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BRITAIN'S PRODUCTIVITY GAP IN THE 1930s : SOME NEGLECTED FACTORS

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I. INTRODUCTION

The recent historiography of interwar British industrial development offers an intriguing but ultimately rather unsatisfactory menu of rival interpretations. Although informed to an extent by descriptive statistics and drawing on concepts from business history, the literature contains very little in the way of formal economic or quantitative analysis of productivity performance. Indeed, unlike the 1870-1914 period, the 1920s and 1930s were neglected by the revisionist pioneers of the new economic history and yet they represent a key part of the story of Britain's relative economic decline.

In this paper we argue that current discussion of the progress and potential of British industry in the 1930s place too great a weight on the presence of new industries or the absence of modern corporate structures while relatively neglecting the important roles of human capital, of the determinants of the outcomes of bargaining over work effort and of the process of exit of inefficient producers. Simple economic models are used to yield insights into factors inhibiting productivity in 1930s Britain which have been given little prominence in the historiography. We further seek to establish the plausibility of these claims using both econometric and case study evidence to elaborate on the well-known data of productivity levels and growth across different sectors of industry.

A note of distinct optimism has appeared in some accounts of the interwar economy. For example, Pollard in his widely used textbook sums up the state of play as follows: "The view that, after a poor performance in the 1920s, the 1930s saw a genuine breakthrough, is indeed

widespread and finds support not only in the output statistics but also in the quality of the modern investment and the structuring of British industry towards the growth-oriented sectors in the second phase" (1983, p.53). This relatively favourable interpretation has its roots in the thesis of a regeneration of the economy through the productivity advance of "new" industries as originally argued by Richardson (1967) and in the strong emphasis placed by Matthews et al (1982, Ch.16) on the revival of total factor productivity growth in the interwar period following a climacteric in the early twentieth century.

While both these arguments are valid to some extent, when put into an appropriate context they are much less powerful than is often thought. As is well-known, the new industries hypothesis has been somewhat controversial and the share of new industries in productivity growth is sensitive to definitional and measurement procedures (Broadberry and Crafts, 1990b). However, three more important points should be remembered with regard to optimistic assessments based on a new industries platform. First, even if it can be shown that "new" industries had relatively fast productivity growth, this begs the question as to what characteristics of these sectors were particularly conducive to this good performance. Second, enthusiasts of the new industries' productivity record tend to ignore international comparisons. Third, it is important to bear in mind that new industries' growth might have been faster in a counterfactual situation of better management and/or economic policy.

Total factor productivity growth in British manufacturing rose from 0.6% per year in 1873-1913 to 1.9% in 1924-37 (Matthews et al., 1982, p.229). This was indeed a welcome improvement. On a comparative

basis, however, there is less reason to applaud. In the United States total factor productivity growth in manufacturing rose from 0.7% in 1889-1909 to 5.3% in 1919-29 and 2.0% in 1929-39 (David, 1990, Table 2) such that the British acceleration was not sufficient to avert a widening productivity gap. Rostas (1948), whose estimates are reviewed in detail later, found that American productivity was 2.25 times the British level in the mid 1930s. It should also be noted that time series analysis appears to reject the notion of a climacteric in trend growth in industrial output and productivity around the turn of the century as opposed to a temporary fluctuation (Crafts et al., 1989) and this also rather weakens the notion of revival in the interwar period.

A much more pessimistic view of British industry in the 1930s is obtained by reading the works of Chandler or, in much the same tradition, Elbaum and Lazonick. Chandler (1990) explores in detail his familiar theme that Britain did not generally succeed in emulating American moves towards achieving economies of scale through mergers to develop multi-unit, vertically-integrated, hierarchical and managerial firms and thus failed to take advantage of the opportunities of the second industrial revolution. Elbaum and Lazonick (1986, p.5) develop this line of argument into a vigorous account of British decline: "Successful capitalist development in twentieth century Germany, Japan, and the United States demonstrates the ubiquitous importance of the visible hand of corporate bureaucratic management. To meet the international challenge, British industries required transformation of their strategies of industrial relations, industrial organisation, and enterprise management. Vested interests in the old structures, however, proved to be formidable obstacles to the old transition from competitive to corporate modes of organisation".

Certainly we would wish to agree that there is a strong prima facie case for criticising the quality of British management in the interwar period. For example, Gourvish in his recent survey of business histories concluded that "training for management was rare and recruitment could be astonishingly casual" (1987, p.26) while "the 'club' atmosphere of most boardrooms was a key factor influencing attitudes to organisational change... even large companies retained a cosy amateurishness" (1987, p.34). Again, Hannah (1983) points to a substantial number of specific cases of poor managerial response to strategic and organisational needs between the wars, including Associated Electrical Industries, Cadbury-Fry, Distillers, GKN, Morris Motors, Tube Investments and Vickers. Nevertheless, there are good grounds for believing the Chandler thesis, although somewhat plausible, to be seriously overstated and likely to explain only part of the British productivity gap.

First, it must be remembered that at no point is there any attempt to quantify the effects of the alleged failures. Although Chandler (1990, p.393) sees German industry as closer to the American than the British form of organisation, labor productivity in German industry barely rose above British levels before the 1960s. For 1935, Broadberry and Fremdling (1990) find a German/UK productivity ratio of 1.02. Even in some of what Chandler calls the 'Greater Industries' where the German advantage over Britain was biggest, the gap between Britain and America was larger still (Broadberry and Crafts, 1990a). In blast furnaces, for example, where German labor productivity was 148% of the British level, American productivity was 362% of the British level. Further relevant quantitative information which can be brought to bear is in a study of American owned and managed firms operating in the UK in the

early 1950s matched with British firms in the same sectors. This found the American managed firms had productivity levels 34 percent higher (Dunning, 1958, p.181). As expected the American firms were superior; however, this is only about a quarter of the productivity gap found by Rostas.

Second, the adoption of multidivisional organisation in British industry after World War 2 seems to have achieved rather less than a reader of Chandler would suppose. Although, 72 percent of the top 100 companies were M-form by 1970 compared with 40 percent in Germany (Channon, 1973, p.67; Dyas and Thanheiser, 1976, p.29), German labor productivity in manufacturing had moved 30 percent ahead of the UK level having been only two-thirds of it in 1950 (Van Ark, 1990). Moreover, econometric investigation of the effects of the adoption of M-firm organisation in Britain found a positive effect but one sufficient to raise productivity by only around 15-20 percent (Steer and Cable, 1978).

Third, the 1950s and 1960s saw a substantial attempt by British firms to achieve rationalisation and economies of scale through mergers along the lines advocated by Chandler and Elbaum and Lazonick. In general, the results were disappointing; while Franks and Harris (1986) show that the stock market predicted improved profits on the announcement of successful bids, Meeks (1977) found that post-merger performance in the period 1954-72 was on average characterised by reduced profits and productivity. The case studies in Cowling et al. (1980) found efficiency gains from mergers to be small and even in the most successful examples like GEC productivity improvements were only in the 15 to 25% range. This suggests that, at the very least, the Chandler school pays insufficient attention to the conduct rather than the structure of

industry. It is clear that the productivity performance of British industry between the wars has not been well-analysed by either the optimistic or pessimistic camps in the current historiography. Besides the failure adequately to quantify, there has also been too little attention given to aspects of the 1930s economy which both economic theory and 1980s experience suggest may have had a substantial influence.

The 1980s saw a surge in manufacturing labour productivity in the UK which rose by 50% (Department of Employment, 1990) while the manufacturing productivity gap between Britain and Germany which had been rising and reached 63% in 1979 fell back to 38% in 1988 (Van Ark, 1990). It is widely agreed that this resulted very largely from behavioural rather than structural changes leading to a reduction in X-inefficiency and restrictive practices, contingent on a reduction in trade union bargaining power which was given a great impetus by the shock of severe recession and rapid exit of firms at the start of the decade (Bean and Symons, 1989; Crafts, 1991; Metcalf, 1989; Wadwhani, 1989). The improvement in productivity seems to have stemmed from changes in the conduct rather than the structure of industrial relations (Batstone, 1988) and to have resulted from the labor shakeout which might have, but in practice usually did not, come after mergers.

It is interesting to look again at the 1930s with this recent experience in mind. On this basis, the recession of 1929-32, a severe shock, could be expected to reduce trade union bargaining power and stimulate labor productivity. However, the stance of policy contrasts with that of the Thatcher years; in the 1930s, broadly speaking, policy strove to reduce the competitive pressures on enterprises in particular through raising tariff barriers, encouraging cartels, restricting foreign

capital flows and devaluing the pound - all of which forms a strong contrast with the "cold bath" of the 1980s. Such an environment could be expected to militate against productivity improvement by raising barriers to entry, by reducing the rate of exit of the inefficient and by encouraging restrictive practices.

Indeed, a surprisingly neglected factor in discussions of British industrial performance in the interwar period is the role of cartelization and collusion which was so greatly strengthened during the 1930s (Gribbin, 1978). The 1950s saw a legislative onslaught on these agreements through the Monopolies and Restrictive Practices Commission and the Restrictive Practices Act. The evidence resulting from these investigations is quite damning and suggests they were a serious impediment to productivity improvement by sustaining high cost producers and removing pressures to eliminate X-inefficiency (Elliott and Gribbin, 1977). This neglect is rather curious given the emphasis of neoclassical economic historians like McCloskey (1970, 1973) and Sandberg (1981) on the role of competitive market forces in preventing persistent problems by the eradication of weak management in the pre-1914 period.

A further key feature of 1980s British manufacturing, is the continuing relatively low level of skills in the labor force resulting from training standards which compare very unfavourably with those in countries like Germany. Work at the National Institute of Economic and Social Research reflected, for example, in the case studies by Daly et al. (1985) found that productivity gaps as large as 60% between British and German firms could result from this skills shortage. Although weaknesses in technical and vocational training have not been particularly prominent in the mainstream literature on 1930s' industrial

performance, there is good reason to suppose that they had a serious adverse impact on productivity in that period also given the critical accounts to be found in Sanderson (1988) and Barnett (1986, pp.201-5, 232-3).

It seems to us that it is useful to re-examine industrial productivity in the 1930s with these concerns in mind. We hope to show that the hitherto neglected factors to which we have drawn attention in this introduction (restrictive practices and union bargaining power, absence of competition and barriers to exit, human capital) have a significant role to play in accounting for Britain's productivity gap in addition to those stressed in the recent institutional failure literature.

II. MODELLING PRODUCTIVITY DIFFERENCES

Differences in relative productivity in a cross-section of industries can arise in a number of ways. The simplest possibility is that any difference between labor productivity levels in Britain and America in a given industry arise from factor endowments rather than total factor productivity. Thus we have for the i^{th} industry:

$$\text{RELPROD}_i = f(\text{RELCAP}_i, \text{RELMAT}_i, \text{RELHUCAP}_i, \text{RELMKT}_i) \quad (1)$$

where in industry i RELPROD is relative capital per worker, RELMAT is relative material inputs per worker, RELHUCAP is relative human capital per worker and RELMKT is relative market size. In addition to the traditional factor endowments of capital and materials, equation (1) also allows for variations in the use of human capital and in home market

size.

Weak labour productivity performance in a sector may also be associated with failure to minimise costs resulting in avoidable shortfalls in total factor productivity. For example, firms may not adopt technological improvements or scrap obsolescent plant or prevent shortfalls of worker effort levels as well as their counterparts abroad. Such arguments have always been strongly made by historian critics of British business management (Coleman and MacLeod, 1986; Landes, 1969). In other words these writers see Britain's inadequate response to the challenge of the Second Industrial Revolution in America as a crucial determinant of relative labor productivity. Capital and/or product market conditions must, of course, be permissive for such failure to persist. In this case it might be supposed that barriers to entry, collusion and strong unions would be important determinants of relatively weak performance in British industry. In practice, it would be difficult to argue that factor endowments are totally unimportant, so an eclectic approach would combine market failure and factor endowment variables:

$$\text{RELPROD}_i = f(\text{RELCAP}_i, \text{RELMAT}_i, \text{RELHUMCAP}_i, \text{RELMKT}_i, \text{CR3}_i, \text{TARIFF}_i, \text{UNION}_i) \quad (2)$$

where CR3 is the three-firm concentration ratio, TARIFF is the tariff rate and UNION is trade union density.

Such a specification is inevitably ad hoc and may well fail to do justice to a failure of competitive forces hypothesis. In particular, recent work in economics has emphasised the conduct rather than the structure of industry. As Machin and Wadhvani (1989) propose, wages and

effort can be modelled as the outcome of a Nash bargain between firms and unions:

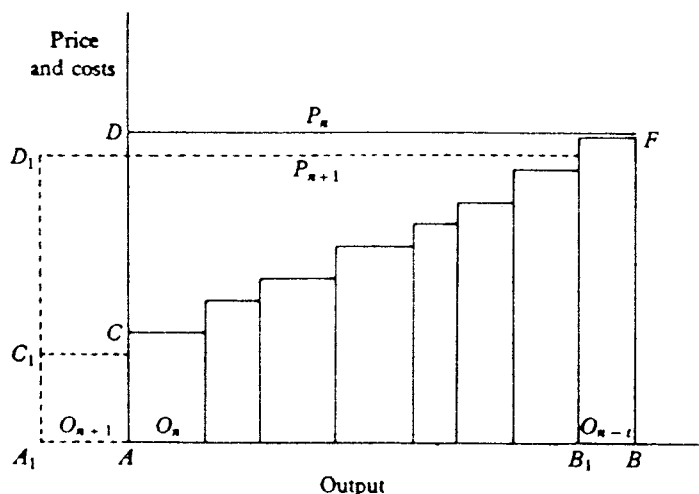
$$\max Z = [W.g(EN) \cdot N - U^0]^\beta [R.f(EN) - WN - \pi^0] \quad (3)$$

where W is the wage, E is effort, N is employment, R is revenue, U^0 and π^0 are the respective status quo points for the union and the firm, and β is the relative bargaining strengths of workers. In this type of model, changes in the level of unemployment, trade union density, demand conditions and the level of concentration affect the status quo points of union and firms, and hence impact upon the level of effort and measured productivity. Machin and Wadhvani (1989, p.22) and a sister paper by Nickell et al (1989) found for 1980s Britain the main location of the ending of restrictive practices to be in unionised firms in industries where concentration fell and that falls in employment had powerful effects on subsequent productivity growth. The interpretation they propose sees this as a new bargaining equilibrium. Such a bargaining approach is a potentially fruitful way of examining Britain's interwar productivity experience.

Turning to the role of collusion, in a cross-section there may be effects associated with the array of vintages of capital employed by profit-maximising firms who will continue to operate plant which covers variable costs where the marginal plant is determined by improvements to best-practice techniques and the strength of demand, as emphasised by Salter (1960, pp.58-60). Momentary equilibrium in the vintage model is illustrated in Figure 1. The current price P_n is composed of operating costs AL and capital costs including normal profits CD of best-

practice plants constructed in the present period. On older vintages operating costs are higher until on the marginal plant they equal BF , which is approximately equal to the current price. Plant with higher

FIGURE 1



operating costs has been rationally scrapped. Technical progress in the next period will reduce AD to A_1D_1 and cause further scrapping of old equipment as price falls to P_{n+1} .

Within the Salter model, if prices are kept artificially high by collusive agreement, the exit of older low productivity plant is delayed. Such collusive agreements allowing the survival of firms with relatively high costs appear to have been common in interwar Britain (Howard, 1954), and in cases like steel the range of costs was very large (Tolliday, 1987). However, the spread of costs at the time the agreement was made would vary between industries according to the differential impact of recent technical change in reducing costs markedly and

eliminating the quasi-rents on old vintages. We would not therefore expect a uniform impact of collusion.

More importantly, perhaps, market power depends on barriers to entry or the degree of contestability of the market, which we can expect to depend on the existence of sunk costs or precommitments by incumbent producers rather than on market structure.

Measures such as the three-firm concentration ratio can therefore be misleading indicators of the extent of product market competition. In the British soap industry, for example, CR3 in 1935 was 70%, one of the highest (Leak and Maizels, 1945, Appendix 3). Nevertheless, the entry of the American firm, Procter and Gamble during the 1930s forced Unilever to rationalise drastically, cutting the 49 factories of 1929 to 11 by 1939 (Cohen, 1958, p.257). This suggests that a regression approach to relative productivity is likely to require augmentation by case studies if the role of obstacles to competitive forces is to be adequately understood.

III. RELATIVE PRODUCTIVITY IN THE 1930s

There have been a number of studies of the level of labor productivity in the UK relative to the US. The most widely accepted study for the 1930s is by Rostas (1948a), who established comparative labor productivity levels for 1937/35, based on a careful matching of information from the UK Census of Production for 1935 and the US Census of Manufactures for 1937. The US Census for 1937 was preferred to the 1935 Census because of the low level of capacity utilisation in 1935 (which would bias the results in favour of the UK), and because it was

closer to the much more detailed 1939 Census, which provided additional information.

We are thus using an industry-of-origin approach in contrast to the income comparison approach favoured by Kravis et al (1982). This is essential if we wish to see how relative productivity varied between industries, as the theory of comparative advantage would lead us to expect. Note further that the concept of productivity used by Rostas was physical output per operative where possible, thus avoiding problems of price deflation.

Elsewhere, Broadberry and Crafts (1990a) use the base year estimates for 1937/35 to extend the comparison back in time to 1909/07 and forward to 1947/48, to provide a dynamic picture of the evolution of Britain's productivity gap over the first half of the twentieth century. Here, however, we limit ourselves to a snapshot of the economy in the mid-1930s, concerning ourselves with the cross-sectional variation in the productivity gap.

Our primary measure of productivity in this paper is relative US/UK labor productivity which is given in Table 1. The unweighted average of the 31 industries gives US productivity as 2.24 times higher than the UK level. The ratio is 2.15 using British employment weights and 2.18 using US employment weights. Thus it is clear that there was already a substantial productivity gap between Britain and the US by the 1930s. We note that there was also considerable variation in relative productivity across the sample.

We see Britain as having a smaller productivity gap in the

lighter industries, particularly in textiles and clothing and food, drink and tobacco. For industries 16-31, the average productivity ratio is 1.67 or 1.72 using UK or US employment weights, respectively. The heavier industries generally have a larger productivity gap, particularly in metals and engineering. For industries 1-16, the average productivity ratio is 2.50 or 2.57 using UK or US employment weights, respectively. These results have their counterpart in the trade data used by Crafts and Thomas (1986) to calculate Britain's revealed comparative advantage. On this measure five of the top six sectors are in the lighter industries (16-31).

TABLE 1

Relative Productivity of Labor (Y/L); US/UK

	<u>Y/L</u> <u>1939/35</u>
1. Bricks	1.32
2. Glass Containers	2.64
3. Cement	0.99
4. Coke & By-Products	2.36
5. Soap	2.85
6. Matches	3.36
7. Seedcrushing	1.05
8. Blast Furnaces	3.62
9. Steelworks	1.97
10. Iron Foundries	1.54
11. Machinery	2.68
12. Radios	3.47
13. Electric Lamps	5.43
14. Motor Cars	2.94
15. Tin Cans	5.77
16. Cotton Spinning & Weaving	1.50
17. Woollen & Worsted	1.31
18. Rayon	1.85
19. Hosiery	1.56
20. Boots & Shoes	1.41
21. Grain Milling	1.73
22. Biscuits	3.45
23. Beet Sugar	1.02
24. Margarine	1.52
25. Fish Curing	0.50
26. Manufactured Ice	2.19
27. Brewing	2.01
28. Tobacco	1.60
29. Paper	2.47
30. Rubber Tyres & Tubes	2.85
31. Linoleum & Oilcloth	1.70

IV. EMPIRICAL RESULTS

1. Data

The data set is described in detail in Broadberry and Crafts (1990a). Here we merely provide a brief list of sources. The dependent variable, output per operative, is presented in Table 1, and is taken from Rostas (1948a). Turning to the variables representing factor endowments, we use the US/UK ratio of horse power per worker from Rostas (1948a) for capital. For human capital we use data on earnings per operative from the UK Census of Production for 1935 and the US Census of Manufactures for 1937. The data have been converted to a common currency using a purchasing power parity of £1 = \$4.94 from Rostas (1948a, Table 2). For materials, we use the ratio of fuel costs per operative from the Censuses, again converted at the purchasing power parity of £1 = \$4.94. For market size we use data on the US/UK relative scale of output from Rostas (1948a, Table 18).

However, in addition to these economic fundamentals of factor endowment and market size, we also include a number of variables to capture weak UK performance. To capture the possible use of sub-optimal plants in the UK, we include as a variable the average plant size on a comparative US/UK basis, from Rostas (1948a). In fact, contrary to popular belief, although plant size was smaller in the UK in a number of well publicised cases such as steel works, motor cars and cotton, in general plant size was larger in the UK, and in some sectors, (particularly foods) four to five times as large.

The rest of our variables attempt to quantify distortions to

the competitive environment in Britain, and are therefore collected on a UK-only basis rather than on a comparative basis. We would expect these variables to be detrimental to productivity only in particular historical circumstances as suggested in Section II. The three firm employment ratio is taken from Leak and Maizels (1945, Appendix 3), while the nominal tariff rate is from Hutchinson (1965, Appendix A). The bargaining power of labour is captured by the trade union density from Bain and Price (1980).

2. Relative Productivity Results

In Table 2 we list and describe the variables which we use to explain Britain's productivity gap. In addition, we report simple correlation coefficients between relative productivity and each of the explanatory variables. However, simple correlation may be misleading, so in Table 3 we present results of regression of the US/UK relative productivity level on the set of variables listed in Table 2. All reported equations are in logarithmic form, which ensures that the fitted values of the dependent variable remain positive.

The first equation in Table 3 includes all the explanatory variables, apart from the tariff rate, since tariffs were zero in some industries, and cannot therefore be included in a logarithmic specification. However, in a linear specification, the tariff variable was statistically insignificant. The finding that relative capital intensity was not a significant factor is in accord with the fact that in over half the industries in our sample, capital productivity was higher in the US, with an unweighted average of 1.14. This indicates that higher US labor productivity was accompanied by higher total factor

TABLE 2

Simple Correlation with US/UK Productivity Level

<u>Variable</u>	<u>Description</u>	<u>r</u>
RELMAT	US/UK Fuel/Gross Output	-0.16
RELCAP	US/UK HP per Worker	-0.25
RELHUMCAP	US/UK Average Earnings	0.47
RELMKT	US/UK Gross Output	0.41
RELPLANT	US/UK Plant Size	-0.041
CR3	UK 3 Firm Employment Concentration	0.19
TARIFF	UK Nominal Tariff	0.18
UNION	UK Union Density	0.074

TABLE 3

US/UK Productivity Level Regressions:
All Variables Measured in Natural Logarithms
Dependent Variable : RELPROD
Estimation Method : OLS

	<u>Equation 1</u>		<u>Equation 2</u>	
	<u>Coefficient</u>	<u>(Standard Error)</u>	<u>Coefficient</u>	<u>(Standard Error)</u>
RELMAT	0.11	(0.13)		
RELCAP	-0.067	(0.20)		
RELHUMCAP	1.04	(0.37)	0.99	(0.32)
RELMKT	0.26	0.090	0.30	(0.078)
RELPLANT	-0.11	(0.099)		
CR3	0.18	(0.11)	0.17	(0.090)
UNION	0.14	(0.20)		
CONSTANT	-1.33	(0.95)	-0.80	(0.37)
\bar{R}^2	0.619		0.648	
SE	0.342		0.328	
N	27		27	

F(4,19) = 0.364

productivity.

The correct interpretation of the human capital variable, which is measured by relative earnings, requires some discussion. First, it may be argued that there is reverse causation with higher productivity leading to higher earnings. In fact, however, this is unlikely in a cross-section, since as Salter (1960, pp.156-157) notes, wage changes were not correlated with productivity changes in individual industries over the period 1924-1950. Rather, industries competed in the market for labor, with productivity changes leading to changes in relative prices. Different average earnings levels between industries, then, reflected differences in the composition of the labor force by industry with respect to human capital. Second, it is possible that the effects of trade union bargaining distort the earnings measure of human capital. However, we would expect two effects, which tend to offset each other so that any net effect would be small, working through movements along the demand curve for labor (through the union wage differential leading to substitution of capital for labor) and also through an inward shift of the labor demand curve if trade union presence leads to restrictive practices. Both these claims are frequently advanced in the historical literature. Third, the finding that inputs of human capital are reason for America's superior labor productivity would be consistent with the Crafts and Thomas (1986) finding that Britain's revealed comparative advantage lay in goods which required relatively little human capital.

The important role for market size would be expected on the basis of the existing literature (e.g. Frankel, 1957). Differences in the length of production runs are widely held to allow higher productivity in America than in Europe (Pratten, 1976) and market size can be expected to affect plant size and proximity to minimum efficient scale (Scherer et al, 1975).

Since a number of the variables in the first equation of Table 3 have little explanatory power, we report a second equation, which explains the variation in the productivity ratio across our sample in terms of human capital, market size and concentration. The F-test for equation 2 against equation 1 is easily satisfied.

However, as has been argued in Section II, it is market power that we see as damaging to productivity, and this is unlikely to be adequately captured by variables like the concentration ratio. In looking for evidence of the weakness of competitive forces, we have been guided by the pattern of residuals from equation 2 in Table 3. A large positive residual (above one standard error of the equation) indicates an unexpectedly poor UK performance, given the values taken by the explanatory variables. We found large positive residuals for bricks, blast furnaces, tin cans, electric lamps and biscuits. A large negative residual indicates an unexpectedly good UK performance, which we found in cement, beet sugar and rubber tyres and tubes.

3. Bargaining and UK Productivity Growth

In this section we follow up empirically the suggestion in Section II that a bargaining approach may shed light on Britain's interwar productivity experience. The basic data source is the 1935 Census of Production, which permits calculation of the average annual growth rate of labour productivity 1924-35 (PRODGR) for a cross-section of 79 industries as in Crafts and Thomas (1986), but excluding the very smallest. The average annual growth rate of the capital/labor ratio (CAPLABGR) is based on the growth of horsepower per worker from the 1930 Census of Production and relates to 1924-30 only, since no horsepower

data are available for 1935. EMPFALL is the percentage decline in employment 1929-32, obtained from Beck (1951), while NEW is a dummy variable taking the value of one for industries frequently referred to in the literature as 'new industries'. TUDUM is a dummy variable taking the value one for heavily unionised industries as in Crafts and Thomas (1986). It is not possible to measure unionisation accurately for industries at this level of disaggregation on a cardinal basis. PCMDOWN is a dummy variable taking the value one for industries where the estimated price-cost margin fell by more than 25 percent between 1924 and 1935. The price-cost margin was estimated as in Cowling (1982, p.163) using his #2 definition, i.e. $(\text{value added} - \text{wages})/(\text{value added})$. For the sample as a whole the mean for 1935 was 0.573 compared with Cowling's estimate of 0.576 in 1948. A lower price cost margin reflecting lower market power would in the bargaining literature be expected to reduce restrictive practices and to raise productivity.

In Table 5 we report results for a UK productivity growth equation, based on the approach of equation (3). The dependent variable is productivity growth (PRODGR). The growth of capital intensity (CAPLABGR) has the expected positive sign. The fall in employment (EMPFALL) is a shock variable, similar to the one which plays an important role in the productivity growth of the 1980s (Nickell et al, 1989). A sharp fall in employment acted to reduce the bargaining power of labour and hence to induce an increase in bargained effort. The use of unemployment instead of the fall in employment produces similar results.

The new industry dummy (NEW) also has a positive sign, as would be expected given the prominence accorded to the new/old industry divide

in the literature. However, it should be noted that the new industry variable is by no means dominant. Both the dummy for high union density (TUDUM) and the dummy for a fall in the price-cost margin (PCMDOWN) have an important role to play. It should be noted that the use of the change in the price-cost margin as a continuous variable gives similar results, but with a slightly reduced level of statistical significance. These results suggest that the bargaining conditions in labor and product markets had an important bearing on productivity performance in interwar Britain.

The low-effort equilibrium characteristic of the British economy during the 1930s and 1940s was widely remarked on by contemporary observers, especially in comparison with the United States. For example, many of the Anglo American Council on Productivity reports commented on what they saw as different attitudes in the British and American workforces, which can be thought of as reflecting a different Nash bargain over work effort. For example, the Report by the visiting British team on Rayon Weaving (AACP, 1949, p.4) was much impressed by the 'ready acceptance by all of change in working conditions... and by the hard work, prompt timekeeping and acceptance of a full work load which was very evident everywhere', while the Report on Building (AACP, 1950, p.55) found that 'a large part of the difference between American and British productivity can be accounted for only by the individual attitude towards work'. Detailed studies such as those of Scott et al (1956) and Zweig (1951) indicate a substantial measure of support for Hutton's (1953) overall assessment in the light of the international comparisons that UK management-labour relations had frequently settled for a quiet life in which overmanning and restrictive practices were conceded and not challenged: 'The drawbacks or shortcomings in Britain, the brakes on

productivity, are not due to the quality of industrial relations... Those relations are frequently of the best. The hindrances seem due to the more restricted content of those relations' (Hutton, 1953, p.144).

As Broadberry and Crafts (1990b) note, this low-effort equilibrium was inadvertently supported by government policy during the Depression of the 1930s. Given the price, wage and unemployment setting behaviour of the period, the product and import price falls associated with the negative demand shock had the potential substantially to raise both real wages and unemployment. The Treasury response was to encourage collusion and cartelisation in an attempt to raise prices and prevent the elimination of inefficient firms for fear of the unemployment consequences. This was successful as a damage limitation exercise, but had distinctly unfavourable effects on long run productive potential.

TABLE 4

Productivity Growth in the UK 1924-35

Dependent Variable : PRODGR
Estimation Method : OLS

	<u>Coefficient</u>	(Standard Error)
CAPLABGR	0.134	(0.066)
EMPFALL	0.040	(0.018)
NEW	1.409	(0.527)
TUDUM	-1.386	(0.734)
PCMDOWN	1.732	(0.828)
CONSTANT	0.800	(0.433)
\bar{R}^2	0.244	
SE	1.774	
N	79	

4. Collusion in British Industry

In the relative productivity equation of Table 3, product market power is measured by the concentration ratio. However, recent work in industrial organisation has stressed that a high degree of concentration does not necessarily imply a high degree of market power (Tirole, 1988). Although by postwar standards the interwar British economy was not yet heavily concentrated, there was a growing degree of collusion between firms involving market sharing and pricing agreements which were encouraged rather than resisted by government policy during the 1930s. Thus the Finance Act of 1935 gave tax exemption to industry wide levies raised for approved schemes for reducing capacity. By 1943 there were 2,500 Trade Associations compared with 500 in 1919 and by the 1950s it appears that up to 60 percent of the manufactured output may have been produced in cartels (Gribbin, 1978, p.24). The early work of the Monopolies Commission was highly critical of the activities of cartels and ultimately only 10 of the 2,430 agreements registered under the Restrictive Practices Act of 1956 were successfully defended as being in the public interest.

In Table 5 we present direct evidence on the extent of collusion, drawing on a number of contemporary surveys. For the early post-First World War period we rely on Rees (1922), who was concerned to show how the First World War had greatly strengthened the tendency to collusion which was already apparent before the war. For the mid-1920s Levy (1927) notes the chief existing cartels and trusts in the second edition of a book originally published in 1909 on British monopolies, cartels and trusts since the sixteenth century. For the mid-1930s we have drawn on the evidence of Lucas (1937) who was writing as a bemused

TABLE 5 : Collusion

	Rees (1922)	Levy 1927	Lucas (1937)	PEP (1957)
1. Bricks				6
2. Glass Containers	Assoc. of Glass Bottle Manuf. of GB and Irl.	Glass Bottle Trusts and Syndicates		1
3. Cement	Cement Makers' Federation	Portland Cement Trust		3
4. Coke & By-Products				13
5. Soap	Lever Bros.	Lever Bros. and Soap Trust		3
6. Matches	Bryant & May	Bryant & May	Bryant & May	1
7. Seedcrushing	British Oil & Cake Mills, United Premium Oil & Cake Co., Jurgens, Maypole			
8. Blast Furnaces				2
9. Steelworks	Steel manuf. Associations	Steelworks Associations	British Iron & Steel Federation	8
10. Iron Foundaries	National Light Castings Assoc., Cast Pipe		National Light Castings Assoc.	41
11. Machinery				10
12. Radios			British Elec. & Allied Manuf.	8
13. Electric Lamps	Electric Lamp Manufacs. Assoc.		Electric Lamp Manuf. Assoc.	7
14. Motor Cars			Motor Trade Assoc.	10
15. Tin Cans				10
16. Cotton Spinning & Weaving	J. & P. Coats	Fine Cotton Spinners' & Doublers' Trust, Sewing Cotton Trust (Coats)	Lancashire Cotton Corporation, J. & P. Coats	4
17. Woollen & Worsted				13
18. Rayon		Artificial Silk Trust (Courtaulds)		18
19. Hosiery				5
20. Boots & Shoes				7
21. Grain Milling			Millers' Mutual Assoc.	10
22. Biscuits				10
23. Beet Sugar				5
24. Margarine	Jurgens, Maypole Dairy Co. Van Den Bergh's			2
25. Fish Curing				2
26. Manufactured Ice				6
27. Brewing				5
28. Tobacco	Imperial Tobacco	Tobacco Trust	Imperial Tobacco	3
29. Paper			Wallpaper Manufs. Trust	3
30. Rubber Tyres & Tubes				40
31. Linoleum & Oilcloth				4

American observing the tolerance in Britain of anti-competitive practices that were illegal in America. Finally, we include the number of trade associations for the early post-Second World War period from Political and Economic Planning (1957), produced during the revival of competition policy in the 1950s.

This survey cannot claim to be exhaustive, merely noting the instances of collusion that contemporaries felt to be significant. Furthermore, only in the case of Lucas was any kind of systematic attempt made to distinguish between different types of collusive behaviour. Nevertheless, it is fairly clear, even from this limited information, that interwar Britain was a highly collusive economy, particularly in the relatively poor performing heavier sections of industry.

It may be wondered why the dominant firms in the cartels did not act to force the inefficient firms out of business. The issue of exit in the interwar British economy is clearly in need of further research, but one obvious point to be made here concerns the free rider problem. It may have been socially beneficial for one of the dominant firms to force the high cost producers out of business, but this was not a costless strategy. There would always have been an incentive to wait for another firm to bear the costs. In one well-documented case, the cost of buying out the quotas of the smaller tinplate producers helped to seriously weaken Richard Thomas and Co., and made them vulnerable to their rivals, Baldwins, Lysaghts and GKN (Tolliday, 1987, Chapter 5).

It may also be wondered why cartels were so damaging for British industry in the interwar period, when they were allegedly so beneficial for Germany in the pre-1914 period. Our answer here is that this question is based at least partly on a misreading of the evidence on

the role of German cartels. Here we are in broad agreement with the views of Chandler (1990, pp.423-424) who is sceptical of the benefits of cartels in Germany, noting that in many instances, they held back mergers that would have been beneficial to the development of the corporate economy and they led to the survival of inefficient high-cost plant. We find this a more convincing interpretation than that of Schumpeter (1943), recently reaffirmed by Webb (1980) in the case of the German steel industry, that cartels encouraged innovation by reducing the riskiness of investment.

V. CASE STUDIES

In picking the industries to study in more depth, we have been guided by the residuals from equation 2 in Table 3. We have chosen to study those industries with both large residuals and a reasonable amount of reliable information. Of the British poor performers this includes tin cans, electric lamps and blast furnaces. The British good performers considered are cement and rubber tyres and tubes.

1. Tin Cans

Tin cans was a notoriously poor performing sector in the UK, and appears with a large positive residual in our sample. In this sector competition was effectively suppressed by metal Box (MB), formed in 1921 from the four major producers (Reader, 1976). In the 1920s MB followed an expansionary policy of acquisitions, but without effective rationalisation. In 1929 the American Can Co. set up a subsidiary in Britain, which threatened the Metal Box near-monopoly. However, MB turned to American Can's major US rival, the Continental Can Co. An

agreement was signed between MB and Continental which gave MB exclusive rights for fifteen years to use Continental's equipment, processes, patents and methods. There was also a market sharing agreement to the effect that neither company would manufacture in the other's territory (Prais, 1981, pp.245-246).

In 1931 the American Can Co. gave up trying to fight MB's entrenched position and agreed to stay out of the UK market for 21 years. Thus MB effectively had a complete monopoly from 1931 through to 1958, when American Can re-entered the British market. The monopoly was enforced through long term leasing for can closing machines, which the canning companies were not allowed to buy. The price cost margin, as measured earlier, rose from 0.489 in 1924 to 0.766 in 1935. The contrast with the soap industry is noteworthy where, as noted earlier, the entry of Procter and Gamble galvanized Unilever.

The very poor level of productivity in this sector dominated by Metal Box, would not be expected by a reading of Chandler (1990). He praises MB's transformation into a modern industrial enterprise of world class (1990, pp.316-20). Yet Reader (1976) notes, despite the general eulogistic tone of his company history, that MB failed to establish effective managerial control in the interwar period, and remained little more than a collection of individual companies carving up a monopoly market. The inefficient component companies continued to earn quasi rents with outmoded technology and organisation, during the period of rapid technical progress in the American industry, with the growth of the food canning industry. After serious personality conflicts had threatened to get out of hand, in 1943 a report was commissioned from a firm of management consultants, which was damning in its criticism of the

company's management. Reader (1976) claims that the deficiencies were speedily corrected, although the persistence of the huge productivity gap into the late 1940s (Frankel, 1957; Paige and Bombach, 1959) casts serious doubt on this. This example underlies the importance of looking beyond the structural features stressed by Chandler to conduct and influences upon it where productivity outcomes are concerned.

2. Electric Lamps

The electric lamp industry was regulated in a highly anti-competitive way by a trade association. This poor performing UK industry was one of the first cases investigated by the Monopolies and Restrictive Practices Commission (1951). In 1919 the Electric Lamp Manufacturers' Association of Great Britain Ltd was formed, and was estimated by the Sub-Committee on Trusts in 1920 to control between 90 and 95 percent of industry output. The implications of this cartel were surely distinctly unfavorable for productivity.

The Association fixed retail prices and trade terms and maintained a system of exclusive agreements and quotas. A register or 'Black List' was maintained to endorse price maintenance, exclusivity, and quotas. Patents were also used to enforce discipline with licenses granted only under restricted conditions. The domestic monopoly was supported by an international agreement, generally known as the Phoebus Agreement, after the administrative office set up in Geneva (S.A. Phoebus). In 1933 the members of the English Lamp Manufacturers' Association of GB Ltd formed themselves into the Electric Lamp Manufacturers' Association (ELMA), joined by the British Philips Co. and Stella, subsidiaries of Philips of Holland. The leading companies were

GEC and AEI Group, and these companies were followed by a tail of high-cost producers, kept in business by the cartel enforced high prices.

In 1935, the ELMA members fought off the threat of competition from low priced lamps by introducing limited quantities of a 'Type B' lamp with lower quality and lower price. These cheap non-branded lamps were sold in low priced stores as 'fighting brands'. The price-cost margin of 0.602 in 1935 compared with 0.611 in 1924. The success of ELMA in maintaining effective barriers to entry and high prices was highlighted by the Board of Trade (1946, p.126) who regarded the ratio of 2.5 in prices of lamps in Britain compared with the US as excessive. The business history by Jones and Marriott stresses the role of the price rings in fostering an atmosphere of cosy inefficiency among the big companies (1970, p.171) and notes that the 1968 merger between AEI and GEC occurred after the break-up of the price rings when competition painfully exposed the failure to rationalise in the 1930s (1970, p.316).

3. Blast Furnaces

The degree of competition in the blast furnaces or pig iron industry is complicated by the issue of vertical integration within the iron and steel industry. Rostas (1948b, p.113) notes that the proportion of pig iron produced and used molten or cold in integrated iron and steel works was 41 percent in 1924, 47 percent in 1928 and 59 percent in 1937.

Pig iron from blast furnaces not attached to steel works thus accounted for less than half of total output by the 1930s. The price cost margin for the sector as a whole was boosted by protection and rose from 0.234 in 1924 to 0.428 in 1935. However, the price of marketed pig

iron was determined competitively by world market conditions. The Balfour Report found that a policy of regulating prices was regarded by manufacturers as ineffective in bad times and unnecessary in good times (Rostas, 1948b, pp.109-110). Although after the introduction of the tariff in 1932 an effective British Iron and Steel Federation was set up (in 1934) and the British steel industry joined the International Steel Cartel (in 1935), pig iron remained a relatively competitive trade. As Hexner (1943, p.10) notes, it happened that entrepreneurs and countries strongly connected by cartels in the market of steel exports competed in the market of pig iron.

The British pig iron industry thus appears to have exhibited the worst of all possible worlds. Half of the output was in the integrated sector, where collusion among steel producers allowed the survival of too many small scale plants, while the other half of the output was in the marketed sector where competition drove down prices to levels where gross margins were insufficient to cover capital costs. As Tolliday (1987, pp.326-327) notes, as integrated firm thinking of investing in a new best-practice blast furnace would be bound by the cartel price for steel, thereby losing its best weapon for obtaining trade. Outside the BISF, a company would face the threat of a price-cutting war and thus have difficulty raising finance for so risky a project. The result was a very wide spread of costs (Tolliday, 1987, pp.38-44). It should be noted that wage bargaining procedures entrenched by internal labor markets also slowed down the exit of high-cost plants by lowering wages relatively in those plants (cf. Figure 1) (Wilkinson, 1989).

4. Cement

Cement provides a clear contrast to tin cans, electric lamps and pig iron, because UK performance was relatively good, both in an absolute sense (labor productivity was roughly equal in Britain and America) and on the basis of a large negative residual. At first sight, this might appear surprising, since cement became effectively cartelised in 1934. However, a careful look at the industry indicates that the 1934 Agreement, fixing prices and quotas, was only reached after more than a decade of cut-throat price competition which eliminated inefficient producers. The details of this episode can be gleaned from a number of studies by Cook (1958), Williams (1958), Rostas (1948b), and Shaw and Sutton (1976).

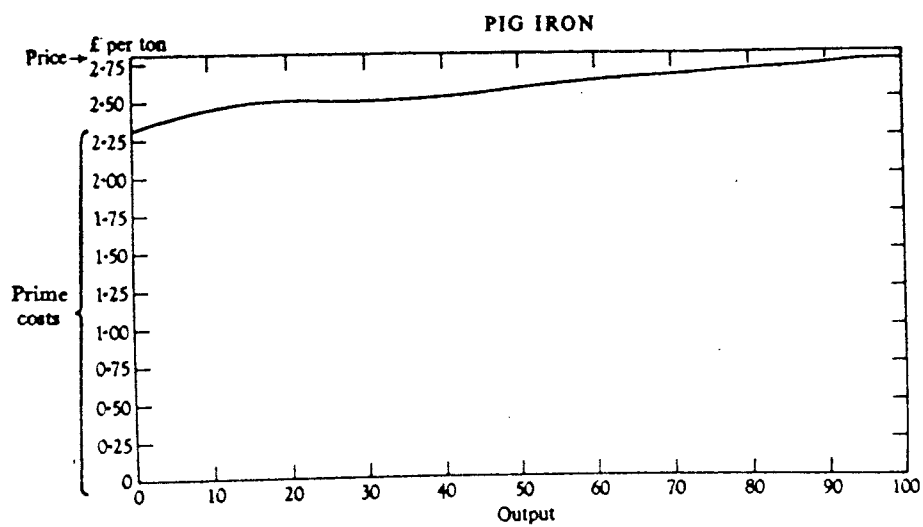
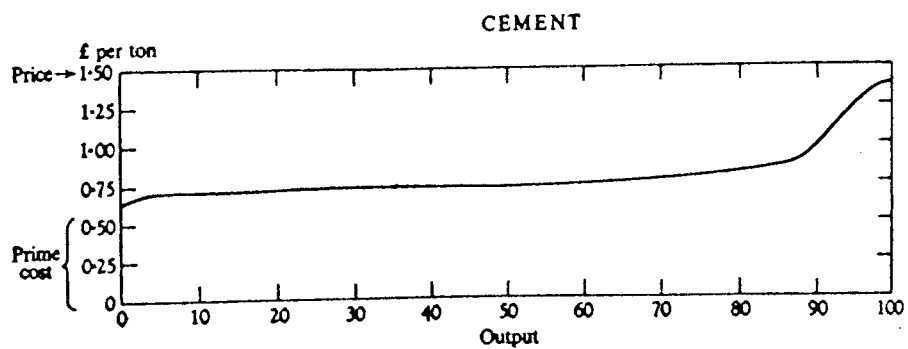
The 1934 Agreement instituted a base point pricing scheme, and a system of quotas based on average output over a number of years, (Rostas, 1948b, p.77). Shaw and Sutton (1976) suggest that the 1934 price fixing agreement can be seen as a response to price cutting during the depressed conditions of the 1920s and early 1930s. Their argument is based on the high fixed costs model of Scherer (1980, pp.206-7). Faced by a fall in demand, firms with high fixed costs are tempted to undercut rivals so as to maintain a high degree of capacity utilisation, since with high fixed costs a lower degree of capacity utilisation must result in serious losses. Rostas (1948b) shows that during the 1920s gross margins were barely sufficient to cover capital costs, while by 1935, with the establishment of the price fixing agreement, gross margins were substantially above capital costs.

It seems clear, then, that in the case of cement, effective

collusion was only achieved after a period of technical progress and intense competition, which resulted in the elimination of old vintages of capital. In 1935 the costs of Associated Portland Cement had fallen to 58% of the 1925 level (Cook, 1958, p.93). Competition ensured that by 1934 only technically up-to-date capacity remained in operation. The cartel was, however, very successful in raising profit margins - the Board of Trade (1946, p.92) gives rates of return for Associated of 4-8 percent in the pre-Depression years of the late 1920s rising to 20% in 1935-8. Barriers to entry were sustained through exclusive dealing arrangements (Ministry of Works, 1947, p.20). Nevertheless, cartelisation in 1934 did not result in the preservation of a long tail of low productivity firms.

This can be seen graphically in Figure 2, which compares prime cost curves in cement and pig iron, from Rostas (1948b). These show what proportion of the output of each industry was produced at each level of prime costs. Firms were arranged in ascending order of average prime cost per unit of physical output. Prime cost per unit of physical output was first adjusted to take account of variations in the selling prices of different firms. These curves can be thought of as an empirical equivalent to Figure 1. A high price fixed by anti-competitive behaviour enables old vintages of capital to earn quasi rents where the prime cost curve is upward sloping, as in pig iron. However, in an industry like cement, the prime cost curve in 1935 is flat over almost the whole industry. In these circumstances, a cartel fixing a high price would not lead to the continued production of a long tail of inefficient firms.

FIGURE 2



5. Rubber Tyres and Tubes

Rubber tyres and tubes was a highly concentrated industry (CR3 = 76 in 1935) in which Dunlop was the leading British producer throughout the period before World War 2. Dunlop was transformed into an efficient, modern corporation after 1921 under the Chairmanships of Sir Eric Geddes (Jones, 1984, p.44) and is singled out by Chandler (1990, p.304) for praise as a successful emulator of American enterprise. In this case the productivity evidence supports Chandler's assessment but again it seems important to relate this to the competitive environment in which Dunlop operated.

Two points especially need to be stressed. First, there was a substantial entry of foreign companies into Britain after the imposition of a 33 1/3 % tariff in 1927 (Goodyear, Michelin, Firestone, Pirelli and India Tyre and Rubber). The new entry increased competitive pressures and established new producers with decent productivity performance. Second, although Dunlop took the lead in establishing the Tyre Manufacturers' Conference in 1929, price cutting was common throughout the 1930s as members found it difficult to enforce agreements and it was only during wartime control (1942-6) that restrictive practices were successfully implemented. (Monopolies and Restrictive Practices Commission, 1955, p.48,81,109). (The price-cost margin rose only very slightly (by 0.018) between 1924 and 1935.) The indications are of a competitive environment quite unlike the situation in Electric Lamps or Tin Cans.

VI. SUMMARY AND CONCLUSIONS

The main empirical findings of the paper can be summarised as follows. First, a cross section regression for the mid-1930s reveals that the British industrial productivity gap was the result of lower human capital, smaller market size and was higher in concentrated industries rather than from smaller plant size or lower capital per person. Second, investigation of case studies provides support for the hypothesis that competition, cartelisation and entry conditions had important effects on productivity outcomes which are not readily captured by a regression approach. Third, a regression based on the newly popular models of bargains over effort and restrictive practices indicates that changes in market power and adverse employment conditions had significant effects on productivity growth in interwar Britain.

Against the background of the large average productivity gap reported in Table 1, we regard British productivity performance in the 1930s as disappointing and would question recent optimistic assessments of the period. Nevertheless our interpretation of the underlying reasons for the productivity gap differs from that of the Chandler school who are perhaps the most prominent recent critics. Our review of the evidence suggests that it is incorrect to place a large weight on corporate structure and points to the importance of factors such as the competitive environment as a key determinant of conduct, i.e., how effectively factors of production are used. Differences in exit rates of inefficient firms and in the level of X-inefficiency emerge as major potential sources of the Anglo-American productivity gap. This argument is based on the results listed above but is also strengthened by reference to the experience of the post-1945 British economy.

Among British business historians it has again become fashionable heavily to blame managerial failure for the relative decline of the twentieth century British economy, claims which have had little attention from new economic historians. In the market environment of interwar Britain many of the arguments used by McCloskey and others to counter similar charges concerning the late Victorian economy are less persuasive; for example, by now there is a large productivity gap and competitive forces are so weak as to allow degrees of freedom for managers to fail. Serious consideration and modelling of the roles of the "neglected factors" (restrictive practices and union bargaining power, absence of competition and barriers to exit, human capital) can potentially put this failure into an appropriate perspective and in our view represents a promising direction for an analysis of interwar British industry based on rational decision-making in the best traditions of new economic history.

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