Appendix 6

The stability of forge production

It is an underlying assumption to the computation made in chapter 6 that forge output figures from one date can be applied to others. In order to demonstrate that this assumption has some validity I have prepared a series of charts of the production of particular groups of forges, based mainly on annual figures obtained from forge accounts (figures 6.1-2 and A6.1-3). In certain cases the figures have been adjusted because they related to a period other than a year. This applies to the initial years of the Stour and Bringewood accounts, as set out in appendices to Ince 1991b, where it is apparent from the rent paid that the first 'year' for Cookley Forge was in fact five quarters. Similarly the figures for Dean forges, meaning works belonging to the (Foley) Forest Partnership using pig iron mainly from their furnaces in and around the Forest of Dean are for various periods shorter than a year and those for 1725 to 1728 are for five quarters. This has also meant that an annual output has occasionally had to be estimated from the output in part of that year.

Unfortunately the only really long series of figures come from the 18th century and mainly from the best located forges (in commercial terms). Those in more remote locations are much less well represented. However Blackpool in Pembrokeshire, Llancillo in Herefordshire, and Shelsley in Worcestershire may be regarded as being in that category. Most of the series of figures are wholly or mainly from a single source. This does not apply to the figures in figure A6.1, which combine figures from Philip Foley's records around 1670, from the Ironworks in Partnership, and from the (Knight) Stour Works accounts. In a gap between these I have placed the figures from the *c.*1716 and 1718 lists with interpolated figures.[1] Also included is an estimate of the production at Shelsley Forge, calculated on the basis of the pig iron supplies to Richard Avenant and his successors there, but I have not used the much lower purchases for their last two years, when the existing stock was probably being run down prior to the expiry of the lease nor have I used the equivalent figures for the 1690s which are much lower, but may well reflect there then being an alternative source of pig iron, namely Tilsop Furnace.[2]

There was inevitably some random fluctuation of forge output and I have therefore smoothed the figures somewhat by plotting a three year moving average of the output rather than the output itself (except in figure 6.3). From these graphs it is obvious that forges did maintain their level of output within a relatively narrow range over very considerable periods. This contrasts very markedly with blast furnaces, which worked in discontinuous campaigns. Thus Bringewood and Charlcot Furnaces seem to have operated alternate years

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[1]. King 1996d. For *c.*1716 has used for 1715 and an interpolated figure for 1717 to join them to the 1718 figure. .

[2]. Goodman 1980, 30; Goodman thesis, 2066-34; Schafer 1978, 101.

Figure A6.1

File: Stour chart/av chart

Figure A6.2

Stour forges3 1725-1812/Av. Chart

Figure A6.3

Stour Forges3 1725-1812/Chart3

from the mid 1730s to mid 1750s and Hales and Aston likewise thereafter, so that averages have to be obtained from figures that vary between nothing and 600-950 tons per year.[3] G. Hammersley considered that the amount of pig iron made at furnaces varied so much from year to year that it was doubtful whether an reliable average could be obtained.[4]

Most forges made iron every year and the fluctuations are relatively modest, as is fairly obvious from the various graphs. In almost all cases the standard deviation is relatively low, commonly in the region of ten percent of output. It is rather higher for Blackpool, where the graph shows an obvious peak of output about 1712. It is also larger for Llancillo where a decline in output is obvious during the early 1720s, no doubt as an aftermath to the embargo period (see figure 6.1). When these statistics are calculated for Wilden for the whole period for which figures are available including the period of initial growth after its conversion to a forge in 1647, the standard deviation is 15% of the mean output, but this falls to 7% when its first six years are excluded, which may indicate that the third finery was added in the early 1650s, rather than in 1647. For some of the Stour forges after 1725 it is obvious from the graph that there was a period of growth up to the mid 1730s, which has therefore been excluded that period from the calculations of standard deviation. At the Mitton Forges and Bringewood, which were among the largest forges in Britain, production fluctuated rather more, but still within a relatively narrow range. It is conceivable that at Bringewood, where there was both a furnace and a forge, a choice had to be made whether to use greater or lesser proportion of the available charcoal in the furnace rather than in the forge. In the graph based on these figures (figure A6.2) it is very noticeable that the lines representing the output of Whittington, Cookley, Wolverley and Bromford Forges, which were all two finery forges are tightly grouped together, though Bromford is rather higher than the rest from the 1750s to the 1770s. Perhaps this is not entirely surprising since they were all (except Bromford) being powered by the same river. Upper and Lower Mitton and Bringewood, which were all three finery forges, all have rather higher outputs. This is examined further in figure A6.3, which shows the average of each group a five year moving averages.

The forges which have the greatest fluctuations of output seem to be those in more remote areas, with less good access to the manufacturing area around Birmingham: at Shelsley pig iron had to be carried about eight miles from Redstone Ferry near Stourport to the forge and the products taken back again. Llancillo was in rural southwest Herefordshire, some distance from the river Wye, while at Blackpool there was a substantial coastal voyage from the Forest, but a considerable portion of its iron was sold locally in Carmarthenshire and Pembrokeshire and also in Somerset and north Devon, rather than being taken back up the Bristol Channel to Bristol.[5]

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[3]. Ince 1991b, various appendices.

[4]. Hammersley 1973, 601-02.

[5]. Foley a/c: the addresses of some customers appear in the accounts; others can be identified from addresses in Prankard a/c. Most customers bought ½-5 tons per year, but Samuel Wallis and Edward then Richard Taylor all of Bristol often bought ten times that amount or more.

Forges in relatively remote areas might be able to obtain charcoal more cheaply because of that remoteness, but are also likely to have had higher transport costs in bringing in pig iron and taking bar iron to market, and this cost is likely to have weighed against them in periods of low prices and led to their having to cut output or even to their closure, whether temporary or permanent. Such forges with their greater vulnerability to changes in the commercial climate, are less well-represented by surviving accounts. This means that the data just does not exist to permit complete certainly, but the relatively long periods of reasonable stability make the assumption seem to be a fairly soundly based one. For a computation, such as that made in chapter 6, which is based on a sample, some assumptions have to be made and those adopted there seem the most likely to produce a reliable estimate.