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Is small beautiful? Mine size in the British interwar coal industry

By BEN FINE

In seeking to deny economies of scale, Greasley concludes that, 'The key to higher productivity in interwar coalmining was *the spatial concentration of production*, which required the integration of cutting, loading, and winding into an efficient overall system'.[1] I agree with this view; indeed, it is what I was attempting to demonstrate in the context of the debate over whether rationalization of the industry into fewer larger pits would have been conducive to greater efficiency.[2] It is hard to understand how Greasley can simultaneously argue for a lack of economies of scale and for the need to concentrate production unless he is attacking the rather weak proposition that throwing more machines and miners down a given pit infrastructure will yield more than proportionate gains in production. That will surely depend on such factors as excess capacity within mine layout.[3]

Greasley reports on other studies, including his own, estimating production functions which yield constant returns to scale. There are sometimes problems with these, such as failure to take into account the number of mines and the degree of excess capacity, but the implication would be that the level of output for any one mine is indeterminate. Surely it is also the case that if constant returns are to be found across a region or the country as a whole, this is liable to reflect a mix of those with increasing and decreasing returns? Why was output not concentrated on those mines with increasing returns, for which econometric estimates in retrospect would then have been completely different?

These are unduly polemical points, relying upon a theory of competition that is inappropriate to the industry under consideration. Greasley's main point, however, seems to be devastating—that the capital stock index that I constructed, out of machine-cutters in use, more than doubled while the actual capital stock remained more or less the same over the interwar period. He suggests that this has the effect, given declining output and labour, of biasing upwards the estimate of scale economies and of returns to labour. Suppose, then, that the real (Cobb-Douglas) production function is given, with familiar notation, by:

$$\ln Q = a + b\ln L + c\ln K$$

If K is incorrectly measured by $k = 2K$, then:

[1] Greasley, 'Economies of scale', pp. 158-9 (my emphasis).

[2] And also whether rationalization was or was not impeded by cartelization. See also Fine, *The coal question*.

[3] This is why estimating economies of scale, however accurately, on the basis of seasonal or cyclical variation is far from satisfactory—although, ideally, account should be taken of these factors in estimating more fundamental relationships.

$$\ln Q = a + b\ln L + c\ln k/2$$
$$= (a + c/2) + b\ln L + c\ln k$$

This simply has the effect of shifting the intercept term, not of changing the estimate of scale economies, although this is only exactly so if the difference between the two capital stocks remains in the same proportion.

Why then do I get scale economies where others, especially Greasley, do not? One way of examining this is to attempt to reconcile the different empirical estimates in terms of specification and data employed—as Greasley has attempted in terms of the capital stock measure. This is beyond the scope of this rejoinder, and such efforts are almost certainly subject to rapidly diminishing returns. It is perhaps more important to emphasize the differences in motivation.

For Greasley, it is one of assuming the industry is in or moving towards perfectly competitive equilibrium, in which entrepreneurs are rationally choosing technology on the basis of relative prices of hand-got and more machine-intensive methods of production. It does not follow, but neither is it surprising, that constant returns should be estimated on this basis.

My motivation has been different. Subject to data availability and manageability, the issue is to estimate the effect on output if more capital and labour had been concentrated on fewer mines. Hence the use of the Cobb-Douglas production function[4]:

$$\ln Q = a + b\ln L + c\ln K + d\ln N$$

where N is the number of mines, with d expected to be negative. In this light, the use of K as measured by (quality adjusted) cutting machines seems much more reasonable, since it is a proxy for the extent to which mechanization has been introduced and concentrated. By contrast, if it is considered that the problem with the industry is too many pits, with too little capital (or mechanization) thinly spread, then the aggregate measure of capital stock is entirely inappropriate. Consider an extreme example in which large numbers of simple mines are sunk at great capital expense but without any other equipment. Then, no doubt, we would measure constant or diminishing returns. In the interwar period, large numbers of small mines, constant overall capital stock, and increasing—albeit slow—mechanization, suggest that this is at least part of the picture.

Nonetheless, I confess that the capital stock measure is far from ideal.[5] It might also have included conveyors and horsepower. The problem here is that, while these might have been incorporated into an index of the capital stock, they tend to be highly correlated with machine-cutting and would have created estimation problems if included as separate independent variables. Interestingly, Greasley reports that seam thickness and length of roadway are inversely correlated to one another, and that both are significant only when separately estimated.[6] This begs the question of why output was not

[4] The production function was estimated as a demand for labour and with a growth variable to allow for excess capacity.

[5] It might also have been worthwhile to have used underground rather than overall labour.

concentrated on those pits with more advantageous seams and underground transport.

At the end of the day, calculations such as these, whichever one is inclined to believe, are extremely rough and ready. At most, they should be seen as establishing a predisposition in research conducted at a more disaggregated level wherever this proves possible. In this context, there is comparative evidence to draw upon, both between the UK interwar industry and its contemporary competitors, and with UK performance after nationalization. In each case, it is stretching the historical imagination to believe that geology and technology were sufficiently unique at that time and place to deny the presence of scale economies and the benefits that could have flowed from rationalization, reorganization, and mechanization.

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[6] Greasley, 'Economies of scale', p. 156.

Footnote references

Fine, B., *The coal question: political economy and industrial change from the nineteenth century to the present day* (1990).

Greasley, D., 'Economies of scale in British coalmining between the wars', *Econ. Hist. Rev.*, XLVI (1993), pp. 155-9.