-wide and industry-by-industry comparisons have suggested that the productivity gap between Northern Ireland and the UK was due primarily to lower productivity in individual Northern Ireland plants. This has been equated to a low level of company competitiveness, and has contributed to a policy based on the principle of backing winners. The analysis presented here confirms that productivity in Northern Ireland plants did lag behind similar UK plants from 1981-91, but indicates that plant-level productivity shortfalls accounted for only a third of Northern Ireland's overall productivity deficit. The remaining two-thirds was due to a structural disadvantage related to Northern Ireland's industry-mix and plant size distribution. The implication is that even if productivity in all Northern Ireland manufacturing plants was raised to the UK average level for similar production units, regional productivity would remain significantly below the UK average.

Northern Ireland's structural disadvantage reflects a general tendency among the UK regions for structural factors to reinforce plant level productivity differences. Indeed, similar although less extreme structural disadvantages related to industry-mix and plant-size are also observed in the East Midlands of England and Yorkshire and Humberside (Roper, 1994). For these regions the coexistence of significant structural and plant level weaknesses suggests the inadequacy of policy designed solely to improve the competitive position of existing plants. Instead, there is a need to adopt a more strategic approach designed to develop the competitiveness of existing plants and also to stimulate economic activity in higher value added sectors and plant size-bands.

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