COMPETITION, GROWTH AND ECONOMIES OF SCALE IN THE IRONFOUNDRY INDUSTRY OF GREAT BRITAIN

A Ph.D. thesis submitted to the
University of Aston in Birmingham

by

David Michael Warren Naunton Hitchens

December, 1974.

ABSTRACT

In this study we examine the extent to which firms in the Ironfounding industry are adjusting to minimum efficient scale as an explanation for the changing size distribution of firms in the industry over time. A description of the industry indicates that any attempt to discover such a mechanism of change is complicated by the wide variety of foundry work undertaken in the industry. As such the possibility of an industry wide unique minimum efficient scale of firm is unlikely. Tests using the "survivor technique" indicate that there may (at least) be common scales which are below minimum efficient scale.

Our method of analysis is not to pinpoint the various minimum efficient scales for foundries producing different kinds of output, but rather to follow a dynamic approach. This involves an examination of the inter-relationships between competition, growth and economies of scale.

A realistic approach is adopted to examine the degree of competition between firms. The size of competing groups and the size distribution of firms within competing groups are also analysed as is the relationship between the firm and its customers.

Measuring economies of scale directly involves huge problems. We sidestep this issue by measuring the overall "efficiencies" of firms of differing size.

Growth of firms is introduced as the method through

which firms adjust to minimum efficient scale. A two-fold purpose is achieved through this analysis. Certain direct hypotheses relating economies of scale to the growth of the firm are tested, and in addition to this we examine the nature of this growth in order to establish the reliability of an analysis which rests on a cross-sectional approach to the problem.

Finally, statistically we relate the competitive status of firms of differing size to growth and the assumed success of firms in the industry.

ACKNOWLEDGEMENTS

Thanks are due to the many people who helped in this research. I am indebted, in particular, to Dr. John Tzoannos for his help, encouragement and careful supervision. I am most grateful to Dr. Diana Pheysey for her help and support especially during the difficult early stages. The Management Development Advisory Unit to the foundry industry assisted in many ways, especially in familiarising me with the industry and in arranging access to several firms. Mr. John Edmonds, the senior management adviser to the Unit, was most helpful. Finally, the project would not have been possible without the financial support of the S.S.R.C. for the first two years and of Aston University thereafter.

CHAPTERS

LIST OF TABLES AND FIGURES

INTRODUCTION

The central problem in this research is the effect of the size of the firm on the efficiency of production in Ironfounding. In particular we are concerned with the impact of economies of scale.

Chapter 1 describes the ironfoundry industry in general. This description provides the background for our discussion of the following hypothesis in Chapter 2:

> "Firms adjust to minimum efficient scale or leave the industry."

This hypothesis is associated with attempts to measure the optimum size of firm from census data, using the "survivor technique". A minimum efficient scale is assumed to be necessary for survival because of competition. The method by which firms survive is assumed to be one of adjustment involving growth.

Hence in Chapter 3 we discuss the theoretical links between economies of scale and competition and growth.

In Chapter 4 we discuss the design of our research and in Chapter 5 the sample, the sources of data and the procedure for data collection.

Chapters 6 to 8 present the analysis. The three elements: competition, economies of scale, and growth, are treated separately and independently.

Finally, in Chapter 9 we bring together the results of the analysis and draw conclusions.

CHAPTER 1

IRONFOUNDING IN THE UNITED KINGDOM: A DESCRIPTION

SYNOPSIS: In this chapter we describe the changing demand for iron castings, the technique of production and the structure of the industry.

This study focuses on ironfounding in the United Kingdom. Although this is our only concern, an introduction to the British Foundry Industry in general will serve to indicate the importance of ironfounding in the classification of castings.[1] The foundry industry in the U.K. is regarded, unlike comparable industries in other countries, as a separate industry from iron and steel making, forging, and other fabrication methods. The British foundry industry is concerned with the production of shaped castings from molten metal exclusively produced by firms or parts of firms.

Casting as a method of shaping metals has developed from 4000 B.C. when arrowheads formed from copper were found to be more easily cast than forged. Since then casting developed into a closely guarded art because of the great skill required in making the moulds to shape the molten metal. After World War II rapid developments occurred in founding which have resulted in lifting it from an art based to a science based industry.

The castings industries can be classified by the base metal used in the output. Table 1.1 indicates the output by base metal for 1971. From the table it can be seen that most output is accounted for by grey-iron castings which in tonnage and price is the major output of the combined industries. Although there is some overlap between the castings made by different production units, in general the distinction between ferrous and non-ferrous foundries is quite clearly defined.

Within the cast iron category more than one type of iron can often be distinguished, again, manufactured in separate foundries. The major distinctions lie between grey, malleable, spheroidal, graphite and "others" which include white and alloy irons. Table 1.2 illustrates the rate of production of each of these irons. From the table it can be seen that the output of S.G. iron rose during the period often at the expense of grey iron.

These different kinds of iron are distinguished on the basis of their properties. Malleable irons are heat treated to convey exceptional ductility while maintaining or even increasing the strength of the basic material. S.G. or modular irons are so called because of the nodules which replace the flakes of graphite in grey cast iron. These irons are as flexible as grey irons but have much higher strengths. Again, highly alloyed cast irons have been introduced in special instances where resistance from corrosion and high temperature is required. This brief account serves only to indicate that iron casting incorporates a family of irons and that metallurgical research

Table 1.1

PRODUCTION OF CASTINGS BY METAL BASE - 1971

	'000 Tons	£m in current prices
Iron castings	3346	419
Steel castings	259	82
Aluminium castings	133	79*
Copper base castings (including brass and bronze)	72	73*
Zinc base castings	69	35*
Magnesium castings	1	N.A.
Investment castings (1970)	-	35

*N.E.D.O. estimates.

Sources: D.T.I.
S.C.R.A.T.A.
World Bureau of Metal Statistics.
Zinc Development Association.
British Investment Casters Trade Association.

Table 1.2

OUTPUT OF IRON CASTINGS IN THE U.K. - '000 TONNES

	Grey	Malleable	S.G.	Total
1963	3522	194	N.A.	3718
1964	4000	214	N.A.	4214
1965	3924	225	N.A.	4149
1966	3598	216	113	3928
1967	3277	196	129	3603
1968	3241	201	173	3614
1969	3408	210	198	3816
1970	3395	206	231	3832
1971	2921	192	233	3346
1972	2809	177	294	3281

Source: Department of Trade and Industry.

has accommodated the demands of the consumer industries which the foundry industry serves.

Figure 1.1 is a model of the casting process. It illustrates the basic steps of the casting operation. In general the basic requirements are sand, a pattern and molten metal. Sand is blended with other ingredients, and is then used for moulding around the pattern. Metal is fed into a furnace where it is melted, poured from the furnace into ladles, and finally into the moulds. The metal is allowed to solidify, the sand is removed from the casting which is then cleaned. Gates and visers (the channels and reservoirs through which the molten metal flows and collects) are removed, and the casting is cleaned - perhaps by sand blasting. It is inspected before being made ready for delivery.

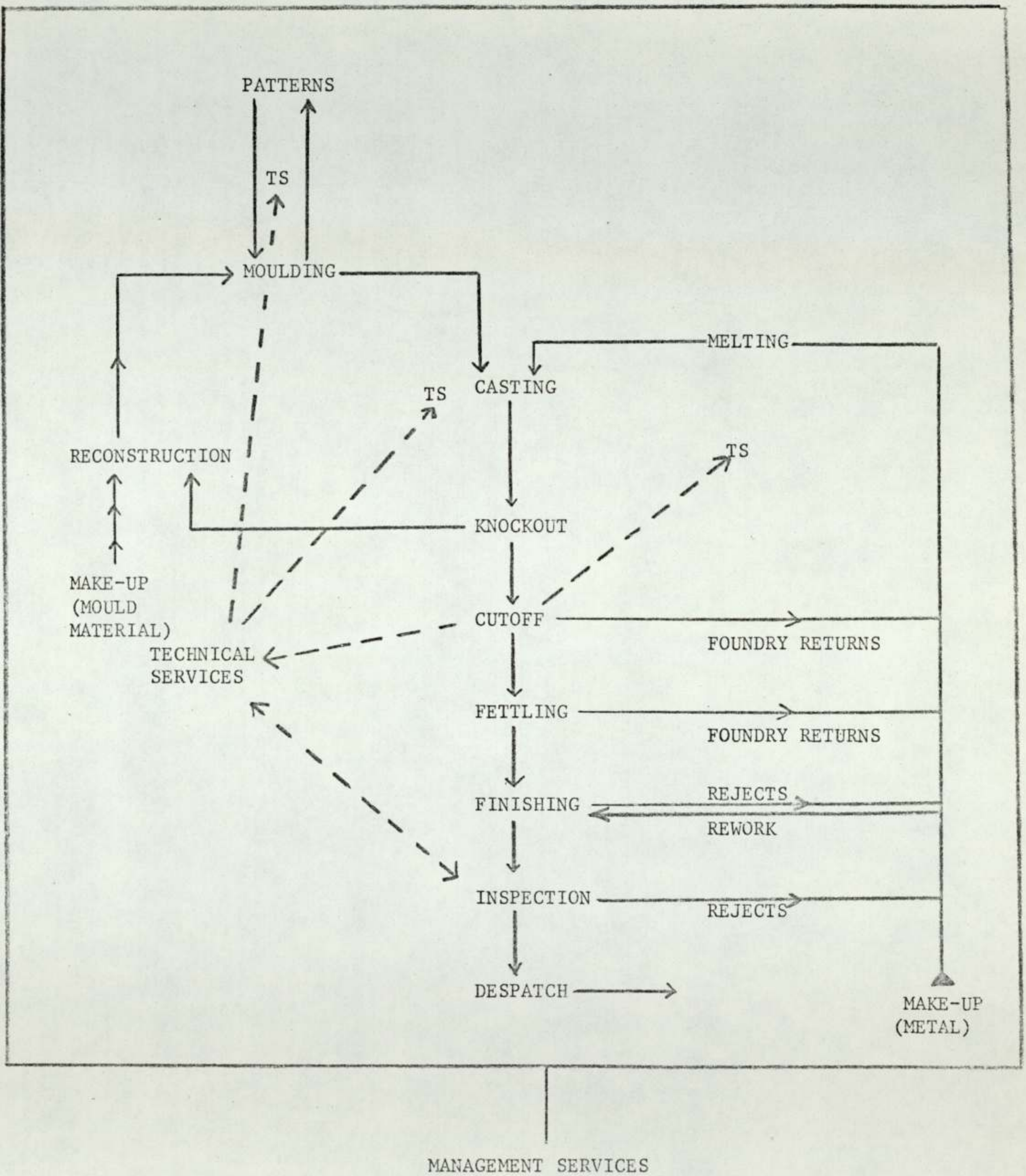
DEMAND

The demand for castings is a derived demand, but ingot moulds and some domestic castings are final products. Demand is both economic and metallurgical. Objects amenable to casting are generally cheaper than forgings or weldments and from the metallurgical point of view castings do not have directional properties: no laminated or segregated structures exist which means that strength, ductility and toughness are equal in all directions.

Demand is highly variable. From graph 1.1 it can be seen that since 1950 the demand for castings is cyclical over periods of four years. Table 1.3 shows the demand

Figure 1.1

MODEL OF THE CASTING PROCESS



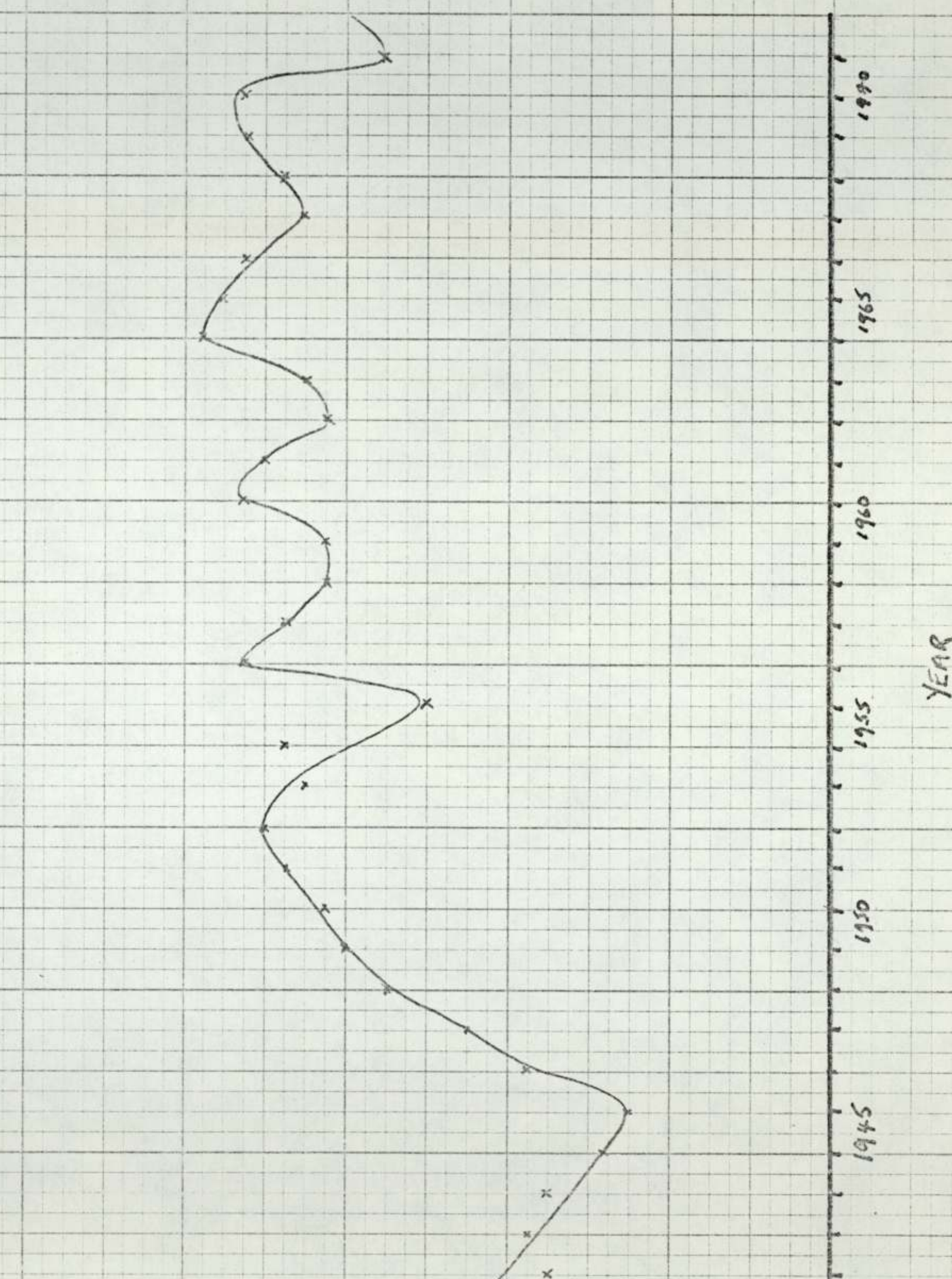

TONNAGE OUTPUT (MILLION TONS)
4m
3m
2m
1m
1940
1945
1950
1955
1960
1965
1970
YEAR

Table 1.3

OUTPUT OF IRON CASTINGS BY INDUSTRIAL SECTOR - '000 TONNES

	1963	1971	1972
Motor vehicles and cycles	557.8	772.2	850.6
Tractors	287.2	194.4	169.8
ENGINEERING INDUSTRIES:-			
Mechanical engineering	657.1	513.4	444.9
Machine tools	165.2	133.4	115.1
Electrical engineering	112.7	81.1	71.7
Shipbuilding	44.3	37.2	30.1
Building and allied industries	454.8	369.2	345.2
Domestic goods	116.5	84.3	79.7
Pressure pipes and fittings	523.1	366.2	389.2
Ingot moulds and bottom plates	451.0	474.7	468.8
MISCELLANEOUS:-			
Coal mining	25.1	14.6	12.4
Railways (permanent way)	72.9	61.3	49.1
Tunnel segments	48.1	9.5	33.0
Other	202.0	232.9	221.1
Total	3717.8	3345.5	3280.8

Source: Department of Trade and Industry.

for castings by industrial sector. [Tonnage as a measure of output is used simply as a unit of convenience though this does not necessarily reflect either cost or price between different products.] The present importance of customer industries is the result of considerable changes, over the years, in the development of these industries. We shall consider briefly their present and future importance to ironfounding.

AUTOMOBILES

The automobile sector has held the largest slice of ironfounding production since 1958, having risen from the second lowest in 1935. Predictions by the National Economic Development Committee (N.E.D.O.) report, however, suggest that the rate of growth of new registrations will decrease as compared with the last decade. This is partly due to international competition, the concentration of competition into Europe, (for which slow growth is also anticipated) and moves towards larger commercial vehicles. This does not suggest that the share of output will become less important, but that simply the rate of growth will slow down. More important, possibly, will be the effect of technological innovation in the automobile industry. In the past the ironfounding industry has been able not only to accommodate but also to contribute to vehicle design in the face of international competition. What might happen now is that new types of engine may be introduced which cannot be cast in iron, and improvements in the quality of aluminium engine castings or electric vehicles will be strong and serious economic competitors for the ironfounding industry.

ENGINEERING INDUSTRIES

Next most important of the ironfounding markets are the engineering industries. A distinction is sometimes drawn between general engineering and heavy engineering castings. The aim of the distinction is to separate long standing traditional basic "heavy plant" from more intricate castings involved in machinery as distinct from plant. Before the second World War engineering castings were dominated by heavy bulk applications such as marine and ships engines and gas plant, but since the war the lighter end has taken an increasing hold on the market.

Changes in steam-raising plant design, and steam as a source of power, the decline of shipbuilding, and changes in gas and chemical plant specifications have reduced the importance of the traditional heavy castings. On the other hand, electrical plant and equipment and special purpose machinery is growing fast.

Again there has been a tendency for a shift from heavy castings to light castings even for the same end product. Thus there has been a decline in the "weight" of castings used, which also reflects to some extent a decline in the cost of the casting. This shift is accentuated by the effect of a shortage of raw materials in the 1950's which led to engineers exploiting non-cast designs and to the adoption of steel fabrication.

The net effect of this is that on the heavy engineering side some markets have been closed. In the lighter engineering industries some substitution has taken place, and thus the rate of growth of castings to this sector is less than the rate of growth of this sector, both in value and volume. Castings, however, are competitive with steel fabrication, particularly if the product is standardised and allows the advantages of long runs.

Here we summarise the N.E.D.O. predictions for the engineering industry.

MECHANICAL ENGINEERING

Differential growth rates in this area do not reflect casting usage. This, combined with growth in value rather than output, and the use of better-designed lighter castings, and a move towards substitutes for castings, in some cases, suggests that higher growth projections which exist for this sector should, at least, stabilise casting requirements.

MACHINE TOOLS

Although 1970 was a bad period for this industry, predictions are favourable and thus a substantial increase in casting requirements is forecast.

ELECTRICAL ENGINEERING

A switch from heavy to light electrical engineering production has affected casting usage which was more important to the heavy side of the industry. However, it is predicted that the heavy sector will recover, thus, allowing for substitution, particularly by plastics and aluminium, it is expected that the demand for iron castings will increase.

SHIPBUILDING

British shipbuilding has faced a crisis from international competition. Although the demand for shipbuilding throughout the world is increasing, it is expected that even stronger competition will develop and over capacity will affect the industry. However the prediction is that the demand for castings will remain at the same level as in 1971.

BUILDING AND ALLIED INDUSTRIES

The next sector of importance to consider is for building and allied industries. The use of iron castings in basic construction work has decreased since 1960, losing ground because of developments in building techniques. Multi-storey buildings tended to reduce the demand for down pipe and guttering. Also road building techniques do not now require a proportionate increase in manhole covers. But the rate of progress in the construction industry has been high, and, together with the degree of substitution for plastic rainwater goods, the demand in this sector has become increasingly vulnerable. Thus overall demand is expected to fall due to this threat.

DOMESTIC GOODS

Demand for castings for domestic goods has fallen due to a change from solid fuel stoves, ranges and fires to electrically fueled equipment, and this fall in demand is expected to continue.

PRESSURE PIPES AND FITTINGS

Demand for pressure pipes and fittings is affected by the level of public expenditure, particularly on water and gas distribution, and is also affected by the degree of substitution to other materials, for example the extent to which demand is satisfied by the properties of spheroidal graphite iron pipes and by importation and exportation. The N.E.D.O. prediction for this sector is for increasing growth in public expenditure generating an increase in demand for pressure pipes and fittings. Substitution for other products is uncertain though 80% of the demand is expected to be met by S.G. irons.

INGOT MOULDS AND BOTTOM PLATES FOR THE IRON AND STEEL INDUSTRY

The British Steel Corporation produces 90% of ingot moulds and bottom plates, the rest is produced in the private sector. Competition has developed from a new process, namely, continuous casting. This is an alternative process which does not require the use of ingot moulds and bottom plates. Capacity will be developed for the use of this new process, but in the short term it is not expected that the demand for ingot moulds and bottom plates will fall. However, in the long term these foundries will be faced with closure.

COALMINING

There has been a continuing downward trend in the demand for castings for coalmining. This is expected to continue.

RAILWAYS

Technically the trend is for less use of iron castings for track and for replacement demand for vehicles. The demand for tunnel segments is variable.

OTHER

Castings produced under the heading "other" are mainly for the engineering sector.

Demand historically contemplated and conclusions on demand

As we have seen the demand for castings is highly varied and complex. Irrespective of the projected fortunes and misfortunes of the sectors supplied, it should be noted that ironfounding is, above all, a flexible industry. What is important is that the changes in the pattern of demand, irrespective of the special factors we have considered in our review, reflect a shift in emphasis towards technically more advanced and complex products.

The major threats presented to the industry lie in products which may easily be substituted for iron castings. The extent to which competition from these substitutes will increase is difficult to estimate at present, but what is certain is that the industry is vulnerable in some, but not all, applications. However, such substitution is not only one way - improvements in the basic metal make it more competitive, and malleable iron is, in many cases, being used as an alternative to steel.

In summary we quote from Tripp:[2]

> "In years to come, the forces of electronics and automation may lead to a state of affairs in which the ironfoundry may become so altered as to be unrecognisable. Nevertheless, there is no reason to suppose either that a change of this kind will come within the foreseeable future, or that the demand for iron castings will cease."

PRODUCTION

Iron castings are produced in a wide range of firms and nationalised undertakings. A large number of these firms are very small. Iron casting is the sole activity of most of these firms, but some produce steel and non-ferrous castings in addition, and a significant proportion, estimated to be 30%,[3] is produced by tied foundries, foundries producing castings for their own internal use. Foundries producing for their parent companies may produce solely for this purpose or, alternatively, may also produce additionally for sale to other firms.

Almost all foundries employ some form of mechanisation and expect to do so increasingly in the future. But despite the presence of a broad size distribution of foundries the extent to which standard mechanised techniques may be used is limited by the wide range of products produced. Scope for the introduction of mechanisation lies more with repetition foundries which concentrate more on long runs of identical castings than foundries concentrating on jobbing activities or short runs.

An examination of the structure of the industry indicates that it has undergone substantial changes. Particularly there has been a high rate of closures. Table 1.4 indicates the size distribution of foundries between 1954 and 1971. In this period just over 46% of foundries have survived. Such statistics are of course affected by changes in ownership, but the indication is that there has been a highly significant decline in the

Table 1.4

DISTRIBUTION OF IRONFOUNDRIES IN THE UNITED KINGDOM BY NUMBERS EMPLOYED

Employees	1954	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1- 10	392	264	224	Not available	230	208	175	143	139	131	121	111	112	
11- 25	416	361	326		309	273	266	250	252	221	200	195	199	
26- 50	386	333	338		283	274	256	224	254	216	201	200	186	
51- 75	203	155	157		135	139	132	126	105	93	97	85	85	
76- 100	103	90	105		98	87	81	74	78	69	69	64	53	
101- 200	188	143	145		118	118	125	139	124	122	114	112	110	
201- 300	55	69	64		58	59	61	56	53	43	46	51	40	
301- 400	18	20	22		21	27	27	22	24	28	31	28	28	
401- 500	17	9	12		17	13	13	17	11	14	11	12	5	
501-1000	36	36	35		28	31	27	19	17	18	18	18	15	
Over 1000	8	8	7		9	14	13	11	10	10	12	11	10	
Total	1822	1488	1435	1387	1306	1243	1176	1111	1037	965	920	887	843	806

Source: Department of Trade and Industry.

number of foundries. Table 1.5 indicates that the risk of closure is itself distributed by size. Naturally the data are distorted by firms being reclassified into different size groups over time but, numerically, the greatest decline has occurred within the smaller size groups. Corresponding increases have only occurred, consistently over the period, in the group employing between 301 and 400 employees.

Tables 1.6 to 1.10 examine the problem in a different way. Here we examine distributions by tonnage of output of the number of establishments, and the total tonnage output of these establishments. Tables 1.7 and 1.9 indicate that only establishments in the highest production group increased both in the number of producing establishments and in total output over the period considered. And the more conclusive evidence of a bias in favour of large firms appears in Table 1.10 where tonnage output is compared with total output for each year in question. Thus the changing share of total output in each group is shown over time.

N.E.D.O. suggests four explanations for this occurrence.

(a) An increasing number of engineering firms have decided to buy their castings from specialist foundries rather than retain their own general purpose capacity.

(b) The fall in demand for engineering castings has led to the closure of many of the smaller jobbing foundries.

Table 1.5

PERCENTAGE SURVIVAL IN EACH SIZE GROUP.
FOUR PERIODS ARE TAKEN. PERCENTAGES RELATED TO THE NUMBER OF FOUNDRIES AT THE END OF THE PERIOD AS COMPARED WITH THE BEGINNING OF THE PERIOD.

Employees	Period			
	1954-1960	1960-1965	1966-1971	1954-1971
	%	%	%	%
1- 10	67.6	66.2	78.4	29.0
11- 25	69.0	73.9	79.6	49.0
26- 50	86.0	78.8	73.3	48.0
51- 75	76.4	85.2	67.4	42.5
76- 100	87.4	90.0	71.7	51.2
101- 200	76.1	87.5	79.1	58.9
201- 300	125.1	88.5	71.5	72.8
301- 400	111.0	135.0	127.0	156.0
401- 500	52.9	69.1	38.4	29.8
501-1000	100.0	75.0	78.0	41.7
Over 1000	100.0	162.5	90.8	80.0

Table 1.6

NUMBER OF ESTABLISHMENTS DISTRIBUTED BY TONNAGE CAPACITY

Tonnage Production	1955	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Under 200	493	349	330	342	344	290	248	224	229	193	168	154	168	
201- 400	285	245	223	210	221	188	178	168	166	159	149	125	115	
401- 800	336	279	270	283	252	232	218	213	184	179	164	172	164	
801- 1200	177	143	147	135	119	120	117	111	109	91	91	84	74	
1201- 2000	189	148	164	141	134	140	146	147	131	107	102	105	92	
2001- 5000	184	175	167	147	150	146	157	133	131	128	140	127	124	
5001-10000	72	70	74	69	70	76	71	76	61	72	65	75	68	
Over 10000	63	66	64	60	59	73	77	74	70	70	78	77	71	
Total	1799	1475	1439	1387	1349	1265	1212	1146	1081	999	957	919	876	

Table 1.7

SURVIVORSHIP BY TONNAGE CAPACITY FOR FOUR PERIODS.
NUMBER OF ESTABLISHMENTS ONLY

Capacity	Period			
	1955-1960	1960-1965	1966-1971	1954-1971
	%	%	%	%
Under 200	70.8	71.1	75.0	34.1
201- 400	86.0	72.7	68.5	40.4
401- 800	83.0	78.1	77.0	48.8
801- 1200	80.8	81.8	67.0	41.8
1201- 2000	78.3	98.6	62.6	48.7
2001- 5000	95.1	89.7	93.2	67.3
5001-10000	97.2	101.4	89.5	94.4
Over 10000	104.7	116.6	95.9	112.7

Table 1.8

TOTAL PRODUCTION IN EACH RANGE - '000 TONS - BY CAPACITY (TONNAGE)

	1955	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Under 200	45.1	28.0	25.2	35.5	31.7	22.2	22.7	19.9	21.5	19.1	23.2	14.9	17.8
201- 400	83.8	72.0	65.7	61.1	64.5	55.2	52.6	36.1	49.9	47.5	43.6	36.6	34.3
401- 800	191.0	160.8	156.5	162.9	145.5	135.5	128.3	124.2	103.0	102.8	93.7	99.3	94.1
801- 1200	172.7	140.5	143.2	134.2	117.7	119.7	112.8	110.6	104.9	90.5	89.5	85.4	74.2
1201- 2000	294.7	227.1	254.9	218.8	205.8	219.6	224.5	225.7	203.5	164.5	160.8	163.9	140.2
2001- 5000	583.5	543.5	532.5	476.3	475.1	452.9	48.2	409.3	433.5	408.1	433.4	389.7	377.0
5001-10000	497.8	470.5	500.6	468.6	492.8	519.9	482.0	504.1	424.1	492.8	433.3	492.7	449.1
Over 10000	2056.5	2325.2	2127.4	1967.1	2126.0	2622.6	2579.0	2435.8	2205.6	2232.0	2478.4	2489.6	2106.0
Total	3925.0	3967.6	3806.0	3524.5	3659.1	4147.7	4083.2	3865.7	3545.8	3557.0	3755.9	3772.1	3292.7

Table 1.9

SURVIVORSHIP IN EACH CAPACITY RANGE BY TONNAGE OUTPUT FOR FOUR PERIODS.

Capacity	Output			
	1955-1960	1960-1965	1966-1971	1954-1971
Under 200	62.1	81.1	89.4	39.5
201- 400	85.9	73.1	95.0	40.9
401- 800	84.2	79.8	75.8	49.3
801- 1200	81.4	80.3	67.1	43.0
1201- 2000	77.1	98.9	62.1	47.6
2001- 5000	93.1	88.5	92.1	64.6
5001-10000	94.5	102.4	89.1	90.2
Over 10000	113.1	110.9	86.5	102.4
Total	101.1	102.9	85.1	83.9

Table 1.10

TONNAGE OUTPUT AS A PROPORTION OF TOTAL OUTPUT FOR EACH CAPACITY RANGE FOR EACH YEAR

	1955	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Under 200	.01	.007	.007	.01	.009	.005	.006	.005	.006	.005	.006	.004	.0054
201- 400	.02	.018	.017	.017	.018	.013	.013	.009	.013	.0134	.012	.010	.0104
401- 800	.049	.041	.041	.046	.04	.033	.031	.032	.012	.029	.025	.026	.029
801- 1200	.044	.035	.038	.038	.032	.029	.027	.029	.030	.025	.024	.023	.023
1201- 2000	.075	.057	.067	.062	.056	.053	.055	.058	.057	.046	.043	.043	.043
2001- 5000	.149	.137	.14	.135	.130	.109	.118	.106	.122	.115	.115	.103	.114
5001-10000	.127	.119	.132	.133	.135	.125	.118	.130	.12	.139	.115	.131	.136
Over 10000	.524	.586	.559	.558	.581	.632	.632	.630	.622	.627	.66	.66	.64

(c) The increasing ability of mechanised foundries to undertake the production of small batches of castings more economically than in the smaller foundries.

(d) The low level of demand for heavy castings in recent years has led to the elimination of some capacity catering for this demand.

Attention has also been drawn to the likelihood of further closures being induced by the withdrawal of the regional employment premium and consequent reduction in the competitive status of those foundries which had received the premium.

Regional Production

The distribution of ironfounding by region is shown in Table 1.11. Two points emerge. First, there is high concentration of production in the East and West Midlands associated with the centres of engineering and motor manufacturing. Second, these regions have a larger average size of foundries than elsewhere, and regions with a low percentage of production have comparatively smaller foundries.

(Note: The larger average size in the North and in Wales is influenced by the production of ingot moulds.)

Factors of Production and the Production Process

(a) Manpower and Employment

Employment in ironfoundries has steadily declined. Thirty per cent fewer were employed in 1972 as compared with 1963 (see Table 1.12). Using tonnage as a measure, output per man year has increased

Table 1.11

IRONFOUNDRIES BY REGION

	Number of Foundries		Percentage of Foundries		Reduction 1968-1971		Production as Percentage	Average Productivity per Foundry
	1968	1971	1968	1971	Number	%	1971	1971
North	51	45	5	5	6	12	8.5	6148
Yorkshire and Humberside	152	137	16	16	15	10	8.5	2080
East Midlands	95	86	10	10	9	9	22.0	8344
East Anglia	19	18	2	2	1	5	1.1	2302
South East	109	87	11	10	22	20	8.4	3163
Wales	35	31	4	4	4	11	7.5	7935
West Midlands	227	198	24	23	29	13	27.5	4609
North West	134	114	14	14	20	15	7.0	2079
Scotland	95	82	10	10	13	14	7.0	2705
Northern Ireland	12	10	1	1	2	17	0.5	1650
Total	965	843	100	100	122	100	100	

Source: Department of Trade and Industry.

Table 1.12

EMPLOYMENT AND CRUDE PRODUCTIVITY INDICES IN IRONFOUNDING

	Numbers '000s	Index 1963=100	Tons per man year	Index 1963=100
1963	120.3	100	30.9	100
1964	122.6	102	33.7	109
1965	123.0	102	33.7	109
1966	115.8	96	33.9	110
1967	106.6	89	33.8	109
1968	100.0	83	36.1	117
1969	100.8	84	37.9	123
1970	101.0	84	37.2	120
1971	93.4	78	35.8	116
1972	84.9	71	38.6	125

Source: Department of Trade and Industry.

during this period.

(b) Occupational Structure

Foundries are increasing the proportion of managerial and technical employees and also operators and reducing the proportion of the craft occupations (see Tables 1.13 and 1.14). A large proportion of the skilled force is concentrated in smaller foundries, the trend being towards greater mechanisation with size and thus a move towards operators.

Table 1.13 indicates the low percentage of scientists and technologists for what has become a science based industry dependent on technical change and strict quality control. This shortage is to some extent offset by the services of the British Cast Iron Research Association.

Of further interest is the age structure of managers and supervisors. A Foundry Industry Training Committee analysis reported by N.E.D.O. shows that about half the total are over 47 years of age, one-fifth below 35, about one-fifth are aged above 55. This presents a problem because traditionally management is recruited from the pool of scientists and technologists, and although their mean age is low, their proportion of total manpower is also low.

PRESENT AND FUTURE PRODUCTION TECHNIQUES

Melting

The main method of melting is the coke-fired cupola. Hot fired cupolas have been introduced but are only economic over long daily melting periods; a further

Table 1.13

OCCUPATIONAL STRUCTURE OF IRONFOUNDING

	Year	Numbers	%
Managers and Supervisors	1969	6662	7.4
	1970	6880	7.7
	1971	6906	8.2
Technologists and Scientists	1969	118	0.1
	1970	129	0.1
	1971	158	0.2
Administrative and Professional	1969	1393	1.5
	1970	1319	1.5
	1971	1344	1.6
Technicians	1969	1718	1.9
	1970	1796	2.0
	1971	1748	2.1
Skilled Employees	1969		17.4
	1970		17.4
	1971	14683	17.4
Clerical and Office Staff	1969		6.5
	1970		6.7
	1971	5685	6.7
Operators	1969		52.3
	1970		52.3
	1971	45341	53.2
Other Occupations	1969		12.9
	1970		12.1
	1971	11656	10.7
Total	1969		100.0
	1970		100.0
	1971	84620	100.0

Source: F.I.T.C.

Table 1.14

EMPLOYMENT OF MOULDERS AND COREMAKERS BY FOUNDRY SIZE

Foundry Size	1969	1970	1971
1- 100	21.5	20.5	18.2
101- 200	10.7	10.2	9.4
201- 500	4.8	4.3	4.6
501-1000	2.4	2.6	2.2
Over 1000	1.6	1.7	1.3
Total	6.9	6.7	6.1
Number	6236	5981	5155

disadvantage is the high capital cost of controlling fumes from these plants. The requirement to economise on coke consumption has led to the use of twin blast systems, which are likely to be steadily introduced. An alternative method of melting is the electric furnace, but its use is not prevalent.

In the long run the problems of air pollution, and the deterioration of coke, may lead to new forms of potential heat such as natural gas. Such problems are particularly important for the smaller foundries because stringent control implies high capital costs.

Moulding

Moulding can be considered in relation to the major market divisions, i.e. between jobbing castings and repetition castings.

If we first examine moulding techniques for repetition castings, the moulding material - silica sand - is cheap, found in large quantities and sufficiently refractory to withstand high temperatures. If green sand moulding continues, it is likely that moulding machine development will follow the trend of high pressure moulding. It is likely that the mechanical development will follow the lines of improved housing, methods of applying pressure and methods of control, so that down times are decreased. In terms of the moulding material, improvements will be made in terms of freer flowing and additives to give improved skin finish and dimensional accuracy.

The problem of moulding for jobbing foundries is a different one. The sand mixer has been an important improvement in developing self-hardening sands, but the real threat is from the lack of skilled men. A move towards automation will be necessary to overcome this problem, perhaps with computer aided production techniques. New developments will revolve around self-hardening sands and techniques to improve dimensional accuracy. The moulding box will probably remain crucial to the process.

Coremaking

The need for higher speed production of dimensionally accurate cores has led to fast setting chemical binders and coremaking materials. Hot curing of resin and the CO_2 silicate cold process are the major changes. Cold curing resins indicate a move towards reducing costs.

Fettling and cleaning

Little change has taken place in this part of the production process. Cleaning processes are labour intensive because mechanisation is difficult due to the variety of castings. In general, short blast machines and high speed grinders are available. Improvements are more likely to come from better moulding techniques and coremaking, which will reduce the degree of finishing required.

Heat Treatment

Malleable iron castings and most S.G. iron castings require heat treatment before use. Heat treatment is provided by annealing furnaces and improvements in this process are directed towards continuous annealing furnaces, shorter cycle times and more accurate control of processes involved.

Quality Control

The demand for high quality castings has led to the use of sophisticated testing methods.

Raw Materials

The major raw materials are foundry pig iron, iron and steel scrap, coal and coke for the cupolas in which the metal is melted. The most important trend is the progressive increase in the use of scrap in proportion to pig iron used. Price differentials have encouraged this switch and foundries use as much scrap as is technically possible. The price of coke has also been a problem and is responsible for much of the price increases in final castings.

COSTS AND INVESTMENT

Cost Structure of Foundries

Table 1.15 indicates the average cost structure of foundries. And N.E.D.O. makes the following observations about the relationship between prices and costs.

(a) The rate of increase of wages in ironfounding has been greater than the trend of casting prices but the gap is narrowing.

(b) Coke prices have increased faster than price.

(c) Pig iron prices have lagged behind price.

Investment (see Table 1.16)

Two observations may be made:-

(a) There is a lack of investment in plant and machinery, hindering the adoption of new techniques.

(b) There has been a lack of investment both to improve the working environment and to control

Table 1.15

COST STRUCTURE OF FOUNDRIES

	£ per tonne	%
Wages and salaries	49	39
Ferrous raw materials	20	16
Fuel and power	14	11
Other, depreciation and profit	42	34
Total	125	100

Source: Cooper Brothers.

Table 1.16

INVESTMENT IN IRONFOUNDRIES (£ million current prices)

	1963	1968	1970
Land and buildings	4.5	2.6	3.0
Plant and machinery	7.7	13.3	16.4
Vehicles	0.6	0.8	1.1
Total	12.8	16.7	20.5
Investment as % of turnover	4.6	5.0	4.9

Source: Census of Production and N.E.D.O. Estimates.

external pollution.

CONCLUSIONS

Our introduction to the industry illustrates the wide variety of products produced by foundries and the techniques available in the production process. We have noted that the industry tends to classify itself by base metal used, although some firms also produce non-ferrous castings. Given the degree of heterogeneity, another criterion for classification is the production method. Naturally there are many dimensions of classification and the one which we use here is based mainly on the distinction between jobbing and repetition work. Jobbing foundries are normally concerned with one-off or small batch jobs. Repetition foundries, on the other hand, are associated with longer runs of particular castings. The distinction is simple and useful but is naturally handicapped because it does not exactly match firms by other characteristics.

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CHAPTER 2

THE HYPOTHESIS

SYNOPSIS: The problem of survival is examined in this chapter. In particular we examine the hypothesis that this is related to the operation of economies of scale. Alternative issues are considered, especially the possibility that survival may be determined by the conditions of demand. Finally we examine the relative positions of small and large firms, and the specific reasons for the continuing existence of small firms.

Our analysis of the overall data available on iron-founding indicates that major changes have occurred in the structure of the industry over time. These changes create problems for the analyst. Furthermore, production embraces more than one kind of production technique and market. Thus the crude statistics conceal many differences related to size of firms, production technique and type of output.

Overall this kind of change, it is claimed, is generated by economies of scale[1] in the general case, but the complexities of the industry suggest that such an hypothesis must be validated (or supported) by a more detailed examination.

One further indication of the forces of economies of scale generating such a change is the size distribution of firms by region. It was shown in Chapter 1 that larger size was usually associated with higher concentration of output in particular regions of the country. Now if production supports a local market it would be expected that -

(a) the optimum size of firms will be determined by the size of the market, and

(b) the larger the number of firms competing the more likely that adjustment to optimum size will take place.[2]

More detailed examination of the industry suggests that simple optimum, in the sense of a unique minimum efficient size related to capacity output is complicated by the wide range of foundry work.

Some foundries specialise by length of run, size and weight of castings, and techniques employed, while other foundries do not specialise but produce a wide range of castings by differing techniques. Clearly, size as a simple dimension of scale economies is inadequate and the economies of specialisation, length of production run, raw material costs, capital and operating costs, and market limits for each individual product are important in addition to the size of foundries.

If we examine some of the sources of economies of scale it is likely that they are technically important in sand preparation, in iron production and air conditioning, in mechanisation and automation, in melting, and in moulding and coremaking.[3]

Thus in conclusion there is prima facie evidence for an examination of the degree of importance of economies of scale as a force influencing and continuing to influence the structure of the industry.

THE SURVIVOR TECHNIQUE IN DETAIL

The survivor technique is intended to demonstrate the optimum size of firms in terms of private costs. A fundamental postulate is that competition between different sizes of firms sifts out the more efficient enterprises. It solves the problem of minimum efficient scale as follows:[4]

> "classify the firms in an industry by size, and calculate the share of industry output coming from each class over time. If the share of a given class falls, it is relatively inefficient, and in general is more inefficient the more rapidly the share falls .....
>
> An efficient size of firm, on this argument, is one that meets any and all problems the entrepreneur actually faces: strained labour relations, rapid innovation, government regulation, unstable foreign markets, and what not. This is, of course, the decisive meaning of efficiency from the viewpoint of the enterprise."

Stigler then examines the principle in more detail. For the technique to work firms must compete with firms of other sizes, and these firms must sell in a common market. Competing firms must be price competitive.

No claim is made to estimate the shape of the long run average cost curve (L.R.A.C.) below minimum efficient scale, except insofar as costs are presumed higher the greater the rate at which firm size classes lose their share of the market. However, this rate of loss is also affected by the durability of productive resources in use, competition in the factor markets, and degrees of general efficiencies of firms in the industry.

Saving[5] in applying the technique describes the associated problems of estimation. These difficulties revolve around -

(a) the measurement of size. Plant size is a multi-dimensional concept involving the variety of products produced, the rate of production of each final product and the degree of vertical integration.

(b) the problem of industry classification. Industries must be defined to include plants which are producing closely related products.

The estimation technique used by Saving involved comparisons of industry value added produced by different size classes in 1947 as compared with 1954. In so doing some classes are observed to be experiencing declining shares whilst others are observed as experiencing increasing shares. Thus an assumption is made that firms are on a path towards equilibrium. Another assumption is that this path towards equilibrium involves a unique optimum size, in as much as the optimum size has not changed during the period of measurement. The major assumption of the technique is that growing size classes are within the range of optimal size, whilst declining classes will decline until they vanish.

However, a number of biases may intrude. Industry definition may be too broad. The range of optimum size may be increasing. The industry might have more than one distinct optimum size.

Shepherd[6] illuminates further problems of the survivor technique. But first he describes the important advantages. These are threefold. First the technique finesses the problem of the capitalisation of rents into costs, a process which drives disparate measured average costs toward equality.[7] Second, the unit of output is unambiguously defined (as the plant) and third, the technique takes into account dynamic elements which goes beyond the traditional static equilibrium analysis.[8]

The major difficulties, however, are as follows. The technique is descriptive insofar as it tells us what the surviving range is, but there are other reasons why plants of varying size might survive. Second, it considers all costs not just production costs. Third, it lacks any indication of the degree of economies of scale. Fourth, if the distribution of firms or plants is constant over the time period considered, it must be concluded that every plant is of optimal size. Thus the technique cannot be used on its own, but should be used in connection with other evidence.

Yet another problem is that general agreement between Shepherd, Weiss and Saving is lacking. Particularly when the estimates are brought forward to a later period beyond 1954. Further, comparisons of five of Bain's[9] estimates with the survivor technique by Shepherd showed that only three of the estimates were tolerably close. Also comparisons on the basis of the surviving "number of plants" were made with the basis "of share of industry value added" and further discrepancies were found between the estimates. Shepherd concluded that the more reliable results were for relatively trivial industries, whereas in terms of the more important[10] industries reliability was lacking.

THE SURVIVOR TECHNIQUE AND IRONFOUNDING

In applying the survivor technique to ironfounding a number of different measures were used. These are summarised in Tables 1.5, 1.7, 1.9, 1.10 (in Chapter 1).

Table 1.5 shows the percentage survival over four periods of the number of establishments in each (employee) size group. Hence column 1, for example, shows that in the employee size group 1-10, the number of establishments of that size existing in 1960 as compared with 1954 was 67.6%. Similar calculations are shown for the periods 1960-1965, 1966-1971, 1954-1971. The advantage of considering more than one period, though these periods are arbitrary, is that there is both a check on consistency and an indication of the rate of change between periods. In terms of overall consistency, firms in the size group 301-400 employees were consistently increasing in comparison with establishments in both larger and smaller size groups. Exceptions to this trend were as follows. For the period 1954-60, the number of establishments in the size group 201-300 employees and over 500 employees were increasing and constant respectively. And in the period 1960-65 the number of establishments in the size group "over 1,000" was increasing. The breakdown of the years 1954-71 into three sub-periods, shows that the rate of closure (inferred by subtracting percentage survival from 100), decreased for establishments of 11-25 employees, increased for establishments of 26-50 employees, and 201-300 employees, while for the others no consistent pattern emerges.

For the whole period 1954-1971 the rate of closure up to the surviving range (301-400 employees in terms of growth) was a decreasing function of size; above that range there was an abrupt drop in survival which again became an increasing function of size.

Table 1.7 examines the same problem differently. The classification here is not employees but tonnage capacity. Survival in a similar way to Table 1.5 relates to establishments. In this case no consistent pattern emerges except that establishments with a capacity greater than 10,000 tons were surviving and growing, whereas the rest were declining.

Tables 1.9 and 1.10 classify foundries by tonnage output but in this case Table 1.9 examines tonnage output in each capacity range over time. Again the best survivors are in the largest capacity range. And survival in this case as with the other measures is an increasing function of size.

Table 1.10, differently again, classifies foundries by capacity but the output in each year is a percentage of the total output of the industry for that year. In this case a different picture emerges. Here establishments in the capacity range 5,001-10,000 come into the picture. But most clearly the largest firms above 10,000 tons maintain an increasing output. The picture is consistent with a further "visual" analysis separating peak years of foundry production from the troughs. The peak years illustrated here are 1955, 1960, 1964-5, 1970 - and the troughs are 1962, 1967-8 (see Table 1.10).

The survivor estimates we have developed so far relate the risk of death to tonnage production and the number of foundries in each size category. We may also examine the same problem using net output, from census of production data. Table 2.1 arrays establishments by numbers of employees and net output as a proportion of total net output for each size category, for the two years 1954 and 1968.

All size classes show a decreasing share of output except for establishments of between 200 and 300 employees, and for those above 750 employees.

As such the different measures do not agree.

Table 2.1

PROPORTION OF NET OUTPUT BY ESTABLISHMENT SIZE CLASSES FOR THE TWO YEARS 1954 AND 1968

Employees	1954	1968
25- 49	.073	.033
50- 99	.111	.073
100- 199	.182	.123
200- 299	.085	.117
300- 399	.083	.069
400- 499	.061	.069
500- 749	.166	.108
750-1500	.133	.22
1500+	.077	.108

Source: Census of Production.

CONCLUSION

On the assumption that the gainers are within the range of optimal size and the losers outside this range, our analysis suggests, on the measure of employees and establishments, that establishments in the employee size group 301-400 employees is the optimum. On capacity, establishments above the capacity range 5,000, at least, or certainly 10,000 tons, are within the optimum range.

Because cross-referencing between capacity and employee size classes exactly was not possible, it should be noted that establishments with a tonnage capacity greater than 10,000 tons included establishments employing 301-400 employees, and marginally smaller size groups.

Using net output data we observed increases for firms between 201 and 300 employees and above 750 employees. Overall this suggests that the concept of a unique optimum is probably not applicable here.

Nevertheless, we have indicated that survival is related to size. In terms of the survivor technique this is an indication compatible with the concept of economies of scale.

The Importance of Economies of Scale

The major importance of optimum scale of production is that from the point of view of society output is produced with maximum efficiency. Other factors, however, also come into the picture. Probably most important is the idea of relative scale. Thus, if the number of possible production units is dependent upon the size of the market, so is the number of possible units of minimum efficient scale. Now if that scale is large in proportion to the size of the market, then the price one pays for firms of minimum efficient scale may be that of monopoly or oligopoly.

Estimates of Minimum Efficient Scale in Ironfounding

Pratten[11] estimated minimum efficient scale for two types of foundry. His estimates are tabulated in Table 2.2.

The indication is, given the different types of output, optimal scale will vary. For some a large, for others a small output will be necessary. Of total market output the two estimates reported here are unimportant in terms of the percentage of total market. However, minimum efficient scale for cylinder blocks represents a large proportion of the total submarket.

Other Factors Influencing Survival

Given the heterogeneity of output and the multiplicity of markets served, our overall data will conceal different optima (although these may imply common sizes which are inefficient). But other factors will also affect survival. For example, survival by size of firm could be linked to the changing demand for different products produced by the industry as a whole. To test this we would require data on individual products and markets by size of firm. We would also require data on the changing demand for these products together with the specificity of production within individual producing units. This is to say the problem may not only lie on the supply side but on the side of demand. However, in

Table 2.2

TWO ESTIMATES OF MINIMUM EFFICIENT SCALE FOR IRONFOUNDRIES

Type of Ironfoundry	Estimates of Minimum Efficient Scale				
	Minimum Efficient Scale (Physical Output)	% increase in costs per unit at 50% Minimum Efficient Scale (over costs at Minimum Efficient Scale)		Minimum Efficient Scale as % of	
		Total Costs	Value Added	U.K. Market 1969	Submarket
(a) Cylinder blocks	50,000 tons	10	15	1	30
(b) Small engineering castings	10,000 tons	5	10	0.2	-

Source: C. F. Pratten, "Economies of Scale in Manufacturing Industry", C.U.P. 1971.

the absence of such data, we are able later in our analysis to examine the degree to which foundries (by size) are flexible between markets, and for the present we shall continue our analysis from the standpoint of production.

Other factors relate to changes or differences outside the ceteris paribus conditions of the scale-cost curve. One such example is the possibility of technological "creep" between the periods of measurement. And it is to such factors that we now turn.

Advantages and Disadvantages of the Size of the Firm

Depending upon how the concept of economies of scale is defined, there are a number of other factors which place larger firms at an advantage over smaller firms.

General Advantages

Financial economies are important to the large firm. It is both easier and cheaper for a large firm to raise money. Larger firms also are more able to spread risks. Where they are more diversified poor performance of some products is more likely to be offset by the performance of others. Further, larger firms may have the advantage of market power. Such power may lead to savings in the factor market, or advantages in the product market.

The Position and Problems of the Small Firm

Further differences may be considered between small and large firms. We shall pay particular attention to the problems and the survival of small firms because (as we have seen) most of the ironfoundries below our estimated optimum sizes are small.[12]

There is a broad literature on the problems of small firms and the relative advantages and disadvantages of the size of the firm. It is not the purpose of this section to review this literature but simply to review some of those factors involved.

> "Among the factors influencing the relative position of firms of various sizes we may distinguish technical factors such as large scale economies; market factors such as imperfect competition on the one hand, and oligopoly on the other hand; and finally the cost of borrowing."[13]

But there are others:-

There are:

> "a vast number of influences on performance at work. Some of these are quantifiable, others aren't; some are external to the firm, others are internal and managerial, and of the latter many are subtly interwoven."[14]

The technical factors Steindl sees to be those attributable to economics of scale whilst the effect of market factors:

> "will be seen in the proportion of total cost to sales ... with an increase in size, large scale economies will tend to reduce cost in proportion to sales, and oligopoly power will tend to increase price and therefore sales in proportion to cost; whereas imperfection will tend to reduce prices, and, or, increase cost for bigger firms as compared with smaller ones."[15]

As for the cost of borrowing, the simple fact he sees is that the long-term capital market is open to small firms only at a prohibitive cost.

In examining the rise and decline of small firms, Boswell found that the sociological evolution of the business was more important than the size of the firm, and in particular the age of the business.[16]

Hence there are more than economic criteria to be taken account of.

Factors Determining the Existence of Small Firms

Steindl[17] examines four general factors affecting the continuing survival of small firms. These are first, that small firms lose ground depending upon the extent that large firms grow. And the speed at which this occurs depends upon the rate of accumulation of big capital at the expense of small capital. Second, imperfect competition protects the small firm's market and may be an important element in its survival. Third, oligopolistic conditions in the industry may produce, on the part of the leading firms, a deliberate policy of retaining a periphery of small firms, if only to prove that there is no "monopoly" in the industry. And lastly, the "gambling" initiative of small firm entrepreneurs partly explains both their existence and their high turnover.

The Importance of Small Firms

What has been said above suggests that the continuing survival of small firms is tainted with a degree of inefficiency at least in the economic system. But small firms may contribute to other dimensions of efficiency. Where lower costs are possible it is important that they should be passed on to the consumer, and where new and more efficient technical means of production are possible, these should be exploited. And "small firms, historically, have played an important part in both these dimensions of efficiency."[18]

The Bolton Committee summarises the importance of small firms thus:[19]

(a) Where optimum size is small, the most efficient form of business organisation is the small firm.

(b) Small firms may flourish in a specialised or limited market not economically open to the large firm thus adding to the otherwise possible variety of products and services produced.

(c) Specialisation of supply to other larger firms, producing at lower cost than that attainable by the large firm.

(d) Small firms provide effective competition.

(e) They are an important source of innovation in products, techniques and services.

(f) They are the breeding ground for new industries.

We have examined reasons for survival of small firms and for their importance. We now wish to examine the reasons for their decline.

In his survey, Boswell[20] found that:

"the main causes of decline appeared to be the market and technological factors, and the limitations of inheritor management. But the human factor seemed to be more important."

Bolton[21] similarly found difficulties relating to information, particularly regarding management. These lie especially in the fields of costing and control, organisation of administration, marketing, the selection of personnel, technological change and production control.

Finance[22] remains a continuing disability for small firms. These disadvantages comprise institutional discrimination, the cost of finance, and the lending arrangements of banks. However, the idea of a "gap" has been rejected by the Bolton Committee though in practice high costs are observed[23] coupled with vulnerability. On the other hand ignorance may create this gap in practice.[24]

We will not concern ourselves further with the various alternative factors affecting the size of the firm other than economies of scale, except to note that there are other influences at work.

CONCLUSIONS

The hypothesis that:

"firms adjust to minimum efficient scale or leave the industry"

was put forward to explain in part the changing structure of the ironfounding industry. This economies of scale hypothesis is associated with a technique for measuring optimum scale, which is the Survivor Technique. We illustrated that the technique has many shortcomings, including its assumptions, which reduce the validity of any firm conclusions. When we applied the technique to ironfounding, using different measures, we found that it produced no unique estimate of minimum efficient scale, but that the risk of death was correlated with size. It was also noted that other factors affected the size of firms and that small firms are more risky due to their size alone. In addition, because of the complexity of the industry which we are examining, the possibility that the changing size distribution of firms was a function of the demand for the particular output of firms of different sizes was not ruled out. This is an "unknown".

In the next chapter we will examine the theoretical connection between competition, growth and economies of scale. The connection is implied by the survivor technique because of the sifting of work from less to more efficient units of production and an adjustment to minimum efficient scale.

We are not "testing" the survivor technique but simply illustrating the requirement for research into efficiency and the size of the firm using the technique.

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   (b) In the absence of direct estimates of optimum size, overall size of plant is a proxy. R. D. Rees, in "Optimum Plant Size in U.K. Industries: Some Survivor Estimates", Economica, November, 1973, p. 394, correlated his estimates with the average plant size of the largest plants accounting for 50% of the industry's output. "r" was .79 for 1968. This again suggests grounds for a general hypothesis.

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13. J. Steindl, "Small and Big Business", Oxford 1945, p.13.

14. J. Boswell, "The Rise and Decline of Small Firms", London, Allen & Unwin, 1973.

15. J. Steindl, op. cit., p. 19.

16. J. Boswell, op. cit., p. 179.

17. J. Steindl, op. cit., p. 59.

18. Bolton Committee Report, op. cit., p. 29.

19. op. cit., pp. 83-84.

20. J. Boswell, op. cit., p. 140.

21. Bolton Committee Report, op. cit., p. 113-4.

22. Such difficulties were identified by the Macmillan and Radcliffe Reports. Report of the Committee on Finance and Industry, 1931, H.M.S.O., Cmnd. 3897. Report of the Committee on the Working of the Monetary System, H.M.S.O., Cmnd. 827.

23. R. Harrison and R. E. V. Groves, "Bank Loans and Small Business Financing in Britain", University of Aston, Working Paper Series No. 13, December, 1973.

24. Though the Bolton Committee found a lamentable ignorance amongst small firm owners to the sources of finance, the above research suggested that growth was related to different forms of finance up to the capital market (Equity, retained earnings, overdrafts, bank loans, mortgages, private individuals, Merchant Banks, I.C.F.C.) and that the phase dominated by the banks is the longest and also the period at which firms are most vulnerable.

CHAPTER 3

COMPETITION, GROWTH AND ECONOMIES OF SCALE

SYNOPSIS: We have examined the industry and raised an hypothesis to explain in part the changing structure of the industry. This is economies of scale. In this chapter we examine the meaning of efficiency and economies of scale. We do this assuming perfect competition. Later we examine the problems of this broad but very useful assumption.

We are interested both in the measurement of economies of scale, and in the process of change: the adjustment within an industry to the forces of scale economies. We restrict our discussion in this part to theories relevant to industries, such as ironfounding, which are not dominated by very large firms, but which have a relatively low concentration ratio.

We will first describe economies of scale from first principles. We then examine our assumptions about competition and the theory of the firm. Lastly we move on to examine the growth of firms. Clearly we shall be unable to review all the literature on economies of scale, growth and competition. It has been an area for vast discussion and controversy. As such we will emphasise some aspects whilst passing over the detail of other aspects.

EFFICIENCY

In economics efficiency may be defined by the subjective satisfaction of individuals in society, which would in turn determine how the community's scarce resources should be allocated between different ends, the method of production and how total output is to be distributed.

For the firm efficiency is taken to be a relationship between costs of production and the output produced. This has two aspects, a technical aspect relating physical input per unit of physical output, and a cost aspect, relating the cost of the input to the value of the output. Again these costs may be isolated into social costs and private costs. Where private costs differ from social costs, producers will gear output to their private costs. In a competitive world consumers will not be best off because the relative prices of goods will not equal their relative marginal costs. Differences are the subject of legislation. Here we are interested in the private costs of the firm.

To produce, a firm must first consider the technical aspect of production. This is the production function. The production function describes the possible techniques of production and these techniques embody factors of production and time. The use of factors of production involves disutility and scarcity. Labour may prefer leisure. Capital involves postponing consumption for future uncertain rewards; involving two components time and risk. Land is free except insofar as it is capital. Factors of production, then, involve disutility or they are scarce. Faced with a set of production possibilities we seek to use the most efficient technique.

For the production function we can write:

$$O = f\ (X_1\ X_2\ X_3\ \ldots\ldots\ X_n)$$

where O is output and $X_1 \ldots\ldots X_n$ are inputs. For each fixed output we may choose a combination of inputs which requires more of one factor and less of another, but never more of each factor. Such a combination of factor inputs describes an isoquant, a curve concave to the origin. An infinite number of isoquants exist for differing levels of output. At first it might be thought that the specification of the production function is purely an engineering problem. At a highly disaggregated level this is true, but to examine all the processes in which a firm involves itself is an enormous task. But the engineering technique has been used.[1] In general, though, the problem of specifying the production function lies within the domain of the economist.

Having examined the technical conditions of production the next problem is price or allocative efficiency. This rests on the index of marginal product and opportunity cost. Given the technical conditions, a firm must minimise the cost of a given output by considering the relative price of inputs. For this we write -

$$\frac{MPPX_1}{P_1} = \frac{MPPX_2}{P_2} = \ldots\ldots \frac{MPPX_n}{P_n}$$

Where $MPPX_1$ is the marginal physical product of factor 1 and P_1 is the price of factor 1.

In our text books both the technical and price decisions are illustrated on a two dimensional graph describing two factors of production: labour and capital. In diagram 1 we illustrate -

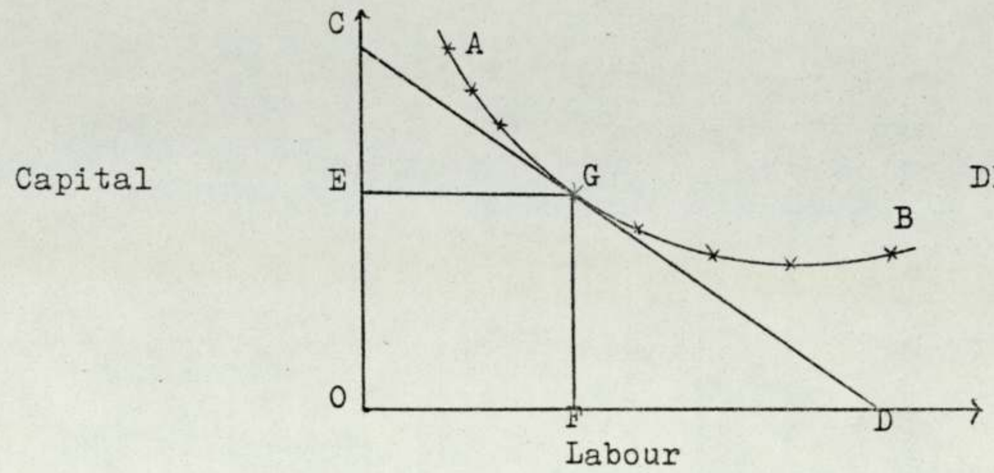

DIAGRAM 1

the decisions. AB represents the isoquant, the technical production frontier, and CD represents the isocost line, the relative cost of capital and labour. It is just at the point G, with factor combination OF and OE, that our minimal cost rule will be fulfilled. In this way a firm will solve its efficiency problem for a given output.

OPTIMAL SCALE

We have so far considered two tests of efficiency. Other tests are now required, in addition to the conditions of technical and allocative efficiency. Optimal scale efficiency is usually distinguished from technical and allocative efficiency. We might expect that firms will not begin at minimum efficient size for many reasons,[2] these include incomplete knowledge of the market, incomplete knowledge of competitors' reactions to new entrants, and so on.

Economies of scale may simply be described as the reduction in cost per unit of output as a firm grows in size. The idea of best size is usually based on the rationale that factors of production normally circulate in discrete units and an optimum combination of such factors is attainable with precision only at large scale production. Thus, for example, returns to scale will arise when a doubling of output does not require a doubling of every input. There is some controversy amongst economists as to the acceptability of this definition of returns to scale.

Peston[3] describes these conceptual difficulties.

He looks at the question in the following way. If we assume that factor combination x is efficient for producing y, this implies that x cannot produce a combination greater than y. Then it follows that ax produces ay. This explanation is based on divisibility of factors of production and implies, and can only imply, constant returns to scale, by definition. Thus, only by suggesting the possibility that scale parameters are not free to take on all positive real values, can varying returns be brought into the picture. This is the tautological approach to economies of scale. A metaphysical approach suggests that observed differences are the result of an unmeasurable latent factor. The approach Peston suggests is what he calls the "common sense" approach. This is to determine by actual observation whether proportionate variations in factors leads to proportionate variations in outputs of commodities, or whether proportionate variations in output requires proportionate variations in factors. This essentially is to ignore the theoretical concept of returns to scale and to accept in its place the possibility of imperfect replication of factors of production at differing scales.

In describing economies of scale at this stage, we follow Stigler.[4] The possibilities are these.

THERE ARE NONE

In this case constant returns exist. This means marginal costs will be constant for all outputs when the inputs are in proper proportion. Short run marginal costs will rise (because of diminishing returns) but long run marginal costs are constant. Depending on the rate of output of the firm, marginal costs may be greater or smaller than long run marginal costs. In which case the long run marginal cost condition is not fulfilled.

INCREASING RETURNS TO SCALE

This arises when a doubling of output does not require a doubling of every input. Where this occurs the long run marginal cost curve of the firm will be downward sloping and there will be economies of scale.

RETURNS TO SCALE DECREASE

This arises when a doubling of output requires more than a doubling of some input. Where this occurs the long run marginal cost curve of the firm will be upward sloping.

Whether it is the case that returns to scale decrease has been a subject of long controversy. Problems have arisen both on the theoretical side and the empirical side. Co-ordination[5] has been proposed as the problem limiting the size of the firm, while it has been argued that such problems disappear under static conditions,[6] leaving rising factor supply curves and declining product demand curves to limit the size of the firm. On the other hand the economic treatment has been proposed to be irrelevant because it fails to accept aspects of the theory of organisation and management[7] whereby organisational measures may be taken to allow expansion without incurring higher costs of production in practice.

Indeed the organisational theorists tend to criticise the economists view of management difficulties as a proposition they have accepted opportunistically.[8] Nonetheless the difficulties of co-ordination and control are real but the precise problems as yet unchartered. It is clear, though, that managers manage and economies of large scale production are not automatic; they must be reaped in practice. Hence irrespective of a limit to the size of the firm due to rising costs, on the other side of the coin falling costs fall equally within the domain of the manager.

Thus the problem is whether the long-run average cost curve should be considered to be L shaped (possibly falling) or U shaped. Empirical evidence has shown no sign of the sharply rising long-run costs.[9] Naturally this evidence is subject to criticism on the grounds of the validity of the results, but more especially on the grounds that, because in practice there is no evidence, it does not follow that ultimately long-run average costs will not rise.

Our attitude for present purposes is to accept the idea of an L shaped curve rather than a U shaped curve. And it is precisely the increasing returns to scale in which we are more particularly interested.

Two other issues are important. One is the case of external economies and diseconomies of scale, to which we shall return. The other is specialisation.

As the industry grows activities can be performed on a scale large enough to allow specialisation. In this case firms will seek to delegate increasing and decreasing cost functions to other industries. Division of labour takes place between firms.

ECONOMIES OF THE LENGTH OF PRODUCTION RUN

Armen Alchian[10] suggests some propositions for cases where production is not continuous. He directs attention to three characteristics of production:-

(a) the rate of output,

(b) volume of output,

(c) programmed delivery dates.

He illustrates the connection between these three characteristics by a series of propositions; the most important are:-

(1) The faster the rate at which a given volume is produced, the higher its cost. A restatement of diminishing returns.

(2) The average and marginal cost per unit of total volume decreases as total volume increases, holding the rate of production per unit constant. An example is learning.

We have now discussed the general case of economies of scale under competitive conditions, with some attention drawn to external economies, specialisation and the special case of finite production runs: we shall return to these problems and examine them in more realistic terms later.

We have so far considered three criteria for efficiency. Technical, price and relative scale conditions. Bain[11] suggests as a fourth criterion for efficiency firms should achieve efficient rates of utilisation of their plant facilities in practice. The theory has been extended to meet cases in which demand and output requirements are given functions of time and random variables with known probability density function.[12] With dynamic production requirements the production plan can be smoothed by manipulating inventories, thus increasing marginal cost can be avoided by producing in advance when, for example, demand rises seasonally. When fluctuations are uncertain, buffer stocks can be held balanced against the cost of sales loss and storage.

Much else has been written on efficiency criteria for evaluating firms, but it does not directly concern us here. There are, for example, dynamic considerations centering on problems such as the life cycle of products made by firms, and research and development undertaken.

THE SPECIAL CASE OF X-EFFICIENCY

The criteria which we have discussed in this part assume maximum efficiency of production, given the state of technology, at differing levels of output. However, Leibenstein[13] introduced the concept of X-efficiency which underlines the omissions or perhaps the naivity of the economists' efficiency criteria. The central theme is that labour and its organisation will have associated with it varying degrees of efficiencies. Put simply the output of one man may have a necessary minimum but also a possible maximum, and in between output is an illustration of varying degrees of X-efficiency. The implication of this concept is that such inefficiencies may be more important in terms of wasted resources than the allocation of resources. Empirical testing of the concept has provided considerable evidence of X-efficiency.[14]

ECONOMIES OF SCALE: MEANING IN PRACTICE

We have examined the meaning of economies of scale in principle: here we shall examine economies of scale in practice.

One of the most widely quoted commentators on the sources of economies of scale is Florence.[15] He sees them as comprising three principles:-

(1) The principle of massed or pooled reserves. This implies that if reserves are kept against certain contingencies, their effectiveness will increase, or their cost decrease, with the size of operations. This principle is based on the statistical rule that errors are more likely to cancel out in a number of cases, the larger this number is.

(2) The principle of bulk transactions. This implies that the cost of dealing in large quantities is sometimes no greater than the cost of dealing in smaller quantities, or that it is not proportionately greater.

(3) The principle of multiples. This implies that both technical and human assets are purchased in different capacities, and the full employment of all of them will be secured only at a level of output which is the lowest common multiple of the optimum capacities of them all.

It is also shown that these economies do not necessarily imply a large firm, but may imply a group of firms with products diverging from or converging to the same process.

Another distinction usually drawn is that between technological economies derived from producing large quantities in large plants and managerial and financial economies derived from improved managerial division of labour and from a reduction in costs made possible when purchases, sales and financial transactions can be made on a large scale. Penrose,[16] however, suggests that these distinctions, in practice at any rate, cannot be made. The size of plant is not independent of managerial and financial economies, nor is the size of firm independent of technological economies, although these relate more directly to the plant. Such distinctions in one sense would however be desirable. Bain,[17] for example, notes a popular view amongst American economists, which is that economies of multiplant firms are strictly pecuniary in nature, and because of their oligopolistic implications not justified as a matter of social policy.

A further distinction is drawn between internal economies and external economies. Economies which arise from within a firm as it increases its output and economies which arise outside the firms in an industry when the output of the industry as a whole is increased. These external economies can also be distinguished into two kinds. First economies which are external to firms in the industry but internal to firms in other industries, because the output of the latter industries is supplying the former industry which is expanding. Second, economies which are due to the environment. Some regions for example may possess advantages over others in the supply of skilled manpower, professional and industrial services etc. Our concern is with internal economies and, as such, these alternative economies will be ignored.

There are a number of factors which determine the optimum size of plants in practice apart from the theoretical determinants discussed earlier. We shall first consider the general determinants and then in more detail the important dimensions of scale other than the size of firms.

In general the following are the major determinants.

(1) The size of the market determines the optimum size for the individual plant. This, of course, is important up to the point of optimum.

(2) The greater the complexity of the productive process, the greater the likelihood that optimum plant size will be larger. This is because as the number of productive processes increases the greater the likelihood of indivisibilities.[18]

(3) It is argued that capital intensiveness increases the optimum size of plant for two reasons.[19] First, capital intensiveness is associated with larger productive units. And second, where industries are less labour intensive, labour co-ordination problems are reduced.

(4) The variability of demand affects optimum size because stability allows plants to have a higher ratio of fixed costs to variable costs. If demand is variable, plants which have a high ratio of variable costs to fixed costs will have an advantage in adjusting to demand.

DIMENSIONS OF SCALE ECONOMIES

Pratten[20] in an empirical investigation of economies of scale notes that scale has many dimensions in practice. These dimensions include: those affecting selling and distribution costs, and those affecting the overall dimensions of scale.

(A) Factors affecting the efficiency of production include:

(i) the total output of products through time,
(ii) the duration of production runs,
(iii) the rate of production of particular products through time,

(iv) the extent of standardisation,

(v) the capacity of units of plants, machines and production lines within plants,

(vi) the total capacity of individual plants,

(vii) the overall size of a complex of plants at one site,

(viii) the extent of vertical integration.

(B) Those affecting selling and distribution costs:

(i) sales to each customer,

(ii) the geographic concentration of customers,

(iii) the size of consignments to customers.

(C) Those affecting the overall dimensions of scale:

(i) the size of firms,

(ii) the scale of an industry,

(iii) the scale of a national economy.

The following he notes as affecting diseconomies of scale:

(a) (i) the labour supply in an area available to a firm,

(ii) the space available at one site for a factory,

(iii) the supply of natural resources available (where necessary),

(iv) the supply of material produced as a by-product of another process.

(b) The efficiency in use of a factor of production.

SUMMARY

We may conclude this section by emphasising two points. First, the concept of economies of scale is one of a number of efficiency criteria and empirical testing of the concept must consider these. It is very possible for economies of scale to be present in principle but not reaped in practice.

Second, the concept of economies of scale is itself multidimensional. Thus the simplicity of the text book exposition is a poor guide to its measurement. The measurement of a theoretical proposition depends upon the clear definition of what it is that is to be measured.

A NOTE ON THE ADVANTAGES OF VERTICAL INTEGRATION

We include the case of vertical integration because, as we have seen, many of our ironfoundries are tied. Vertical integration implies certain special advantages and characteristics which we shall discuss briefly.

Here we are only concerned with backward vertical integration. In discussing the advantages it is in order to make some theoretical remarks. There will be no advantage if the backward integrated firm is purely competitive.[21] For other cases we may make the following comments:

(a) The general advantage of integration is one of cost advantage. Such cost savings would be the otherwise incurred costs of buying in the market. Profits included in the output of the "acquired" process are successfully avoided. Sales promotional costs are avoided. Combined stocks may be minimised. There are the general well-known advantages of, for example, the integration of processes under "one roof" in the steel manufacturing industry where increased efficiencies are possible, better co-ordination of processes, etc.

(b) There are, of course, disadvantages. Vertical integration may be unsuccessful. Administrative costs of co-ordinating different stages may be greater than the otherwise cost savings. Such administrative changes may also, as we shall see in the case of ironfounding, increase the competitive inefficiency of the backward "acquired" firm in comparison with other firms at that stage.

ECONOMIES OF SCALE AND COMPETITION

ADJUSTMENT TO ECONOMIES OF SCALE IN A COMPETITIVE INDUSTRY

We now turn to the problem of firms adjusting to economies of scale in a competitive industry, industry output being fixed. This we examine from the point of view of the determination of equilibrium in a competitive market.

Our competitive industry is one in which (a) the number of individuals is so great that no one can influence prices appreciably by varying his demand or supply and is therefore forced to regard prices as constant parameters independent of his own behaviour, and (b) there is free entry and exit to and from each trade in the industry.

In the long run the firm adjusts to market price by producing where price equals marginal cost. And should the price drop below average total cost the firm will seek to withdraw its resources from the industry. Costs are opportunity costs and when average revenue is below average cost the firm is not using its resources to their best advantage. Its chance to withdraw may come when its fixed factors (if they are specific) are used up in the production process. In the long run the firm will stay in the industry only as long as its average total revenue is equal to its average total costs. As firms withdraw price will rise and equilibrium will be reached when the remaining firms in the industry are able to cover their costs. Otherwise the reverse situation may be the case and the argument is symmetrical.

Now if there are economies of scale in the industry, firms can reduce their average costs by building larger plants. They will do this under the assumptions of perfect competition because they see the opportunity to make more profit. Firms will expand their scale of operations where there are falling long-run costs until each firm is at a point where no unexploited economies remain. In reducing its cost the firms in the industry will be involved in a competitive struggle, and, given industry demand, some firms will be pushed out of the industry as other firms grow to their minimum efficient scale.

If the demand to the industry changes, either a shortage will develop or an excess of productive capacity will develop. In the short run firms will stay as long as they are covering their short run variable costs, but in the long run these firms will leave the industry. Industry price will rise and a new competitive equilibrium will develop. If the industry is a falling cost industry then an increase in demand will lower average costs; a decrease in demand will raise average costs. And vice versa for an increasing cost industry.

It is clear that firms in a contracting industry which is not an increasing cost industry will be at more of an advantage if they are of minimum efficient scale than if they are not.

Before we consider developments away from the perfect competition model which best illustrates the effects of economies of scale, it is worth noting why it is so commonly considered and has not already been abandoned.

Stigler[22] defends it in two ways. First that it is a generalisation and like all generalisations cannot be expected to describe particular cases. Second, it is most generally used as the standard model of analysis. In addition, he attempts a redefinition of the concept.

Another defence is that it has often been considered a more desirable form of competition than others. This is to say that it is socially more acceptable. This is the normative view of the model. But such a view has been attacked[23] on the grounds that a lack of competition promotes the possibility for firms to take risks and accept the costs of research and development and to introduce new products and technologies.

DEVELOPMENTS[24]

The fact that firms could exist at different scales, side by side, led to a development away from the idea of perfect competition. Development took place because of the lack of applicability of the theory to many situations. This movement from perfect competition and the concept of equilibrium came with the lack of observed reality in its application.[25] The problem was that a stable situation could occur which, with the (firm's) expectations of falling long run costs with increased output, led to the requirement that marginal revenue should fall faster than marginal costs. This contradiction led to the development of falling demand curves to individual firms. These falling demand curves were the theoretical tools of Joan Robinson[26] and E. H. Chamberlin.[27] Mrs. Robinson's analysis was criticised on the grounds that her falling demand functions fell for no other reason than that they were assumed to fall. Furthermore, her theory had less general applicability than Chamberlin's theory because it did not cover the problems of small competing groups.

Chamberlin's large group model assumed most of the characteristics of classical competition, but his demand curves fell because of consumer preferences.

The major characterisation of this form of competition is of a market selling similar but differentiated products. Much effort is devoted to non-price competition. Firms which face the downward sloping demand curves possess the usual short run cost curves and its equilibrium in the short run is the same as the monopolist. The firm is not a price taker, it can negotiate between price and output until profits are maximised. The major predictions of the theory are (1) the presence of excess capacity, and (2) that firms will engage in non-price competition of a kind which would be wasteful under perfect competition. In industries displaying this kind of competition, higher prices will exist but with excess capacity a normal rate of return will be expected on capital. The most efficient firms will make a higher rate of return and the least efficient a lower rate of return than the others.

In the long run equilibrium will, with the free entry of new firms, be the tangency of the firm's own demand curves with the long-run average cost curve.

There has been considerable dispute over the assumed uniformity of the cost and revenue curves facing each firm. However the model is more realistic than that of perfect competition, and can be modified to increase its approximation to reality. For example, firms producing similar products may produce products of different qualities with accompanying differences in costs. Hence firms may be of different sizes and have different prices, but in the long run, with free entry, excess profits will be eroded and equilibrium will be reached with normal rates of return.[28]

Problems with the theory are: the assumptions of symmetry and of free entry; the possibility of firms being very different from each other; and the difficulties of testing the theory.[29]

OLIGOPOLY

Chamberlin also paid attention to the small group model. This model implied mutual effect of individual firm's decisions, repercussions would be felt by other producers of the actions of each producer. In the case of closed entry he foresaw three possibilities: either independent price competition whereby prices would be forced down to long run average costs, or collusion and a monopoly price (which he favoured), or an intermediate position between the first two whereby firms would accept the supplies of each of the other firms and independently maximise profits. With free entry results would be reduced so that normal profits would be obtained. Again any useful conclusion depends upon the strategy followed, the similarity of the products produced, cost conditions and the conditions of demand.

The small group competition was developed beyond this into the oligopoly form.

Fellner's[30] solution to the oligopoly problem is one of collusion. The acceptance by businesses of modes of behaviour. Baumol[31] on the other hand denies this interdependence. In his case there is no drive for maximum profits but instead the maximisation of sales, given a minimum level of profit. However, it is possible to develop a number of oligopoly models assuming different strategies, and hence having different solutions.

It becomes clear that models have been developed along a continuum from perfect competition to monopoly to describe the competitive behaviour of firms. The effect which this has on long run average costs depends upon which model we accept. In other words, simple observation of costs of production and the size of firms depends upon cost conditions, entry conditions, market conditions and what firms are trying to achieve. And thus differences could be explained in combination.

In conclusion, and returning to long run costs, we have seen the dilemma which was created was that, if long run costs were falling, either competition was not perfect or the firm was not in equilibrium. And, in effect, the dilemma was resolved by the falling demand curve to the individual firm.

Now once we accept the notion of imperfections and the possibility that these imperfections may not be uniformly distributed, then the analysis becomes theoretically increasingly difficult, if only because firms are more free to follow their own inclinations and to do so without threat. The relevance of this to our hypothesis is that imperfections may be distributed in such a way as to successfully finesse, for the firm, any problems of being below minimum efficient scale. It is to these alternatives we now turn.

A NOTE ON FIRM GOALS

Any examination of the goals of the firm is immediately critical of the assumption of profit maximisation. And the idea that profit is the only goal of the firm has been criticised because it is frequently wrong. Though the idea that firms prefer more profit to less is not disputed. Examples of other goals are sales volume, dividends, market share, etc. and commentators have observed that these goals exist as well as profit.[32]

It is only under conditions of perfect competition, or that which approximates to perfect competition, that firms failing to maximise profits will be forced out of business. Whatever other goals firms choose, those firms that do not react to profit will become weaker in comparison to those that do.[33] Second, is the strategy required for maximisation so complex that it is impossible for most decisions? Third, goals of firms are observed to be in the form of satisfactory levels of achievement.[34]

Clearly the attack on profit maximisation is powerful. The idea of maximisation has been attacked because it may be too complex. The idea of profit has been attacked because it is thought firms have multiple goals.

We may now examine the alternative goals of firms in more detail. To discover the objectives of the firm we might take it out of the market place and decide what it is the firm is trying to achieve. This is difficult and Baumol[35] states the difficulty in the following way. He sees management as too busy solving its day-to-day problems to have time to take a careful look at its long run goals. Indeed the problem is compounded by the distortion between intentions and action, intentions and possibilities, and consistency.

However, the tendency now is to extend the concept of the goal to include other things besides profit. Particularly where the business is owned by one group and controlled by another. The distinction between ownership and control has particularly been noted by Marris.[36] There is evidence, though, that, without this separation, a goal other than profit may be pursued.[37] Thus, placing profit on one side, theories have been developed around maximisation including sales,[38] and a utility function.[39] These theories yield predictions differing from profit maximisation. And yet another goal firms might follow is simply one of survival.[40]

GROWTH AS A GOAL

Growth will be examined in more detail later in this chapter. However it is relevant to examine growth as an important goal in this section. Traditionally the economic consideration of growth goals has been the pursuit of profits and the minimisation of costs. (We have already discussed goals which may be alternatives to profit.[41]) From the point of view of cost this is the problem of economies of scale. Theory suggests that firms will pursue a path which will minimise their costs, but in order to do so they are dependent upon the degree of competition and the constraints already discussed on achieving optimum size. Further, it is arguable that a pursuit of minimal costs is itself dependent on what firms believe their long-run average cost curve looks like.[42]

Other reasons for the growth of firms are reviewed by Starbuck.[43]

New models of the firm which have moved away from the idea of profit maximisation include growth as at least one argument in the goal of the firm, notably Marris[44] and Baumol[45] (in the maximisation of the rate of growth of sales revenue). Williamson[46] compares the effect of maximising profits, growth and sales. We will return to the issue of growth later. The relevance of such growth motives for economies of scale is that they presuppose constant costs. No longer may it be considered that long-run costs limit the size of the firm. And the only ultimate limit to the size of the firm may lie with management.[47]

SUMMARY

1. We have discussed the concept of economies of scale in a competitive industry and noted the equilibrium position of the long-run average cost curve and the size of firms in the industry.
2. We introduced imperfections into the market and considered in particular the case of imperfect competition. We noted that the theory had been

heavily criticised but also that it approached reality to a greater extent than perfect competition. The long-run equilibrium position was noted - that price equals long-run average cost, but because individual demand curves were downward sloping such an equilibrium would suggest excess capacity.

3. We briefly considered oligopoly and monopoly but these market conditions are not of direct relevance to the industry we are examining.

4. In the case of market imperfections we noted that firms would be allowed a certain degree of autonomy. As such we reviewed alternative goals the firm might pursue, but in particular we noted the goal of growth, upon which new theories of the firm have been based, and the derived criticisms of profit maximisation.

5. No attempt was made to provide elaborate details of theories of competition, (these are many), and, indeed we would conclude this section by emphasising the importance of imperfections in the market, and thus the freedom from strong competition, and the lessening importance of the size-cost relationship, than the predictions of the theories.

CONSTRAINTS ON FREEDOM FROM COMPETITION

Our hypothesis that the changing size distribution of firms in ironfounding is the result of the process of adjustment to economies of scale, presupposes a considerable degree of competition. In particular it presupposes that relatively advantaged firms grow at the expense of disadvantaged firms, to adjust to minimum efficient scale or grow beyond it. In specifying such advantages and disadvantages, the hypothesis of economies of scale minimises the importance of imperfections or frictions in the market, and in particular it suggests that firms of varying size are competitive and that this competition is price competition. What we shall now consider are those features which tend to promote competition in an industry.

Our considerations are placed within the context of the industry. If this was not so it would be possible to define one firm in our industry as competing (through a chain of substitutes) with every firm in the economy.[48]

What factors, then, promote competition? Andrews[49] considers the factors affecting the demand curve. Particularly he examines product differentiation, selling costs, and the question of new entry. On product differentiation he makes the point that for firms selling to other firms preferences should be considered rational, and thus in the longer run a business must sell its product at no more than would be asked for by a duplicate, produced by any other business, thus affecting the falling demand curve for the long run analysis. In the short run goodwill will exist but this will not be without regard to prices offered by others.

As for new entry, this may be actual or potential. And the new entrants need not be beginners but might be established elsewhere. And this competition may be very strong indeed. This obviously affects the highest price sustainable by the producer and will depend upon the cost function of the alternative producer. Andrews suggests these conditions, assuming an L shaped long-run average cost curve, lead to an equilibrium of price, but not of output "the latter being determined by goodwill so long as a business remains fully competitive."[50] In the case of product differentiation he expects explicit or actual oligopoly situations to arise, but at the same time the possibility of competition (because of new entry). There is concensus over this practical view of competition. Although real differentiation of products may suggest different costs of production, the promotion of competition is dependent upon the number of firms, the question of new entry and the degree of similarity of products.[51]

What is required then, is strong competition to effect a redistribution of output towards firms of minimum efficient scale. And as we have seen, a number of factors tend to promote competition (which means that firms can expect only normal profits in the long run), and it is to these factors we now turn.

THE INTERDEPENDENCY OF OUR VARIABLES

It is a simple statement to say that, if competition is open, and there are a great number of firms producing similar products, then firms will be more competitive and, given similar profit objectives, the likelihood will be that firms will adjust to minimum efficient scale. The problem is that the question of scale, of product differentiation, and of numbers of competitors, interact with each other, and with the possibility of new entry. It is because of this that we shall mainly concern ourselves with new entry competition.

NEW ENTRY COMPETITION

As we have seen one crucial element in competition is the question of new entry. Entry may be distinguished in two ways - actual entry and potential entry. Actual entry is defined as production by a new firm in the industry of a product which, in the minds of the buyers, is a perfect substitute for goods already sold in that industry. Entry is not the result of a new firm taking over an established firm in an industry, but a new firm may be defined as a firm already established in another industry which builds productive capacity, developing a new product line which belongs to another industry.

When will firms enter an industry? This depends upon the perceived profitability of such a course of action. The entrant will be concerned with cost conditions and demand conditions as a result of his entry. The demand conditions and hence profits will depend upon the course of action (if this is possible) taken by firms already established in the industry. Essentially these actions will be the result of the output which firms elect to produce in the face of entry and the resultant drop in price which they are willing to accept.

Conventionally the barriers to entry are threefold. Firstly, product differentiation - the preference of buyers for products already produced by established firms as compared with new entrants. However, such preferences can be overcome by sales promotion and the essence of the barrier is that sales promotional costs incurred by the new entrant result in costs per unit of output greater than those of established firms.

The next important barrier is absolute cost barriers. Absolute cost advantages exist if the costs of established firms, at any comparable scale of output, are lower than those of potential entrants. These advantages may derive from, for example, lower prices paid for inputs by established firms.

The next major barrier to entry is economies of scale. If scale economies are important, and costs below minimum efficient scale steep, then entry may require production on a large scale.

Other barriers may be classified as legal barriers: such as patent rights, or exclusive rights to a productive technique. These barriers may be subsumed under absolute cost barriers, but legal barriers prohibiting entry absolutely, or requiring special government licenses, must be classified separately.

We may now turn to look at the effect of these entry barriers.

The question of entry is usually tackled from the point of view of measures taken to forestall entry. This is because if only normal profits are being made within an industry the question of new entry fails to arise.

Where there are no entry barriers price will equal long-run costs. If there are entry barriers, it is possible for the existing firms to make supernormal profits. And the question arises as to which long-run profit maximising strategy will be best. In particular there is seen to be a limit to the price which firms may adopt without attracting entry. New firms will reduce the total market available to the existing firms, although the existing firms will still be able to reap supernormal profits per unit of output, but the market for that output will be truncated by the existence of new firms. (The demand curve facing the individual firm will move downward and to the left of the original demand curve.) Thus interest has centred around entry forestalling policies.[52]

Limit pricing theories have been adapted mainly to the existence of economies of scale (although they may be adapted to other barriers to entry). Our interest in the concept is if entry is free and easy we can expect firms in the long run to make only normal profits. In the event of entry being difficult, firms may be making supernormal profits and it is to the evidence of this, and the significant barriers, that we now turn.

It is as difficult to establish entry forestalling as it is to measure potential competition,[53] hence evidence of higher rates of return in industries with high barriers to entry may be affected by other factors. Nonetheless Bain's[54] evidence suggests that industries with very high barriers tend toward high excess profits and monopolistic output restriction. The main culprit in establishing excess barriers is product differentiation,[55] though economies of scale are not unimportant.[56]

In one sense we move full circle. Thus to propose that the existence of free entry removes excess profits in the long run and is more conducive to firms adjusting to economies of scale because they are more competitive may be taken also to mean, that the existence of free entry is itself an indication of scale economies being unimportant in the industry.[57] However, it is not our concern as to whether such minimal efficient scale is substantial.

SUMMARY

We have examined factors which tend to promote competition. In particular we examined "new entry" competition. Our intention was to establish which competitive factors would be conducive to assisting the changing structure of the ironfounding industry through the forces of economies of scale. And we maintained that such competition would be relevant where numbers of firms of differing sizes, selling similar products in an open market, were price competitive, without control over their pricing and output policies. It is of course necessary that such firms should pursue profits. It might be added that if we assume an L shaped long-run average cost curve, we do not set an upper limit to the size of the firm.

A NOTE ON CONCENTRATED BUYERS

Seller competition is not the only relevant competitive variable when we are considering our industry selling its output to other industries. In such a case the relative size distribution and concentration of buyers becomes important. It is only important to consider one such case here, and that is oligopoly. Under such circumstances we could expect some control over price by the larger buyers, no control by sellers, and a bargaining position over the restriction of output which is commensurate with the product-demand function, over time, facing the buyer firm. Where this influence over price is considerable we should further expect that the costs faced by the seller firm will be important and therefore, where possible, minimised. But because our ironfoundries sell many products the prediction of the conduct of moderate buyer concentration becomes relevant, and here we quote from Bain.[58]

> "With only moderate buyer concentration and a fringe of small buyers, collusive and parallel buyer action is usually not in evidence, and the record of performance suggests that a price close to the competitive level is frequently attained by virtue of buying price policies which are strongly influenced if not dominated by independent and competitive action."

Under such circumstances we may follow the orthodox considerations of seller competition with an "eye" to the possibility of collusive oligopoly.

CONCLUSIONS ON COMPETITION AND ECONOMIES OF SCALE

We derived a solution to the effect of falling long run costs in a competitive industry. However, where industries are less competitive, problems of adjustment to minimum efficient scale shift to the demand curve facing the individual firm: and thus to imperfections in the market. It is possible for the imperfections to be distributed in such a way that relative inefficiencies due to scale are compensated. However, we examined factors which could serve to promote competition, and in particular we raised the question of new entry. Clearly the greater the degree of competition, and a common pursuit of profits, the greater will be the likelihood of adjustment to minimum efficient scale. Those firms which do not pursue this adjustment will eventually be squeezed from the industry.

ECONOMIES OF SCALE, COMPETITION AND GROWTH

We have examined the static conditions of economies of scale and competition. When we examine growth we are introducing a dynamic element. We have examined the necessary connection between competition and economies of scale, here we are concerned with the dynamic adjustment to minimum efficient scale. To put it another way, the survivor technique is concerned with dynamic changes and assumes that changes are the result of economies of scale. Here we check the theoretical literature to see if we can predict a connection between scale questions and growth.

OVERVIEW OF GROWTH THEORIES

Neoclassical economic theory predicts that firms will maximise profits, and thus will grow where they see a profitable opportunity. The means of growth will not be a problem because unlimited supplies of finance will be available to serve such opportunities, and, in essence, the firm will grow until all such opportunities are exhausted. Given this, knowledge of a U shaped long-run average cost curve should tell us what size we should expect firms to be. Difficulties arise with the L shaped long-run average cost curve. Here long-run costs are constant and the theory becomes indeterminate as to the expected size of firms.[59]

"One of the most discredited concepts in the theory of the firm is that of an "optimum size". Empirical evidence has provided no substantiation for the thesis of a long run U shaped cost curve and, since firms are not restricted to the sale of a single product, or even a particular range of products, there is no more reason to expect profitability to decline with size than there is evidence to suggest that it does. This raises the question as to what does limit the size of a firm. The answer that has been given is that there are important costs entailed in expanding the size of a firm and that these expansion costs tend to increase with the firm's rate of growth."

Even more important, and creating greater difficulties, are the effects of market imperfections. These may be such as to protect firms of different sizes irrespective of long-run cost considerations. Furthermore, imperfections and demand creation also bring differing firm objectives into play, and it is to these considerations that new growth models have been developed.

Of major importance is the "managerial revolution".[60]

"In traditional capitalism, the decision taker has private property rights over his instruments. He has the rights of exclusive use and enjoyment subject only to certain limited restraints on his freedom to damage others. Both financially and morally such a capitalist is encouraged to aim for profit."

Directors, on the other hand, of the modern corporation, are more free and:[61]

"the rules tell us little about the game. Implicitly they define a field (the economy), some players (producers and consumers) and some balls (goods and money)."

Because the competitive environment is imperfect, little is known about the ball-game behaviour of corporations. Much attention is directed to such firms, and motives in addition to profit are attributed to their managers, especially the motive of growth.

Such growth models take over from the static models of profit maximisation and sales maximisation[62] and some[63] choose to assume maximum growth as a more realistic assumption of the firm.

The main features of these growth models are: the formulation of a "steady state" system whereby the main variables - profits, sales, assets, development expenditure, etc. grow at a given constant rate over time. A utility function incorporates motives of management which allows the inclusion of possible steady state paths and thus the optimum growth rate. Assumed lack of constraints include constant returns which requires that increased scale is not constrained in the long run by diminishing returns. The rate of growth is constrained by (on the supply side) lower efficiencies, limited supply of finance during time periods, (being related to profits, dividend policy, new issues and borrowing) and share price. On the demand side the firm must sell goods, without derisory price reductions. Hence the expectation of constant profitability is required. Demand creation is important in this and this assumption leans on innovation, advertising and product differentiation.

Other important features are that growth is limited by the fear of takeover[64] and not lack of funds[65] and that faster growth costs more money than slower growth.[66]

Other models[67] include those following the "Law of Proportionate Effect" hypothesis,[68] viewing growth as a large number of randomly distributed forces. Others examine specific opportunities, for example, Penrose[69] saw that there might be advantages from moving from one position to another quite apart from the advantages of being in that different position. Such motives for growth may be the savings in unit costs. Andrews[70] suggests that businesses will grow for short run cost savings as well as those of the long run. The businessman is "unaware" of optimum size. He expects improvements from growth and further improvements from more growth. Each growth effort will be followed by a period of higher costs until consolidation has taken place and the new position secured. Similarly, Penrose views growth as a series of steps, at each step taken the sight of further growth opportunities would tend to make achievements seem insignificant. For Penrose there was no necessary direct link with costs except that firms would only take profitable opportunities. Growth would involve the exploitation of advantages which may be also internal to that firm.

Other models not discussed here fall under the category of behavioural models.[71]

Our concern with growth theory does not in general incorporate the "managerial" revolution type. Most foundries are small and owner-controlled. Here we shall examine some more direct relationships between scale economies, and growth.

LINKS BETWEEN GROWTH AND ECONOMIES OF SCALE

The problem here is whether we can unambiguously confirm or disconfirm that growing firms are achieving economies of scale. And that where ingestion is taking place within an industry (a transfer of work), then this is for cost reasons.

The major difficulty which arises is that growth is a dynamic consideration and the ceteris paribus conditions of the long run average cost curve may not apply. Thus, in addition to (perhaps) exploiting economies of scale, growing firms may exploit other advantages from their new size, from changed technological conditions, and from the collection of internal resources available uniquely to them. Other economies will be the economies of selling, research opportunities, monopolistic competition, etc.

Such changing conditions resulting from growth make comparisons difficult between firms producing different levels of output and indeed may make comparisons impossible. Comparisons with other firms producing a smaller output, or with the same firm when its output was smaller, may be impossible because at the two stages of production circumstances may differ considerably. Nonetheless the larger firm may produce at lower cost. But is this lower cost due to economies of scale?

Growth and Efficiency

Mrs. Penrose indicates that there are advantages from growth which increase the internal efficiency of the collection of productive resources of the firm which need not also be correlates of the economies of the size of the firm.[72] This is improved efficiency from the point of view of society.

GROWTH AND ECONOMIES OF SCALE AND EMPIRICAL INFERENCE

We have indicated some of the advantages from growth which may be the result of advantages other than economies of scale. We now turn our attention to the directions of the growth and the implications of these (a) for the possibility of comparison between firms of economies of scale, and (b) in terms of our initial hypothesis of the shifting of work from less to more efficient firms due to cost conditions.

We shall examine three cases:-

(a) growth within the same market;

(b) growth through diversification;

(c) growth through merger.

In each case the advantages of new size may be due to reasons other than economies of scale. Our view is that case (a) and case (c) when it is also case (a) provide a basis for comparison, whereas case (b) and case (c) when it is also case (b) do not.

Growth and Profitability

We assume that growth will be determined by profitability. Thus the choice of growth direction will be determined by this, and the choice to diversify need not necessarily imply lack of profitable opportunities in the present area of production (whether through economies of scale or not) but due to the possibilities in terms of profitability open to that firm. An example might be risk, whereby firms may prefer not to specialise and have all their eggs in one basket, when there is the possibility of demand changing adversely towards them.

DIRECTIONS OF GROWTH

(a) Growth within the same market

Growth in the same market may derive scale economies. But as we have seen changed circumstances may destroy any reasonable basis for comparison. Two considerations may be dealt with:

(i) It may be the case that the market itself is growing in total, thus firms are growing as a result of increased total demand.

(ii) Alternatively, the total demand may be more or less fixed. In this case successful growth will be at the expense of other firms serving the market. And this in turn implies a comparitive advantage of the growing firms over some other firms.

Now conditions which will bring about a comparitive advantage (assuming there is competition), may be those due to scale economies, the general distribution of efficiencies, or market imperfections, or successful improvements, or innovations in the products.

As Downie[73] puts it, on the process of relative growth, of innovation and of changes in relative efficiency:

> "It is plausible that in reality there will be periods of what may be called ingestion, during which the structure of efficiency relatives if broadly undisturbed and the strong are engaged in consuming the weak, and that these will be followed by periods of revolution, when technique is in the melting pot, old kings are being dethroned and new ones are coming to the fore."

For our purposes, in analysing the foundry industry, overall output has been more or less fixed over time. From the side of production, and given the survivor technique, we would be in a better position to make a judgment on the impact of size on efficiency where firms are similar and growing within the same market (providing that there are not great imperfections in the market or other advantages systematically favouring firms of larger size). Such comments are not however true of diversification. Why? Because we could easily be misled.

To give a simple example. If a firm of large size decides to produce a product already produced by a firm of small size, and does this successfully at lower cost, this does not mean (a) that that larger firm is required to produce this product or (b) that the production of that product is efficient (as compared with its production by the smaller firm) if its production was split off from the parent company. Thus just the advantage of unused capacity and shared resources of the large firm make for the reduction in cost of the additional product. In reality the smaller firm may grow, and specialise, and produce this product efficiently without the requirement of large size. Hence with cross-section analysis, this is our problem.

(b) Diversification[74]

Diversification refers to the variety of output of the firm. Firms will diversify depending upon the profitability of alternative opportunities open to them, the riskiness of existing fields of production, constraints on producing the same output such as market imperfections, share of the market possibilities, etc. Equally the ability to diversify will be dependent upon a number of factors, entry possibilities, etc.

Meaning of Diversification

Mrs. Penrose[75] describes this when a firm:

> "...... without entirely abandoning its old lines of production, ... embarks upon the production of new products, including intermediate products, which are sufficiently

different from the other products it produces to imply some significant difference in the firm's production or distribution programmes."

Thus it has many meanings. Diversification within the same area of specialisation, or a departure from the existing area into new markets with the same production base, new products with new technology for old markets, or new markets, new products and new technology.

Now diversification may imply cost savings all round because of shared resources. Alternatively, the new size of the firm may be unimportant if the activities could be hived off with no increase in costs. Alternatively, the initial size of the firm may have been important in order to achieve the new activity because, for example, of the need to produce within this new field at minimum scale. But with diversification we are presented with problems which do not, on a cross-sectional comparative basis, allow us to decide whether the output of different lines of production are produced at lower cost. Thus in terms of our hypothesis, if larger firms initially producing different products consume smaller firms, they may produce this added product at lower cost than the other firms but this may not be due to inefficiencies in the scale of production, for that product, of the consumed firms, because of shared advantages. On the other hand the large firm may produce the new product at minimum efficient scale but the size of that firm is not an index of that scale.

(c) External Growth

There are a number of advantages in acquisition. Speed of growth, cost advantages, market advantages, readily available technical resources and know how, etc. Acquisition may take place as a form of diversification or, alternatively, for the production of similar products. What efficiency gains might we expect? There may be economies of multi-plant organisation. These may be real or simply pecuniary. There may be market advantages whereby a greater proportion of the total market is controlled by one firm. And in declining industries where excess capacity exists and there is strong competition, acquisition will encourage the scrapping of old machinery and the investment in new ones by reducing the degree of uncertainty associated with excess capacity; and, further, it will increase the proportion of assets under efficient management.

There may be economies of scale associated with acquisition - particularly where new growth in the same market would otherwise have been difficult (due to, for example, market imperfections). Also, opportunities might arise for increased specialisation of different lines of production. However, where this is accompanied by true diversification, increased efficiencies may be present, but not necessarily those of scale in the narrow theoretical sense.

CONCLUSIONS

We are interested in the influence of economies of scale on the changing structure of the ironfounding industry. Since larger size brings advantages over smaller size beyond those of economies of scale, we have sought to show that there are difficulties in establishing whether increased production by larger firms (at lower cost) at the expense of smaller firms, is in fact attributable to economies of scale in the narrow theoretical sense. It is more promising to make a judgment if firms are growing in the absence of diversification as we are concerned with a cross-sectional analysis in our approach to the problem. It has been shown that diversification gives rise to difficulties in interpreting scale-cost advantages in the narrow theoretical sense.

ECONOMIES OF SCALE AND THE RATE OF GROWTH

We have already examined growth goals of firms and the new theories of growth which are "rate of growth" theories. Here we shall concern ourselves with the rate of growth and the achievement of economies of scale. In particular, we shall examine the Law of Proportionate Effect and the growth of firms.

In order to show a link between economies of scale and the rate of growth, it is necessary to assume a link between unit costs and profits, and that growth is based on profits.[76]

The Law of Proportionate Effect[77]

> "The typical size-distribution of firms is positively skew, with a few large firms and many small firms. In practice this skewness can often be removed by plotting the frequencies against the logarithms of size. The resulting curve often approximates the normal curve, so that the original distribution may be deemed to be log normal. The widespread occurrence of this type of distribution is interesting because it suggests an equally widespread law of growth of firms which produces this common distribution."[78]

The implication of the model is that firms within different size groups have the same average proportionate growth. Second, the dispersion of the growth rates is the same. Third, the distribution of proportionate growth rate is log normal. Fourth, the relative dispersion of firm sizes increases over time.

The effect on firms is that each firm faces the same distribution of growth possibilities. Actual growth is determined by random sampling from the distribution of possibilities. Thus it is luck. Some firms may be lucky and sustain growth for a time, others unlucky and have less than the average growth rate. But each has the same prospect of growth.

There are three fundamental questions raised by this law. What are the theoretical implications of the law? Does it hold, and therefore describe firm growth particularly well? What policy implications are implied by firm growth and concentration?

We shall concern ourselves with the theoretical implications of the law.

Economies of Scale and the Law of Proportionate Effect

It has been postulated that the law holds only for firms exceeding minimum efficient scale in the industry. As Simon and Bonini put it:[79]

> "if, as we have postulated, there exists approximately constant returns to scale (above a critical minimum size of firm) it is natural to expect the firms in each size-class to have the same chance on average of increasing or decreasing in size in proportion to their present size."

Simon and Bonini compared the actual numbers of plants in an industry with those predicted by the Yule process. They discovered that deviations from the predicted (i.e. where there existed fewer plants) compared favourably with Bain's estimates of minimum efficient scale.[80]

A similar exploration by Mansfield[81] examined only those firms above Bain's minimum efficient scale estimates. He found Gibrat's law did not hold for six of the ten cases examined. In these cases the variance of growth tended to be inversely related to size.

Hymer and Pashigian,[82] on the other hand, in their tests, found that the mean rate of growth was not related to size, while the standard deviation of the distribution of growth rates was inversely related to size.

On equi-growth rates they conclude that their data is consistent with the constant costs hypothesis. But they also suggest that this is consistent with falling costs. To discriminate between the two they examine standard deviations. They rule out rising unit costs because if internal diseconomies exist then further expansion of the firm would lead to higher costs and declining profits.

The argument that costs may be declining is based on the point that the variance of growth for small firms is greater than for large firms and that this is due to both decline of some firms and greater incentive of other small firms to realise cost savings. Thus that small firms will have a higher incentive to grow, as well as a high probability of decline, leads to greater variability of growth rates amongst smaller firms as compared with larger firms. Thus it is possible, on this argument, for average equi-growth rates to be consistent with constant long-run costs as well as falling long-run costs.

Had the results differed, Hymer and Pashigian comment:

"We have decided the implications of declining variance but constant average. What if we had found declining variance combined with large firms growing at a faster rate? Our hunch is that this would strengthen the case of economies of scale. But what if we had found declining variance and large firms growing more slowly than small firms. We would have been at a loss to explain this in any simple fashion."

These arguments[83] presuppose a relationship between profits and costs, and growth coming from profits (directly or indirectly). It is, of course, necessary that other conditions, for example, the goals of firms, should be the same, and not systematically related to size.

However, on declining costs, two arguments criticise their conclusions. First, if costs are continually declining there is no reason to believe that smaller firms will have a greater incentive to grow than larger firms. Second, if growth is dependent on profits, whatever the incentive to expand, the means will not necessarily be readily available for firms to grow.

In examining decreasing standard deviations Hymer and Pashigian raise the hypothesis that large firms are a collection of independent small firms of critical minimum size. The greater diversification of the larger firms will decrease the variability of their growth rates relative to smaller firms. They test this hypothesis by means of the rule that the standard deviation of the mean of large samples is $^1/\sqrt{n}$ times the standard deviation of the population where n is the size of the sample. They find that the actual deviations are greater than the predicted deviations. And hence the observed reduction in dispersion is not as great as one would have expected.

In this way they conclude that the divisions of the firms are related (through economies of scale), subdivision would raise costs, thus costs are not falling and then becoming flat but are continually declining.

SUMMARY

As we have seen, the connection between economies of scale and the rate of growth is that, for constant costs, we should require equi-growth rates combined with dispersion of growth rates unrelated to the size of the firm. If the dispersion of growth is greater for smaller firms this may be consistent with falling costs.

CONCLUSIONS

We have examined the concept of efficiency and its relationship to economies of scale. We have also examined the relationship between economies of scale and competition and economies of scale and growth.

Our concern is: (a) whether the ironfoundry industry is sufficiently competitive between firms of differing size to induce an adjustment to minimum efficient scale; and (b) is the growth path which firms adopt one which constitutes an unambiguous drive towards scale economies, for those firms below minimum efficient scale? For those firms above minimum efficient scale it is a question of whether they are exercising their scale advantages to drive firms below optimum scale out of business. The forces of growth and decline are syncronised if the total market for castings is not growing at the same rate as the output capacity of ironfoundries is increasing.

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CHAPTER 4

INTRODUCTION TO THE ANALYSIS

SYNOPSIS: In this chapter we explain our approach and consider overall methodological problems of measurement.

In terms of our theoretical review, to examine the impact of economies of scale on the ironfounding industry, implies considering the following:

(a) An assessment of the degree of competition in the industry to appraise the extent to which the competitive elements are conducive to a restructuring of the industry through the impact of economies of scale.

(b) To directly examine the effect of size on efficiency.

(c) An examination of the growth of firms in the industry, particularly to see whether the effect of the growth of the firm is such as to produce direct cost advantages over smaller firms in the industry. This implies (as we have seen) an examination of the rate of growth of firms, and the direction of growth of firms.

The scheme which we have chosen to present our analyses of these three related topics is to treat them, in the first instance, as independent sections. We will then return to the interrelationships of the variables in the light of our empirical results.

METHODOLOGY

Here we will discuss measurement problems at a very general level, the specific problems will be considered later.

In general,[1] the problem with social science is both a problem of measurement and of the substantiation of theories. There are major difficulties in closing the gap between theory and research.

Other problems relate to the extent to which the body of theory available is useful in analysing a problem at hand. Thus not only will there be problems of measurement but also problems of unambiguous and directly relevant theory. Even where the theory is clear and relevant it may contain propositions which are not directly testable. (Some theories incorporate a combination of testable and untestable propositions.) Where this is the case, in devising tests we involve ourselves in theoretical assumptions about the behaviour of those variables which we cannot test. Measurement problems become entangled in theory. The assumptions we make about the behaviour of unmeasured variables may sometimes be amenable to testing by indirect means (such as repeated sampling). In any case, it is necessary for the instruments we select to be valid indicators of the concepts contained in our propositions. We must measure what we intend to measure and not something else. The extent to which we have satisfied this requirement may itself be a matter of opinion.

In this chapter we are going to anticipate the technique of analysis to measure aspects of competition, growth and economies of scale. We do this in order to discuss separately the special methodological problems associated with our measures.

In general two sources of data were used. The first was through questionnaires. This involved two types of questions, factual and perceptual. The second was financial data, collected from Companies House.

QUESTIONNAIRES

The general problem faced is one of validity and reliability. With factual questions, are the respondents telling the truth? And with perceptual questions - what respondents believe is the case, do they act according to what they say?

The connection between beliefs and actions is crucial. Actions imply beliefs, but expressed beliefs may not imply present actions, though they may predict future actions.[2]

Our concern with what entrepreneurs take to be the case, is that this will be more reliable than structural possibilities - what could (theoretically) be the case, or indeed what is the case? Thus with competition - what entrepreneurs believe are the important dimensions of competition will influence their behaviour to a greater extent than the factual possibilities open to them.[3] This is because they may not know the factual possibilities.

Similarly, the relationship between long-run costs and size is importantly determined by what businessmen believe is the connection.[4]

In tapping such beliefs we face special problems. This is because we may be deceived by what the person says or what he does. This is both a philosophical question and a problem of research technique. We are obliged to accept the possibility that the truth will be concealed. And the extent to which the truth will be concealed will depend upon the relationship between what a person thinks and what he says, and between what a person says and what he does.

The connection between a person's questionnaire response and what he really thinks may vary according to the type of question that is asked. Controversial questions, leading questions, or questions of a highly personal nature, especially those with an evaluative element, are more likely to invite concealment.

With these problems in mind we turn to questionnaire technique. In general a number of techniques are available[5] to effect a situation to increase the validity of replies. These include logically interrelated questions randomly ordered so that inconsistencies become apparent; asking the respondent what he thinks the concensus is; having a number of questions related to verifiable facts to induce the respondent into a pattern of truth telling. Further, open ended questions permit responses outside the conceptual framework that has been adopted. Thus the respondent's viewpoint need not be distorted. However, the structuring or partial structuring of questions is important because it establishes a common frame of reference thus generating comparability, hence increasing reliability and also encouraging the inarticulate to reply to open ended questions.

In our questionnaire design we have incorporated many of these possibilities to increase the validity and reliability of responses.

FINANCIAL DATA

There are two problems with accounting data. One involves measurement and comparability. The other the relation between the accountants and the economists notion of profit and capital.[6]

We will consider both the profit and loss account and the balance sheet. The profit and loss account is a statement of both current revenue and costs. Accounting conventions distinguish between the various categories of income and cost. The residue of income over cost, or vice versa, is the profit or loss made by the company. Difficulties arise over the differing conventions used to calculate profit, particularly those relating to items in the balance sheet. The balance sheet sets out the stock of capital and the liabilities including those of ownership to which the company is responsible. The assets in the balance sheet are valued by the company's conventions at book value, which usually means they are estimated at other than market value. The overall problem is the valuation placed on similar assets between companies will differ according to these conventions. Differences will be more or less considerable according to the distribution by age of these assets, whether certain companies revalue their assets[7] etc. In addition, the method of valuation will be reflected in the profit calculation because the whole system of the profit and loss account and the balance sheet is based upon a method which is a tautology.

These problems have to be accepted unless individual companies accounts are systematically adjusted to increase comparability. In our study we rely not only on accounting data. However, in so far as our analyses are dependent upon such data, we must assume that differences are not a correlate of the size of the firm in our study.

THE METHOD

The method used in this study is what might be described as a "multi-dimensional" approach. This is because (as we have seen) our overall hypothesis has several implications, on the one hand, and on the other, for each implication there may be a number of independent (or related) tests. Thus two types of inconsistency may be encountered. One is that the compartmentalisation of the concepts, and the tests of these concepts, may suggest to us that economies of scale are important and unimportant at the same time. The results may be ambiguous or inconclusive. Alternatively, the differing techniques for measuring the same thing may differ in the results they give. We should again be placed in an inconclusive position. These are risks that one takes with multiple concepts and with multi-dimensional measures. We believe, however, that the interrelationships of economies of scale, competition, and growth in the foundry industry are in reality highly complex, and that a few simple propositions measured undimensionally might give spurious results however apparently "conclusive".

SUMMARY

We have considered the broad methodological problems associated both with the measurement of theory and with the research instruments used in that measurement.

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CHAPTER 5

THE SAMPLE AND DATA COLLECTED

SYNOPSIS: This chapter describes the method and sources of data collection.

Two research tools were used. One was to collect data from the published records of firms. The second was to collect data through a postal questionnaire. Each will be considered separately.

PUBLISHED RECORDS

The Foundry Industry Training Committee, as part of their work for the industry, had collected data on a number of aspects of ironfounding production. This data related generally to base metal used, production methods, and the markets of individual foundry establishments. More precisely, their data related to grades of iron:

IRON

(1) iron unspecified

(2) grey iron up to grade 12

(3) grey iron up to grade 17

(4) grey iron over grade 17

(5) spheroidal graphite iron

(6) malleable iron

(7) alloy irons

From these materials we chose foundries which were exclusively producing castings from materials other than spheroidal graphite iron and malleable iron. These last two are high quality irons requiring special processes.

Data was further available on melting methods. Cupolas are most usually used and foundries using this method were selected.

Materials and melting methods were the only two criteria used for our initial selection of foundries from data the F.I.T.C. had collected on the whole population of ironfoundries.

These criteria produced a population (of this kind) of 277 establishments. Any firm may operate one or more establishments and in practice no foundry in this population included more than two establishments.

Our initial data on these 277 establishments included other technical aspects of foundry production. Specifically we were provided with data on first, production method. The following categories were employed:

(1) Jobbing.

(2) Semi-mechanised - machine moulding only.

(3) Semi-mechanised - machine moulding and gravity conveyors.

(4) Mechanised - moulding machines, sand conveyors, hoppers, mechanised track, mechanised knockout, mechanised casting conveyors to fettling.

(5) Advanced mechanised - further including mechanical core laying and mechanically assisted pouring.

Each category was further subdivided by output weight, generally light (up to 5 cwt.), medium (up to 5 tons) and heavy (over 5 tons).

Further data was made available on the process of production, the kind of moulding technique employed and the technique for setting sand.

Lastly, data from the F.I.T.C. included markets, the size of establishments (employees) and the region in which the establishments were located.

We established from the whole population a common denominator of materials used, and accepted this further data as independent variables from which we would further subdivide the population. Because a large number of characteristics were made available to us, it was necessary to make certain simplifying assumptions about further classifying firms. In so doing, we were interested in comparing similar firms, but at the same time subdividing our population into very dissimilar kinds of foundries. We will return to this later.

The 277 establishments produced 257 firms. With the names of these 257 firms we proceeded to collect financial data for the period 1971 to 1962 - a ten year period. Such data is available at Companies House, London (for firms incorporated in England and Wales) and in Edinburgh (for firms incorporated in Scotland). A detailed summary of the profit and loss account and balance sheet was recorded for each firm and for each year where this was available.

Because many of our firms were small much of our data was restricted to the period after 1967. The 1967

Companies Act had made it compulsory for private firms to publish their accounts thereafter, and to a large extent we had to rely on data following this period.

Two problems arose. One was that several companies in our initial list had at the time of collection (March-June 1972) not submitted their accounts, or had only done so for one or two years in our period. The second problem was that for some companies ironfounding was not listed as a principal activity and therefore their accounts also included other activities and because of this were excluded.

Data collected from companies over the whole period tended to relate to foundries which were subsidiaries of a holding company usually concerned with the production of products which incorporated iron castings. As such their accounts were reliable inasmuch as those copied related to subsidiaries for which the principal activity was ironfounding but necessarily their accounts were subject to the added problems of both the treatment of subvention payments and the calculation of profit.

Table 5.1 illustrates the data available for companies in each time period.

This presented us with a problem for later analysis because we wished to examine aspects of these accounts over a period of time. We further required that the results should be reliable inasmuch as they related to the same sample of firms for each period. In the event, for the period 1970-1967, 140 firms could be grouped. Later, because of negative net assets for some firms and

Table 5.1

FINANCIAL DATA AVAILABLE FOR COMPANIES IN EACH YEAR

1971	1970	1969	1968	1967	1966	1965	1964	1963	1962
55	170	203	190	176	105	52	51	39	35

errors in data collection, a satisfactory sample of 123 firms was obtained. The bulk of our statistical analysis then related to these 123 firms. Further analyses were conducted on other years to examine general consistency with our overall findings, but these are not detailed here. Without exception the results tended to support our findings on the analysis of 123 firms.

Of these 123 firms, 70 were independent and in the main private companies, the remaining 53 firms were subsidiaries.

GENERAL ANALYSIS OF THE 123 FIRMS

Tables 5.2, 5.3 and 5.4 describe the distribution of these 123 firms by size, region and production method.

No detailed breakdown is given for markets supplied because individual foundries tended to supply several markets and, further, the markets themselves are broad categories suggesting the possibilities of several different products. However, Table 5.10 gives a breakdown of the main market supplied. This was calculated in terms of tonnage production for the year 1970.

It was decided that because of the high degree of heterogeneity in foundry production, that a simple distinction would be drawn. The industry, it was decided, could sensibly be subdivided into jobbing foundries and repetition foundries. The distinction is based mainly on the length of run of each individual casting. Naturally the distinction holds better for jobbing foundries than repetition foundries but it is a convenient subdivision and one acknowledged in the industry. Any

Table 5.2

FINANCIAL DATA SAMPLE DISTRIBUTION BY REGION

		n
1.	South East	6
2.	East Anglia	-
3.	Oxford, Berks., Hamps.	5
4.	South West	4
5.	West Midlands	46
6.	East Midlands	9
7.	Yorkshire	17
8.	Scotland	14
9.	Wales	4
10.	Lancashire/Cheshire	15
11.	North East	3
		n = 123

Table 5.3

FINANCIAL DATA SAMPLE DISTRIBUTION BY SIZE

Employees	n
25- 50	45
51- 100	34
101- 200	26
201- 500	15
501-1000	2
Over 1000	1
	n = 123

Table 5.4

FINANCIAL DATA SAMPLE DISTRIBUTION BY PRODUCTION METHOD

	n
Jobbing	83
Semi-mechanised 1) Semi-mechanised 2)	26
Mechanised) Advanced Mechanised)	14
	n = 123

further subdivision, we felt, would reduce our sample so drastically that any statistical method would produce results unreasonably tentative and given the drawbacks of financial accounting data for comparative purposes, we felt any overall benefit gained would be greatly outweighed by the necessary clerical work which would be entailed. This was particularly important because only part of our research rested upon this kind of information.

QUESTIONNAIRES

In addition to data collected from published sources, lengthy questionnaires were sent to all ironfoundries in the industry. Details of the questionnaire are included in the Appendix. The questionnaire was tested in two ways. First, a selection of foundries were asked to complete it, with comments and, second, it was distributed amongst experts and those very familiar with the industry.[2]

In the course of correcting the questionnaire it became very clear from the comments received that to expect any reasonable response rate would, because of the nature of the questions asked, be very uncertain indeed. One reason given, was that foundries in general were very cautious about the kind and the amount of information they would be willing to release. Indeed, as it turned out, one company refused to complete the questionnaire because they were negotiating a sensitive and secret contract with a company abroad, despite the fact that the questionnaire was not designed to reveal such information.

Because of such privacy it was decided to construct four similar questionnaires. These would differ in the kinds of information requested and the likely length of time to complete. Yet a further precaution was taken. This was to allow firms to omit questions they felt to be too confidential. And finally a guarantee of complete confidentiality was given so that companies would not be named nor identifiable from the analysis.

The questionnaires fell roughly into two groups. Two major questionnaires; one requesting all but financial details (from firms for which financial information had already been collected), the other included a request for financial data. The second two were, in effect, the complete questionnaire divided into two parts. One, the larger part, required less numerical detail and was accordingly enlarged slightly for rough approximations to answers to questions which were not asked in detail. The second, and last, was nearly all numerical, but very brief.

All foundries in the Foundry Trade Directory were circulated with a questionnaire. And apart from those firms which were destined to receive the major questionnaire without financial questions, the other three were randomly distributed to all other foundries in the industry.

Out of the total population of ironfoundries a number are vertically integrated. These are known as tied foundries - foundries owned by firms which consume the castings made. Such foundries produce for the market, independently of the requirements for their own firm, to varying degrees. In general, we excluded from our returns those firms which were producing almost exclusively for their own use and retained replies from firms producing solely for the market or at least in part.

It is estimated that approximately one-third of all iron castings is produced by tied foundries, given this approximation we would estimate that our response rate was in the order of 20%.

Because we were necessarily at the mercy of the goodwill which existed in the industry for this kind of research, we were anxious that our sample, now reduced to 146, was not random and perhaps unrepresentative of the industry.

We proceeded then to make some simple tests of the data received. The simplest of all such techniques is to test for any difference between firms which responded immediately and those which responded after the first (and only) reminder.[3] Only one statistical difference emerged of any importance, within our framework, and this was in reply to a question asking firms to estimate what they believed to be their optimum size. This difference is tabulated below (Table 5.5).

Table 5.5

OPTIMUM SIZE ESTIMATES BY IMMEDIATE RESPONDENTS COMPARED WITH RESPONDENTS AFTER THE FIRST REMINDER

	n (Valid replies to question)	$\bar{x}$ Estimate of optimum (1.0 = optimum size)	S.D.	S.E.	T.	Dof.	Prob.
Immediate reply	29	0.7257	.201	.037	-2.6	55	.012
After 1st reminder	28	1.2042	.972	.184			

Such a difference makes sense inasmuch that parts of the questionnaire made it clear that we were concerned with the impact of the size of firm on the efficiency of firms in the industry. Hence, one interpretation of this result would be that firms responding after the first reminder (of which there were 47) considered size to be of less importance to them than firms replying immediately.

Two other tests were conducted. One was to test between questionnaires received from our pre-selected F.I.T.C. sample and foundries which fell outside this group. The second was a simple +-test on profitability between firms in our initial sample for which profitability data had already been collected and firms which "volunteered" to disclose their accounts. On the first no significant difference was encountered which could not be explained by our initial sampling frame. On the second there was no significant difference in profitability between the two groups.

We were satisfied, then, that the data we had collected came from broadly similar populations. Further mention should be made of the distribution of returns between questionnaires. We were surprised that the long questionnaires were returned in approximately the same proportion as the two shorter questionnaires. However, the briefest questionnaire, which referred mainly to financial and output data, was least liked. This, one expects, is because these kinds of questions, simply relating output variables (tonnage, employees, etc.) to financial data is well recognised as a weak method of measuring efficiency in this industry; particularly because there is no convenient and rigorous measure of output. Weight is unreliable because it does not reflect the intricacy (the value) of work done. At the same time the differences between possible measures of profit are all too well known. Furthermore, firms tend to be more cautious about revealing such data.

The four questionnaires were received in the following proportions. Differences between the type of firm which replied to each are also listed.

PROPORTION OF QUESTIONNAIRES OF EACH TYPE RECEIVED*

Long Questionnaire	Short Questionnaire	
III IV	II	I
74	54	18
(50.7%)	(37.0%)	(12.3%)

Possible differences were examined over certain crucial variables relating to the type of firm responding. These are listed below.

DIFFERENCES BETWEEN FIRMS RESPONDING TO DIFFERENT QUESTIONNAIRES

On size of firm	No statistical difference
On type of firm (jobbing/repetition)	

In addition, our initial letter included a request to firms to reply if they positively did not intend to complete the questionnaire. This was mainly for clerical reasons, but we decided, in addition, to examine the

*NOTE: This refers only to questionnaires used in the later analysis.

reasons given for refusing to co-operate. It would obviously be useful to know what "kind" of firm did not co-operate. Naturally one would expect an element of "politeness" to creep into the replies but nonetheless the reasons given were as follows (Table 5.6).

Table 5.6

LETTER REPLIES REFUSING TO CO-OPERATE

Reason	Replies to covering letter	Replies to reminder	Total
Closure of foundry	41	10	51
Tied foundry	24	3	27
No reason	27	3	30
Too busy to complete questionnaire	14	8	22
Information requested, not recorded or available	2	4	6
Drastic internal changes to firm's organisation of production	6	-	6
Information too confidential	2	1	3
Questions too specific for the kind of work undertaken by foundry	3	1	4
Total	119	30	149

There were four main categories of non-response. Firms on our list which had closed (they had not necessarily closed recently); foundries which produced exclusively, or in the main for their own internal use; many firms gave no reason; and a number felt that the questionnaire would require too much time to complete.

In general, this confirmed what we said earlier, that most of our completed replies came from foundries which produced for the market and thus do not represent the completely tied firm.

THE POPULATION AND THE SAMPLE

We move on to examine the representation the replies gave in comparison with the industry taken as a whole. We examined this representation in terms of region, size distribution and total tonnage output. There are a number of unknowns. The size and regional distribution of tied foundries, and the distribution of foundries by the kind of work they take on. Tonnage output is not very reliable because weight is not a good index of output for the industry.

We had decided not to classify foundries by the market for which they produced the castings, partly because this involved undue complexities where many foundries were producing for a number of markets. And partly because this, in itself, is not a good representation of output either. For example, firms producing for the automobile industry will produce a range of castings and the production of one kind of casting for the industry by one firm could quite possibly be very different from those produced by a second firm for the same industry. We chose, therefore, to classify firms by production method, assuming that, with a given method, firms could be flexible between markets. For this reason we do not classify, below, in detail firms by market representation (see tables 5.7, 5.8, 5.9, 5.10).

Table 5.7

THE SAMPLE AND THE POPULATION: SIZE DISTRIBUTION

Employees	1971	Financial Data Sample	Questionnaire Sample
Less than 25	311	-	32
26- 50	186	45	25
51- 75	85)		
	)138	34	30
76- 100	53)		
101- 200	110	26	27
201- 300	40)		
301- 400	28) 73	15	21
401- 500	5)		
501-1000	15	2	6
Over 1000	10	1	3

Table 5.8

THE SAMPLE AND THE POPULATION: REGIONAL DISTRIBUTION

Employees	1971	Financial Data Sample	Questionnaire Sample
North	45	3	8
Yorkshire and Humberside	137	17	18
East Midlands	86	9	14
East Anglia	18	-	2
South East	87	11	15
South West	35	4	8
Wales	31	4	6
West Midlands	198	46	40
North West	114	15	18
Scotland	82	14	15
Northern Ireland	10	-	-
n		123	144 (total 146)

Table 5.9

SAMPLE AND POPULATION COMPARISON BY TONNAGE OUTPUT

Industry total 1000 tons	Financial Sample	Questionnaire Sample
3395	Unreliable	395.062*

*83 firms only

Table 5.10

MARKET DISTRIBUTION OF FOUNDRIES SAMPLED

Market	Financial Data Sample Markets/	Questionnaire Data Sample Markets*
Motor Vehicles and Cycles	14	7
Engineering Plant and Machinery	27	-
Mechanical Engineering	38	25
Machine Tools	6	15
Shipbuilding	3	1
Building and Allied Industries	20	7
Domestic Goods	6	4
Pressure Pipes and Fittings	-	2
Ingot Moulds and Bottoms	-	1
Miscellaneous	8	2

/Foundries operate in many markets, hence these figures represent only the most important market for 1970 calculated by tonnage output.

*Not all questionnaire respondents main market were available.

THE FIRMS REPRESENTED A MORE DETAILED BREAKDOWN

SURVEY FIRMS

We have examined the firms represented in our survey sample relative to the population. We shall now look more closely at the kind of firms represented. In general we identified firms in a similar way to the F.I.T.C. classification, but we included other important classificatory criteria. Further, as before, we had to come to terms with some means of simply classifying firms. Two possibilities were open to us. Either we could use a statistical technique[4] - cluster analysis, to identify similar and dissimilar factors between firms. Or we could base our classification on a priori judgment about the features of firms which would necessarily suggest comparability. In addition we could not disaggregate the industry to such an extent as to make the sample size of each subpopulation too small. Again we chose the overall simplification of jobbing foundries and repetition foundries. Statistical techniques of classification are only as good as the number and importance of the variables which are included in the computation and thereby need not necessarily signify any especially accurate or realistic distinctions between and within groups in the subpopulations of firms.

Below, then, we describe the important characteristics of firms in our questionnaire sample (Tables 5.11 to 5.16).

Table 5.11

FIRM STATUS OF QUESTIONNAIRE SAMPLE

	n	%
Independent	76	52.8
Supplying partly for the market (mainly members of a group)	68	47.2
Total	144	

In general, firms which were subsidiaries of other firms produced for the group, castings for their own consumption. But in large part they also produced for the market in general.

Table 5.12

TYPE OF OUTPUT OF QUESTIONNAIRE SAMPLE

	n	%
Jobbing	40	28.0
Mainly Jobbing (>50% output is jobbing)	40	28.0
Mainly Repetition (>50% output is repetition)	27	18.9
Repetition	36	25.2
Total	143	

This was the rough categorisation we chose to use. Later in the analysis it was decided to merge jobbers and repetition foundries according to whether the former or latter was the major concern of the firm. This was for statistical reasons.

Table 5.13

TYPE OF OUTPUT AND SIZE OF FIRM OF QUESTIONNAIRE SAMPLE

Size (employees)	0-25	26-50	51-100	101-200	201-500	501-1000	>1000
Jobbing	28 (35.0)	16 (20.0)	17 (21.2)	13 (16.2)	6 (7.5)		
Repetition	3 (4.8)	9 (14.3)	13 (20.6)	14 (22.2)	15 (23.8)	6 (9.5)	3 (4.8)

In general, the jobbing foundries were on average smaller than the repetition foundries. Also, as is shown below, a higher proportion of repetition foundries in our sample were members of a group.

Table 5.14

TYPE OF OUTPUT AND FIRM STATUS OF QUESTIONNAIRE SAMPLE

	Jobbing	Repetition
Independent	47 (58.7)	28 (44.4)
Member of Group	33 (41.2)	35 (55.6)

Some firms are members of foundry groups producing exclusively castings. Thus in our later analysis this was taken into consideration.

The overall proportion of castings to sales is given below (Table 5.15).

Table 5.15

CASTINGS OUTPUT AS A PROPORTION OF TOTAL SALES

$\overline{X}$	S.D.	n
74.8986	34.0890	69

And the average number of plants operated by firms (Table 5.16).

Table 5.16

NUMBER OF PLANTS OPERATED IN QUESTIONNAIRE SAMPLE

$\bar{x}$	S.D.	n
1.2877	0.6920	73

These then were the main variables which concerned us in classifying firms, and it is as well to examine our later statistical techniques, now.

Apart from our simplification between jobbing foundries and repetition foundries, we will examine why it should be useful to introduce firms which are partly producing for their own use.

In this study we are more importantly interested in market forces affecting firms. And it is for this reason that we might well expect firms producing outside the general market to "behave" in a different way. There are advantages in vertical integration which overall may outweigh the disadvantages of higher costs per unit of output that these "tied" foundries might otherwise experience. We approached this problem of these differences by asking these firms what they felt to be the advantages and disadvantages to them of vertical integration. These are tabulated below.

ADVANTAGES AND DISADVANTAGES OF VERTICAL INTEGRATION. THE "TIED" FOUNDRY PARTLY PRODUCING FOR THE MARKET

ADVANTAGES

(1) Continuity of orders especially providing security in times of recession. And the ability to smooth out demand peaks and troughs.

(2) The availability of shared services (accounting, maintenance, transportation).

(3) Fund availability.

(4) Technical assistance.

(5) Bulk purchasing advantages.

(6) Long term planning.

DISADVANTAGES

(1) Difficulty in allocating true overhead costs, leading, often, to higher unit costs of production. "The overheads of 'big brains' and liaison."

(2) Conflicting demands between the group and outside, leading to a big impact on the order book when the parent company is slack and a tendency to "push out" customers when the parent company is busy. Thus sales to outsiders is inhibited by fear of group preference during periods of high demand.

(3) Because of the generally low priority of the foundry relative to the group, the foundry is dependent on the group for survival or closure. Advantages of group finance are thus offset to this extent, and also because of a feeling of higher than actual or necessary overheads, lower prices to group members and, for finance, the requirement of detailed proof of return on capital expenditure.

(4) Problems attributable to bureaucracy. Especially slow decision making.

These advantages and disadvantages of tied foundries serve to distinguish them as a separate category. The overall effect of these advantages and disadvantages would be difficult to weigh up, but importantly two considerations can be mentioned. The first is, that these foundries, in part, produce castings for customers outside the group and, second, for their products within the group they are required to be price competitive with outside foundries. Thus similar efficiency criteria apply but the extent of the overall cost advantage to the group of vertical integration is not here possible to ascertain.

We thus, initially, identify three types of foundries. Jobbers, repetition and tied foundries which may either be involved in jobbing or repetition work.

SOME POINTS ON RESEARCH TECHNIQUE AND METHOD OF ANALYSIS

Our method, then, is the cross-section approach. The financial data has both a cross-section element and a time dimension. But much of the data received from the questionnaire is point in time data, except insofar as requests are made for historical changes and developments.

SAMPLE SIZE

For two reasons, first because of missing data and questions inappropriate to the respondent and, second, because not all firms were asked the same question, the number of observations in each separate analysis will fluctuate. This will also be the case when the total sample is disaggregated.

THE SIZE DIMENSION

There are a number of possibilities available in the choice of the size variable. For example, it is possible to choose sales, employees, net assets, value added, tonnage output, etc. If all indices were highly correlated the problem of which to choose would not arise, indices would be interchangeable. For example, with capital and labour, problems arise because larger firms may use more capital than labour than smaller firms.

In our research the choice of size variable is, in any case, reduced. Employees and tonnage output are the only size variables available in the questionnaire data. More variables are available in the financial data. These are sales, employees, net assets, fixed assets and total assets. The following table is a correlation matrix of these different variables. High correlations are found between all variables with the exception of employees (Table 5.17). On further investigation (Table 5.18) it was noted that net assets increased faster in relation to employees as the size of firm increased. Hence the measure employees, if anything, underestimates the size of the firm. Thus, in the absence of a satisfactory output variable, both employees and net assets have been used. The questionnaire data only had satisfactory net asset data in 46 cases, so employees has been used as the size variable overall, though checks were made on those questionnaires for which net assets were available. Similar comments may be made for the financial data where net assets was used as our size dimension. Checks again were made using employees but again we did not have data on the number of employees for all the companies studied.

Table 5.17

THE RELATIONSHIP BETWEEN DIFFERENT MEASURES OF SIZE, 1970 ONLY. PEARSON CORRELATION COEFFICIENTS

		Sales	Employees	Net Assets	Fixed Assets	Total Assets
Sales	a	All independents	.8228 n = 65	.8972 n = 69	.8334 n = 69	.9492 n = 69
	b	Repetition x	.7720 n = 24	.8894 n = 27	.8255 n = 27	.9505 n = 27
	c	Jobbers	.7108 n = 41	.7525 n = 42	.4786 n = 42	.7836 n = 42
Employees	a			.6162 n = 66	.6340 n = 66	.7169 n = 66
	b		x	.5446 n = 25	.6061 n = 25	.6720 n = 25
	c			.4339 n = 41	.1148 n = 41	.4328 n = 41
Net Assets	a				.8922 n = 70	.9346 n = 70
	b			x	.8797 n = 28	.9189 n = 28
	c				.8051 n = 42	.9560 n = 42
Fixed Assets	a					.8584 n = 70
	b				x	.8339 n = 28
	c					.7925 n = 42
Total Assets	a					
	b					x
	c					

Table 5.18

FACTOR PROPORTIONS

Log employees = f log net assets	Independents				Repetition				Jobbers			
	a	B (S.E.)	r^2	n	a	B (S.E.)	r^2	n	a	B (S.E.)	r^2	n
1970	-2.287	.56971 (.06016)	.58357	67	-2.279	.60139 (.08747)	.67267	25	-1.9809	.36443 (.08854)	.303	42
1969	-2.1229	.49589 (.05231)	.58031	67	-2.083	.51587 (.07069)	.68052	27	-1.8384	.29152 (.07945)	.262	41
1968	-2.1978	.53105 (.05379)	.59988	67	-2.097	.51988 (.06819)	.69923	27	-1.9972	.3778 (.09179)	.308	42
1967	-2.2784	.58686 (.06123)	.77941	28	-2.205	.56328 (.08462)	.78688	14	-2.285	.57424 (.15847)	.523	14

BIBLIOGRAPHY AND NOTES

1. See, for example, J. M. Samuels and F. M. Wilkes, "Management of Company Finance", Nelson, 1971, pp. 414-417, for the problems of transfer pricing.

2. We are grateful to the Management Development Advisory Unit to the Ironfounding Industry, based at the University of Aston, for help in this respect.

3. Problems and possibilities for highlighting the effects of non-response are given in William G. Cochran, "Sampling Techniques", Wiley, 1953, p. 292.

4. The F.I.T.C. used cluster analysis in "A Company Approach to Industry Manpower Forecasting", Alan Moss, Foundry Industry Training Committee, 1973.

CHAPTER 6

COMPETITION IN IRONFOUNDING

SYNOPSIS: We have examined the theoretical implications of competition and economies of scale in Chapter 3. It was shown that the importance of economies of scale reshaping the ironfounding industry was dependent upon competition; the greater the degree of competition the greater the likelihood of adjustment to minimum efficient scale. This is to say that to speak of an industry comprising a number of firms identical in every respect, except for size, would be incompatible with falling long run costs, perfect competition, and equilibrium at the same instant. It is precisely the imperfections in the market which we shall concern ourselves with here. And in this respect we are developing a framework to examine whether the competitive elements are conducive to an adjustment to minimum efficient scale. These competitive requirements were that firms should be of differing size, should sell in a common market, and should be price competitive.

Thus, in general, long run cost conditions will be important where firms are producing similar or identical products, where price is given and beyond the control of individual firms, where demand is price elastic and where excess long run profits are not being made. It is to these general factors we now turn.

MEANING OF COMPETITION

> "There is probably no concept in all of economies that is at once more fundamental and pervasive, yet less satisfactorily developed, than the concept of competition."[1]

And the general tendency is to regard it as meaning the opposite of monopoly.

Andrews[2] adopts the concept "open competition" as the special feature of the idea of competition best applicable to the manufacturing world. This he further defines as "nothing more than that such an industry is formally open to the entry of new competition."[3]

RECAPITULATION OF THE IMPORTANT ASPECTS OF COMPETITION

In Chapter 3 we highlighted a number of important dimensions of competition. In particular these were the following:

(1) the number of competitors,

(2) the behaviour of competitors,

(3) the distribution of preferences for the products of the firm,

(4) the degree of product differentiation.

In the case of firms selling products to other firms, we noted that it was more important to assume rationality on the part of the buyer, than might otherwise be the case. As such, points 3 and 4 merge. Preferences we are assuming are real. This of course does not deny goodwill, as a short-run phenomenon, but existing within the context of prices.

(5) the degree of freedom of entry,

(6) the possibility of buyer concentration.

A NOTE ON EXCESSIVE COMPETITION

It should be noted that in describing these competitive elements, where such conditions are present, there could exist destructive competition.[4] This we shall discuss briefly here. Reasons for the "ideal" to become destructive are the presence of mixed competition between industries, resource immobility, and the presence of an imbalance in the industry structure at the time of observation. The symptom is a maladjustment of supply to demand, chronically subnormal earnings and high rates of business closure. Easy entry sustains the overcapacity when demand changes, as does slow exit. Under such circumstances adjustment is slow, but merger movements and general efforts to restrict competition to preserve competitors may result, often at the expense of small firms, by exclusionary and predatory tactics of large firms.

Given this it is necessary to consider such possibilities in our analysis and in the interpretation of our results.

MEASURES OF COMPETITION

The usual measure of competition is the concentration ratio. Concentration may be seen as something affecting current behaviour but is also the result of previous behaviour. Thus cause and effect are entangled. The degree of concentration in an industry will be the result of many factors[5] - the pursuit of efficiency, technological change, desire to restrict competition, barriers to entry, large scale sales promotion, etc. Hence interest in this structural feature of industries has revolved around both the explanation of concentration and the effect in terms of the behaviour and conduct of firms in industries with different levels of concentration. Bain,[6] for example, makes the point that larger profits will be expected with higher seller concentration, than with moderate or low concentration, where collusion is likely to take place.

However, concentration measured as a single ratio is unreliable as Kaysen[7] points out. His argument is that many other factors are relevant to the power situation, particularly the rate of growth of demand, the character and speed of technological innovation, the degree to which sellers operate in other markets, product differentiation and the firm's goals are amongst them.

CONCENTRATION MEASURES

Market concentration is usually measured from the supply side.[8] The concept is applied to groups of principal products. Such principal products may themselves be grouped because they share the same raw materials or the same processes. The establishment rather than the firm is the unit of production. This is the way the concept of the industry is built up in practice. And clearly there will be considerable divergence from the kind of industry described theoretically. Thus the success of the concentration measure is itself highly dependent on the success of the census planners.

Difficulties arise because establishments are "inappropriately" classified. Such difficulties would include high diversity of output from a particular establishment, another difficulty arises if a large proportion of the output of the industry is exported - overstating the concentration measure. Further problems of overstatement include counterveiling power. Understatement of concentration arises out of, for example: census definition of control which may not equate with actual control. Vertical integration is another source of understatement; others include transport costs and the possibility of regional markets.

Measurement is based on a choice of both techniques and variables. The variables used may be sales, value added, employment or assets. They have their shortcomings. Assets[9] may overstate concentration because large firms are likely to use more capital intensive techniques, employment may understate it for the opposite reason. Sales conceals vertical integration. Value added looks best as a measure of work done.

The next problem is the method of measurement. Usually this is in the form of the concentration ratio, which is the proportion of industry output accounted for by a number of enterprises. Other methods are available besides this simple fraction. Similar but graphic is a cumulative measure of output on one axis against cumulative total industry share on the other. Steeply rising curves depict greater concentration than gentle ones. The concentration curve is not generally available because information is required on each firm.

Critics dislike the concentration ratio because it will not differentiate between monopoly and oligopoly. Others have suggested a better index. For instance,[10] a three digit index has been suggested, one figure denoting the share of the largest firm, another denoting the number of firms each with a market share of a certain percentage, and yet another figure illustrating the joint share of all firms over the same certain percentage market share.

Other kinds of measure include, for example, the Lorenz curve. The Lorenz curve is familiar as an inequality measure. It is graphic, the vertical axis denotes the cumulative percentage of industry output whilst the horizontal axis concerns the cumulative percentage of firms in the industry from smallest to largest. If the graph is "boxed-up" a diagonal line drawn from left to right would represent firms of equal size. But, of course, the usual "Lorenz curve" lies below this line. The further the Lorenz curve is from the line of equal distribution the greater is the concentration of firms in the industry. The Gini coefficient measures this. This measures the area between the line of equal distribution and the Lorenz curve. The Lorenz curve differs from the concentration ratio because it will reflect changes taking place amongst firms outside of the large producers in the concentration measures. Such changes might take the form of mergers between firms narrowing the gap. This last point has also produced a criticism of the measure because high fatality amongst smaller firms reduces inequality, but the market behaviour of the largest producers is likely to remain unchanged.

Controversy centres around the search for a summary measure whether it be the ratio type or the inequality type. Because (as we have said before) the size distribution of firms is often closely lognormal, the variance of the logarithms has been suggested as a measure.[11]

Our view is that the single measure is just a start. A judgment on the nature of competition in an industry would be premature if it derived from a unique ratio. Nevertheless, we shall examine the significance of concentration.

THE CONCENTRATION MEASURE AND ECONOMIC THEORY

The reason for the adoption of the concentration measure is because the number and size distribution of firms in an industry is likely to be closely bound up with their behaviour and performance. What might be expected? The usual rule is to compare with perfect competition. High concentration is likely to mean profits (even in the long run) above opportunity cost. And from a resource allocation point of view - fewer resources will be engaged in concentrated industries than elsewhere where more resources will be used. Secondly, in highly concentrated industries there will not be the same drive for internal efficiency.

On the positive side though, concentration may be the inevitable result of economies of scale and the internal security large firms may feel may encourage them to undertake research and development.[12] However these need not be so.

Now the point of all this is that economic theory in its view of market competition is fairly straightforward on two points - perfect competition and monopoly. Certainly with regard to perfect competition, pricing and output policies are a function of market structure. Now in real life things need not be so simple (or extreme). The structure may be similar to the competitive structure, in which case individual firms will be likely to have little influence over their pricing policies and will look towards efficiency. Theory highlights structures similar to monopoly but, alas, theory is imprecise except for specifying that some interdependence will exist between the firms. And the concentration ratio may suggest the direction towards which an industry tends.

EVIDENCE OF CONCENTRATION

Evidence of concentration in British manufacturing industry comes mainly from a study by Evely and Little.[13] What they did was to take a sample of 220 industries and discovered that nearly two-thirds of these were industries of low concentration for the year 1951. Suggesting that the bulk of British manufacturing industry was not highly concentrated. Grouping industries they found that industries associated with high capital requirements were more highly concentrated. In addition, some further structural features were examined. These included the three firm concentration ratios, the size ratio of firms and the number of firms in the industry.

This produced some interesting results. Industries of medium concentration fell into three categories: (a) many firms with large size ratios; (b) few firms with small size ratios; and (c) many firms with small size ratios. Thus although these industries had similar concentration ratios, they would be unlikely to have similar market behaviour. Under such circumstances it would seem that industries with small size ratios and small numbers would display tacit collusion, while those with many firms and small size ratios would be strongly competitive and those with few large firms and many small firms would suggest that large firms would create tacit arrangements amongst themselves to increase their control, but their policies would be modified by the presence of a large number of small firms. Thus more detailed analysis suggests that different kinds of market behaviour might exist. Similar conclusions were found by Kaysen and Turner.[14]

And for low concentration "it may be said that there are seventy-four trades ..... where there is a likelihood that perfect competition, in the absence of collective regulation will be operating. The presence of giant concerns in the other twenty-six trades suggests on the other hand, despite low concentration, that competition will not be fully operative ....."[15]

We move on to examine the relationship between concentration and market behaviour and performance. In general, as far as behaviour is concerned, a move away from the competitive situation means that prices are no longer determined externally and will be set by some kind of collusion or some other kind of interdependence.

As far as performance is concerned, this generally relates to such aspects as size efficiency, the relationship between long run costs and prices, innovation and promotion. As far as allocative performance is concerned, the prediction is that where monopoly exists price will be above marginal cost, output will be restricted, and long run excess profits will be earned.[16]

The relationship with economies of scale is that concentration may be the result of a drive to minimum efficient size, and in such a case, (given a flat minimum cost curve) the question arises of what is the scale at which minimum long run unit cost is achieved.

In terms of other aspects such as innovation, some[17] supporters of oligopoly share the view that large oligopolistic concerns are the principal gènerators of technological change by virtue of the new products, processes, and product improvements. This is because the demands of modern technology are so great that only large firms can undertake research and development. Indeed they must innovate in order not to be outstripped by their rivals.

The problem with innovation is that measurement is difficult. Most research has concentrated on the input side such as the amounts spent on Research and Development and the number of patents filed (though there is not a necessary relationship between the two).

We have described measures of competition and the broad reasons why competition is an important variable.

In addition we have seen that a search for a unique summary variable is misleading because it can disguise market behaviour which might be expected to be very different between industries sharing very similar concentration ratios.

We now move on to discuss the effect of concentration, particularly empirical relationships between concentration and profitability and then the relationship between concentration and economies of scale. Finally, for our purposes, we shall discuss why we are interested in a more "pure" measure, and we will then go on to discuss our measure, with particular reference to the ironfounding industry.

CONCENTRATION AND PROFITABILITY

Bain[18] examining whether profit rates were directly related to concentration studied forty-two industries for the period 1936-1940. He found no conclusive evidence of any closely related linear relationship of industry concentration to profit rates.

Levinson,[19] on the other hand, analysed the relationship in nineteen major groups for the years 1947-1948 to 1957-1958. He found that the data indicated a strong relationship particularly after 1951 between profit levels and 1954 concentration ratios.

Similar results were found by Weiss[20] using different indices. He computed correlation and regression coefficients. The resulting correlation coefficient was .73 increasing to .84 when output growth was introduced as an additional variable. He concluded that in general his study supported the traditional views about the impact of concentration on resource allocation and distribution.

Stigler[21] also analysed the relation between concentration and the rate of return. Concentration indices were obtained for 1935, 1947 and 1954. Two periods were covered - 1938-1947 and 1947-1956. His results he described as somewhat ambiguous but on the whole negative.

Collins and Preston[22] examined a new collection of empirical data. They found a statistically significant but not always strong association between concentration indicators and profitability. The strength of their findings varied depending on the profit measure used. In their conclusions[23] they remark "The generally assumed correspondence between concentration measures and the degree of oligopoly, including the behavioural implications of the latter, is at least in part substantiated by the finding that there is a significant association between concentration and indicators of profitability in numerous and varied samples of industries based upon various classification systems. The other side of the coin is that concentration does not explain everything, and in some cases it appears to explain nothing at all. Thus, not surprisingly, the answer seems to lie somewhere between the extremes."

Another form of analysis conducted by Bain[24] included barriers to entry as an additional competitive variable. This is the threat of entry as a behavioural constraint. Relating this to profit rates he found very high barriers predicted higher profits (the barriers were defined in terms of scale-economy barriers, product differentiation barriers, absolute cost barriers, and capital requirement barriers). But he tentatively stated there were no great differences in profit rates between industries of substantial and moderate to low entry barriers. As far as concentration is concerned, within the substantial entry barrier category, industries of higher seller concentration seemed on average to have higher profits than those of medium seller concentration, and within the moderate to low category a rough relationship of seller concentration to profits was again apparent. Thus, in effect, the condition of entry and seller concentration were by no means intercorrelated, and both variables seemed to have some independent influence on profit rates. The conclusion was that seller concentration alone is not a sufficient indicator of the probable incidence of extremes of excess profits and monopolistic output restriction. Caution was pronounced over the sample size and data used.

Our conclusion at this stage, after examining some of the empirical results of concentration and profit rates, is that concentration does seem to influence profit rates but also that concentration is a quite inadequate measure of competition. This is indicated by both the diversity of the results of these analyses and also by the effect of introducing conceptually new dimensions of competition.

It is worth noting Bain's conclusions on the condition of entry and the workability of competition. Industries with high barriers tended towards high excess profits and monopolistic output restriction. Lower, though substantial, entry barriers tended towards smaller excess profits, and a lesser degree of monopolistic output restriction. Those with low barriers seemed to be plagued with inefficiency of chronic or recurrent excess capacity (excess capacity because, perhaps, of a secular decline in demand against long-lived equipment, in which case average price is below average cost, although this is not an inducement to entry nor is it a barrier to entry if the price were to rise and persist above long-run minimal average costs). Lastly, performance may be higher, in general, with moderate to low concentration in industries with substantial or moderate to low barriers to entry. Lastly, the main culprit in establishing barriers to entry, would seem to be product differentiation. Moderate barriers are fairly innocuous and extreme economies of scale posed a serious problem in only two out of twenty industries.

CONCENTRATION AND ECONOMIES OF SCALE

We move on now to discuss the relationship between concentration and economies of scale. The question at stake is whether we can reap economies of scale and at the same time enjoy the advantages of atomistic competition. Scherer[25] has paid attention to this question. And sums up "..... a long and complex chain of analysis, integrated consideration of plant scale economy imperatives, the decentralising pull of transportation costs, and plant specialisation patterns, leaves us less sanguine about the opportunities for enjoying minimum production costs and atomistically structured markets simultaneously. Although concentration approaching oligopoly threshold levels, on a nationwide four-digit industry plane, appears mandated by scale economies in only a small minority of cases, the threshold may be breached in perhaps as many cases as not when regional market fragmentation and plant specialisation forces intrude."

Scherer[26] took as his data on minimum efficient scale, estimates by Bain,[27] Pratten, Silberston and Dean,[28] and Scherer, Beckenstein, Kanfer and Murphy.[29] These estimates were achieved by (Bain's) engineering analysis supplemented by questionnaire and interview data, (Pratten et al) engineering data in terms of production and material costs only and (S.B.K.M.) through interview data.

We might dwell briefly on some other estimates that he took. He drew a distinction between plant size economies and the economies from the volume of output of a single product; and concluded[30] ... "It seems clear that the links between concentration and the realisation of product-specific scale economies in production are quite intricate. Higher concentration _may_ permit larger production lots and longer runs, but by paralysing price incentives for specialisation, it can also work in the opposite direction. We need to know much more about the conditions under which one propensity is stronger than the other."

Although this analysis is based on U.S. data, it suggested that economies of scale are not, in general, important in relation to the total market, and therefore, in terms of concentration, are not a necessary pre-requisite. In other words, we do not need high concentration to achieve the advantages of scale economies in general. Pratten's evidence, however, suggests that appreciable economies of scale existed in the industries he studied in relation to the size of the total market. However, his research was biased towards such industries.[31]

CONCLUSIONS

Now the point of the discussion so far is two-fold. Firstly, we have illustrated the inadequacies of measures of competition. In summary - the single overall measure hides possible frictions in the market and therefore tells us little about the behaviour and performance of firms in that market except in a very general way and in certain cases. It does little more than provide some hints.

Secondly, we have noted that given this single measure it seems likely, but is not necessarily the case, that output will be restricted and profits higher in more concentrated industries. And when we look at recent research on economies of scale, concentration is not necessarily justified in those terms. This last point, of course, is what we are interested in here. Is the competitive environment such as to favour firms of minimum efficient size, and as such encourage firms to grow to minimum efficient size or leave the industry. What we are interested in is more precise measures of competition. And it is to this we now turn.

COMPETITION AND IRONFOUNDING - SOME ALTERNATIVE MEASURES

Our examination and discussion of measures of competition will be specifically related to ironfounding. As such a brief introduction to the special circumstances of ironfounding will be given here.

In terms of competition we are analysing a fragmented industry with a heterogeneous output. The industry is, for the purposes of the census of production, defined on the basis of principal products. In general, firms in the industry receive contracts from customer firms.

One special case is the "tied" foundry, discussed earlier. Tied foundries either wholly produce castings for their own internal use, or they will produce also for the general market. In some cases production for their own use may be considered by the buyers of their products to be competitive with similar possible supplies from outside firms. In this way, many firms in our sample, considered themselves to be competitive with outside firms despite the fact that part of their market is captured. In this respect we might generally assume that in the long run such tied foundries will necessarily need to be as efficient as their counterparts in the industry in general. They may, of course, have some advantages, in particular the advantages of vertical integration, of which transport costs, production planning and quality control are but three examples.

MEASURES OF COMPETITION

What economics tells us is that in general there are three aspects of competition. There is a market, there are sellers and there are buyers. Furthermore, the typologies of competition lie on a continuum from monopoly to perfect competition, each with definitive characteristics.

We are here going to develop a framework to describe competition so that we can indicate whether significant economies of scale will penetrate throughout the industry in such a way as to create cost advantages and disadvantages due to scale.

It seems to us that in developing a framework to examine the frictions in the market, theoretical economics gives us only some indications of what to look for in practice. We have already isolated three relevant issues important to us here. These are imperfections in the market, the number of competitors, the behaviour of competitors, the possibilities of oligopsony and the degree of free entry.

Now the cornerstone of competition, as we see it, is that there is a market. This market in ironfounding may be defined in at least two ways, from the point of view of supply.

(i) Firms actually producing a product, on contract.

(ii) Firms having the potential of meeting that contract.

We thus expect more firms to be capable of producing the product than actually do. Hence the number of firms in (i) is less than the number of firms in (ii). This is process based competition.

Now given this market - a market containing actual producers and a penumbra of potential producers - two questions arise. What is the competition within this market and what differentiates this market from other markets within the industry.

Now competition within the market may take the form of collusion or strong price competition, for example. And different competitive groups of firms may differentiate themselves from each other because they have different production functions. Differentiation will be based both on capability and efficiency in producing any specific product. Apart from the likelihood of overlap between one competitive group and the next, differences as we have said will depend upon the efficiency of the factor combination in the first group relative to its output and the efficiency of the factor combination in the second group relative to its output. Differentiation between these groups will be due to possible incapabilities in producing similar outputs or simply differences in the efficiencies of producing the same output. This is a form of specialisation.

COMPETITION WITHIN THE GROUP

In contract work specifications are laid down and what firms are selling is the ability to fulfil the contract (the products themselves will be different). These firms will differentiate themselves in the way they display this ability. Now in the general case differentiation takes the form of advertising, differences in design, customer service, quality, maintenance, etc.

These differences allowing firms some control over price.

These alternative forms of competition must be legitimate. There is no point in advertising if advertising a product is known to be useless. And it is in this respect that firms will perceive competition as important norms relative (and relevant) both to their customers and to the behaviour of their direct competitors. Where buyers are assumed to be rational, they will accept products from firms which best meet their requirements. In the case of ironfounding, given their own production function and product market.

Thus in seeking to answer the question of competition between firms in a group, we have drawn a conceptual distinction between these relevant competitive variables (whether they be price, quality or whatever) and the degree to which individual firms believe they have a competitive advantage over their competitors as a result of, for example, lower price, or higher quality.

Firms seeking to maximise their profit will do so with respect to these characteristics of demand. Firms will seek to influence the demand curve facing their individual firm. In so doing they will adjust to the market requirements.

THE SIZE OF THE COMPETITIVE GROUP

Competition within the group will be affected by the number of direct competitors and the protection the group is afforded. In this case there may be no competition (collusion) or other oligopolistic forms of competition if the group is small.

THE THREAT OF NEW ENTRY

The threat of new entry, as we have seen, effectively destroys the protection which might otherwise be afforded to the group.

FORMS OF NEW ENTRY

Protection depends on new entry. In this industry two forms of new entry are considered. The first is the extent to which competitive groups are differentiated from each other, and the second is the degree to which substitute products are available from other industries.

Hence in addition to competition within the group, the boundaries defining the kind of contracts which firms can fulfil within each submarket is a further dimension of competition. Given that our supply is defined in terms of the ability to produce, we may expect that this ability has short term boundaries. In addition, we would expect these boundaries to define the upper limits for one group of firms, but not necessarily the same limits for another group of firms working in a different submarket. We would expect overlap. It is precisely the existence of these boundaries which provides at least the short run protection for firms in one submarket relative to firms in other submarkets. The more "real" the boundaries the greater will be the exclusiveness of the submarket.

The condition of free entry is difficult to estimate. One restriction on the behaviour of firms in this industry, however, is the impact of substitutes available from firms producing similar products in other industries.[32]

OTHER ISSUES

The importance of scale economies restructuring the ironfounding industry across the board requires that firms should compete with firms of differing size. Thus a further necessary test, in addition to the competitive behaviour of firms, is the size distribution of competitors.

Next, as we have seen, buyer strength is an important element in industries which supply customer industries. Hence we are interested in the dominance of customers over the supplier firms.

COMPETITION AND IRONFOUNDING: THE APPROACH

We accepted the notion discussed earlier that firms would comprise competitive groups. And because firms needed to be classified by process, we assumed that this would be the basis for direct competition and the discriminating factor between competing groups.

In addition we assumed that each competitive group would have norms of competition associated with them. The features of such competitive norms might be price or non-price competition but they would be features which were perceived as important aspects of the demand requirements for products produced by the competitive groups. And although we would expect firms to have a regard for prices of competing firms, other factors would also be important in terms of buyer firms choosing between competing firms.

In one respect such differences might be seen to reflect differences in general efficiency otherwise these differences might be described as those similar to product differentiation.

Given these "norms" of competition within the group, firms will compete in terms of their relative ability to satisfy these conditions.

Let us explain this most carefully. We discovered as our later analysis will show that there were three extremely important competitive norms - price, quality and delivery. Now the implication of this is that customers considered these three aspects to be very important in deciding their buying policies. Now, if competition is perfect, no firm will have a comparative advantage over other firms in the competitive group if equilibrium subsists. If competition is not perfect there will be differences.

The extent to which firms face a downward sloping demand curve, at any moment in time, will depend upon (we assume) real differences, and these differences are a function of the demand curve which we accept to be the competitive norms of the group.

THE QUESTIONS ASKED

Our information was collected from firms in the industry. The approach was through a postal questionnaire. Questionnaires, as a research tool for gaining information, pose special problems in their own right. Particularly the technique requires of the respondents the ability to internalise the questions and the knowledge to answer them. We shall assume this to be a legitimate method and move on to examine the questions asked.

We have already examined the framework, a pilot study indicated which precise questions were most relevant. On competition within the group of firms price, reliable delivery, quality and location were indicated to us to be of most relevance. The importance of location (an odd man out) is precisely the importance of transport costs and regional markets. Such costs might offset gains in terms of production costs with increasing size and output.

Firms were asked the importance of these variables in terms of the firms they competed with (Question 2). Complementing this question was whether they felt they had a competitive advantage on these variables over and above the other firms they competed with (Question 3). The basis of competition (Question 4) incorporated a series of technical variables, except for one, which was to discover whether competitors were located within a particular region. Competition from substitute products (Question 1) was a simple direct question as were the number of direct competitors and the size distribution of these competitors (Questions 5, 6, 7).

THE IMPORTANCE OF BUYERS

As we have seen buyer strength is an important variable. It is however difficult to define and we examined the following aspects of this question. First, the degree of dependence of the firm on its principal buyer (Question 30). This was defined as the importance (in terms of the output of the firm) of the major customer. We examined also possible interdependence or dependence of the buyer on the firm (again in terms of the proportion of total purchases of that supplier from that firm) (Question 32). Two other related aspects of this question were the total number of customers (Question 28) and the number of different markets operated in (Question 35).

EMPIRICAL RESULTS ON COMPETITION

CONCENTRATION

As we have seen, concentration is a proxy measure for competition. The concentration ratio for the five largest ironfoundries in 1963 was 33%. Nearly two-thirds of all iron castings are made in 78 foundries producing more than 10,000 tons of castings a year. As such the industry can be described to have just medium concentration levels and it is the effect of this that we are now interested in.

THE TECHNIQUE OF ANALYSIS

Replies from firms are first presented analysed as a whole. Because we are interested in scale economies and our technique of analysis is to examine a cross-section of firms of different sizes, we are also interested in differences in our competitive variables which are related to the size of the firm; these differences will be presented after the main analysis. In addition, we disaggregated the industry into tied foundries, jobbing foundries and repetition foundries. Again differences will be presented after the main analysis.

THE COMPETITIVE GROUP

PERCEIVED COMPETITIVE NORMS OF THE COMPETITIVE GROUP

We have discussed the importance of the competitive norms of the group. Perception of these norms has a dual purpose. First it indicates aspects of the demand for products produced by the groups and, second, because these aspects are perceived by firms, the replies are important insofar as they indicate the expected demand rather than the actual demand, although expectations and facts may coincide. What is indicated is what firms believe is expected of them rather than what may be possible in terms of competitive pricing and output strategies with a known individual demand curve, or indeed with collusion.

Firms were given a choice of four aspects of competition to rate separately on a five point scale from "extremely important" to "not at all important". Firms were not asked to rank order their replies (they could claim that all four aspects are extremely important). We hoped to be able to test the questionnaire for discrimination by allowing these choices. No reply was a further alternative. The question was also open ended so firms could include other important aspects.

Table 6.1 is a frequency distribution of the results. It will be noticed that price, quality and reliable delivery are all rated very or extremely important in about 80% of replies. The distribution is highly skewed. Location is very much less important and the distribution is skewed in the other direction with 64.4% of firms saying it is unimportant. Table 6.2 indicates the mean and standard deviation of the distribution.

Table 6.1

PERCEIVED COMPETITIVE NORMS OF COMPETITIVE GROUP

	Extremely Important	Very Important	Moderately Important	Not very Important	Not at all Important	n
Price	62 (50)	44 (35.5)	13 (10.5)	3 (2.4)	2 (1.6)	124 (100%)
Reliable delivery	48 (38.7)	52 (41.9)	20 (16.1)	1 (0.8)	3 (2.4)	124 (100%)
Quality	53 (43.4)	49 (40.2)	17 (13.9)	1 (0.8)	2 (1.6)	122 (100%)
Location	4 (3.4)	6 (5.1)	32 (27.1)	51 (43.2)	25 (21.2)	118 (100%)

Table 6.2

PERCEIVED COMPETITIVE NORMS: STATISTICAL SUMMARY

	$\overline{x}$	S.E.	S.D.
Price	1.728	.082	.919
Reliable delivery	1.880	.081	.903
Quality	1.797	.080	.887
Location	3.714	.091	.993

This analysis isolates location but does not discriminate between the other three. The implication of this is that the competitive group is perceived as competing in three equally important aspects. However, this aggregate importance conceals relative differences perceived by respondents in different firms.

Spearman rank correlation coefficients were computed between pairs of the four variables; only one significant result was obtained: this was a correlation of .3840 between quality and delivery, suggesting similar rankings. However, the correlation coefficients between all other pairs were insignificant at the 5% level suggesting no general consistency in the ordering of the variables. Thus not all firms agreed on the order of the importance of the four variables.

The results imply that firms are price competitive but stringent competitive requirements are also required on both delivery and quality. Further interpretation can be made by examining perceived competitive advantages. But before we move on we shall examine replies under "other" - additional remarks made by respondents to this question.

Below (Table 6.3) is a frequency distribution of these included factors.

Table 6.3

SPECIAL FACTORS AFFECTING PERCEIVED COMPETITION

		n
1.	Personal contact	5
2.	Company service/after sales service	3
3.	Quick response to production problems	3
4.	Type of plant/production technique	2
5.	Special knowledge of customer industry	2
6.	Own pattern shop and machining	1
7.	Effective sales organisation	1
8.	Technical assistance on design	1
9.	Possible range of castings	1
10.	Importation	1
11.	Specialisation	1

One of the surprising results indicated in this table is that so few suggestions were made. We would expect that other factors were important, but the infrequency of alternative replies suggests to us that we have included the major factors.

PERCEIVED COMPETITIVE ADVANTAGES OF THE FIRM

We move on to consider the major interrelated question. The perceived competitive advantages of the firm relative to its competitive group. Table 6.4 is a frequency distribution of the results. Respondents were asked to reply to this question in a similar manner as the first question. The modal results are first, delivery; second, high quality advantage; and third, low price advantage.

Examining the mean and standard error (Table 6.5) we find that delivery advantages are singled out as more important than price advantage or quality advantage, both of which are "important". This suggests that firms are relatively inflexible over price and quality. Flexibility revolves more around delivery promises. Again location is unimportant.

The distribution of replies under price advantage (Table 4) indicates that firms are actively price competitive but for a greater proportion of firms comparative advantages are achieved through delivery and quality.

Table 6.6 shows the correlations between perceived competition and perceived own advantages. High correlations exist between delivery and location, less so for quality. There is a low correlation between price and low price advantage. The latter suggests a general inflexibility over price.

One argument for a stronger correlation on delivery compared with quality competition is that quality has a greater time dimension than delivery. Firms can make

Table 6.4

PERCEIVED COMPETITIVE ADVANTAGES OF THE FIRM RELATIVE TO GROUP NORMS

	Extremely Important	Very Important	Moderately Important	Not very Important	Unimportant	n
Low price advantage	27 (22.3)	35 (28.9)	39 (32.2)	12 (9.9)	8 (6.6)	112 (100.0)
Delivery advantage	51 (41.5)	45 (36.6)	22 (17.9)	4 (3.3)	1 (0.8)	123 (100.0)
High quality advantage	37 (31.6)	35 (29.9)	25 (21.4)	11 (9.4)	9 (7.7)	117 (100.0)
Locational advantage	5 (4.3)	15 (12.9)	32 (27.6)	42 (36.2)	22 (19.0)	116 (100.0)

Table 6.5

PERCEIVED OWN ADVANTAGES: STATISTICAL SUMMARY

	$\bar{X}$	S.E.	S.D.
Low price advantage	2.492	.103	1.137
Delivery advantage	1.841	.081	.901
High quality advantage	2.339	.115	1.249
Locational advantage	3.504	.101	1.096

Table 6.6

COMPETITION - FACTORS AFFECTING COMPETITIVE BEHAVIOUR

NON-PARAMETRIC SPEARMAN
ZERO ORDER CORRELATION COEFFICIENTS

Own competitive advantages	Perceived factors affecting competition			
	Price	Delivery	Quality	Location
Low price	.1792 n = 122 sig. .048			
Delivery advantage		.7482 n = 124 sig. .001		
Quality advantage			.4543 n = 117 sig. .001	- 0.1193 n = 115 sig. .003
Locational advantage				.6790 n = 116 sig. .001

delivery promises more easily than they can assure high quality.

Table 6.7 examines the relationship between competitive advantages. No significant correlation exists except that there is some trade-off between price advantages and high quality. As quality becomes more important price becomes less important though the coefficient is small. (Because high quality advantages were negatively correlated with locational advantage, a first order correlation was computed between quality and price controlling for location, this raised the correlation coefficient.)

Table 6.7

RELATIONSHIPS BETWEEN OWN ADVANTAGES

	Low price	Delivery	High quality	Location
Low price	x	insig.	- .2197 n = 115 sig. .018	insig.
Delivery		x	insig.	insig.
High quality			x	- .2335 n = 112 sig. .013
Location				x

Since quality and location correlated, we examined the trade-off between price and quality controlling for locational advantage.

Low price - .2640 with high quality
dof. 44 sig. .038

Before leaving "perceived competitive advantages" we turn to factors submitted by firms under "other". Table 6.8 is a frequency distribution of the results.

Table 6.8

SPECIAL FACTORS INCLUDED UNDER "PERCEIVED COMPETITIVE ADVANTAGES"

		Frequency
1.	Direct contact with customer	9
2.	Cosmetic appearance of finished casting	1
3.	Specialist knowledge/experience	4
4.	Flexibility	4
5.	Rapid estimating	2
6.	Long association	2
7.	Specialised production	4
8.	Company service/after sales service	5
9.	Good transport rates	1
10.	Aggressive sales policy	1
11.	Wide range of size and grade of iron	1

Again we are surprised that so few firms suggested alternative factors. And again it would appear that the major variables were considered.

THE DEFINITION OF THE COMPETITIVE GROUP

We turn now to the definition of the competitive group. A more provocative way of seeking an answer to this, it seemed to us, was not to ask the question: "on what basis do you differentiate yourselves competitively from other firms?" but does "the extent to which you compete with other firms depend upon whether they ...... (possess certain characteristics)?"

We were interested here particularly in the technical aspects which differentiated groups. Six general categories were chosen but region was included to discover whether competition was generally contained within a region.

Now although the question is an important dimension of competition the significance of the results is hard to analyse. This is because it is difficult to estimate the precise implication of these factors in defining competitive groups.

Table 6.9 is a frequency distribution of the results. It can be seen from the table that "special equipment", "numbers off" [length of production run], and "finishing processes" are skewed more towards "extremely important" than the other factors, although box size is important. Versatility, proof machining and region are less important (Table 6.10).

Now these technical generic groupings are themselves variables. Thus the importance of any one defines a boundary at any point along that variable. This is to say that given that 31 respondents agreed that "special

Table 6.9

FACTORS AFFECTING THE BASIS OF COMPETITION

	Extremely important	Very important	Moderately important	Not very important	Unimportant	n
Special equipment	31 (27.9)	27 (24.3)	18 (16.2)	19 (17.1)	16 (14.4)	111 (100.0)
Box sizes	17 (14.9)	37 (32.5)	27 (23.7)	19 (16.7)	14 (12.3)	114 (100.0)
Numbers off	23 (21.3)	30 (27.8)	22 (20.4)	19 (17.6)	14 (13.0)	108 (100.0)
Versatility	13 (12.1)	30 (28.0)	26 (24.3)	17 (15.9)	21 (19.6)	107 (100.0)
Region	8 (7.5)	12 (11.2)	26 (24.3)	30 (28.0)	31 (29.0)	107 (100.0)
Finishing processes	22 (20.6)	24 (22.4)	32 (29.9)	15 (14.0)	14 (13.1)	107 (100.0)
Proof machining	5 (4.9)	7 (6.9)	11 (10.8)	29 (28.4)	50 (49.0)	102 (100.0)

Table 6.10

STATISTICAL SUMMARY OF THE FACTORS AFFECTING THE BASIS OF COMPETITION

	$\bar{x}$	S.E.	S.D.
Special equipment	2.661	.133	1.411
Box sizes	2.791	.116	1.239
Numbers off	2.734	.127	1.324
Versatility	3.046	.127	1.321
Region	3.611	.118	1.229
Finishing processes	2.778	.124	1.292
Proof machining	4.097	.113	1.142

equipment" was very important in defining the basis of competition from which they competed with other firms, this does not imply that these 31 foundries had the same equipment or competed with each other.

It is precisely for this reason that these factors only indicate the items which differentiate groups and in most cases (table 10) they are important.

In analysing this question two other interrelated questions were considered. First (Table 6.11) did correlations between these factors imply a particular kind of foundry - jobbing or repetition? and second, did these items imply a particular kind of competitive behaviour within the competitive group?

Although we will not dwell on this aspect, Table 6.11 indicates that many of the factors were themselves inter-correlated. These were not correlated with a particular type of foundry (jobbing or repetition) neither did they significantly affect competition in any subgroup.

<u>Table 6.11</u>

ANALYSIS OF THE BASIS OF COMPETITION

	Special Equip. ment	Box Size	Numbers Off	Versatility	Regional	Finishing Processes	Proof Machining
Special equipment	x	.4606 n = 110 sig. .001	insig.	insig.	insig.	insig.	insig.
Box size		x	.3750 n = 107 sig. .001	insig.	insig.	insig.	.2615 n = 101 sig. .008
Numbers off			x	insig.	insig.	.3294 n = 105 sig. .001	.4010 n = 99 sig. .001
Versatility				x	.4136 n = 106 sig. .001	insig.	insig.
Regional					x	.3632 n = 106 sig. .001	insig.
Finishing process						x	insig.
Proof machining							x

Additional factors volunteered in answer to this question are given in Table 6.12.

Table 6.12

ADDITIONAL FACTORS AFFECTING THE BASIS OF COMPETITION

		f.
1.	Craft foundry	1
2.	Metal grades/trade names	1
3.	Ability to change	1
4.	Competitors sales effort	1
5.	Own pattern shop and machining facilities	1
6.	Heat treatment	1

Our results on the basis of competition begs more questions than it answers. Do differences form an effective barrier between groups and, if so, how important are these barriers in affecting possible competitive behaviour within each group? How much do these groups overlap? To what extent do these factors imply specialisation? What time dimension do these barriers imply?

THE NUMBER AND SIZE DISTRIBUTION OF DIRECT COMPETITORS

Table 6.13 is a frequency distribution of the number of direct competitors. The modal value is between 4 and 10 firms and well over half the sample (65.5%) had between four and twenty competitors. Essentially, though, direct competition is amongst "the few".

Allied to this question in an investigation of economies of scale is the relative size distribution of direct competitors. This is the relative size of firms competing for the bulk of the output of individual foundries. Table 6.14 shows that over 50% of firms in our sample were competing mainly with firms of the same size. The rest, in our sample, were competing with mainly larger firms. In our questionnaire we asked firms to define the size group they competed with if it was not the same. In general, if firms did compete with larger or smaller firms this indicated the size group either immediately above or below their own. This is to say, in our questionnaire, firms of size 26-50 employees competing with "larger" firms would normally indicate that these "larger" firms were employing 51-100 employees.

Table 6.13

NUMBER OF FIRMS COMPETING DIRECTLY

	n	%
None	6	6.9
1- 3	14	16.1
4- 10	38	43.7
11- 20	19	21.8
21- 50	6	6.9
51-100	2	2.3
101-200	1	1.1
201 +	1	1.1
	n = 87	(100)

Table 6.14

ARE COMPETITORS MAINLY OF THE SAME SIZE?

	f.	%	n
Yes	66	55.5	119
No	53	44.5	

IF NOT, ARE THEY -

	f.	%	n
Larger?	37	78.7	47
Smaller?	10	21.3	

NEW ENTRY COMPETITION

Given that competition is amongst the few and although firms are price competitive, if we are going to make some statement about economies of scale reshaping the ironfounding industry it becomes vital to discover whether these firms are likely to reap excess profits.

As we have seen, one crucial variable which we may accept as having important implications for small group competitors is the extent to which competition within that group is "threatened" by new entry competition. We have already distinguished between potential new entry and actual new entry but it is important to consider one other form of new entry competition. This is the potential for substitution of products made within the competitive group. Such a threat will be determined by the cost function of the potential (substitute product) new entrant. Clearly this will have important implications for the upper most end of the demand curve facing all firms in the group. Also the extent to which the substitution is actual (given preferences are rational) will effect the shape and position of the demand curve. Thus we may safely assume that the demand curve will both move to the left and become more elastic for any single firm within the competitive group given actual substitute competition from outside.

The idea of substitution is a more real consideration for the ironfounding industry simply because (a) [as we shall see] profits are not excessive, and (b) [as N.E.D.O. points out][33] the industry is threatened by technological change in the products produced by the customer industries.

When considering potential new entry it is important also to realise that these firms are already well established in other industries and not therefore a new venture coming into the industry at perhaps a small scale.

Table 6.15 is a frequency distribution of the results obtained. Sixty per cent of firms did so compete and these competitive products are listed below. The significance of the threat of potential entry in an industry which is not growing is to place a constraint on the upper limit of price. We can imagine that as you go up the demand curve it becomes increasingly elastic insofar as a switch would be made to alternative products if castings were not forthcoming at a competitive price. These substitute products are listed in Table 6.17.

There was some indication that vertically integrated foundries were more sensitive to such potential competition than firms exclusively producing castings. However, we would expect such firms to be more alive to possible future changes because of their more intimate connection with the final product. At the same time, at least fifty per cent of firms exclusively producing castings were "aware" of possible substitution. The results were not size dependent (Table 6.16).

Table 6.15

COMPETITION WITH SUBSTITUTE PRODUCTS

	f.	%	n
Yes	76	60.3	126
No	50	39.7	

Table 6.16

FIRMS PRODUCING PRODUCTS OTHER THAN CASTINGS

Size (employees)	Yes	No	n
Under 25	6 (54.5)*	5 (45.5)	11 (15.1)
26- 50	6 (40.0)	9 (60.0)	15 (20.5)
50- 100	9 (50.0)	9 (50.0)	18 (24.7)
101- 200	10 (66.7)	5 (33.3)	15 (20.5)
201- 500	5 (55.6)	4 (44.4)	9 (12.3)
501-1000	2 (50.0)	2 (50.0)	4 (5.5)
1001+	1 (100.0)	- (0.0)	1 (1.4)

*Figures in brackets refer to percentages across.

Table 6.17

SUBSTITUTE PRODUCTS FOR IRON CASTINGS LISTED IN REPLIES

1. Fabrications
2. Non-ferrous castings
3. Steel castings
4. Plastics
5. Forgings

In general, a useful analysis would involve a comparison of the costs of production and the quality of products made by substitute techniques as compared with iron castings. However, given the range of products, such a task would be heavily time consuming and is certainly outside the scope of this thesis.

BUYER CONCENTRATION: THE THREAT OF MONOPSONY

In addition to the competitive variables already discussed, we wish to examine some further structural features of competition in this industry. This is from the point of view of the customers of the firm.

In so doing we examined four features of buyer concentration. These were:-

(1) the importance of the principal customer to the firm,

(2) the dependence of that principal customer on the firm,

(3) the number of customers,

(4) the number of different markets operated in.

Clearly this area of economics does not provide determinate solutions for different strengths of dependence. However, the following points can be made.

1. Firms highly dependent on large buyers will sell at a cost to the buyer which is as low as possible. This in the long run cannot be below average cost to the seller.
2. Where interdependence exists, sellers and buyers will both attempt profit maximisation.
3. Situations (1) and (2) depend on the exclusiveness of competition.
4. Some indication of this exclusiveness from the seller side will be the alternative opportunities of the firm, as compared with the alternative opportunities of the buyer firm.

5. Alternative opportunities are a dynamic consideration. For the firm some indication of this will be the comparative number of customers and markets the firm already operates in.

We examined customer relationships on a four point scale. This is reproduced below (Figure 1).

Figure 6.1

THE IMPORTANCE OF THE FIRM TO THE CUSTOMER AND THE CUSTOMER TO THE FIRM

1A. The importance of our largest customer.	1B. The degree of dependence of our largest customer on our firm for iron castings.
The largest customer is our	We are -
sole outlet (100% output)	sole supplier (100% purchases)
major outlet (50-99% output)	major supplier (50-99% purchases)
medium outlet (10-49% output)	medium supplier (10-49% purchases)
minor outlet (0-9% output)	minor supplier (0-9% purchases)

Now levels of dependence and interdependence may take the form of specialisation or special advantages subsisting between two firms. In any case, under such conditions, frictions would exist in the market.

The extent or the direction of the power conflict is not illustrated by this statistical relationship.

THE RESULTS

Table 6.18 indicates the dependence of the firm on its largest customer. The modal ranking is "medium outlet" but the mean lies somewhere between "major outlet" and "medium outlet".

Equally (Table 6.19) there is a high degree of dependence of that largest customer on the firm supplying them. The modal ranking is "major supplier" and the mean lies between "major supplier" and "medium supplier".

Because with firms which are tied there is a <u>necessary</u> relationship between the firm and the customer, Tables 6.21 and 6.22 isolate independent foundries from these tied foundries.

It can be seen from these tables that the general results do not alter much.

Table 6.20 indicates that there is a relationship between the importance of the largest customer and the dependence of the largest customer on that firm though this relationship is not strong. However, this measure only examines the degree of similarity between the rankings of the replies. Simple examination of the table indicates that customers are on average more dependent on the firm than the firm is on them.

Now, as we have said, the effect this will have on pricing will depend upon the alternative opportunities of both the customers and the suppliers. Before drawing any conclusions on this point we may further examine the degree of dependence of the firm by examining the number of customers supplied on average and the number of markets operated in. Naturally, theory gives us no indication of exactly what to expect, but if both were very small then the degree of dependence would be larger than if the

Table 6.18

DEPENDENCE OF FIRM ON THE LARGEST CUSTOMER

		n
(a)	Sole outlet	2
(b)	Major outlet	23
(c)	Medium outlet	40
(d)	Minor outlet	6
Total		71

Table 6.19

DEPENDENCE OF THIS LARGEST CUSTOMER ON FIRM

		n
(a)	Sole supplier	8
(b)	Major supplier	36
(c)	Medium supplier	21
(d)	Minor supplier	4
Total		69

Table 6.20

CORRELATION COEFFICIENTS OF INTER-DEPENDENCE

	r	n	sig.
All firms	.3348	69	.005
Independents only	.3369	38	.012
Jobbing foundries	.4349	20	.028
Repetition foundries	.2681	17	.149

Table 6.21

THE DEPENDENCE OF THE FIRM ON ITS LARGEST CUSTOMER FOR INDEPENDENT AND TIED FOUNDRIES

Largest customer is -	Independent	Tied
Sole outlet	- (0.0)	2 (6.2)
Major outlet	11 (28.2)	12 (37.5)
Medium outlet	23 (59.0)	17 (53.1)
Minor outlet	5 (12.8)	1 (3.1)
Total	39	32

Table 6.22

THE DEPENDENCE OF THE CUSTOMER ON THE FIRM FOR INDEPENDENT AND TIED FOUNDRIES

	Independent	Tied
Sole supplier	5 (13.2)	3 (9.7)
Major supplier	18 (47.4)	18 (58.1)
Medium supplier	12 (31.6)	9 (29.0)
Minor supplier	3 (7.9)	1 (3.2)
Total	38	31

reverse was the case.

The average number of customers was 142 and the average number of markets operated in was 4. Hence although this evidence is not conclusive, it would indicate that the degree of dependence of the firm is not that great, although further information is required on the importance in terms of output of these other customers.

In order to discover whether the dependence of the firm and the interdependence of the firm and the customer had any significant effect on competition, we examined correlations between these customer aspects and our competitive variables discussed earlier.

The results overall were not significant. On disaggregation, however, the following tendencies were suggested between the importance of the largest customer on the firm and our competitive variables. For jobbing foundries only, price competition was significantly less important (correlation -.39 n = 21) but the correlation coefficient was not strong. For repetition foundries only, location as a competitive factor was important the greater the degree of dependence on this largest customer (correlation coefficient -.48 n = 17). And for all foundries, and on disaggregation, there was a positive correlation between specialised equipment as the basis of competition and the importance of the largest customer (correlation: all foundries .3236 n = 68; independents .4749 n = 36; repetition .48 n = 17; jobbers .46 n = 19). This last result is probably the most important. It suggests that there is a degree of specialisation in the industry. However, despite this specialisation, in the absence of further correlations firms are generally still as competitive as we described before. There was no significant relationship, for example, between dependence and the number of competitors.

Having described competition overall, we will consider two other issues before concluding this chapter. The first is differences due to disaggregation and the second the effect of size of firm on our competitive variables.

1. ON DISAGGREGATION

We will recall that foundries could be subdivided on the following criteria. On an economic criterion - whether they were independent or tied, and on a technological criterion - whether they were involved in jobbing or repetition work.

(a) TIED AND INDEPENDENT FOUNDRIES

As we will recall there was a tendency for tied foundries to feel the impact of potential competition (correlation coefficient -.3638 n = 126). Besides this one statistically significant result, tied and independent foundries were statistically identical, on our competitive variables. Furthermore, as we indicated earlier, the importance to the firm of its principal customer and the dependence of that principal customer on the firm were logically related to the tied foundry. Hence positive correlations were found between these: (principal customer correlation coefficient .3361 n = 64, and dependence of customer correlation coefficient .5476 n = 38). However, as we noted from the tables on this issue, the mean value for both lay between major and medium supplier/outlet.

(b) JOBBING AND REPETITION FOUNDRIES

No differences were found on disaggregation on competitive variables. Three statistical tests were undertaken: non-parametric (Spearman) correlation coefficients, a t-test and an F-test. All were consistent.

2. SIZE

Our interest in the size of the firm is two-fold. First our study of economies of scale uses the cross-sectional approach; thus in our later analyses, when we consider economies more closely, we are interested in whether the circumstances facing firms of different sizes are the same. Second, our hypothesis, illustrated by the survivor technique, may be interpreted by differences which might exist due to differences in the size of firm and competition alone.*

(a) THE RESULTS

Two tests were conducted. One, using the technique of simple correlation, the other an F-test. No significant results were found using the F-test,

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*For example, small firms might be more competitive than larger firms.

size plotted on a seven point scale. However, some statistically significant correlation coefficients were observed. Particularly these were the following. Quality advantages were more important for larger firms (quality advantage with size, correlation coefficient -.2304 n = 117). And larger firms tended to compete with a larger number of foundries (correlation coefficient .2285 n = 88). However, in both cases, the correlation coefficient is very small indeed.

SUMMARY

On disaggregation and in comparison with size few statistically significant results were obtained. These were marginal. It is important, however, to raise one issue due to the lack of any relationship with size. This is that because no relationship was found between the number of customers, the number of markets operated in and the firm's relationship with its customers and the customer relationship to the firm, then there is no proportional relationship with size. But in absolute terms the importance of any individual customer or market is necessarily greater for the larger firms.

CONCLUSIONS

Table 6.23 is a good summary table of the results discussed in this chapter. A factor analysis[34] conducted on the competitive variables considered, illustrates that nearly all the variance of the individual factors can be accounted for by factors other than price. However, price competition is very important, hence we may safely assume that firms have little or no control over price but compete on other variables. In more detail our results were as follows:-

1. Firms perceive competition to be based equally on price, delivery, and quality.
2. Firms are not very flexible over the prices they charge but compete more importantly on delivery. However, there is a high correlation between the degree to which delivery is important and the comparative advantages of firms to delivery competition. Which suggests that inefficiencies or differences in delivery are not great.
3. The degree to which firms are unable to meet quality demands is much greater and this may be a significant factor affecting the demand to individual firms. To some extent there is a trade-off between quality advantages and the importance of price as an advantage. And in addition there was some indication that quality advantages were positively related to the size of the firm.

Table 6.23

FACTOR ANALYSIS OF COMPETITION: VARIMAX ROTATED FACTOR MATRIX

		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
1.	Competition from substitutes	0.21371	0.01755	0.03743	0.06707	0.54501	-0.08708	0.25115
2.	Price competition	0.10134	-0.12874	-0.04381	-0.14211	0.06402	-0.17876	-0.87957
3.	Delivery competition	0.84119	-0.04578	0.20348	0.24982	0.28774	0.04543	-0.16938
4.	Quality competition	0.35104	0.08720	-0.00006	0.72561	0.02292	0.19021	0.01380
5.	Local competition	-0.13103	0.69749	0.00040	-0.00043	0.18872	0.06925	-0.06568
6.	Low price advantage	0.25333	0.04255	0.06596	-0.23924	0.36241	0.01660	-0.14056
7.	Delivery advantage	0.89286	-0.18735	-0.20209	0.08269	-0.0119	0.08502	0.01145
8.	High quality	0.01485	-0.06785	0.04557	0.82952	-0.3085	-0.03027	0.12105
9.	Locational	0.09122	1.11455	0.14988	-0.02469	-0.01454	0.19469	0.04202
10.	Special equipment	0.08784	0.26229	0.53004	-0.01216	0.31306	0.31314	0.24424
11.	Box size	0.06058	0.20816	0.44720	0.04320	0.26133	0.63383	0.03917
12.	Numbers off	0.15258	0.05162	0.24587	-0.09022	-0.04765	0.84026	0.06892

		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
13.	Versatility	0.22477	-0.06755	0.51267	0.21153	-0.30048	0.59336	-0.08718
14.	Regional	-0.18356	0.33192	0.43582	-0.23150	0.11326	0.05919	0.21340
15.	Finishing processes	-0.04119	-0.03804	0.60979	0.28236	-0.06826	0.33014	0.32039
16.	Proof machining	-0.25252	0.20584	-0.04849	0.30066	0.13412	0.61235	0.29630
17.	Number directly compete	0.01298	0.02689	-0.53256	0.02542	0.12025	-0.09646	0.14343
18.	Competition between same size	-0.06947	0.28539	-0.01494	0.01596	-0.07469	-0.01259	0.16238
19.	Proportion castings of sales	-0.07789	0.02654	-0.15800	0.00206	0.69934	0.10986	-0.19509

2, 3, 4, 5 = perceived competition
6, 7, 8, 9 = own advantages
10-16 = the common bases of competition
17, 18 = number of competitors and the comparative size of competitors
19 = proportion of sales accounted for by castings.

Factor	Eigenvalue	% of variance	Cumulative %
1	4.00992	32.3	32.3
2	2.54890	20.5	52.8
3	1.83879	14.8	67.7
4	1.47018	11.8	79.5
5	1.04994	8.5	88.0
6	1.78015	6.3	94.2
7	0.71465	5.8	100.0

PRINCIPAL VARIABLES ISOLATED:

Factor 1 reliable delivery competition/delivery advantage
2 locational competition/locational advantage
3 special equipment/versatility/finishing processes (neg.) number of competitors
4 quality competition/high quality advantage
5 competition from substitutes/proportion castings of sales
6 box size/numbers off/versatility/proof machining
7 price competition.

4. Firms do not compete effectively on price which suggests that it is given.
5. Any excess profits which might be gained within competing groups is likely to be offset by potential new entry.
6. The importance of other competitive variables considered tends to rule out the likelihood of collusion.
7. Points five and six tend to offset the importance otherwise of firms competing in small groups.
8. Location is an important factor affecting a minority of firms in our sample.
9. The degree of importance of the bases of competition separating competing groups tends to be a technological variable and the extent to which this divides competing groups uniquely from each other is a capital cost consideration outside the scope of the present research.
10. The degree of dependence of the firm on its largest customer is not insignificant, but bilateral agreements are more likely. Such dependence does (marginally) suggest specialisation.
11. The number of customers and markets operated in is (on average) large and unrelated to size, which would suggest that dependence is not an overwhelmingly important factor.
12. Firms on average compete with other firms of similar size. Those which do not tend to

compete with firms in the next size grouping. A separate test was conducted for those firms which were competing with firms of differing size, on our competitive variables, and no significant results were indicated.

IMPLICATIONS OF THE ABOVE CONCLUSIONS FOR ECONOMIES OF SCALE RESTRUCTURING THE INDUSTRY

1. Our analysis of competition suggests that firms within competing groups are independently price competitive, competing also on other factors. That the demand curve facing the individual firm is unlikely to be highly inelastic, on the contrary probably fairly elastic.
2. These conclusions have implications for cost conditions within each competitive group. Particularly, (1) that firms would seek to minimise long run costs; (2) that the likelihood of an across the board adjustment to minimum efficient scale tends to be ruled out by the technological factors which differentiate competing subgroups, together with the size distribution of firms within these subgroups.
3. The protection afforded to the firms through location, in terms of (a) competing with other firms, and (b) determining their optimum size is not important. Few firms had an advantage due to location.

The extent to which these competitive groups are exclusive product subgroups has not been determined.

What then becomes important is the optimum size for these products; and where these differ, in terms of our initial hypothesis - survivorship influenced by the presence of scale economies - the extent to which inefficient scales are shared. However, that competition is at least, in part, size specific, suggests that though within groups scale is important, across size as a broad dimension, scale is not.

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CHAPTER 7

ECONOMIES OF SCALE AND EFFICIENCY IN IRONFOUNDING

SYNOPSIS: In this chapter we discuss possibilities for measuring economies of scale in ironfounding. Because of the special difficulties involved, we decide to measure the relationship between efficiency and size. Three direct indices are considered: profitability, the Downie index and the Farrel test. In addition, three supportive indices are considered: the age of assets, contractual mix, and perceived advantages and disadvantages of competing with firms of differing size. Finally, we examine one scale dimension: the length of the production run.

First we will examine possibilities for measuring economies of scale.[1] Economies of scale refers to the long-run costs of the firm (plant). In theory it applies to an homogenous product. And the long-run average cost curve is the "envelope" curve of the short-run cost curves to the firm (plant). Some variables are measurable, but in an estimation of the theoretical concept of economies of scale, we come across fantastic difficulties. Speight[2] observes "that there are almost insuperable problems in the way of any attempt to construct a set of real life cost curves which correspond exactly to those we find in our text."

Ideally, empirical evidence on economies of scale should be obtained by observing the variations in costs associated with different scales of plant or firm, with all other influences held constant.

Two methods of study can generally be distinguished. One is the engineering approach, the other the statistical approach. The basic differences between these approaches is that the first may be described as essentially ex ante in nature, the latter ex post. Mixtures of the two have been used. For example, data based on engineering studies, combined with other data, is the preferred approach used notably by Bain[3] and Pratten.[4] The latter estimated minimum efficient scale from engineers, accountants and managers estimates.

THE ENGINEERING APPROACH

In the engineering approach each element of the production process is studied to discover the relation between inputs and outputs at different scales for that process. These relations are combined to give the overall input-output relations. Prices are introduced to transform these relations into cost-output relationships.

One notable study, using this approach, is that by Chenery[5] on pipeline transportation. The approach is attractive because hypothetical plants of different sizes can be simulated and their costs compared. Its main advantage is that many variables can be held constant, e.g., quality and type of output, quality of factors of production, location, etc. Thus the approach tends to embody the assumptions underlying the theory.

Data is usually collected on the costs of individual units of industrial equipment, initial investment in plant and equipment and operating costs.

The approach has, however, several shortcomings. It seems that economies of scale for plant is more susceptible to study through the engineering approach, and this in itself is limiting. The approach is also limited by the engineering data available. Usually data on presently utilised productive processes is used, when this is extended to larger scale these observations may be inappropriate. As Pratten[6] points out, scale observations above those actually existing may imply new technology contradicting the assumption of constant technology. Also the approach shows ideal rather than actual relations of size and cost; this may not be what we want.[7] Furthermore, because in practice the technique involves data sources of usually newly constructed plants of diverse sizes for which much work may already have been done by the firm for its own internal decision making, in a stagnant industry few firms will have thought of building new plants and hence above the unit cost consequences of alternative size dimensions.

Further difficulties arise because the pricing of factors in the engineering estimates would necessarily be determined by short run market conditions in the factor markets. And these factors are assumed to be in perfectly elastic supply. Other problems arise on a practical level. The number of observations generated is usually small. There are high costs in obtaining complex estimates. Further, the estimates may lack rigour, especially with conditions such as Haldi and Whitcomb's[8] "stochastic increasing returns." Here random variations may be a factor in reducing costs in larger organisations. The example they give is the stock of spare parts for machinery. Stock of particular parts will be lower in large organisations because the variance of the number of breakdowns will not increase in proportion to the size of the firm. Also, Walters'[5] main objection is that engineering data, like cost accounting data, relates to processes. One of the difficulties in translating such results into cost functions is that processes and the cost of processes may interact with one another and may not be additively separable.

Lastly, engineering estimates relate to technical economies of scale and as such management and the cost of management is ignored.

THE STATISTICAL APPROACH

The statistical approach usually concerns itself with either the production function or the cost function.

The cost function describes cost as determined by the level of output and the prices of inputs when the firm uses the most efficient technique. The cost function reflects not only technological conditions of production but also competitive conditions in factor markets.

Costs of the firm are defined as those payments which will induce factors of production to stay in employment.[10] The appropriate definition of cost in a long run competitive situation is that it is identical with revenue. Average long run cost then equals price. In a monopolistic situation, total costs will not equal price because some factors will be earning rents. Most studies exclude profits,[11] thus probably underestimating costs.

The main problem with statistical cost analysis is keeping the experimental data uncontaminated by the influence of factors extraneous to the relationship required. We really have two possibilities. First, to use time series data, whereby the average cost of a larger output is compared with a smaller output produced by the same firm. Then two problems arise. We cannot easily make the assumption of constant technology, neither given imperfect competition can we say more than that the result is true for that firm. Further, there is the problem of the firm being subject to exogenous shocks during the period of measurement. The second possibility is to investigate the long run average cost curve from cross-sectional data. Many problems arise and we shall consider these in turn.

If we consider estimating the theoretical long run average cost curve from a cross-section of competitive firms, we must note a most damaging criticism by Friedman.[12] He says the average cost curve will be the same for all firms and independent of the output of the industry. All firms in the industry will then show the same output and average cost. Any differences would be mistakes and appropriately valued by the market. Differences due to specialised factors of production would again, when valued by the capital market and by accountants, still show the same average cost for each firm. The answer to this is that in an imperfect world we can expect two things. First, size may be determined by local demand. Second, product differentiation will allow firms of different size to exist side by side.

The second point Friedman makes is that total costs should be equal to total receipts. Cross-section results would then show apparently constant returns. Again, in a less than perfectly competitive world, average costs would differ between firms. Such differences reflecting variations in prices charged by different firms and economies of scale.

The theory of cost curves assumes that in costs we include only those payments necessary to secure the factor services required. It would seem illogical then to include all profits and rents in costs.

Other difficulties[13] with cross-sectional data relate to the variability of conditions between firms of different size. These include the age of assets, the quality of management, differing payments to factors of production, external economies and diseconomies of scale, and so on. Thus, for example, if we should find that there exists some kind of L shaped curve, does this imply economies or simply that successful more efficient firms grow faster? Penrose puts this more simply.[14] If the cost is cheaper in a larger firm than in a smaller firm, and size is the only variable, then economies of size are present, though not necessarily economies of scale, for the lower cost of the additional output may be due only to the size of the firm that undertook it and not the scale at which the output itself is produced. Any solution to these problems would appear to rest upon careful interpretation supported by other data.

Another criticism is known as the regression fallacy. It is assumed that the output produced by each firm is a random variable and the variation of output about the mean value is not controlled by the firm. When firms are classified by output the largest firms are likely not to be producing at an abnormally high level on average, and the converse is true for small firms. This, as Smith[15] points out, means that the statistical approach generally assumes that each cost-size observation used represents a point on the long run cost curve, that is that every output studied is the optimal output for that plant or firm.

Lastly, Steindl[16] surveys the factors influencing the relative position of large and small firms besides the existence of economies of scale which will be reflected in the data. These really boil down to the fact that the combined effect of large scale economies, imperfect competition and oligopoly will be seen in the proportion of total costs to sales. Large scale economies will reduce costs, oligopolistic elements will increase price, and imperfections in the market will reduce prices and increase costs for bigger firms as compared with smaller firms.

Yet another problem is the diversity of output of individual firms. Only if it can be assumed that there is similarity of product mix between firms can this difficulty be partially overcome. Johnston[17] observes that this is not so much a statistical problem as a lack of theory:

> "The real world preponderance of multiproduct as against single-product firms is probably the inverse of the space their respective analyses occupy in economic theory. The theorist, in this context, is like a zoologist, whose task is to study the octopus. He reacts to the complexity of the beast by defining the octopus with only a single tentacle and proceeding to study that hypothetical creature very thoroughly, but unfortunately the real octopus with many tentacles may behave very differently from an imaginary octopus with only one."

From this brief review it would seem unlikely that a true long run average cost curve could be measured. However, different methods can be used to estimate the curve, and at best using the statistical approach, a "shopping list" type of analysis might allow for many of the confounding effects. Such an analysis, therefore, at least in part, depends upon the judgment of the researcher.

Two other approaches should be mentioned. One is the survivor technique; this has already been described in detail in Chapter 2. The other is concerned with asking managers what they think their long run cost curve looks like. The approach has the obvious advantage of saving time and money, but the main problem with the approach is first related to the businessman's understanding of the concept, and second, of his having the knowledge to answer the question. It is, however, useful insofar as it indicates the expectations of businessmen which has some relevance to growth theory.

In summary each technique has its advantages and disadvantages. Our concern is with the effect of economies of scale in practice and thus comparative cost analysis is the most amenable technique and it is to this we now turn.[18]

EFFICIENCY

In Chapter 3 we examined the concept of efficiency and noted that the concept could be defined in at least three ways: technical efficiency, allocative efficiency and scale efficiency. Scale efficiency is thus but one of a number of efficiency criteria and, as we have seen, to measure the scale curve we must assume that firms have adjusted to the other criteria.

Now it is possible to finesse the problem of measuring economies of scale by measuring overall efficiency. This is particularly the case when we are interested in economies of scale in practice.[19]

In measuring the efficiency of a cross-section of firms we are interested in the relative efficiency of firms of varying size. Similar problems of comparability arise and if we find that larger firms are more "efficient" we cannot conclude that this is due to economies of scale, without other evidence. All we can say is that it is simply size of firm which is important.

And the size of firms which exist in the industry at that moment (or moments of measurement in time).

On the other hand, if we find no difference in the relative efficiency of large and small firms we may conclude that economies of scale in practice are not important at the time of measurement. And this may be because firms of differing size are not exploiting scale advantages open to them in principle, or that they are inefficient on other criteria, or that imperfections in the market are sufficient to outweigh relative cost disadvantages.

SUMMARY

Thus economies of scale as we have described the concept implies a number of assumptions, especially that of minimising costs.

An example, Leibenstein[20] puts X-efficiency this way:

"There is an important type of distortion that cannot easily be handled by existing micro-economic theory. This has to do with the allocation of managers. It is conceivable that in practice a situation would arise in which managers are exceedingly poor, that is, others are available who do not obtain management posts, and would be very much superior. Managers determine not only their own productivity but the productivity of all co-operating units in the organisation. It is therefore possible that the actual loss due to such a misallocation might be large. But the theory does not allow us to examine this matter because firms are presumed to exist as entities that make optimal input decisions, apart from the decisions of its managers. This is obviously a contradiction and therefore cannot be handled."

Thus measures of actual cost of output of firms will also reflect managerial efficiency as well as economies of scale. Measures which examine the difference between revenue and costs will also reflect, apart from market conditions and input decisions, the discretionary goals of the firm.[21]

EFFICIENCY MEASURES CONSIDERED

Three direct measures of overall efficiency are considered and three other supportive measures. The direct measures - profitability, the Downie index, and the Farrel index, are derived from financial data and before we consider these measures of efficiency we shall examine the definition and distribution of our financial variables.

FINANCIAL VARIABLES

There are a number of possible definitions of our main financial indices and the calculation of these will be considered here.

Sales

All reported sales were included.

Profit

Reported pre-tax profit was adjusted. Interest on loans and non-recurring expenses were added back. Income from investment and non-recurring income were subtracted. This was to increase comparability between foundries and to exclude unusual expenses or income incurring in any one year.

DIRECTORS EMOLUMENTS

One particular problem with profit measurement is the distribution of directors emoluments. The problem is that these may be excessive when companies are profitable in order to minimise taxes. Alexander[22] suggests an adjustment based on a comparison with loss making companies. The rationale is that loss making companies do not need to overpay their directors because there is no financial gain; such companies do not pay taxes.

The formula suggested is:

$$EC = OCp - \frac{OCL}{Al} \cdot Ap.$$

Where: EC = excess compensation.

OCp, L are reported compensation for profit making and loss making companies respectively.

Ap, L are the assets of profit making and loss making companies respectively.

The amount "EC" should be added back to profits.

We did not follow this adjustment because:

(a) It is not at all clear that loss making companies will correctly compensate their directors, especially when the directors are owner-managers (which is often the case with small foundries). In this case it might be expected that the excess compensation, calculated in this way, might underestimate the directors compensation, especially in the short run.

(b) There were computational difficulties involved. Particularly, we did not have the level of directors compensation available to us for all companies. One short hand check was made. This was to add back all directors remuneration for all firms. The effect of this will be discussed later.

CAPITAL EMPLOYED

A number of different definitions of capital employed are possible. These include total assets, net assets and net worth. We used net assets.[23] This was calculated as the book value of assets less current liabilities. The book value of assets was adjusted to exclude investments falling outside the principal activities of the company.

SIZE

The different possible measures of size have been considered in Chapter 5. Two measures were used here - net assets and employees. Others are possible such as total assets or sales.[24]

TIME PERIOD

All Company accounts which covered just one year were included. Because there is overlap between years due to differing year end dates, all accounts falling within the year 1st April to 31st March were included. In practice most year end dates fell either at the end of December or March.

DEPENDENT COMPANIES

Fifty-three firms in our sample were dependent companies. The principal activity of these companies was iron castings usually producing (at least in part) for the group. There are special problems with dependent companies which makes their accounts incomparable with independent companies. However, these companies have been included for the sake of comparison and completeness. The problems are (a) that transfer pricing will not usually reflect market price, (b) cost allocation will affect the level of profit, (c) subvention payments will be treated differently between different companies. Subvention payments may be long or short-term loans (or both). We decided to treat subvention payments as current liabilities and current assets, and calculated net assets in a similar way to the calculation of net assets for the independent companies in our sample.

THE TOTAL SAMPLE

All companies were considered irrespective of whether they were making losses during the period, or not. Suffering losses is a dimension of efficiency and the risk of losses forms an important dimension of the expectations of the entrepreneur.

Table 7.1

DISTRIBUTION OF MAIN FINANCIAL VARIABLES - 1970

Variable	Jobbers				Repetition				Independents				Dependents			
	$\bar{x}$	S.D.	Min.	Max.	$\bar{x}$	S.D.	Min.	Max.	$\bar{x}$	S.D.	Min.	Max.	$\bar{x}$	S.D.	Min.	Max.
Sales £'000	144.32	94.79	46.83	470.53	477.20	478.83	59.11	1840	274.58	346.21	46.834	1840	1010.39	1804.9	23.078	8635.34
Employees	48	23	15	122	118	109	24	481	73	68	15	390	181	382	30	270
Net assets £'000	63.41	52.52	7.92	304.1	171.71	212.56	2.537	844.233	107.95	142.499	3.090	882.03	352.11	617.1	3.355	3430
Net assets + overdrafts £'000	66.86	54.68	8.918	304.1	190.66	206.31	3.090	882.304	116.383	148.872	3.090	882.034	412.73	774.97	16.731	3746.8
Profit/ net assets	10.2	15.7	-44.1	39.9	13.6	15.0	-18.8	42.1	14.2	17.0	-44.1	42.1	27.5	101.7	-259.3	533.3
Profit + emoluments/ net assets	24.8	19.5	-36.6	88.7	34.6	27.0	- 1.2	129.3	28.7	23.1	-36.6	129.3	39.3	118.4	-255.1	586.4
Profit/ net assets + overdraft	10.4	14.3	-29.4	39.9	19.1	17.0	- 4.6	61.0	13.9	15.9	-29.4	61.0	14.0	41.2	-168.9	140.1
Profit/ total assets	6.8	9.4	-20.4	26.9	11.3	9.3	- 3.3	33.8	8.6	9.6	-20.4	33.8	8.4	18.0	- 87.2	44.6

DISTRIBUTION OF MAIN FINANCIAL VARIABLES

Table 7.1 shows the distribution of our main financial variables - sales, assets, employees, and profitability. The following points may be made:

(a) Dependent foundries were on average larger than independent foundries.

(b) Jobbers were on average smaller than all other firms in the sample.

(c) Rate of return for dependent firms is higher, more variable and includes extreme observations. For this reason dependent foundries have been excluded from our direct efficiency measures.

(d) When directors emoluments are added back to profits, the profitability calculation becomes "unrealistic". For this reason it was decided to exclude calculations involving directors emoluments.

EFFICIENCY MEASURES

Profitability

The simplest measure of performance is profit. Steckler[25] delineates the problem with this measure:

"While the profitability-size relationship has frequently been analysed, the hypotheses of these investigations have been quite varied, thus creating some confusion. The size distribution of profit ratios have generally been used, but some of the studies attempted to determine the relative efficiency of firms of various sizes (i.e. the absence or presence of economies of scale), while others tested the relative ability of firms to expand through retained earnings. Still other studies have utilised profit ratios as a measure of monopoly power, and there have even been investigations where no hypothesis was advanced, but where results are nevertheless presented."

And Eatwell:[26]

"The majority of empirical studies have ..... utilised the profit ratio as a measure of corporate efficiency. It is difficult to develop any rationale for the utilisation of the profit ratio as a measure of efficiency, other than its ready availability. The size distribution of the profit ratio would seem to have little relevance, in either a theoretical or a practical framework, to the complex problem of the long run costs associated with size of firms."

And Stigler:[27]

"The comparisons of both actual costs and rates of return are strongly influenced by the valuations which are put on productive services, so that an enterprise which over or under-values important productive services, will under or overstate its efficiency. Historical cost valuations of resources, which are most commonly available, are in principle irrelevant under changed conditions. Valuations based on expected earnings yield no information on the efficiency of an enterprise - in the limiting case where all resources are so valued, all firms would be of equal efficiency judged by either average costs or rates of return."

What, then, can be said in favour of using the measure rate of return?

(a) In a near competitive world,[28] profit maximising firms may at any point in time be above or below the optimum. These firms would be expected to have a lower rate of return than firms of optimum size.

(b) In the real world it is the means by which businessmen seek to examine their own relative efficiency,[29] if not for their own firm, over time, between similar firms.

(c) In a dynamic sense, it is an indication to businessmen of "profitable" opportunities. A critical assumption economic theory makes in describing competition is that of the "knowledge" of buyers and sellers. Such knowledge depends on indicators which are available. Profitability is one.

(d) It is an inducement to firms which seek to "increase" their "profitability" and also the source of such opportunities.

(e) In practice it is a measure of the relative success of firms of differing size to operate those firms and as such defines their present ability to stay in business and persist in business by replacing plant when it is required. Changing relative levels of profitability may induce owners in the longer term to withdraw from the industry. Because the measure includes an "entrepreneurial" element, it can be said to be true for those firms with those entrepreneurs assuming their ability to remain constant through time.

(f) It follows from (e) above, that there are two other important aspects to profitability as a comparison of the relative efficiency of firms as understood by businessmen. A snapshot picture alone is insufficient. Opportunities will be reflected both in the variability of profitability and the inter temporal persistency of profitability of firms.

SUMMARY

Economic efficiency can, as we have seen, be defined only within narrow limits. It involves assumptions about the behaviour of the intending entrepreneur and the knowledge of the entrepreneur relative to the intentions and knowledge of all other entrepreneurs. Profitability is often used as a measure of the "efficiency" of firms and it is difficult to justify theoretically - but it is a measure of efficiency available and therefore exists as part of our body of knowledge from which decisions can be, and are being made.

PAST RESEARCH ON THE PROFITABILITY-SIZE RELATIONSHIP[30]

We will not discuss the differing methodologies of previous researchers but we will confine our attention to the overall results of these investigations.

Methodological problems include the definition of variables used, the effect of revaluations,[31] the treatment of directors compensation, and the exclusion of loss-making companies.

There is a broad literature on the profitability-size hypothesis. We do not intend to provide a critique of this. We note that:

(a) Many studies have observed no relationship.[32]

(b) Some studies have noted a negative relationship.[33]

(c) Others a positive relationship.[34]

(d) And that a negative correlation, it has been argued, is the result of increasing capital intensity with size,[35] or the period of measurement.[36]

(e) On disaggregated data relating to individual industries no systematic relationship has been found.[37] However, the importance of disaggregation is noted statistically,[38] and is expected theoretically because of monopoly power,[39] economies of scale, demand conditions, etc.

(f) The variability of intra-group profitability has been shown to be inversely related to size.[40, 41]

(g) And inter-temporal variability of profitability has also been shown to be inversely related to size.[42]

PROFITABILITY AND SIZE IN IRONFOUNDING

Two measures are reported: profit on net assets and profit on sales.[43]

Two functional forms were considered:[44]

$$Y = a + Bx + e \qquad (1)$$

$$Y = a + B \log x + \log e \qquad (2)$$

The first is clearly a "wrong estimation"; it suggests that profitability is a simple function of size, but the second conforms to an intuitive appeal that proportional increases in size will yield increases in profitability.

Our method of analysis was to consider all independent foundries in the first place, and on disaggregation - jobbing and repetition foundries.

THE RESULTS

In general no relationship was found over the four year period between the profit rate and size or profit/sales[45] and size (Table 7.2). The observations were disaggregated and except for an increasing relationship profitability and profit/sales and size in 1970 for jobbing foundries, and a decreasing relationship between profitability and size for repetition foundries in 1968, no relationship was found. Furthermore, in all cases where B was significant, r^2 was low.

Further computations were also made for average profitability over the period and average profit/sales. This has the advantage of partially evening out rates of plant utilisation due to demand. Again no significant relationship was obtained overall.

Table 7.2

REGRESSIONS ON PROFITABILITY

Function		Interdependents				Repetition				Jobbing		
		a	B(SE)	r^2	n	a	B(SE)	r^2	n	a	B(SE)	r^2
PROFITABILITY = f (net assets)												
	1970	.11636	.00023 (.00014)	.03883	70	.199	.00002 (.00017)	.00043	28	.033	.00108* (.00044)	.13232
	1969	.12153	.00002 (.00012)	.00059	70	≠	≠	≠	28	.108	.00014 (.00056)	.00160
	1968	.10704	.00009 (.00018)	.00402	70	.162	-.00005 (.00020)	.00232	28	.054	.00064 (.00067)	.02236
	1967	.09851	.00023 (.00018)	.02267	70	.145	.00010 (.00019)	.01157	28	.048	.00084 (.00079)	.02756
f log (net assets)												
	1970	.02348	.06518 (.04705)	.02745	70	.279	-.03908 (.06299)	.01459	28	-.2055	.18084* (.07783)	.11892
	1969	.20444	-.04533 (.04091)	.01774	70	.208	-.03632 (.05296)	.01776	28	-.2897	-.10543 (.07543)	.04657
	1968	.17363	-.03285 (.05376)	.00546	70	.416	-.13616* (.06512)	.14395	28	-.08865	.10853 (.09979)	.02872
	1967	.08496	.04101 (.05541)	.00799	70	.213	-.02682 (.06293)	.00694	28	-.10872	.12432 (.11390)	.02892
Profit/sales = f log (net assets)												
	1970	-.06830	.06362* (.02253)	.15951	44	.021	.02730 (.03005)	.04906	18	-.07958	.06612 (.04789)	.07358
	1969	-.00971	.03124 (.01780)	.06832	44	.01144	.02444 (.03223)	.03468	18	.01003	.01642 (.03067)	.01181
	1968	-.05513	.05129* (.02341)	.10260	44	-.03701	.04569 (.04554)	.05919	18	-.02973	.03301 (.03722)	.03174
	1967	-.08707	.07927* (.02128)	.21864	44	-.05642	.06482 (.03326)	.19190	18	-.02791	.03035 (.03955)	.02396
Profitability (1970 + 1969 + 1968 + 1967) ÷ 4 = f log (net assets)		-.05234	.09408 (.04900)	.08067	70	.086	.04536 (.08736)	.01657	28	.06241	.01332 (.08620)	.00099
Profit/sales (1970 + 1969 + 1968 + 1967) ÷ 4 = f log (net assets)		-.07331	.06282* (.01705)	.24436	44	-.04352	.05224 (.03425)	.12690	18	-.05062	.04673 (.02758)	.10680

*Significant at the 5% level.

≠Too insignificant for computer estimation.

Table 7.3

PERSISTENCE OF PROFITABILITY

Function	Independents				Repetition				Jobbing			
	a	B(SE)	r^2	n	a	B(SE)	r^2	n	a	B(SE)	r^2	n
Profitability (1970 + 1969)/2 = f profitability (1968 + 1967)/2	.07567	.48409* (.07541)	.37731	70	.07648	.58677* (.13080)	.43629	28	.07104	.41109* (.09436)	.32181	4[illegible]

THE VARIABILITY OF PROFITABILITY AND SIZE

Two considerations are important here. The first is whether the variability of profitability between groups is greater than the variability of profitability within groups. This is the F test. The second is to examine intra group variability within each size class.

The variability of profitability between size groups was tested using the F test. Tables 7.4 and 7.5 show that there was no significant difference. Furthermore, Table 7.5 examines the intertemporal dispersion of profitability. The first and last columns of the table are a breakdown of the sum of profitability and profit/sales respectively for each size group. The mean and standard deviations are shown, and an F test shows that there was no significant difference at the 5% level. This latter measure may be considered an "intertemporal" measure.

THE VARIABILITY OF PROFITABILITY WITHIN SIZE GROUPS

No statistical test was used to examine intra size group variability of profitability. This is because the number of observations (five) is small. It is possible to use a rank correlation test on the variance of profitability in each size group, but here we shall simply, qualitatively, examine the standard deviations in each size group. Again Tables 7.4 and 7.5 examine this, for the four year period under consideration. If we first examine independent firms the results are as follows.

(a) Except for 1968 and 1967, for firms in the 76-100 employees bracket there is a tendency for the variability of profitability to diminish with increasing size.

(b) If we examine the profit/sales relationship. In 1970 variability is consistently a decreasing function of size except in the largest size group. But no such consistent relationship exists for the other years.

(c) If we examine intertemporal variability, we may examine total average profitability and profit/sales for the years 1970-1967 (Table 7.5). In this case the variability of profitability and profit/sales is not related to size groups.

REPETITION FOUNDRIES

(a) For the years 1970-1968 there is evidence of the variability of profitability to decline up to 100 employees in our sample. Above this it rises again. In 1967 no clear relationship exists.

(b) Over the four year period no positive relationship appears between intra group variability of profit/sales and size.

(c) Intertemporal profitability and profit/sales decreases up to 100 employees in the case of profitability but profit/sales is unrelated to size.

JOBBING

(a) No relationship exists between intra group variability of profitability, profit/sales or intertemporal variability of profitability or profit/sales for the period.

Table 7.3 is a regression of past profitability on present profitability. The results are significant, suggesting that previous profitability level indicates a firm's future profitability. Thus there may be "high fliers".

A NOTE ON THE NUMBER OF OBSERVATIONS

As we have noted in our chapter on sampling, the proportion of firms in each size group broadly reflects the firms in the population. However, caution should be used in examining these results, because the number of observations in any size group is small, and especially when we consider jobbing foundries we have very many fewer observations in the larger size groups as compared with the smaller size groups which makes any conclusion somewhat tentative.

GRAPHICAL REPRESENTATION OF THE OBSERVATIONS

Tables 7.6 and 7.7, which graphically represent the observations, plot the dependent variable - profitability and profit/sales against size-net assets. It is clear that there is no strong relationship.

SUMMARY OF FINDINGS ON PROFITABILITY

(1) There is no consistent relationship between size and profitability.

Table 7.4

BREAKDOWN OF PROFITABILITY BY SIZE OF FIRM

	Size	All			Repetition			Jobbers		
	(employees)	Mean	S.D.	n	Mean	S.D.	n	Mean	S.D.	n
1970:	25- 50	.119	.188	37	.269	.212	9	.070	.155	28
	51- 76	.202	.135	13	.265	.162	4	.174	.121	9
	76-100	.145	.147	9	.139	.064	5	.153	.228	4
	101-200	.169	.157	8	.175	.168	7	.126	-	1
	201+	.081	.185	3	.081	.185	3			
			F = .7202			F = 1.0			F = 1.19	
1969:	25- 50	.133	.161	37	.182	.130	9	.118	.169	28
	51- 76	.127	.112	13	.183	.109	4	.103	.110	9
	76-100	.107	.142	9	.090	.074	5	.128	.213	4
	101-200	.101	.186	8	.097	.201	7	.134	-	1
	201+	.109	.243	3	.109	.243	3			
			F = .1094			F = .54			F = .034	
1968:	25- 50	.097	.176	37	.218	.252	9	.058	.126	28
	51- 76	.155	.153	13	.229	.161	4	.122	.147	9
	76-100	.143	.324	9	.052	.141	5	.257	.472	4
	101-200	.126	.152	8	.140	.159	7	.029	-	1
	201+	.068	.205	3	.068	.205	3			
			F = .3077			F = .86			F = 1.5175	
1967:	25- 50	.089	.163	37	.235	.159	9	.043	.137	28
	51- 76	.117	.187	13	.056	.211	4	.144	.181	9
	76-100	.195	.354	9	.079	.098	5	.339	.520	4
	101-200	.178	.176	8	.193	.185	7	.077	-	1
	201+	.144	.295	3	.144	.295	3			
			F = .6675			F = 1.02			F = 2.6942	
			dof 65,4			dof 23,4			dof 38,3	

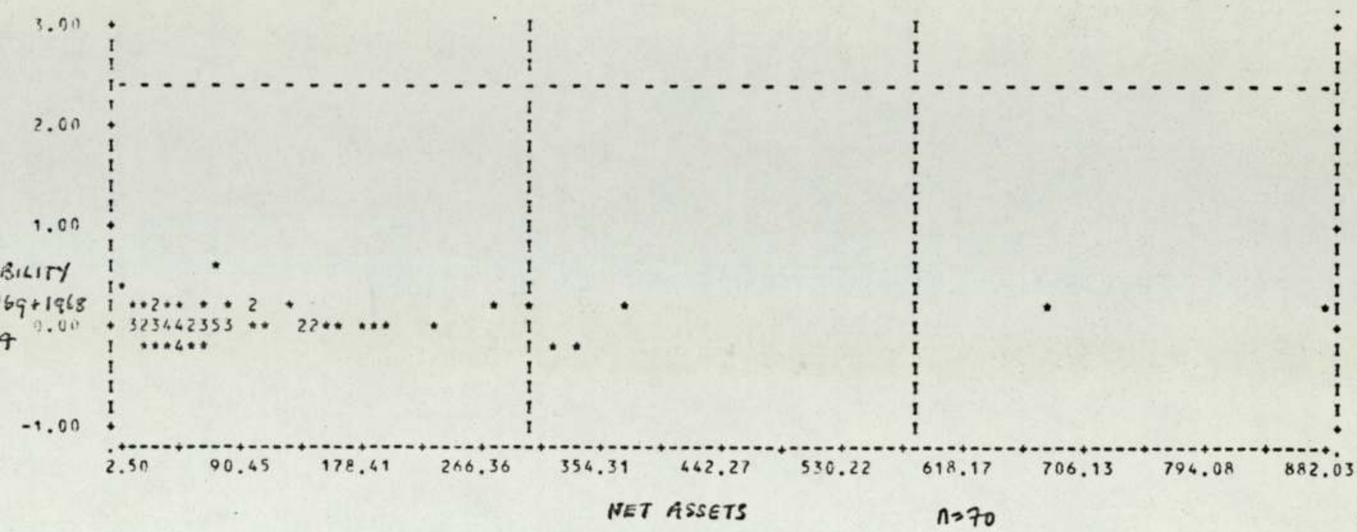
Table 7.5

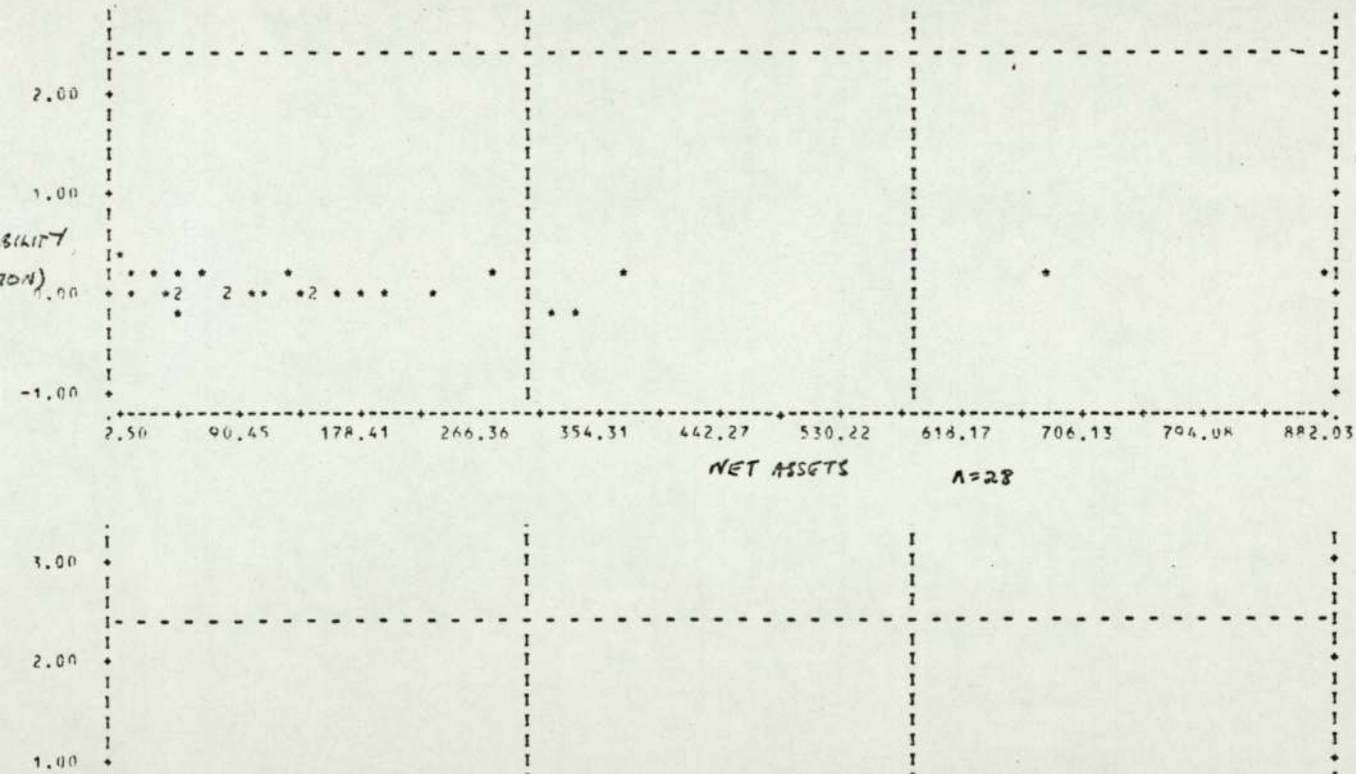
BREAKDOWN OF PROFITABILITY AND PROFIT/SALES BY SIZE OF FIRM

Employees	Sum Profitability			Profit/Sales 1970			1969			1968			1967			Sum Profit/Sales		
	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n
All Independents																		
25- 50	.110	.136	37	.038	.066	36	.044	.051	36	.028	.063	33	.034	.071	21	.040	.052	21
51- 75	.150	.117	13	.084	.065	13	.053	.059	13	.052	.059	13	.038	.058	8	.045	.039	8
76-100	.147	.231	9	.064	.052	9	.045	.043	9	.049	.072	9	.034	.059	7	.039	.054	7
101-200	.144	.154	8	.057	.041	8	.039	.084	8	.043	.098	7	.089	.063	6	.068	.071	6
201+	.101	.207	3	.031	.069	3	.024	.071	3	.023	.073	3	.083	.016	2	.064	.046	2
		F = .2821			F = 1.4813			F = .1847			F = .4262			F = 1.0455			F = .4038	
Repetition																		
25- 50	.226	.141	9	.064	.060	8	.049	.042	8	.052	.062	7	.099	.090	4	.084	.068	4
51- 75	.183	.139	4	.088	.035	4	.061	.027	4	.067	.028	4	.049	.027	2	.082	.024	2
76-100	.090	.090	5	.072	.046	5	.053	.048	5	.044	.076	5	.052	.061	5	.055	.056	5
101-200	.151	.165	7	.057	.041	7	.036	.090	7	.048	.106	6	.099	.070	5	.073	.078	5
200+	.101	.207	3	.031	.069	3	.024	.071	3	.023	.073	3	.083	.016	2	.064	.046	2
		F = .8816			F = .5824			F = .2250			F = .1517			F = .4953			F = .1370	
Jobbers																		
25- 50	.072	.113	28	.031	.066	28	.043	.054	28	.021	.062	26	.019	.059	17	.030	.044	17
51- 75	.136	.112	9	.082	.076	9	.049	.069	9	.045	.070	9	.034	.068	6	.033	.035	6
76-100	.219	.346	4	.053	.063	4	.035	.042	4	.056	.078	4	-.011	.012	2	-.001	.017	2
101-200	.092	0.0	1	.054	0.0	1	.060	0.0	1	.015	0.0	1	.036	0.0	1	0.041	0.0	1
201+																		
		F = 1.4169			F = 1.280			F = .0923			F = .5524			F = .3143			F = .4036	

TABLE 7.6

GRAPHICAL PRESENTATION OF PROFITABILITY AND THE SIZE OF THE FIRM





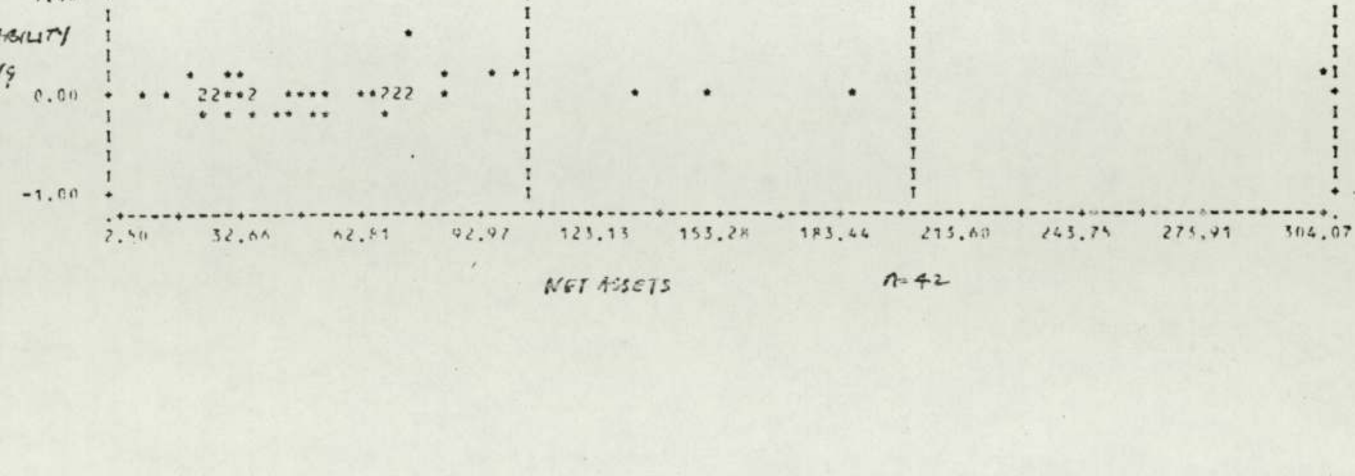
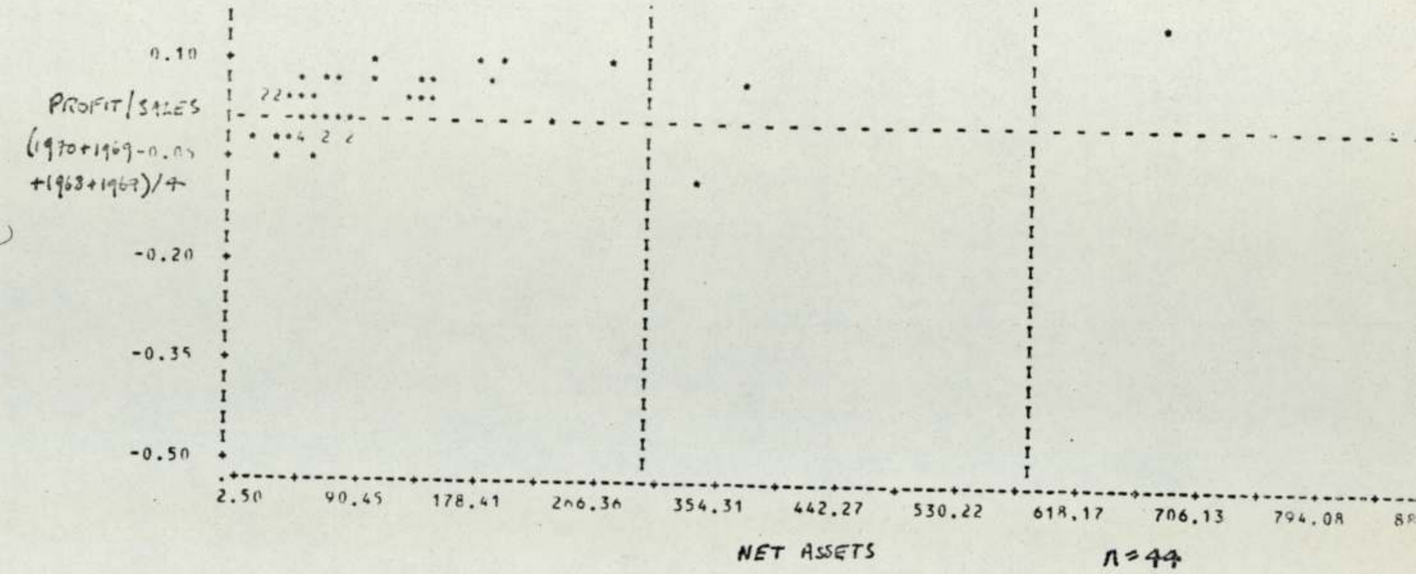
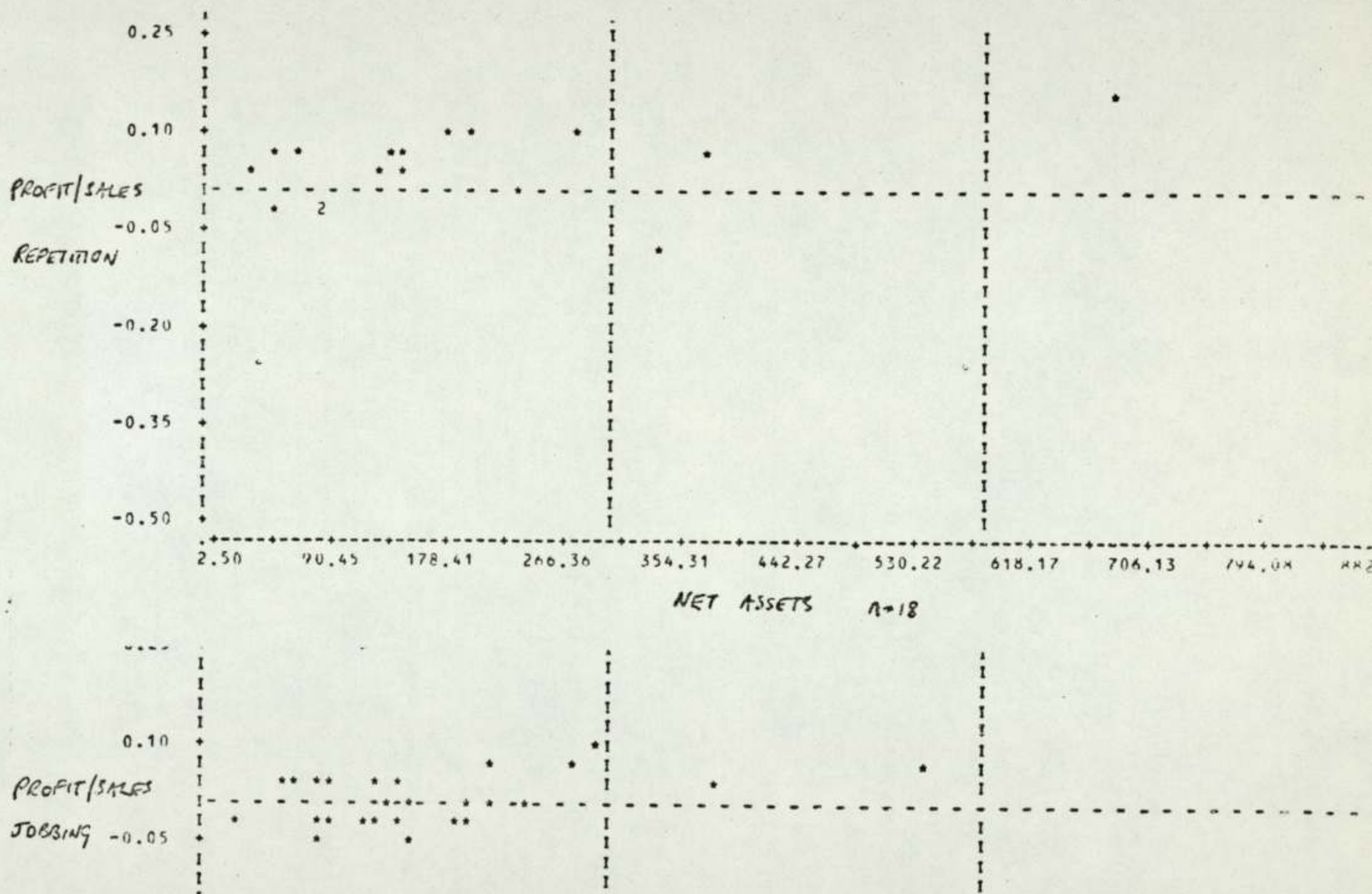
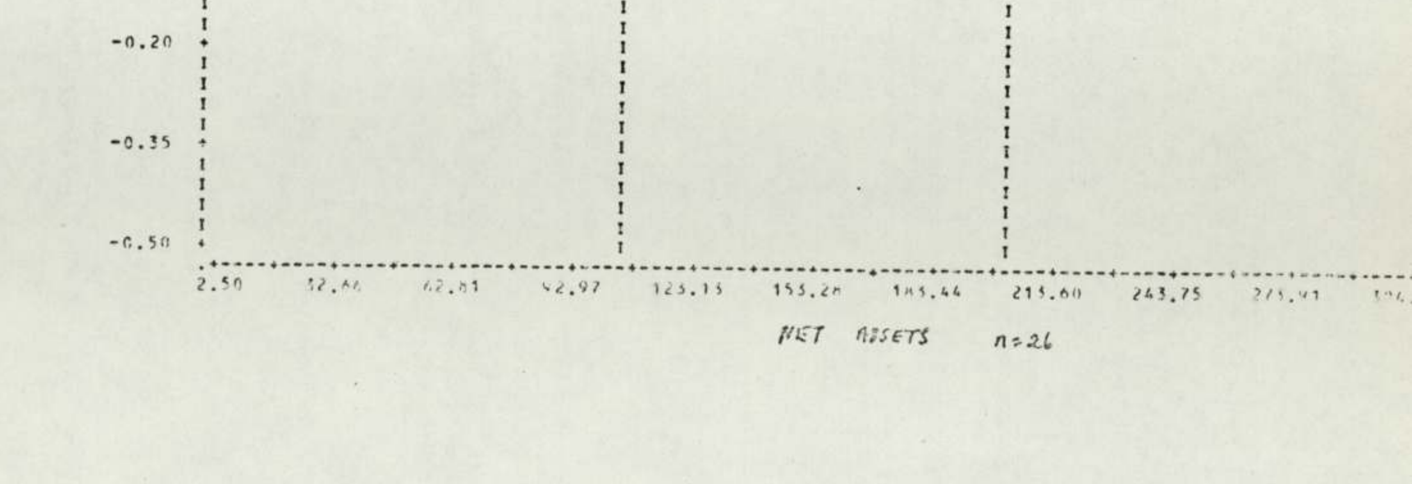


TABLE 7.7

GRAPHICAL PRESENTATION OF PROFITABILITY AND THE SIZE OF THE FIRM







(2) Intra group variability of profitability and profit/sales. There is no consistent evidence of variability within size classes being a decreasing function of size.

(3) Equally there is no consistent evidence of intertemporal size class variability being a decreasing function of size.

(4) On all measures comparisons of the variability of profitability within size groups as between size groups is not a function of size.

(5) Individual firm profitability tended to indicate their future profitability potential.

CONCLUSION

As a summary measure of general efficiency we can find no relationship between these overall financial measures and size of firm.

ALTERNATIVE MEASURES[46]

Dunning and Rowan[47] attempted a total productivity index which would reflect social efficiency. This index may be defined as follows:

$$e = \frac{w^*L + r^*K}{wL + rK} \quad (1)$$

[48]

L = numbers employed
K = value of capital
w = wage rate
r = rate of return on capital
r* = social opportunity cost of capital
w* = opportunity cost of capital

It is assumed by the authors that labour will on average be paid the value of its marginal product. r* is defined as the opportunity cost of capital, and Dunning and Rowan settle for 15%, reflecting an average rate of return for U.K. industry during the period of study 1950-1965.

Where the denominator of equation is net output it can be set to equal value added. Thus the formulation may be reinterpreted as follows:

$$e = \frac{V - rK + r^*K}{V} \quad (2)$$

where V is value added.

Thus (2) becomes:

$$e = 1 - \left(\frac{K}{V}\right)(r - r^*) \quad (3)$$

Now if value added is greater than the numerator of equation (1) -- w*L + r*K, then the firm is allocating its resources more efficiently than the average values w* and r*. And in formulation (3), if r = r* then the efficiency index is equal to 1. If $r > r^*$ then the efficiency index e becomes less than 1 thus suggesting greater efficiency.

THE CAPITAL/OUTPUT RATES

The effect upon e the efficiency index will be reflected by the difference between r and r* and the $^{K}/V$ index. Now the greater the value of capital to output, the greater will be the effect upon the value "e". And where all firms have the same $^{K}/V$ ratio the index will equal the rate of return.

And this is precisely the problem with the index which well illustrates the problem of partial measures of efficiency. The point is this. If the factor mix differs between firms, in the case of the Rowan and Dunning index, firms using comparatively more labour will be assumed to be using that labour efficiently.

We were unable to evaluate foundries using this index because we had no data on net output, just sales. As such we were able to use a very similar index which is the Downie index.[49]

DOWNIE INDEX

His index of efficiency is as follows:

$$e_2 = \frac{Z + r^*K}{Epiqi} = \frac{Z + r^*K}{S}$$

where Z = cost of all current inputs plus depreciation
r* = cost of capital
K = value of capital
Epiqi = S = Sales.

Z = S - rK, where r = the actual rate of return on capital employed.

Thus $$e_2 = \frac{S - rK + r^*K}{S}$$

$$e_2 = 1 - \left(\frac{K}{S}\right)(r - r^*)$$

Thus this formulation is similar to that of Dunning and Rowan, except that it incorporates sales instead of net output. Similar conclusions may be drawn between the effect on e_2 of different capital/sales ratios for differing firms and the accompanying effects of differences in rates of return.

CHOICE OF r*

Dunning and Rowan chose a value for r* which reflected average performance of U.K. manufacturing industry. Downie chose a value for r* as the average rate of profit for the industry.

IRONFOUNDING AND THE DOWNIE INDEX

Downie was interested in the variability about the mean of his index. In our computation we took r* to be 15% and Table 7.8 illustrates the results.

ALL INDEPENDENTS

(a) The variability between groups was not significantly different from the variability within groups.

(b) The intra-size group variability was unrelated to size.

ON DISAGGREGATION

Similar conclusions may be drawn for the disaggregated groups - repetition and jobbing foundries.

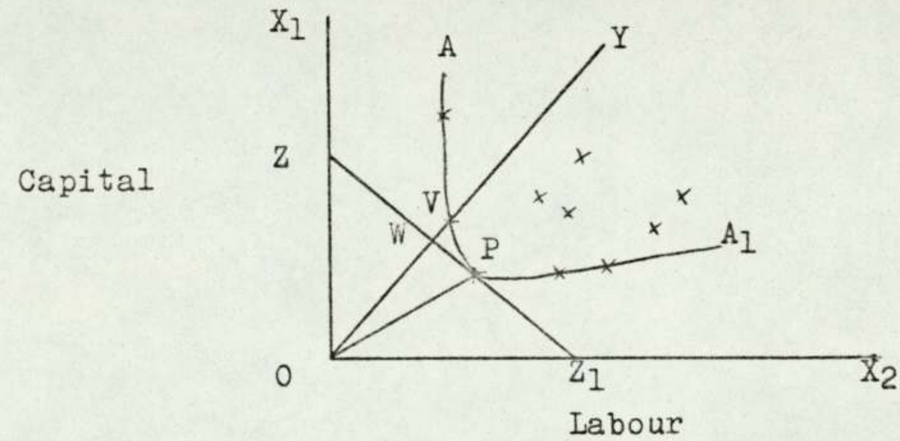
Table 7.8

DOWNIE INDEX

Employees	1970 $\bar{x}$	S.D.	n	1969 $\bar{x}$	S.D.	n	1968 $\bar{x}$	S.D.	n	1967 $\bar{x}$	S.D.	n
All Independents												
25- 50	1.025	.071	36	1.020	.050	36	1.047	.073	33	1.038	.080	21
51- 75	.978	.057	13	1.014	.062	13	1.014	.073	13	1.018	.072	8
76-100	.998	.038	9	1.025	.044	9	1.021	.069	9	1.039	.045	7
101-200	1.013	.061	8	1.041	.101	8	1.053	.156	7	1.018	.130	6
201+	1.013	.061	3	1.019	.077	3	1.025	.074	3	.957	.003	2
		F = 1.3768			F = .2660			F = .5104			F = .5293	
Repetition												
25- 50	.971	.052	8	.993	.035	8	.996	.047	7	.962	.083	4
51- 75	.973	.055	4	.999	.043	4	.992	.056	4	1.004	.058	2
76-100	.999	.027	5	1.023	.028	5	1.038	.056	5	1.033	.047	5
101-200	1.013	.066	7	1.046	.108	7	1.052	.171	6	1.015	.146	5
201+	1.013	.061	3	1.019	.077	3	1.025	.074	3	.957	.003	2
		F = .8239			F = .6650			F = .3910			F = .4380	
Jobbers												
25- 50	1.040	.069	28	1.028	.052	28	1.061	.073	26	1.056	.071	17
51- 75	.980	.061	9	1.021	.069	9	1.024	.080	9	1.023	.081	6
76-100	.998	.054	4	1.028	.065	4	.999	.086	4	1.056	.052	2
101-200	1.010	0.0	1	1.007	0.0	1	1.061	0.0	1	1.034	0.0	1
201+												
		F = 2.0598			F = .0759			F = 1.0960			F = .3309	

THE FARREL TEST

Farrel[50] constructs the following technique which will be illustrated under the assumption of constant returns to scale. For two factors of production X_1 and X_2 the production function is expressed by the curve AA_1. At P the firm is at the optimum both technically and given the price line ZZ_1. However, firm Y is both technically inefficient OV/OY and price inefficient OW/OV. And the total economic efficiency may be designated by OV/OY. OW/OV = OW/OY. Maximum possible efficiency would be OP/OP = 1.



Now if we take observations on X_1 and X_2 we will obtain a scatter diagram. A line joining all such observations nearest the origin may be regarded as the efficiency frontier of the industry. It is not possible to choose between firms on the frontier unless the price line is known, even if it were known no firm conclusion could be drawn because two firms may be operating with minimum cost combination of factors, but may differ in position because their production functions differ. The overall advantage of the technique is that it provides an efficiency frontier for the industry, from which the efficiency of other firms can be measured.

The relationship between this technique and other efficiency techniques is that it is concerned with best practice rather than average practice.

For examples of application of the technique see Farrel, Farrel and Fieldhouse, Timmer and Todd.[51]

The limitations are first, it defines an efficient frontier from a small number of points gathered from the sample, thus new sampling may shift the frontier. Second, these firms are marginal firms and thus the technique is sensitive to extreme observations and measurement errors. Third, the degree of returns has to be decided a priori and is not itself a product of the measure.[52]

THE FARREL TECHNIQUE AND IRONFOUNDING

We tested our sample of firms according to the Farrel technique. We separately examined jobbing and repetition foundries for the three year period 1970-1968. [We had too few observations to test for 1967.] Numbers of employees were used as our measure of labour. Employee compensation could be used insofar as it may be assumed to reflect qualitative differences in labour efficiency; however, a test by size of firm suggested no correlation between employees and their average remuneration.

The sample was split between large and small firms. Tests were conducted on the distance of observations from the frontier. The frontier was first defined by the size of firm and then separately for the total frontier of all firms in the grouping.

Firms in each category - large and small - had to be defined by the number of observations to hand. Thus for repetition foundries, this was firms greater than and less than 100 employees. For jobbing foundries greater than and less than 50 employees. Jobbing foundries are in general smaller than repetition foundries.

THE RESULTS

Table 7.9 illustrates the results. A t-test indicates that there was no difference between large and small firms in both the jobbing and repetition groups for each of the three periods 1970, 1969 and 1968.

CONCLUSIONS ON MAIN TESTS OF EFFICIENCY

The three tests we have been concerned with so far are consistent insofar as no systematic relationship has been found between efficiency and the size of the firm.

No attempt was made to correlate efficiency rankings between each measure. There is no reason for them to be the same, but Todd in his analysis found a greater (and fairly close) relationship between Downie's index and the rate of return and a less significant relationship between the Farrel index and the rate of return.

Table 7.9

FARREL TEST

	Own Frontier Large	Own Frontier Small	Total Frontier Large	Total Frontier Small
1970				
Jobbers	(n = 12)	(n = 24)	(n = 12)	(n = 24)
	.7148	.6646	.6687	.6643
	t = .7402		t = .0672	
Repetition	(n = 9)	(n = 14)	(n = 9)	(n = 14)
	.6888	.6360	.6888	.6023
	t = .6013		t = .96	
1969				
Jobbers	(n = 14)	(n = 28)	(n = 14)	(n = 28)
	.653	.546	.562	.546
	t = 1.5134		t = .2402	
Repetition	(n = 9)	(n = 16)	(n = 9)	(n = 16)
	.696	.642	.667	.622
	t = .5863		t = .4934	
1968				
Jobbers	(n = 13)	(n = 26)	(n = 13)	(n = 26)
	.581	.655	.581	.519
	t = .9108		t = .8190	
Repetition	(n = 8)	(n = 15)	(n = 8)	(n = 15)
	.852	.734	.828	.734
	t = 1.32		t = 1.0515	

SUPPORTIVE EFFICIENCY MEASURES

From our questionnaire data we were able to examine three further measures of efficiency. They are not efficiency measures in as much as they could be used uniquely but provide support for our three primary measures. The first is concerned with the age of assets, the second with the contractual arrangements that foundries enter into with customers, and the last a qualitative analysis of the perceived advantages and disadvantages of competing with firms of varying size.

The first two have a subsidiary purpose of comparing some of the circumstances which may affect possibilities of comparing firms of different size by the measures we have already used. However, we argue that they are also partial measures of efficiency.

EFFICIENCY AND THE AGE OF ASSETS

Cross-sectional analyses on the efficiency of firms in differing size groups assumes that factors extraneous to the issue being measured are constant, or at least unrelated to size. One such factor is the age of assets. Hence it is important to examine such issues and also with the age of assets, it is itself one test of efficiency, which also reflects average adjustment, by size, to technological improvements in the industry.

AGE OF ASSETS AS A TEST OF EFFICIENCY

Again this is a one factor test, but the assets of a firm have rather special and different characteristics from the other factors of production. The assets of the firm are both a stock and a flow. The stock will be added to as machines wear out or become obsolete and will include an element of technical change. However, at any moment in time these assets will have a life. And it is precisely for this reason that we are interested in the average age of assets. Apart from indicating the degree of investment in an industry, firms which seek to withdraw from the industry may wait until the useful productive services of their assets are used up. This will depend upon the life of the assets and the speed of technical change and resulting product improvements.[53] However, firms may stay in business as long as total revenue covers total variable costs, and their assets remain useful.

Where competition is not perfect, firms will have a degree of control over their decisions, and hence may appear inefficient on other measures (because of differing goals, degrees of X-efficiency, etc.) but remain in business because they accept a lower rate of return. Hence age of assets as a measure of efficiency is in essence a measure of the survivorship of the firm.

The reason for drawing a distinction between firms which are growing and firms which are not is as follows. Firms grow for one of two reasons. Either because they want to or because they have to in order to survive (market forces). The advantage of separating out those firms which do not grow is that we get a static array of firms which have adjusted to their present size, and in our sample, have not grown over ten years. Now if size has been maintained over that ten year period, we will be able to observe whether there are comparative disadvantages due to increasingly smaller size reflected in the age of assets. And thus the ability to survive. This probably is the only good test the age of assets will allow. Clearly, if firms are growing, it is usual for them to do so using more capital intensive techniques, thus they will be adding to their stock of assets and decreasing the average age of that stock. Growth will be determined by opportunities in each size group and the will to grow. Thus in controlling for growth we are effectively controlling for both differences in opportunities and differences in the goals of firms due to scale.

Table 7.10

EFFICIENCY AND THE AGE OF ASSETS

Equipment	Age (years)	Values greater than 0%		Size 1970 (employees)		Firms not growing	Growing firms	
		x̄ (%)	S.D.	n	r	r	n	r
Melting plant	To 5	62.88	33.86	34	-.1628	.0171	10	.2377
	6-10	69.9	30.39	30	-.3560*	-.8190*	7	-.3740*
	11-20	75.78	31.86	32	-.1340	-.2551	11	-.0122
	20+	77.82	32.73	22	-.0465	-.1548	11	.2247
Annealing plant	To 5	76.33	33.55	6	-.3935		2	-.9217*
	6-10	78.14	25.06	7	-.0193		0	-.3399
	11-20	78.50	13.26	8	-.7482		2	-.8352*
	20+	67.00	0	1	-		0	
Moulding machines	To 5	58.29	31.25	38	-.2652*	-.4482	10	-.3617*
	6-10	45.31	26.87	32	.0154	.4673	9	.1806
	11-20	50.78	32.56	23	-.0880	-.8077	7	-.4601*
	20+	51.13	32.17	15	-.1857	.0862	5	-.3662
Moulding boxes	To 5	53.42	30.79	64	-.1213	.1986	18	-.0611
	6-10	41.59	24.29	57	.0027	-.0275	16	-.0075
	11-20	42.67	25.18	33	-.0223	.6617*	8	.0901
	20+	45.83	34.19	12	-.1690	-.9252*	4	.0379
Sand plant	To 5	63.24	29.47	45	-.3261*	-.5568*	17	-.3432*
	6-10	60.13	31.83	38	-.0905	.2059	12	.0009
	11-20	57.45	32.38	31	-.1339	.1352	12	-.2876
	20+	60.62	29.14	8	-.4860	-.7522	3	-.4212
Core making machines	To 5	64.57	34.53	30	-.1886	-.3013	8	-.2591
	6-10	66.78	33.72	28	-.1534	-.5947*	9	-.2172
	11-20	66.67	28.60	12	-.4108	-.3651	4	-.9412*
	20+	67.67	45.73	3	.5		1	
Mechanical handling equipment	To 5	57.29	31.23	46	-.1158	-.0983	18	-.0272
	6-10	53.39	27.56	38	-.1995	-.2242	16	-.1631
	11-20	51.48	31.42	21	-.2494	-.4458	8	-.0721
	20+	57.62	29.96	13	-.2823	-.7978	4	-.5588
Fettling plant	To 5	58.44	29.55	48	-.1691	-.2441	12	-.2465
	6-10	48.08	29.53	49	-.0668	-.3394	19	-.1410
	11-20	54.75	31.49	32	-.2028	.1583	11	-.2402
	20+	56.21	31.05	14	-.1138	-.0276	8	-.1508

Further tests:

T-test between independent foundries and members of group
jobbing foundries and repetition foundries (independents only)
no significant differences

Table 7.11

TEST BY SIZE EXAMINATION OF 0% AND >0% OF ASSETS IN EACH AGE GROUP

Plant	Age	Inde-pendents	df	Jobbers	df	Repe-tition	df
Melting plant	To 5	1.37489	3	.58921	3	3.44183	3
	6-10	1.79648	3	4.65375	3	4.6080	3
	11-20	1.49077	3	2.38127	3	3.59649	3
	20+	3.73365	3	.71594	3	4.80112	3
Annealing plant	To 5	2.96296	3	-		2.26146	2
	6-10	4.71528	3	-		4.21587	2
	11-20	1.37016	3	-		.26786	2
	20+	.52941	3	-		.53571	2
Moulding machines	To 5	1.53920	3	.90731	3	2.15580	3
	6-10	6.34375	3	2.48299	3	8.43216	3
	11-20	5.29685	3	6.05769	3	2.44755	3
	20+	1.96473	3	1.29252	3	2.39005	3
Moulding boxes	To 5	2.36094	3	1.35882	3	2.89710	3
	6-10	3.00162	3	2.99498	3	4.31067	3
	11-20	1.98933	3	3.00417	3	2.53148	3
	20+	12.90717	3	5.52653	3	9.16406	3
Sand plant	To 5	1.59457	3	1.58276	3	.53156	3
	6-10	3.41340	3	1.90000	3	6.54541	3
	11-20	3.29915	3	5.86654	3	2.48011	3
	20+	3.99796	3	2.01797	3	3.80306	3
Core machines	To 5	1.44824	3	2.89405	3	.11064	3
	6-10	3.51806	3	6.125	3	13.71429	3
	11-20	.20434	3	6.96429	3	.65359	3
	20+	1.31553	3	-		1.20371	3
Handling equipment	To 5	2.72639	3	2.27679	3	2.24793	3
	6-10	1.18436	3	1.27473	3	5.70359	3
	11-20	3.35625	3	1.73544	3	.98154	3
	20+	2.86965	3	2.45057	3	4.91071	3
Fettling plant	To 5	1.02346	3	.29258	3	3.64809	3
	6-10	.45748	3	1.61616	3	1.05488	3
	11-20	7.24563	3	2.10317	3	3.39470	3
	20+	2.34786	3	2.5000	3	.87753	3

THE RESULTS

Eight general categories of plant and equipment were considered and within each category four age groups. These were "to 5 years", "6-10 years", "11-20 years", "and over 20 years". Firms were required to state the percentage of plant in use in each category.

THE ANALYSIS

Table 7.10, column 4, is a simple correlation between size and the age of assets, in each category, in each age group. Plant age and size were correlated between firms with greater than zero per cent plant in that category. In general there was no relationship.

Table 7.11 was a X^2 test on plant age and size of firms, for firms with zero per cent plant in any one category compared with firms with greater than zero per cent plant in the same category. The results are again insignificant.

Further, a distinction was drawn between firms which were growing and firms which were not growing. This was to examine whether firms which were not growing, arranged by size, had asset ages dependent on size. Again the results were insignificant.

CONCLUSION

Our analysis of the age of assets indicates no systematic relationship between the age of assets and the size of the firm.

EFFICIENCY AND CONTRACTUAL MIX

In this section we are going to make some sweeping assumptions about the relationship between efficiency and contractual mix. Now foundries obtain orders for work through contracts. The nature of these contracts differ. They may either be regular or irregular and it is precisely this distinction which we shall suggest reflects efficiency.

Now from the point of view of the buyer we may safely assume that they have imperfect knowledge of alternatives but recollection of satisfactory service in the past provides a preference for a particular firm. In the short run, knowledge of this fact means that the seller may raise his price knowing that he will not lose all his customers. This is a description of a market which is not perfectly competitive. Our concern is not with whether the industry is perfectly competitive but whether it is more realistic to stress the imperfections than the competition.

"In the field of imperfect competition, and especially in the search for workable adjustments, these matters of degree are of the essence of the problem."[54] We might agree that at any point in time the demand for a particular product in ironfounding is not infinitely elastic. The firm has a monopoly of at least some of its customers. But unless prices are competitive at any moment in time, many former customers may withdraw their custom. Customers do become aware of price differences.

Now we are going to divide up the world of customer contracts into a number of categories on a continuum from sticky to floating. Sticky means relatively permanent where there is no great will to change and floating means transitory.

In the operation of price competition we may fairly assume, ceteris paribus, that, in the long run, customers will switch their affiliation from high-priced firms to low-priced firms. And if demand rises price will rise and marginal firms will become viable. Now the assumption is this: over time sticky contracts will on average move to more efficient firms, and the excess, the less sticky contracts, will be distributed amongst the rest. We assume a queue of attractiveness (from the point of view of the buyer) and sticky contracts will slowly move up the queue depending upon imperfections and the awareness of alternatives.

Why might this be so?[55] Given risk, we assume, firms forming the queue prefer less risk to more. Particularly when demand fluctuates. They prefer a more regular form of contract to a less regular form. At the same time they are aware of competition and the risk of losing these customers. For the rest, less regular or voluminous contracts are available. Once a firm has tended and accepted a contract it has committed some capacity in the short run, and potential customers need to move on. This also, of course, allows for price differentials. Firms quoting low prices for contracts which they meet at a cost higher than price, will sooner or later leave the industry. But acting sensibly we expect, on average, a sifting towards more efficient firms, the more regular contracts. Now if competition is based on price, this will be the regulator. Successful firms will be able to increase their capacity, while less successful firms will have an incentive to narrow their disadvantages. This may be in the form of searching for internal efficiency, or if it is scale, for example, to increase size. Or accept leaving the industry in the long run.

CONTRACTS AND IRONFOUNDING

Contracts were grouped in the following way - "Sales within the firm or group", "regular long term contracts", "regular short term contracts", "single orders unrepeated" and "irregular contracts".

Table 7.13 shows the distribution of these contracts in terms of firms dealing in these kinds of contracts. For example, of the firms with irregular contracts, the average proportion of total output that these contracts accounted for was 37.3% for a total of 37 firms. Unfortunately, these estimates are only available on a point in time basis and as such no dynamic consideration is possible.

Table 7.12 illustrates the relationship between these contracts. The correlations are for firms which had a positive percentage of different contracts. The results are disaggregated for different types of foundry. The significant results which were obtained were between "regular long term contracts" and "irregular contracts".

An inverse association but nevertheless an association. Similarly, an association between "sales within the firm or group" and "unrepeated orders". This last relationship is evidence of the problem highlighted by our tied foundries. Particularly that they were unable to make regular promises to customers because preference was always for the group; thus when the group was busy outside customers were "pushed out". A similar interpretation might be placed upon the association between "regular long term contracts" and "irregular contracts".

Now if we consider these contracts further. "Regular" means that the customers keep returning, and "long term" and "short term" refer to whether the contract lasts for more than or less than a year.

Taking first the exceptional case of castings produced for the firm itself, and regular long term contracts, each were highly correlated with the importance of the principal customer. Now it will be remembered from Chapter 6, that this also indicated, we concluded, a form of specialisation, particularly the requirement of "special equipment" as the basis for competition. Thus given this, and that tied foundries have at least a temporarily captured market, and that regular long term contracts have a time dimension, we would prefer to exclude these from our analysis. Equally important in terms of the long term contracts is the expectation that these will reflect past efficiency but move too slowly to give an indication, on a snapshot cross-sectional basis, of present efficiency.

We would thus prefer to examine our hypothesis about the relationship between regular short term contracts and efficiency in relation to less regular forms of contracts which include here "irregular contracts" and "single orders unrepeated".

Now our hypothesis concerning regular short term contracts is as follows. Firms prefer regular short term contracts because this is the bread and butter of the operation, particularly in a stagnant or declining industry where the opportunity cost of accepting such contracts is not high. In order to get this form of contract firms must be efficient (they must prove themselves to the (rational) buyer). Also the extent to which these contracts might imply discounts suggests further that efficiency, particularly cost efficiency, are important to the firm. In addition, other aspects of competitive efficiency (those highlighted in Chapter 6) will be important to the customer. And it is in this respect that we would expect the distribution of these contracts to reflect efficiency.

Less regular contracts are important insofar as they may be more profitable (particularly to the extent that they do not imply discounts), and the most profitable contract mix will reflect the risk firms are willing to take. This propensity for risk taking we assume, is unrelated to size of the firm.

THE RESULTS

Tables 7.14 and 7.15 illustrate that these contracts were not related to the size of the firm. Again firms were disaggregated according to whether they had grown or not grown over the ten year period under consideration. If firms do not grow then we have a distribution of firms by size which are more amenable to analysis of comparative size advantages. They, for example, do not suffer the short term expense and adjustment to growth.

Again no significant difference by size of firm was discovered overall or for firms which had not grown. A rank correlation test indicated that these results were not on average related to size.

Table 7.12

EFFICIENCY AND CONTRACTUAL MIX. THE RELATIONSHIP BETWEEN CONTRACTUAL MIX

		Irregular Contracts	Regular Long term	Single Orders	Regular Short term	Sales within Firm or to Group
Irregular:	a	-	-.60* 20	Insig.	Insig.	Insig.
	b		-.63* 12			
	c		-.81* 5			
	d		-.53 7			
Regular long term:	a		-	Insig.	Insig.	Insig.
	b					
	c					
	d					
Single orders:	a			-	Insig.	-.78*
	b					
	c					
	d					
Regular short term:	a				-	
	b					
	c					
	d					

a = all firms; b = independents only; c = repetition; d = jobbers.

Table 7.13

DESCRIPTION OF CONTRACTS

	$\bar{x}$	S.D.	n
Irregular	37.2793	30.4683	37
Regular long term	50.6785	34.7405	32
Single orders	21.8437	24.0963	32
Regular short term	48.4500	31.7127	40
Sales to group	63.05	33.19	20

Table 7.14

CONTRACTUAL MIX AND SIZE F-TEST

	All	df	Independent	df	Non-growers	df	Growers	df
Irregular	1.738	3,33	1.00	5,14	.3647	3,3	.7720	4,8
Regular long term	1.68	3,28	3.1	5,11	.5432	3,2	4.13	4,6
Single orders	.52	3,28	.6160	5,14	5.7439	4,2	.7652	4,8
Regular short term	2.29	3,36	.7367	5,21	.1829	5,7	3.3	5,9
Sales to group	.774	3,16	-	-	-	-	-	-

Table 7.15

BREAKDOWN OF CUSTOMER RELATIONSHIPS BY SIZE. WHOLE SAMPLE

		Size (employees)	$\bar{x}$	S.D.	n
1.	Irregular contracts	Under 25	17.200	15.563	5
		26- 50	40.625	39.591	8
		51-100	54.375	31.332	8
		101+	33.375	26.892	16
		F. 1.7384 dof 3,33			
2.	Regular long term contracts	Under 25	70.0	29.155	5
		26- 50	40.0	34.641	6
		51-100	24.0	17.103	5
		101+	52.625	39.052	16
		F. 1.6794 dof 3,28			
3.	Single orders unrepeated	Under 25	20.750	15.457	4
		26- 50	31.250	31.932	8
		51-100	17.143	15.774	7
		101+	18.923	26.228	13
		F. .5187 dof 3,28			
4.	Regular short term contracts	Under 25	41.400	36.329	5
		26- 50	49.444	31.667	9
		51-100	70.455	35.246	11
		101+	39.800	24.507	15
		F. 2.2926 dof 3,36			
5.	Sales to group	Under 25	58.000	36.497	3
		26- 50	80.000	20.000	3
		51-100	82.000	27.785	3
		101+	54.636	37.715	11
		F. .7749			

CONCLUSIONS ON CONTRACTUAL MIX

Our examination of contractual mix in terms of our initial hypothesis - that it reflects efficiency, indicates that firms are not at a disadvantage because of their size.

NOTE

It is possible, if we are mistaken in suggesting that there will be a relationship between "regular short term" contracts and efficiency. And that "regular short term" contracts indicate imperfections in the market. If this were the case then the less regular contracts - the floating contracts, would be competitive. Thus these would reflect efficiency. Again our empirical findings suggest no relation with size. Thus whichever deductive process is used, the conclusions remain the same.

POSTSCRIPT

In addition to this view of the nature of contracts there are other implications of different contractual mixes. The higher the proportion of irregular contracts that a firm caters for the greater the variety of output.[56] In this respect there may be greater costs, for example, due to learning,stock variety of equipment, etc. In this case the test examines the degree of homogeneity of firms compared. It would seem reasonable, for example, to suppose that, on this dimension, the degree of variety of output was similar for firms of different size.

PERCEIVED ADVANTAGES AND DISADVANTAGES OF COMPETING WITH FIRMS OF DIFFERING SIZE

In addition to our other analyses of size we asked firms to indicate their relative advantages and disadvantages of competing with firms of other sizes. The results are shown in Tables 7.17 to 7.20. The best way to analyse these results is by cross-checking. This is to say if firms of size C claim advantages and disadvantages over firms of size D (larger) and similarly of firms of size B (smaller), we compare the perception of firms of size B and D towards firms of size C. The results of this analysis are shown in Table 7.16.

Table 7.16

CONCENSUS ADVANTAGES AND DISADVANTAGES OF COMPETING WITH FIRMS OF VARYING SIZE

Special concensus advantages of smaller size	Special concensus disadvantages of smaller size
1. Price on shorter runs	1. Quality
2. Overheads	2. Technical assistance
3. Contact with workers	3. Capacity
	4. Ability to produce longer runs

Table 7.17

ADVANTAGES IN COMPETING WITH LARGER FIRMS

Employees	Rank Order	
Under 50	1	Personal interest in foundry work amongst managers
	2	Flexibility
	3	Fast delivery
	4	Price on smaller runs
	5	Lower overheads
	6	Quick settlement of queries

Also mentioned: specification, quality, quick estimation, quick pattern change, harmonious labour relations, ability to modify standard pattern designs

51-100	1	Flexibility
	2	Price on shorter runs
	3	Quick delivery
	4	Personal attention

Also mentioned: specification, ability to take on more intricate work, lower overheads, good decision making, quick settlement of queries, skilled craftsmen

101-300	1	Personal interest
	2	Specialised work
	3	Flexibility
	4	Quality
	5	Reliability

Also mentioned: flexibility on length of production run, lower overheads, quicker delivery, harmonious labour relations, price, marketing

301-500	1	Price
	2	Personal interest
	3	Flexibility
	4	Quick delivery
	5	Company service

Table 7.18

DISADVANTAGES IN COMPETING WITH SMALLER FIRMS

Employees	Rank Order		
Under 50	1	Price	
Also mentioned: overheads, less contact with workers, higher costs			
51-100	1	Overheads	
	2	Price	
Also mentioned: less contact with workers, delivery and "none".			
101-300	1	Overheads	
	2	Price	
	3	Personal attention	
Also mentioned: standardisation, long production runs not possible, "none".			
301-500	1	Price	mentioned once
	2	Overheads	mentioned once
	3	Delivery	mentioned once

Table 7.19

DISADVANTAGES IN COMPETING WITH LARGER FIRMS

Employees	Rank Order	
Under 50	1	Capacity
	2	Modern plant
	3	Quality control
	4	Technical assistance
51-100	1	Modern plant
	2	Technical assistance
	3	Capacity
	4	Longer runs
101-300	1	Modern plant
	2	Technical assistance

Table 7.20

OWN ADVANTAGES IN COMPETING WITH SMALLER FIRMS

Employees	Rank Order	
Under 50	1	Quality
	2	Delivery
	3	Capacity

Also mentioned: costing systems, price, technical staff, "know-how"

51-100	1	Capacity
	2	Delivery
	3	Specialisation

Also mentioned: after sales service, good costing, length of runs, range of patterns

101-300	1	Quality
	2	Technical staff

Also mentioned: length of run, finance, price, range of patterns, specialisation, delivery, service and advantages of bulk purchase

As we noted in our chapter on competition, larger firms do have the advantage of quality control. Advantages of smaller size seems generally to revolve around price on shorter runs, lower overheads (this is typical of firms sensitivity over volume of production) and closer contact between management and employees on the shop floor.

To some extent this implies the following possibilities:

A. Over quality - larger firms are on average able to supply castings of a higher quality.

B. Over close contact with workers - suggests the possibility for greater internal efficiency or X-efficiency.

C. Ability to produce shorter runs at lower costs.

Factors C and B may be compensating factors for small firms relative to factor A.

Larger capacity endows larger firms with both an advantage and disadvantage. The disadvantage is the need for greater throughput, the advantage is the ability to produce longer runs.

The recurring mention of overheads has implications for economies of scale. As pointed out in Chapter 3, it might be assumed a priori that when demand was unstable firms of less than minimum efficient size would be less worse off than if demand was stable because the presence of fixed overhead costs. In ironfounding there is a four year cycle (Chapter 1) and this instability, it might be supposed, would favour small firms and hence the importance of overheads.[57]

A TEST ON ONE DIMENSION OF SCALE ECONOMIES

LENGTH OF PRODUCTION RUN

Product specific economies limited to the length of run rather than the size of the plant (firm) are another dimension of economies of scale. Such economies derive from cost savings in set up, possibilities for the introduction of automatic equipment, learning, etc.

In this section we seek to examine the relationship between the length of run and the size of the plant. Is it the case that firms of differing size specialise in production runs of differing length? In Chapter 6 (on competition) we noted a lack of general competitiveness between firms of differing size.

THE LENGTH OF PRODUCTION RUN

In our questionnaire we gave this point two considerations. We asked firms directly what they considered to be their average length of production run. As it turned out, unsurprisingly, the question was omitted by respondents because of the difficulty of giving any firm estimate. As an alternative, we asked for some indication of the number of patterns used per month to produce the castings. This is necessarily linked to the length of production run but is more crude insofar as the distribution of length is not given. We can, however, usefully examine patterns used in relation to firm size.

Table 7.21 gives the size distribution for jobbing foundries and repetition foundries separately. As can be seen the number of patterns used is independent of the size of the firm, though again there is considerable variability in the estimates.

The implication of these results, given that larger firms have greater capacity, is that on average they have longer production runs. This, prima facie, suggests lower unit costs for any particular casting as compared with the same casting produced by a smaller firm with a shorter run.

This raises the problem of product mix. If demand is related to the length of run then firms may well specialise in the length of run. Otherwise we should expect larger firms to be at a considerable advantage over small firms with a curtailed production run.

Table 7.21

A DIMENSION OF SCALE ECONOMIES

(a) Length of production run

Patterns monthly by size (employees)

Patterns	Jobbing			Repetition		
	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n
0- 50	97.5	126.0788	16	160.6667	211.88	12
51- 100	48.08	47.3418	12	263.000	379.22	11
101- 200	132.6	167.1486	15	152.6667	96.42	6
201- 500	90.14	69.2417	7	701.1818	1618.99	11
501-1000	95.0	75.0	2	539.0000	0.0	1
Over 1000	415.0	0.0	1	233.0	182.0	2
Total	101.1698	129.8321	53	336.16	879.14	43
	F = 1.8705			F = .5140		

CONCLUSIONS

We argued at the beginning of this chapter that we could side step the issue of measuring economies of scale, for our purpose, by measuring the relationship between efficiency and size.

In so doing a number of primary measures were considered. On these - profitability, the Downie test and the Farrel test (insofar as they unambiguously measure efficiency) - no differences were found. Two supportive statistical tests were conducted, one on the age of assets, the other on contractual mix. These served two purposes. They supported the comparability of firms, and also in as much as they were argued to be tests of efficiency, indicated no difference with size of the firm.

An analysis of the volunteered replies to an open ended question on the advantages and disadvantages of competing with smaller or larger firms, indicated that larger firms had quality or technical advantages over smaller firms, while smaller firms had price advantages on shorter runs and lower overhead costs.

On the length of run it was shown that this was related to the size of firm.

COMPETITION AND EFFICIENCY

This last point is consistent with our overall analysis of competition, from which two major points may be restated. First, there tended to be specialisation by size of firm, and second, within each size group firms were highly competitive, and the degree of competition was not related to the size of the firm. Given this we could imagine foundries to be a collection of different industries of which size was the important dimension. Thus it is hardly surprising that a cross-sectional approach to the relative efficiencies of firms of differing size should not show any differences given the measures on which our analysis is based.

However, since the risk of survival is related to size, we must also conclude that our sample does not reflect differences in efficiencies. This could be for two reasons. First, that it is the nature of the sample, and/or second, that the industry has reached a stage where efficiencies relatives have stabilised by size of firm.

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18. For estimates of economies of scale in particular industries see, for example:-

    (i) J. S. Bain, "Barriers to New Competition", op. cit.

    (ii) C. F. Pratten, "Economies of Scale in Manufacturing Industry", op. cit.

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39. The effects of concentration have already been noted, see also G. Whittington, op. cit., pp. 74-81. And on decreasing variability of profitability over time and increasing concentration see J. M. Samuels and D. J. Smyth, op. cit., p. 137.

40. J. M. Samuels and D. J. Smyth, op. cit., p. 135 and G. Whittington, op. cit., pp. 49-52.

41. S. S. Alexander (op. cit., p. 232-233) considered this variability might be due to the riskiness of size and examined the variability of profitability with size under the assumption that large firms were a collection of small firms. Using the statistical rule that the standard deviation of the mean of a sample is approximately $1/\sqrt{n}$ of the standard

deviation of the original population. Where n is the number in the sample, he demonstrated that the variability of profitability did decrease with increasing size but to a lesser extent.

42. J. M. Samuels and D. J. Smyth, op. cit., pp. 133-4, G. Whittington, op. cit., pp. 66-72.

43. "Profit/Sales" was a simple ratio. The opportunity cost of capital was assumed to be zero.

44. The functional form $Y = a + B \log x + B_2 (\log x^2) + \log e$ - the parabolic, was not considered though this has been considered by a number of authors. See A. Singh and G. Whittington, op. cit. and H. O. Steekler, op. cit.

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CHAPTER 8

GROWTH IN IRONFOUNDING

SYNOPSIS: In this chapter we examine the means and direction of growth of firms in ironfounding. The applicability of the law of proportionate effect. And the relationship between profitability and growth.

MEANING

> "The size and growth rate of a firm are, respectively, the static and dynamic expression of the same economic phenomenon. Size is the historical expression of growth at one point in time, and the interrelations of state and process play a vital part in any theoretical framework dependent upon the concept of equilibrium. Economic analysis concerning the size of the firm has centred traditionally around the concept of optimum size, with growth part of a loosely defined adjustment mechanism which operates in a yet more loosely defined time dimension."[1]

The connection between economies of scale and growth is precisely that firms will accept opportunities to grow which will enhance their efficiency (assuming monopoly power is absent). It is particularly the case where competition is keen.

Now we have reviewed some of the stimuli for growth earlier. Here we shall pay attention to the direction and rate of growth and try to discover whether this has any implications for economies of scale, and our analysis of the industry.

It will be recalled from Chapter 3 that the direction and the rate of growth were both important aspects to be considered in examining economies of scale. In particular, the direction of growth was important for both conceptual reasons and measurement reasons. In summary the important points were:-

(1) Whether growth was for the same market.

(2) Whether growth was diversified.

(3) Whether growth was through merger (with or without diversification).

(4) Whether the rate of growth was related to the size of the firm.

It was also noted that growth did not necessarily imply economies of scale. Growth would be determined by the perceived profitability of different growth opportunities open to the firm. Growth in any one market would be limited by, for example, the level of demand and imperfections existing in that market.

If a firm diversified it might achieve overall cost reductions but such an achievement would make individual product cost comparisons with smaller firms (which were not similarly diversified) invalid in terms of a judgment of economies of scale.

Thus the implications of growth for economies of scale are not direct. A firm may or may not reap the advantages of scale economies as the result of growth. Thus an examination of the growth of firms will not necessarily lead us to any firm conclusion about economies of scale, except that, insofar as scale economies are available, firms will have the chance to reap them.

What do we wish to know?

In terms of our initial hypothesis - that survivorship was related to economies of scale. We wish, in the first place, to examine how firms grew. Thus irrespective of measurement problems entailed in firms diversifying, it is important to know whether the transfer of work (a) is taking place, and (b) how it is taking place.

GROWTH OF FIRMS AND IRONFOUNDING

We examined the growth of firms in ironfounding in terms of opportunities in two ways. First, an historical evaluation of their growth opportunities taken, and second, an evaluation of future growth opportunities. We were interested in the extent to which growth took place because of market opportunities in terms of growing markets or whether growth was by its very nature predatory, that is at the expense of other firms. Naturally it is possible for both to occur. Growth taking place to cover fresh market opportunities and at the expense of other firms.

THE RESULTS

Tables 8.1 and 8.2 show the results of this inquiry. In general, past growth was at the expense of other firms for 80.8% of our sample, and exclusively so for 70.7%. Growth from fresh market opportunities, on the other hand, was exclusively important for 19.2% of firms and in combination for 29.3%. It should also be noted that there was a significant difference between the size of firms which grew through fresh market opportunities compared with those which did not. These firms were significantly larger.

On the other side of the coin, some firms which had contracted over the period under consideration replied to our questionnaire. Significantly fewer (see Tables 8.3 and 8.4) attributed their decline to a transfer of work to growing firms (28.6%) and accepted a declining market (60.5%) as the principal reason for their own decline.

If these two results are viewed as inconsistent, our interpretation would necessarily rest on the questions of the knowledge of the respondents and the degree of truth telling. If we accept that the results are inconsistent and that respondents told the truth, it is possible that growing firms gaining more orders would be better informed about the source of such orders than firms losing orders. However, the results need not be inconsistent but simply a result of the sample which replied. And, of course, many of the firms from which work had been transferred may already have left the industry.

Table 8.1

REASONS FOR GROWTH

At the Expense of Other Firms?			X Number of Employees	
	n	%	$\bar{x}$	S.D.
Yes	80	80.8	144.425	167.494
No	19	19.2	503.667	1304.9109
Total	99	100.0	210.4082	595.8267
				F = 5.5342

Table 8.2

REASONS FOR GROWTH

Because the Market is Expanding?			X Number of Employees	
	n	%	$\bar{x}$	S.D.
Yes	29	29.3	388.9286	1061.3934
No	70	70.7	139.0	168.9494
Total	99	100.0	210.4082	595.8267
				F = 3.5756

Table 8.3

REASONS FOR DECLINE

Declining Market?	n	%	X Number of Employees $\bar{x}$	S.D.
Yes	26	60.5	85.6538	136.8014
No	17	39.5	152.4706	193.6367
Total	43	100.0	112.069	164.9446
				F = 1.6740

Table 8.4

REASONS FOR DECLINE

Transfer of Work to Other Firms?	n	%	X Number of Employees $\bar{x}$	S.D.
Yes	12	28.6	141.75	216.48
No	30	71.4	102.27	140.26
Total	42	100.0	113.55	166.62
				F = .46

SUMMARY

So far our results accord with our initial hypothesis. At least amongst the smaller firms the transfer of work is crucially important in the growth of the firm. Amongst larger firms fresh market opportunities are also important.

THE DIRECTION OF GROWTH IN IRONFOUNDING

As we discovered in our initial review of ironfounding (Chapter 1), the importance of different markets had changed. Some markets had become more prominent whilst others had receded, though the total output of iron castings over the last ten years, and future expectations, were more or less constant.

We also noticed that techniques had progressed and were likely to do so, and particularly that the markets for special irons, especially spheroidal graphite iron, was increasing probably at the expense of grey iron.

It is in this light that we may examine the direction of the growth of firms in ironfounding. The period of growth reported on by firms covers ten years up to 1972.

We considered the following issues:-

(a) The technical basis of growth.

(b) Growth and diversification.

(c) External growth and diversification.

(d) Future growth prospects.

(e) Changes in methods of production. [The actual changes in methods of production, types of casting and markets are shown in Appendix B.]

(f) Changes in markets served.

THE TECHNICAL BASIS OF GROWTH

We might expect growth to be related to the firm's present operations.[2] In Table 8.7 we examine this growth in terms of a subdivision of the industry between jobbing foundries and repetition foundries. We find that firms tend to grow in relation to their present operations.

Some inaccuracy is present because the classification of the firm relates to 1972, while the growth of the firm relates to the period 1972-1962. Thus very fast growth in one area of production over this period will contaminate the results insofar as that growth will affect their present classification.

However, the results are so significant as to suggest that foundries grew according to their present technology and experience.

THE DIRECTION OF GROWTH

We separately examined internal growth and external growth (Table 8.5).

INTERNAL GROWTH

We first examine internal growth. We classified growth into old markets and new markets with new or old techniques of production. Now the basic techniques of production, as we have seen, are broadly the same. So interpretation of the adoption of new techniques will be

Table 8.5

DIRECTION AND TYPE OF GROWTH

	Wholly for this reason	Mainly for this reason	Partly for this reason	Slightly for this reason	Not for this reason	
Internal Growth:						
for same markets	22 (31.9)	21 (30.4)	16 (23.2)	3 (4.3)	7 (10.1)	69
New markets - same technique	4 (5.8)	13 (18.8)	12 (17.4)	5 (7.2)	35 (50.7)	69
New markets - new technique	8 (11.6)	14 (20.3)	12 (17.4)	6 (8.7)	2 (42.0)	69
External Growth:						
for same markets	4 (16.0)	6 (24.0)	7 (28.0)	2 (8.0)	6 (24.0)	25
New markets - new technique	4 (16.0)	3 (12.0)	4 (16.0)	2 (8.0)	12 (48.0)	25
New markets - same technique	4 (16.0)	6 (24.0)	3 (12.0)	- (0.0)	12 (48.0)	25

in the light of both technical progress and techniques appropriate to the new size of firm, as well as to differences occurring within our classification jobbing and repetition.

The overall interpretation of Table 8.5 for internal growth is that firms, on average, gave a higher priority to growth in their present markets <u>although</u> they moved, on average as a second consideration, into new markets.

EXTERNAL GROWTH

External growth on the other hand, was as likely to be important in old markets as new markets.

GROWTH AND SPECIAL IRONS

A small minority of firms adopted or increased their output of special irons in this period (Table 8.6).

FUTURE GROWTH OPPORTUNITIES

In terms of future growth opportunities (Table 8.12), an open ended question, firms tended to look more towards the basic type of iron and the technique of production than to market opportunities.

GROWTH AND METHODS OF PRODUCTION

Table 8.8 indicates that growth was generally accompanied by changes in the method of production. This, as we have said, will be due both to an appropriate new method of production and to technological change.

CHANGING MARKETS

Following from this, market changes were not necessarily accompanied by changing methods of production (Table 8.10). And growth at the expense of firms (Table 8.9) (most important amongst the smaller firms) was

Table 8.6

GROWTH FOR SPECIAL IRONS?

	n	%	F test by size of firm
Yes	28	25	
No	84	75	
Total	112	100	F = .025

Table 8.7

GROWTH AND TYPE OF FIRM

Type of Firm	Jobbing	Repetition	Type of Growth n
Jobbing	26 (86.7)	4 (13.3)	30
Mainly jobbing	18 (66.7)	9 (33.3)	27
Repetition	2 (8.7)	21 (91.3)	23
Mainly repetition	2 (7.1)	26 (92.9)	28
Total	48	60	

$X^2 = 54.74292$ df 3

Table 8.8

GROWTH AND CHANGES IN PRODUCTION METHODS

Growth	Method Moves		
%	Yes	No	Total
0- 5	2 (6.7)	3 (27.3)	5 (12.2)
6- 10	4 (13.3)	2 (18.2)	6 (14.6)
11- 20	1 (3.3)	4 (36.4)	5 (12.2)
21- 50	7 (23.3)	2 (18.2)	9 (22.0)
51-100	3 (10.0)	0 (0.0)	3 (7.3)
Over 100	13 (43.3)	0 (0.0)	13 (31.7)
Total	30	11	41

Table 8.9

CHANGES IN MARKET, PRODUCTION METHODS AND GROWTH AT THE EXPENSE OF FIRMS

Growth at Expense of Firms	Market Moves		Method Moves	
	Yes	No	Yes	No
Yes	28	20	60 (81.1)	18 (78.3)
No	1	7	14 (18.9)	5 (21.7)

Table 8.10

THE RELATIONSHIP BETWEEN CHANGED MARKETS AND METHODS OF PRODUCTION

Market Moves	Method Moves		
	Yes	No	Total
Yes	27 (54.0)	6 (33.3)	33 (48.5)
No	23 (46.0)	12 (66.7)	35 (51.5)

accompanied by changed methods but not necessarily changed markets.

Thus considering the transfer (of work) mechanism of growth, this may be seen as a result of a new plateau of production technique with or without a change of markets.

IMPLICATIONS FOR THE SURVIVOR TECHNIQUE AND ECONOMIES OF SCALE

So far we have been largely descriptive. We have described broadly how growth has occurred during a ten year period in ironfounding.

The implications for the survivor technique in terms of a transfer of work, is that our data largely supports this. We may restate the major findings. Growth at the expense of firms is important. Those firms which grow, do so on the same technical base, for (usually) the same markets, with new methods of production which are appropriate whether or not market changes occur, and indeed, future growth opportunities are seen to be technical rather than market opportunities.

What this establishes is a degree of competition amongst similar firms. This does not imply (as we have shown) that all firms are similar, but that the competitive transfer of work takes place amongst similar firms.

We have, of course, shown that other forms of growth are also important. External growth combining dissimilar markets and methods, and internal growth through diversification into new markets, and growth for special irons. Our postulate here is that growth is more importantly similar in terms of the firms present and past operations.

GROWTH VARIABLES, SIZE OF FIRM AND TYPE OF FIRM

We examined our descriptive growth variables according to the size (and on disaggregation) and the type of firm. Only two significant results were obtained. These were that smaller firms were less likely to expand into new markets with new techniques (correlation coefficient with size -.2738 n = 43) and thus less likely to change their methods (correlation coefficient -.2676 n = 118). Secondly, jobbing foundries were less likely, as a group, to grow for special irons (correlation coefficient -.2387 n = 111). Statistically all other growth characteristics were similar by size and type of foundry.

IMPLICATIONS FOR ECONOMIES OF SCALE

On their own the results so far tell us nothing about economies of scale. It will be necessary to reinterpret the results in the light of our other empirical findings later. We have, however, established that a transfer mechanism is in operation and that growth takes place within the firm's own experience.

Now, if costs are important, then growth will allow firms to produce at lower average cost per unit up to minimum efficient scale. In an attempt to examine a direct relationship between size and cost reductions due to size, we approached the problem in two ways. First we asked firms if, in their opinion, larger firms had lower unit costs of production. Second, to what extent, given their own kind of output, did they consider themselves to be below minimum efficient scale. This last question was a leading question and affords only two kinds of interpretation. First, the distribution of those which dissented is important (believing that there were no cost gains to increased size) and, second, whether there was any consistency between individual estimates.

The two questions are conceptually different. Individual firms might look to economies of scale as a result of growth, whereas they may or may not exist in practice.

Table 8.11 illustrates that in general (76.9%) firms believed that larger firms did not have a cost advantage over smaller firms. The answers to this question were not related to the size or type of responding firm.

Table 8.13 shows the results of the second question. If we examine only independent firms in our sample we find, from their estimates, that they did in general consider the possibility of cost gains from increased size to be true. Their estimates, which was the ratio of their present best output to their predicted best size, was not, however, related to size. Now the ratio indicates the proportion of best possible (lowest cost) output their present operations cover. And in size classes other than 76-100 employees, gains were expected.

Firms which had grown over the ten year period were considered separately. This was because we felt that firms with the experience of growth would be more able to estimate further expected gains from growth. In this case we find a small correlation with the size of the firm (r^2 .21935); however there remains considerable

Table 8.11

DO LARGER FIRMS HAVE LOWER COSTS?

	n	%
Yes	12	23.1
No	40	76.9

Table 8.12

WHAT ARE THE MAJOR GROWTH AREAS IN IRONFOUNDING?

	Type of Iron	Production Method	Market
f	18	12	14

Table 8.13

ESTIMATES OF OPTIMUM

$$\text{ratio} = \frac{\text{present optimum}}{\text{best size}}$$

(present optimum/best size) = a + B (size [employees])

INDEPENDENTS ONLY:

JOBBERS

a	B(SE)	r^2	F	n
.49858	.09224 (.06715)	.17334	1.88715	15

REPETITION

a	B(SE)	r^2	F	n
.25178	.24814 (.26677)	.11	.86519	11

Size	Dependents	n	Independents	n	Non-growers	n	Growers	n
0- 25			.697 (.275)	6	.875 (.177)	2	.608 (.575)	4
26- 50			.594 (.139)	8	.653 (.255)	2	.575 (.111)	6
51- 75			.795 (.167)	9	.713 (.107)	4	.861 (.187)	5
76-100			2.042 (1.709)	2	-	0	2.042 (1.709)	2
Over 100			.767 (.094)	2	.700 (1)	1	.833 (0.0)	1
				27		9		18

Using discrete categories F = .7135 F = 3.3972

X^2 8.49391 df 2

Indicates no cost gains to tied foundries.

Separate estimates for firms growing and firms not growing.

(present optimum/best size) = a + B (size [employees])

INDEPENDENTS ONLY:

NON-GROWERS

a	B(SE)	r^2	F	n
.83219	-.03840 (.04438)	.09661	.749	9

GROWERS

a	B(SE)	r^2	F	n
.20422	.25972 (.12249)	.21935	4.4958	18

diversity in the results.

Foundries which were tied, supplying castings not only to the general market but also for their own use, on average predicted no cost gains from increased size.

CONCLUSIONS

We have established a transfer mechanism. We have also established that firms of differing size are not on average perceived as having lower costs of production. An investigation of firms' predicted optimum size yielded no unique optimum, but suggested firms expected increased size to yield cost gains. These results are not necessarily incompatible. Cost gains may not be found in practice, but may be available in principle. In addition (from Chapter 6), we noted that the degree of competition between size groups (allowing comparability by size) was not great. Thus intra group optima may be more important than relative inter group cost advantages.

We now move on to examine the rate of growth and size and profitability.

ECONOMIES OF SCALE AND THE RATE OF GROWTH

In this section we wish to examine the relationship between the rate of growth and economies of scale. Also the interdependence of growth on profitability.

It will be recalled that where the law of proportionate effect is seen to be operating, it has been interpreted to imply constant costs.

Now the law of proportionate effect asserts that the growth rate of a firm in any one time period is a stochastic phenomenon which results from the cumulative effect of the chance operation of a large number of forces acting independently of each other, and that the probability of a firm growing at a given rate in any one period of time is independent of the initial size of the firm.

For the law of proportionate effect to fully describe the growth processes of a given size distribution of companies, then two conditions must prevail.

(1) All size groups must have the same proportionate growth rate.

(2) The dispersion of growth rates about the mean must be the same for all size classes.

To estimate (1) we can use the function:

$$\log St = a + B \log St_{-1} + \log e_t$$

Where S is size, and t is the time period. We compare B with 1.

To estimate (2) we may use the F test, and examine whether there is any correlation between the standard deviation of growth in size classes, and size.

PREVIOUS RESEARCH

The evidence of previous studies tend to support the first condition.[3]

Studies have shown that the second condition is not always fulfilled. And that either variability is heterogeneous between size classes with a tendency towards negative correlation.[4] Or the dispersion is negatively correlated with size.[5]

RATE OF GROWTH OF FIRMS IN IRONFOUNDING: THE RESULTS

Table 8.14 indicates that in general (except for 1970-69) firms grew at the same proportionate rate. Different measures were used - sales, employees and net assets.

Furthermore, we separated growing firms from firms which were contracting. And again we find that growth is independent of size. This suggests that any above average higher rate of growth by small firms to achieve minimum efficient scale, offset by firms contracting due to disadvantages of scale, and thus on aggregate suggesting no proportional difference between size groups, does not hold. All growing firms and contracting firms in the period 1970-67 do so at the same proportionate rate, independent of size.

ON DISAGGREGATION

All groups - dependent foundries and independents subdivided into jobbers and repetition foundries grow at the same proportional rate. Except jobbers in the period 1970-69.

THE VARIABILITY OF GROWTH

Table 8.15 - an F test - indicates homogeneity of variance between size groups.

If we consider standard deviations:-

ble 8.14

WTH RELATIONSHIPS

Function	Dependents (n = 53)			Independents (n = 70)			Jobbers (n = 42)			Independents only: Repetition (n = 28)			Independents only: Non-Growers (n = 20)			Independents only: Growers (n = 50)		
	a	B(SE)	r^2	a	B(SE)	r^2	a	B(SE)	r^2	a	B(SE)	r^2	a	B(SE)	r^2	a	B(SE)	r^2
g sales 70 = f g sales 69	.349	.9595 (.051)	.876	.053	1.016 (.018)	.979	.054	1.014 (.048)	.919	.060	1.002 (.0323)	.9835						
g employees 70 = f g employees 69	.077	.968 (.079)	.748	.0105	.967 (.085)	.655	.0183	1.007 (.030)	.965	-.039	.9637 (.024)	.985						
g NA 70 = f g NA 69	.128	.958 (.061)	.829	.382	.9298* (.029)	.9373	.7016	.845* (.062)	.822	.083	.9742 (.023)	.986						
g NA 70 = f g NA 68	-.014	.9745 (.082)	.733	.243	.972 (.030)	.938	.332	.943 (.064)	.85	.115	.9724 (.032)	.972						
g NA 70 = f g NA 67	.067	.970 (.086)	.7134	.4681	.929 (.035)	.912	.517	.907 (.070)	.8076	.342	.8565 (.0844)	.79703	-.29	1.036 (.027)	.988	.529	.944 (.036)	.934

Table 8.15

BREAKDOWN OF THE GROWTH OF NET ASSETS BY THE SIZE OF THE FIRM

Employees		1970-69			1970-68			1970-67			1969-68			1968-67	
	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n	$\bar{x}$	S.D.	n
All Independents															
25- 50	.202	.730	37	.150	.426	37	.210	.526	37	.043	.236	37	.041	.212	37
51- 75	.136	.143	13	.283	.257	13	.412	.328	13	.134	.229	13	.128	.279	13
76-100	.093	.057	9	.124	.144	9	.252	.493	9	.028	.102	9	.104	.382	9
101-200	.076	.104	8	.197	.298	8	.221	.385	8	.104	.199	8	.009	.082	8
201+	.032	.168	3	.089	.197	3	.227	.345	3	.062	.183	3	.112	.129	3
		F = .1795			F = .4444			F = .4553			F = .5591			F = .5605	
Repetition															
25- 50	.037	.208	9	.135	.284	9	.177	.533	9	.089	.110	9	-.010	.365	9
51- 75	.215	.180	4	.338	.227	4	.776	.176	4	.102	.131	4	.357	.256	4
76-100	.088	.024	5	.134	.073	5	.072	.180	5	.042	.051	5	-.056	.131	5
101-200	.081	.111	7	.216	.316	7	.245	.409	7	.115	.212	7	.012	.088	7
201+	.032	.168	3	.089	.197	3	.227	.345	3	.062	.183	3	.112	.129	3
		F = .97			F = .62			F = 2.015			F = .22			F = 1.97	
Jobbers															
25- 50	.254	.828	28	.155	.467	28	.221	.534	28	.028	.264	28			
51- 75	.100	.118	9	.259	.279	9	.250	.232	9	.148	.268	9	.057	.133	28
76-100	.099	.088	4	.112	.218	4	.477	.696	4	.010	.154	4	.026	.233	9
101-200	.037	-	1	.066	-	1	.053	-	1	.028	-	1	.303	.519	4
201+													-.012	--	1
		F = .16			F = .1923			F = .35			F = .5386			F = 1.7751	

(1) All Independents

Variability is highest in the smallest size group - 26-50 employees. Except for the years 1968-67. Above this there is no systematic relationship between the variability of growth and size.

(2) Repetition Foundries

Again variability tends to be highest in the smallest size group, with no systematic relationship with the size of the firm.

(3) Jobbing Foundries

There is a tendency for declining variability with increasing size for jobbing foundries for the periods 1970-69, 1970-68. For the other periods there is no relationship with size.

SUMMARY

Firms grow at the same proportional rate in all but one case considered. There is no general tendency for growth rates to be a declining function of size, though the smallest firms tend to have the highest variability of growth.

NOTE

Tables 8.16 and 8.17 are an analysis of growth rates reported by firms in reply to our questionnaire broken down by the number of employees. The tables indicate that growth is again unrelated to the size of the firm.

Table 8.16

REPORTED GROWTH OF FOUNDRIES OVER TEN YEARS BROKEN DOWN BY SIZE (EMPLOYEES)

%	$\bar{x}$	S.D.	n	
0- 5	62.2	58.39	5	
6- 10	80.33	79.71	6	
11- 20	156.80	121.20	5	
21- 50	257.22	278.97	9	
51-100	496.67	396.68	3	
Over 100	146.57	98.94	14	
Total	177.00	214.90	42	F = 2.5105

Table 8.17

CONTRACTION OF THE FOUNDRY OVER TEN YEARS BROKEN DOWN BY SIZE (EMPLOYEES)

%	$\bar{x}$	S.D.	n	
0- 5	18.00	4.00	2	
6-10	-	-	-	
11-20	124.33	124.70	3	
21-50	60.0	20.0	2	
Over 50	-	-	-	
Total	75.57	93.98	7	F = .1500

CONCLUSIONS

If it is the case that the law of proportionate effect implies constant costs if both the mean and the variability of growth is the same between size classes. Then our data, above 50 employees, supports this.

GROWTH AND PROFITABILITY

INTRODUCTION

We have described profitability as an indicator of general efficiency in Chapter 7. Further, we discovered that profitability was unrelated to the size of the firm as was growth. Now it is natural that we should expect a connection between profitability and growth. This is because profits are both the means of growth and an attraction for outside funds.

However, there need be no simple relationship. Both profitability and growth are related to the state of demand, the competitiveness of industries, managers abilities and decisions, etc. But some relationship should be expected even if it is not a close one.

The problem of comparing growth and profitability is one of identification. Which causes which? As we have said, other factors will affect growth other than profits and vice versa. Equally, in an empirical investigation, the time period is important. Hence lags and leads come into the picture. Marris[6] examines the theoretical position thus:

(a) Neo classical theory tells us that profitable opportunities will be taken (those over and above the going rate of return) and will continue until expansion has gone so far as any prospective return to expansion would be pushed back to its original level.

(b) If there are no constraints on the demand side and firms are entirely self-financing, they will grow in relation to their profitability. If all firms grow at their maximum possible rate, the two rates will become equal over the time period.

(c) If they grow using part of their profits there will be scatter but the rule (or connection) between profitability and growth will be made, i.e. profitability leads to growth, and the regression line can be thus interpreted.

(d) A double connection can theoretically be considered thus producing the identification problem. This is to assume firms maximise long term profitability in relation to present resources. This implies relationships between the rate of return, and the rate of growth and the discounted value of future profits, the retention ratio and (policing the system) the stock exchange valuation ratio.

PAST AND FUTURE PROFITABILITY IN RELATION TO GROWTH

This is the theoretical position. A more practical consideration would be to consider the relationship between profitability and growth as follows.

If we ignore the identification problem of considering growth and profitability simultaneously we may consider past and future profitability in relation to growth. The Penrose effect lays stress on management and suggests that the best profitable opportunities are exploited and thereafter less profitable opportunities. These less profitable opportunities may come about because of managerial difficulties. Thus the relationship between past growth might be curvilinear in form. A high growth rate might be less profitable overall than a small growth rate. Now the problem which arises here is if we examine past and present profitability in relation to growth, there is no reason why we should expect any particular year to have a special effect on profitability.

For example, if we consider past profitability affecting growth, then we may expect growth to be a function of the past profitability of the firm, but the growth decisions are planned and this planning may not occur necessarily in the year or years we choose our profitability variable. In terms of the future profitability of the company, we might expect growth to lead to future profitability (curvilinear in form because of the Penrose effect) but since we might also expect adjustments to take place for the firm to adapt to its size, any future profitability will equally be subject to the problem of the year or years taken. These problems are particularly important because we know that profitability is highly volatile and conditions beyond the control of the firm (e.g. demand fluctuations) will upset any possibility of firm conclusions or the expectation of any close relationship. Ideally long periods should be considered but this is not available in our study. Equally because we are considering a cross-section of firms, we are assuming that firms have similar opportunities for profitable growth, adjust to growth similarly and face similar market conditions and forces.

PAST RESEARCH ON PROFITABILITY AND GROWTH[7]

Whittington found using a simple linear model, but averaged over six year time periods, that the regression estimates on past growth and future profitability were significant in seventeen out of the twenty industries studied. His results relate to all quoted companies. And for this reason we would not expect our results to bear any necessarily very similar tendencies because our sample mainly includes companies which are private. Thus the new growth theories are more relevant to his research.[8]

However, he found that past profitability had a much greater influence on future profitability even allowing for the effect of growth. Thus past growth, when allowing for the effect of past profitability, is not much related to future profitability. In his study the effects of external financing led him to the very tentative conclusion that external finance imposed some discipline on investment plans. In most industries externally financed firms had higher profitability but in other industries they were less profitable. But in most the effect of external financing on future profitability was small and rarely statistically significant.

PROFITABILITY AND GROWTH IN IRONFOUNDING

It is relevant to our study to examine the relationship between efficiencies (profitability) and growth. We are interested in four relationships:

(a) the relationship between past profitability and future growth,

(b) the relationship between growth and future profitability,

(c) the simultaneous relationship between growth and profitability,

(d) the continuity of growth.

There is no special reason to expect growth to be continuous. Firms which grew in one period would not necessarily grow in a future period at the same rate because of the necessary constraints on management to adjust to each successive new plateau of achievement; this is irrespective of immediate growth opportunities facing the firm.

GROWTH AND PROFITABILITY: THE EMPIRICAL RESULTS

We estimated five relationships: (t = time period)

(1) profitability t = f growth of net assets (t - 1) (t - 2) (t - 3)

(2) growth (t - 2) (t - 3) = f profitability (t - 2) (t - 3)

(3) profitability $(t_1 + t_2 + t_3 + t_4)/4$ = f growth 1970-1967

(4) profit/sales $(t_1 + t_2 + t_3 + t_4)/4$ = f growth 1970-1967

(5) growth 1969-1968 = f growth 1968-1967

The major limitation to our analysis was that the time period under consideration was very brief. Thus, irrespective of the definition of the function and the problems of intervening variables, any results must be viewed tentatively.

The sample was disaggregated. We considered all independent firms in the sample and then, separately, jobbing foundries and repetition foundries. Tables 8.18 and 8.19 illustrate the results.

1. Present profitability in relation to past growth was statistically significant at the 5% level in five of the nine estimates although r^2 was low.
2. Similarly growth in relation to past profitability was significant at the 5% level in five of the nine estimates.
3. Some relationship was discovered between profitability and profit/sales and the percentage growth rate 1970-1967.
4. The rate of growth was not continuous.

In view of the fact (Table 8.18) that profitability tended to persist over the period, and past profitability was a good indicator of future profitability, our results should be interpreted tentatively.

Any study of profitability and growth presupposes the need for profitability to grow, and is interested in the effect of profitability on growth. However, when we consider a cross-section of firms, different firms will have different objectives and different abilities to grow. Thus some firms may achieve high rates of profitability and not wish to grow.

Our study here is at present purely descriptive (we wish to draw conclusions, later, from our other data on growth) and we thus note that there is a tendency for profitability and growth to be related, which might suggest that the successful can grow and remain successful. Tables 8.22 and 8.23 illustrate that there is no percentage increase in profitability as a result of growth in the period.

The necessary link between profitability and growth is illustrated in Table 8.21. These are the results of our questionnaire sample. For the majority of firms two sources of funds for growth were used - first, profits and second, bank loans. Bank loans are an expensive form of external finance which cannot be considered long term. Thus firms in the industry can be considered almost as self-financing.

CONCLUSIONS ON PROFITABILITY AND GROWTH

Our conclusion, relevant to our discussion, is that some successful firms grow and that there is no evidence to suggest that they do not remain successful. Combined with our evidence on profitability and the size of firm and size of firms and growth of firms, this conclusion is unsurprising.

Table 8.18

GROWTH AND PROFITABILITY

Profitability and Growth of Net Assets	Independents				Repetition				Jobbing			
	a	B(SE)	r^2	n	a	B(SE)	r^2	n	a	B(SE)	r^2	n
Profitability 1970 = f growth 1970-69	.13563	.03964 (.03815)	.01563	70	.18086	.25407 (.21050)	.05306	28	.09303	.04312 (.03581)	.03496	42
Profitability 1970 = f growth 1970-68	.10185	.22881* (.05202)	.22149	70	.14308	.32743* (.12174)	.21767	28	.06707	.20260* (.05185)	.27625	42
Profitability 1970 = f growth 1970-67	.10920	.12765* (.04154)	.12195	70	.17548	.09855 (.17548)	.05987	28	.06726	.13941* (.04543)	.19054	42
Growth 1970-67 = f profitability 1967	.17425	.66759* (.26347)	.03627	70	.15360	.69738 (.44671)	.08571	28	.18463	.66950 (.34233)	.08727	42
Growth 1970-68 = f profitability 1968	.17362	.54061 (.41046)	.03966	44	.13295	.72005* (.32990)	.22943	18	.19369	.40972 (.73245)	.1287	26
Growth 1970-69 = f profitability 1969	-.14930	2.45351* (.50859)	.35654	44	.00504	.53144* (.21099)	.28393	18	-.14484	3.46250* (.69651)	.50732	26
Profitability (1970 + 1969 + 1968 + 1967)/4 = f growth 1970-67	.09110	.11726* (.03891)	.17783	44	.09577	.29448* (.06266)	.57989	18	.06523	.06733 (.04052)	.10320	26

Table 8.19

PERSISTENCY OF GROWTH

	Independents				Repetition				Jobbing			
	a	B(SE)	r^2	n	a	B(SE)	r^2	n	a	B(SE)	r^2	n
Growth (net assets) 1969-1968 = f growth (net assets) 1968-1967	.07239	-.10264 (.10841)	.01301	70	.08474	.02584 (.10201)	.00246	28	.06802	-.21935 (.17785)	.03664	42
Profit/sales (1970 + 1969 + 1968 + 1967)/4 = f growth 1970-67	.03542	.03489* (.01556)	.10692	44	.5498	.05131 (.03813)	.10168	18	.01991	.02981* (.01314)	.17660	26

Table 8.20

FINANCE FOR GROWTH OVER TEN YEARS

	Mainly by this method	Important method	Partly important	Slightly by this method	Not by this method	n
Retained profits	16 (34.8)	6 (13.0)	8 (17.4)	2 (4.3)	14 (30.4)	46
Long term loans	1 (2.2)	1 (2.2)	3 (6.5)	0 (0.0)	41 (89.1)	46
New issue of shares	1 (2.2)	1 (2.2)	0 (0.0)	2 (4.3)	42 (91.3)	46
Short term loans	1 (2.2)	1 (2.2)	1 (2.2)	1 (2.2)	42 (91.3)	46
Bank overdraft	7 (15.2)	6 (13.0)	5 (10.9)	4 (8.7)	24 (52.2)	46
Group finance	12 (26.1)	1 (2.2)	5 (10.9)	2 (4.3)	26 (56.5)	46

Table 8.21

THE RELATIONSHIP BETWEEN GROWTH AND CHANGING PROFITABILITY 1970-1967

FUNCTION: profitability 1970-profitability 1967 = f growth in net assets 1970-1967

	a	B(SE)	r^2	n
All Independents	/	/	/	70
Repetition	.04681	-.02434 (.07126)	.00447	28
Jobbers	.00607	.00905 (.06495)	.00049	42

Table 8.22

THE RELATIONSHIP BETWEEN GROWTH AND CHANGING PROFITABILITY 1970-1967: GROWING FIRMS ONLY

	a	B(SE)	r^2	n
All Independents	.04844	-.02834 (.06054)	.00454	50
Repetition	-.04494	.15431 (.12619)	.08085	19
Jobbers	.06826	-.06999 (.07101)	.03242	31

CONCLUSIONS ON GROWTH

SUMMARY

1. Small firms grew mainly at the expense of others.
2. Larger firms grew through market opportunities.
3. The technical base of growth remained the same.
4. Internal growth was more importantly for the same market though new markets were of some importance.
5. The market importance of external growth was equally for new and old markets.
6. Firms in the sample did not believe that larger firms, in general, had lower costs of production.
7. Estimates of cost gains from increasing scale were not related to the present size of the firm. (Marginally) growing firms were on a path towards optimum which was related to their present size.
8. Cost gains through increased size was less important to tied foundries.
9. Firms grew (generally) at the same proportionate rate.
10. The dispersion of growth rates was not related to size. Though smallest firms had greatest variability of growth rates.
11. Firms looked to profits (internal) then bank overdrafts (external) as sources of finance for growth.
12. There was a loose connection between profitability and past and present growth but growth did not enhance profitability generally.
13. Growth was not consistent over the time period for each firm.

CONCLUSIONS

Despite the connection between growth and economies of scale discussed in this chapter, we have seen that such a connection is only a tenuous one. The evidence discussed here does not distinguish between cost advantages due to scale economies and advantages due to "success". It is however clear that a transfer mechanism is at work amongst the smaller firms in our sample. But since growth does not favour any particular size group of firms, success and therefore the transfer mechanism, does not especially favour any particular size group. Except that a proportionate growth rate in higher size classes means a higher absolute rate of growth. Thus, if this is at the expense of other firms, there is a higher absolute amount of work transferred to these firms. However, these larger firms also grew from fresh market opportunities.

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CHAPTER 9

COMPETITION, EFFICIENCY AND GROWTH

SYNOPSIS: In this chapter we are going to pull together the main conclusions of the last three chapters. In addition, we shall attempt a suggestion for the transfer mechanism, implied in Chapter 2, which may be at work.

THE HYPOTHESIS RESTATED

In Chapter 2 we examined the changing size distribution of firms over time. The survivor technique, a method for determining the optimum size of firm, suggested that economies of scale might be a force influencing the changing structure of the industry. A number of different tests of the survivor technique were considered and these did not suggest any unique optimum. However, it was shown that firms in the lower size groups had a reduced survival value as compared with firms in the larger size groups.

The survivor technique, in turn, has two fundamental assumptions. These are, that the firms to which the technique is applied are in effective competition within a single market, and that survival is itself dependent upon long-run costs. We noted that for foundries we could not usefully assume a single market and hence we have attempted to test the hypothesis of economies of scale. In addition, we explained that there were other reasons for survival, other than those of economies of scale.

Testing the hypothesis that survival was related to economies of scale and that adjustment was taking place on the supply side (rather than changes in demand) of the industry, we tested the assumptions and implications of the technique.

These were that competition was "sufficiently effective" to bring about this kind of change; that efficiency relatives were related to size; and that adjustment was taking place between firms in the industry. The broad task was both a question of analysis and establishing the degree of, or lack of, homogeneity of firms studied.

ON COMPETITION

On competition we tested the degree of similarity between producing firms, the extent to which price was beyond the control of the individual firm, and the degree of competition between firms of differing size.

Our data relied upon what entrepreneurs believed to be the case in the industry. There was good reason to use this technique. Apart from the relationship between beliefs and actions, as opposed to the relationship between (structural) possibilities and actions, our knowledge that the industry is heterogeneous suggested that any method designed to examine differences over large numbers of firms also required that this could best be achieved if they defined "themselves".

Our major conclusions on competition were that firms were keenly competitive within groups, and these competitive groups also tended to be closely related size classes. Competition took the form of price, delivery and quality with individual firms competing most strongly on delivery. These competing groups were, on average, open to new competition which ruled out the likelihood of excess profits, and the degree of competition on other variables suggested collusion was improbable.

Given that firms grow (Chapter 8) at the expense of other firms, especially in the small size classes, it is likely that demand is also elastic within these groups (imperfections are not extremely important). The importance of oligopsony, monopsony, and bilateral monopoly and oligopoly were hard to determine. On our measures such factors did not favour or disfavour any particular size of firm, and in the light of our chapter on growth did not suggest that this made a marked difference to any transfer mechanism at work.

The immediate importance of our conclusions on competition for economies of scale is that an adjustment across the industry to the forces of economies of scale is ruled out. But this conclusion, of a unique optimum size of firm, is related to the barriers between competitive groups. These were process/product barriers as we determined then, hence in the strict interpretation of the concept of scale economies, size is not important given the different submarkets. To some extent the industry divided up into groups dependent upon the length of run (Chapter 7). Small firms specialised in shorter runs as compared with larger firms. Also firms considered that this determined differences in cost advantages between firms of different sizes.

Lastly, the only consistent competitive advantage which correlated with the size of the firm was quality advantages, which we shall return to later. Larger firms, consistently, had a greater quality advantage than smaller firms.

Our examination of location suggested that spatial barriers were important only in a few cases and, in general, were unimportant.

Within groups firms were highly competitive. This competition was sufficiently strong as to suggest that an adjustment to optimum size would be important for firms competing with each other.

ECONOMIES OF SCALE

We side stepped the issue of directly measuring the scale-cost curve. Instead we chose to measure differences in efficiency due to size. Thus efficiency in this case was defined as efficiency in practice, rather than ideal or best possible efficiency. First, we were interested in efficiency gains due to size, achieved in practice and, second, the idea of measuring general efficiency was chosen because, given the data available to us, we could not unambiguously suggest that this reflected only scale economies. The engineering technique as a method of determining scale economies was effectively closed to us because we would need observations not only on firms of different size but many different types of firms, each of different size.

Our analysis of the relationship between efficiency and the size of firm suggested the following:

There was no difference in either the average efficiency of groups nor the dispersion of efficiency between groups. Three direct measures were considered - the profit rate, the Downie index and the Farrel test. Our indirect or supportive measures equally supported this conclusion. The age of assets were not systematically related to the size of the firm. The distribution of contracts, which we included as a proxy to efficiency, indicated degrees of possible imperfections particularly over time. This is to say that although we considered sticky contracts to be a good indication of satisfactory performance on the part of firms, and a favourable form of customer all round, the more sticky forms of contracts do have a time dimension which would tend to arrest the transfer mechanism. This is especially true in the case of tied foundries.

Written replies to the advantages and disadvantages of competing with firms of differing size indicated, as we have seen, that larger firms had the advantage of higher quality, and given the length of run as a specialism of the size of the firm, this also implied a cost advantage between firms of differing size. Also firms' sensitivity to overhead costs implied, given variability of demand, that this would militate against size and thus optimum size.

If our firms were strictly comparable then efficiency is not related to the size of the firm, on our measures. But given that competition is a function of size of firm, we would not necessarily expect any differences in average efficiency due to the size of the firm. Thus the existence of size related submarkets on the demand side rule out the importance of our cross-sectional analysis of firms of differing size and an hypothesis related to the size of the firm.

ON GROWTH

On growth we established:

(1) A transfer mechanism operating amongst similar firms for similar markets. Thus a process of ingestion is established. This ingestion affecting mainly smaller firms in the industry.

(2) Firms mainly looked towards similar markets for growth. Growing from the same technical base, suggesting that ingestion took place between like and like.

(3) Cost gains from size of a cross-section of firms were perceived in general not to exist, though cost gains were agreed possible for the individual firm.

(4) Tests of the law of proportionate effect suggested that firms grew at the same average proportional rate. An F test showed homogeneity of variance, though smallest firms had the highest variability of growth.

(5) Growth, not consistent for particular firms, was based mainly on profits, then bank overdrafts. There was a loose connection between present and past profitability and growth.

DISCUSSION

In our chapter on growth we established the transfer mechanism implied by the survivor technique. Hence, on the supply side, the transfer of work is important. We did not establish that this transfer was due to economies of scale. The connections between growth and profitability suggests that it may be the successful or most efficient that grow. This success was not related to the size of the firm.

We shall later investigate this mechanism further, but it is important to make some preliminary comments. First, if ingestion is taking place more within size groups than between size groups, we should expect that firms would on average grow in size and move through size classes. Thus the ability of firms to move through size classes is an aspect of this question not investigated here. Second, it is possible that the industry has reached a stage of, at least, temporary equilibrium. These two questions, the degree of ingestion within or between size classes and the extent to which the industry is moving towards or is close to a state of (at least temporary) equilibrium, cannot be answered by our research design. Yet another question unanswered, is the significance of changing demand, or technological creep to the changing structure of the industry. Ceteris paribus, we have seen that foundries are flexible between markets (Chapter 8), and that this flexibility is unrelated to the size of the firm. What we are unable to determine is the extent of this flexibility.

TRANSFER MECHANISMS

Our last concern is to investigate further the transfer mechanism. Downie had a similar concern. He was interested in the transfer of work from less efficient to more efficient firms, at length. In essence he considered two forces to be at work. One was an efficiency mechanism which would bring about such a transfer from the less efficient to the more efficient firms. The effect upon the concentration in an industry would depend upon the extent to which efficiency and growth as the result of increased efficiency, and in a closed system, at the expense of firms, was sustained by the efficient firms.

This is to say, given a distribution of efficiency, then more efficient firms would grow at the expense of less efficient firms. But the more efficient firms need not at this new stage (after growth) remain competitively more efficient. A situation might occur where firms "took turns" in the efficiency game.

Working separately would be the innovation mechanism. It would work in the opposite direction for the following reasons. Where new techniques have been discovered, there will be a distribution of techniques used amongst firms in the industry. And as the technique practised by a firm diverges further and further from that most appropriate, there will come a point where it pays to make a change. Thus the new change will move the firms into the ranks of the up-to-date. Further, as the efficiency transfer mechanism reduces the distribution of costs, given the will to grow, the rate of experimentation for innovation will increase. At some time innovation will be successful, and assuming that the less advantaged firms, in ranking, attempt innovation more, then the successful innovations will occur amongst those firms which were not successful on the last occasion. Relative advantages will change. The old cost relatives will change and a new form of redistribution will take place. Thus:

> "When technique is in the melting pot, old kings are being dethroned and new ones are coming to the fore."[1]

Our interest in the transfer mechanism is a simple one. Given that firms do grow (and in our sample) at the expense of others, what important transfer mechanism is in operation?

We are interested in Downie's idea of transfer mechanisms but it is arguable that the relationship between efficiency-transfers and transfers due to innovation would be as he described. This is simply because efficiency-transfers imply growth. Growth implies the ability to adopt new methods of production - those both appropriate to the new size and those current in the knowledge of innovations. This is particularly important where, as in our industry, important innovation is not the product of experimentation on the part of individual firms, but on the part of an association to which firms may affiliate themselves [in this case the Cast Iron Research Association]. This innovation need not be secret but common knowledge.

Furthermore, as he describes it, efficiency and innovation are but one and the same thing a relationship between inputs and outputs. Artificially he has drawn a distinction. However, efficiency and innovation may differ insofar as innovation produces both cost advantages and a real and improved difference in the output.

Where there is a demand for improvement, improved methods would alter the relative demand between firms producing improved products and firms producing similar products which had not been improved. Irrespective of the costs of production, improvements would alter the demand curve facing firms producing better products. At any point in time the industry would be split (until new capacity was created) and better products could command a higher price. As new capacity is created price would be reduced to its old level.

Now, if innovation also implies lower costs, there will be a double advantage in growth where growth implies innovation. It is quite possible, under such circumstances, for firms to take-off, and drastically increase the gap between the favoured and the disfavoured firms.

TRANSFER MECHANISMS AND IRONFOUNDING

(a) Our examination of competition showed that this was keen in competitive groups of firms of similar size, and that it had three elements; price, delivery and quality. It may be further noted (Tables 6.8 and 6.9) that there was agreement about the demand criteria (Table 6.8), but that the relative advantages (the variables on which firms preferred to compete) were delivery with second and third (and more variable) quality and price advantages.

(b) Our examination of the distribution of efficiency suggested that it was not related to size, neither in terms of the average nor the dispersion of efficiency in size classes.

(c) Growth implied a transfer mechanism amongst smaller firms.

We may conclude, so far, that given imperfections were slight within the competitive groups, then transfer could most appropriately take place through lower price, more reliable delivery, and a higher quality. Now given that firms in our sample considered they were able to meet delivery requirements (opportunities for further competition on this criterion being saturated (Table 6.17 (of Chapter 6) correlation .7482)), greater opportunity would be found through improving quality (Table 6.17 correlation .4543) or lower price (Table 6.17 correlation .1792).

Now a reduction in price implies a reduction in costs where profits are normal. Such a reduction might be the result of increased internal efficiency or economies of scale.

Now as we have seen, firms do see the possibility of cost gains from size, but observe no cost differentials due to present size (as we observed).

The next alternative possibility is to improve quality.

Thus in order to examine the competitive mechanism and transfer mechanism, we intend to examine the competitive advantages developed as the result of growth.

GROWTH, COMPETITION AND THE TRANSFER MECHANISM

Throughout this section, in order to discover the mechanism of transfer, we shall assume that growth was successful.

Now growth, as we have seen, implies a transfer of work for smaller firms (at the expense of other firms) and, on average, for larger firms it implies also growing demand.

In order for growth to be successful, where competition is keen, and where total output of firms is fixed, firms must show a competitive advantage over and above their direct competitors.

GROWTH AT THE EXPENSE OF FIRMS

One way of examining this comparative advantage is to examine competition amongst the gainers and the losers. Two issues are at stake; first we wish to examine whether the gainers and the losers perceive demand and hence competition amongst each other equally. Secondly, if they do, what comparative competitive advantage do the gainers have over the losers.

It is appropriate here to remind ourselves of the geometry of supply and demand curves.

(i) If the output of the competitive group is effectively fixed, then growth on the part of some firms will increase the degree of capacity of supply, at any one time, so that it is not in equilibrium with demand. If firms are producing identical products or are able to produce identical products, then price in the new equilibrium situation will fall.

(ii) If there are imperfections in the competitive group, firms will be facing downward sloping demand curves individually. Such competition is characterised by factors other than price. Under these circumstances the gainers will effectively move the demand curve for their product to the right, at the expense of the losers, the demand curve for them will move to the left.

(iii) In this second case, ceteris paribus, before equilibrium, prices will rise for the gainers, and price will fall for the losers.

Now Table 9.1 examines these issues. As we recall, there were substantially more gainers than losers in our sample.

We shall first consider growth and loss of work within the competitive groups as an exchange of work. The two issues we shall carefully examine are perceived competition and perceived own advantages.

Table 9.1 illustrates the results. Firms were asked to rank the importance of competitive variables on a five point scale from extremely important to unimportant. Because, necessarily, such grading suffers from inaccuracies if we consider individual points, we decided to group results. Particularly, we examined and compared responses in categories 1 and 2. We added them together.

Table 9.1

GROWTH, DECLINE AND COMPETITION

Competitive variable and Descriptive growth variable			% 1	% 2	% 3	% 4	% 5	n 1	n 2	n 3	n 4	n 5	n
Price	All		50.0	35.5	10.5	2.4	1.6	62	44	13	3	2	124
Changing method	Yes	G	53.5	36.0	8.1	1.2	1.2	46	31	7	1	1	86
	No	L	41.4	34.5	13.8	6.9	3.4	12	10	4	2	1	29
At expense of firms	Yes	G	51.9	34.6	8.6	2.5	2.5	42	28	7	2	2	81
	No	G	38.9	50.0	11.1	0.0	0.0	7	9	2	0	0	18
No growth	All	L	58.1	30.2	7.0	2.3	2.3	25	13	3	1	1	43
Market loss	Yes	L	80.8	3.8	11.5	0.0	3.8	21	1	3	0	1	26
Work loss	Yes	L	66.7	25.0	0.0	0.0	8.3	8	3	0	0	1	12
Delivery	All		38.7	41.9	16.1	0.8	2.4	48	52	20	1	3	124
Changing method	Yes	G	43.0	37.2	16.3	1.2	2.3	37	32	14	1	2	86
	No	L	34.5	51.7	10.3	0.0	3.4	10	15	3	0	1	29
At expense of firms	Yes	G	34.6	45.7	16.0	1.2	2.5	28	37	13	1	2	81
	No	G	50.0	33.3	16.7	0.0	0.0	9	6	3	0	0	18
No growth	All	L	39.5	41.9	14.0	0.0	4.7	17	18	6	0	2	43
Market loss	Yes	L	30.8	46.2	15.4	0.0	7.7	8	12	4	0	2	26
Work loss	Yes	L	50.0	16.7	25.0	0.0	8.3	6	2	3	0	1	12
Quality	All		43.4	40.2	13.9	0.8	1.6	53	49	17	1	2	122
Changing method	Yes	G	41.9	45.3	10.5	0.0	2.3	36	39	9	0	2	86
	No	L	57.1	14.3	25.0	3.6	0.0	16	4	7	1	0	28
At expense of firms	Yes	G	38.8	40.0	18.7	1.2	1.2	31	32	15	1	1	80
	No	G	66.7	27.8	5.6	0.0	0.0	12	5	1	0	0	18
No growth	All	L	42.9	45.2	9.5	0.0	2.4	18	19	4	0	1	42
Market loss	Yes	L	40.0	48.0	8.0	0.0	4.0	10	12	2	0	1	25
Work loss	Yes	L	27.3	54.5	18.2	0.0	0.0	3	6	2	0	0	11
Low price	All		22.3	28.9	32.2	9.9	6.6	27	35	39	12	8	121
Changing method	Yes	G	20.5	27.7	32.5	12.0	7.2	17	23	27	10	6	83
	No	L	24.1	34.5	31.0	3.4	6.9	7	10	9	1	2	29
At expense of firms	Yes	G	22.8	32.9	26.6	11.4	6.3	18	26	21	9	5	79
	No	G	22.2	27.8	33.3	5.6	11.1	4	5	6	1	2	18
No growth	All	L	29.3	26.8	29.3	9.8	4.9	12	11	12	4	2	41
Market loss	Yes	L	25.0	33.3	25.0	8.3	8.3	6	8	6	2	2	24
Work loss	Yes	L	33.3	33.3	25.0	0.0	8.3	4	4	3	0	1	12
Growth rate		G	12.2	29.3	43.9	9.8	4.9	5	12	18	4	2	41
Delivery	All		41.5	36.6	17.9	3.3	0.8	51	45	22	4	1	123
Changing method	Yes	G	44.2	33.7	19.8	2.3	0.0	38	29	17	2	0	86
	No	L	37.9	41.4	13.8	3.4	3.4	11	12	4	1	1	29
At expense of firms	Yes	G	37.0	42.0	14.8	4.9	1.2	30	34	12	4	1	81
	No	G	44.4	33.3	22.2	0.0	0.0	8	6	4	0	0	18
No growth	All	L	47.6	31.0	19.0	0.0	2.4	20	13	8	0	1	42
Market loss	Yes	L	50.0	26.9	19.2	0.0	3.8	13	7	5	0	1	26
Work loss	Yes	L	50.0	16.7	25.0	0.0	8.3	6	2	3	0	1	12
Growth rate		G	35.7	42.9	14.3	7.1	0.0	15	18	6	3	0	42
Quality	All		31.6	29.9	21.4	9.4	7.7	37	35	25	11	9	117
Changing method	Yes	G	36.9	29.8	17.9	9.5	6.0	31	25	15	8	5	84
	No	L	14.8	33.3	29.6	7.4	14.8	4	9	8	2	4	27
At expense of firms	Yes	G	36.4	26.0	23.4	7.8	6.5	28	20	18	6	5	77
	No	G	36.8	47.4	0.0	5.3	10.5	7	9	0	1	2	19
No growth	All	L	25.6	30.8	23.1	12.8	7.7	10	12	9	5	3	39
Market loss	Yes	L	30.4	21.7	30.4	4.3	13.0	7	5	7	1	3	23
Work loss	Yes	L	9.1	18.2	36.4	9.1	27.3	1	2	4	1	3	11
Growth rate		G	32.6	30.2	16.3	11.6	9.3	14	13	7	5	4	43

KEY:- G = GAINERS; L = LOSERS

1 = extremely important   2 = very important   3 = moderately important

4 = not very important   5 = not at all important

Table 9.2 examines the results in percentages.

Table 9.2

GROWTH, DECLINE AND COMPETITION. A COMPARISON OF FACTORS PERCEIVED AS EXTREMELY AND VERY IMPORTANT BETWEEN FIRMS GROWING AND DECLINING THROUGH A TRANSFER OF WORK

Growth at the expense of firms and work lost to other firms. (Factors perceived as extremely and very important.)

Competitive Variable		Perceived	Own Advantages
		%	%
Price:	gainers	86.5	55.7
	losers	91.7	66.6
Delivery:	gainers	80.3	79.0
	losers	66.7	66.7
Quality:	gainers	78.8	62.4
	losers	81.8	27.3

The figures can only be interpreted qualitatively because of the small number of observations in our group of "losers".

Firms remain equally highly competitive on their perception of competition amongst their group. Marginally, as predicted from category (ii) of the theoretical implications, price has become comparatively more important for the losers.

Of greater interest, however, is the striking differences in percentages in the delivery and quality categories. If we now go back to Table 9.1 and examine the distribution of the importance of these competitive variables over the five categories, it is particularly noticeable that firms growing at the expense of other firms have a "quality" advantage over the losers.

In the chapter on competition we noted a small trade off between price competition and quality advantages. This makes sense in disequilibrium and it would thus suggest that the transfer mechanism operates through increased quality.

GROWTH FOR GROWING MARKETS, AND CONTRACTION THROUGH LOST MARKETS

We may compare the results above with growth and contraction due mainly to markets. Table 9.3, similar to Table 9.2, illustrates the results.

Table 9.3

GROWTH, DECLINE AND COMPETITION. A COMPARISON OF FACTORS PERCEIVED AS EXTREMELY AND VERY IMPORTANT BETWEEN FIRMS GROWING AND DECLINING FOR MARKET REASONS

Competitive Variable		Perceived	Own Advantages
		%	%
Price:	gainers	88.9	50.0
	losers	84.1	58.3
Delivery:	gainers	83.3	77.7
	losers	80.4	76.9
Quality:	gainers	94.5	84.2
	losers	88.0	52.1

The results are similar, suggesting quality advantages for the gainers but less importantly. The degree of importance is less striking if we examine the distribution on the five-point scale in Table 9.1.

What is the significance of this result? Disappearing markets are not as crucial for foundries, in general, as might first be considered. This is because foundries are able to change their markets because their competitiveness depends more on process.

Table 9.4 illustrates this ability.

Table 9.4

HAVE YOUR PRODUCT MARKETS CHANGED OVER THE LAST TEN YEARS?

	n
Yes	33
No	35
Total	68

And it is precisely the ability of firms to alter their markets which depends upon the degree of specialisation of processes that will affect their survival.

COMPETITION AND OVERALL GROWTH

We may reinforce the above points by examining growth in general. This we do by examining those firms which have changed their methods of production over ten years as compared with those firms which have not. We noted, earlier, that this was statistically and conceptually related to growth, and because of the design of the questionnaires and the pattern of responses, it is statistically more convenient to use this variable as a proxy for growth.

Tables 9.5 and 9.6 illustrate the basic premise that quality competition was perceived as important amongst those who changed their methods as amongst those which didn't. Table 9.6 suggests those which did achieved a comparative advantage.

Furthermore, such changes did not significantly affect the basis of competition, suggesting that these firms were competing within the same groups rather than changing groups. However, Table 9.7 establishes the point that finishing processes were improved and, as a market basis of competition, provided an additional (important) advantage.

Though (Table 9.8) these firms had more competitors, which suggests both the source of change and the greater competitiveness attributable to larger numbers, the protection afforded to firms with fewer competitors would to some extent be trumped by potential competition affecting both groups (Table 9.9).

Table 9.5

QUALITY COMPETITION AND CHANGED PRODUCTION METHODS

Quality Competition	Method and Type Moves		
	Yes	No	Total
1	36 (41.9)	16 (57.1)	52 (45.6)
2	39 (45.3)	4 (14.3)	43 (37.7)
3	9 (10.5)	7 (25.0)	16 (14.0)
4	0 (0.0)	1 (3.6)	1 (0.9)
5	2 (2.3)	0 (0.0)	2 (1.8)
Total	86 (100.0)	28 (100.0)	114 (100.0)

X^2 14.36 df 4

Table 9.6

QUALITY ADVANTAGES AND CHANGED PRODUCTION METHODS

High Quality Advantage	Method and Type Moves		
	Yes	No	Total
1	31 (36.9)	4 (14.8)	35 (31.5)
2	25 (29.8)	9 (33.3)	34 (30.6)
3	15 (17.9)	8 (29.6)	23 (20.7)
4	8 (9.5)	2 (7.4)	10 (9.0)
5	5 (6.0)	4 (14.8)	9 (8.1)
Total	84 (100.0)	27 (100.0)	111 (100.0)

X^2 6.89 df 4

Table 9.7

FINISHING PROCESS BASED COMPETITION AND CHANGED PRODUCTION METHODS

Finishing Process Based Competition	Method and Type Moves		
	Yes	No	Total
1	18 (23.4)	4 (15.4)	22 (21.4)
2	21 (27.3)	3 (11.5)	24 (23.3)
3	22 (28.6)	9 (34.6)	31 (30.1)
4	6 (7.8)	8 (30.8)	14 (13.6)
5	10 (13.0)	2 (7.7)	12 (11.7)
Total	77 (100.0)	26 (100.0)	103 (100.0)

X^2 10.15 df 4

Table 9.8

CHANGED PRODUCTION METHODS AND THE NUMBER OF DIRECT COMPETITORS

Number of Competitors	Method and Type Moves		
	Yes	No	Total
None	2 (3.2)	2 (11.8)	4 (5.1)
1- 3	5 (8.1)	5 (29.4)	10 (12.7)
4- 10	28 (45.2)	8 (47.1)	36 (45.6)
11- 20	18 (29.0)	1 (5.9)	19 (24.1)
21- 50	6 (9.7)	0 (0.0)	6 (7.6)
51-100	2 (3.2)	0 (0.0)	2 (2.5)
101-200	0 (0.0)	1 (5.9)	1 (1.3)
201+	1 (1.6)	0 (0.0)	1 (1.3)
Total	62 (100.0)	17 (100.0)	79 (100.0)

X^2 16.90 df 7

Table 9.9

CHANGED PRODUCTION METHODS AND COMPETITION FROM SUBSTITUTE PRODUCTS

Potential Competition	Potential Competition and Method Changes		
	Yes	No	Total Method Changes
Yes	52 (60.5)	19 (63.3)	71 (61.2)
No	34 (39.5)	11 (36.7)	45 (38.8)
Total	86 (100.0)	30 (100.0)	

If we re-examine these conclusions by size of firm and take an arbitrary cut-off point of 100 employees, we find (Tables 9.11 and 9.12) that perceived quality competition is equally important for firms above and below 100 employees. However, firms below 100 employees (Table 9.12) display a greater variability of quality ability than those above 100 employees. This result, combined with Table 9.10, where more firms above 100 employees had changed their methods, suggests that opportunities for successful growth through quality is greater for smaller firms than for larger firms. Hence given, as we discovered, that smaller firms grew mainly at the expense of others, this reinforces the likelihood of a transfer mechanism based on increased quality.

Table 9.10

CHANGED PRODUCTION METHODS BY SIZE (EMPLOYEES)

Method and Type Moves	Employees	
	<100	>100
Yes	44 (64.7)	43 (86.0)
No	24 (35.3)	7 (14.0)
Total	68 (100.0)	50 (100.0)

X^2 5.69 df 1

Table 9.11

QUALITY COMPETITION BY SIZE (EMPLOYEES)

Quality Competition	Employees	
	<100	>100
1 = very important	59 (83.1)	42 (82.4)
2 = important	12 (16.9)	5 (9.8)
3 = unimportant	0 (0.0)	4 (7.8)
Total	71 (100.0)	51 (100.0)

Table 9.12

HIGH QUALITY ADVANTAGE BY SIZE (EMPLOYEES)

High Quality Advantage	Employees <100	Employees >100
1 very important	35 (52.2)	36 (72.0)
2 important	19 (28.4)	6 (12.0)
3 unimportant	13 (19.4)	8 (16.0)
Total	67 (100.0)	50 (100.0)

X^2 5.6 df 2

TRANSFER AND ECONOMIES OF SCALE

Irrespective of possible gains from size and changing methods, the theoretical notion of economies of scale is ruled out because firms are producing a different (improved) product. Thus in effect, though we may have discovered the mechanism of transfer, we are unable to disentangle the aspect of technical progress and changed products. Thus the assumption that firms are using the best technique open to them and producing basically an homogeneous product is effectively withdrawn, and thus the possibilities for measuring economies of scale through cross-sectional analysis not open to us. This aspect then becomes inconclusive except (because of relative price advantages, there is a trade off between quality advantages and the importance of price competition) that cost conditions in practice are clearly less important.

OVERALL CONCLUSIONS

We have shown that the survivor principle does not illustrate the importance of economies of scale in this industry. This is because of differences existing between groups of competitors which are as likely as not to be of the same size. Average efficiency and the dispersion of efficiency within size groups does not differ between sizes of firms. We did find a transfer mechanism affecting principally smaller firms; this was based on improved quality which was generally associated with the growth of the firm. Our data did not suggest that these firms had a price advantage, but that the conditions of demand were changing favourably towards these firms which had improved the quality of their output.

BIBLIOGRAPHY AND NOTES

1. J. Downie, "The Competitive Process", Gerald Duckworth, London, 1958, p. 94.

APPENDIX A

THE QUESTIONNAIRES

Four questionnaires were distributed to firms in the industry. The questionnaires are numbered I, II, III and IV. Reference to specific questions in the text refer to questions in questionnaire III.

The University of Aston in Birmingham

Department of Industrial Administration

Telephone 021-359 3611

I

THE EFFICIENCY OF IRON FOUNDRY PRODUCTION

This questionnaire forms part of a wider research project on the efficiency of iron foundries. Questions are asked on technical and financial aspects of foundry production.

If you find any questions impossible to answer, please ignore them.

We guarantee not to disclose the identity of firms. If you would like to receive the results of the study, however, would you please insert your firm's name and address.

Name of firm: ______________________________

Address: ______________________________

____

____

The completed questionnaire should be returned to:

D. Hitchens
Industrial Administration Research Unit
The University of Aston in Birmingham
82 Coleshill Street
BIRMINGHAM
B4 7PG

CHARACTERISTICS OF THE FOUNDRY

1. Status of the foundry (please tick)

independent ___

member of group ___

closed company ___

division of firm ___

2. What was the average number of employees for the following accounting years? (please count two part-time employees as one full-time employee)

	1970	1969	1965	1964
Number of employees				

3. What was the output in tons for these years?

	1970	1969	1965	1964
Output in tons				

4. What proportion of your foundry work is

(tons)

grey iron casting ______%

malleable iron ______%

S-G iron ______%

other (please state) ________________ ______%

5. Can you provide the following breakdown of your foundry output?

	% production per annum (tons)	approximate % production for 1964 (tons)	average weight per piece	minimum weight per piece	maximum weight per piece	complexity of casting	%	average number off	average number of different patterns used per month
HAND MOULDED PIECES*						very highly cored average uncored			please tick 0-50____ 51-100____ 101-200____ 201-500____ 501-1000____ over 1000____
MACHINE MOULDED PIECES						very highly cored average uncored			please tick 0-50____ 51-100____ 101-200____ 201-500____ 501-1000____ over 1000____
SPECIAL CASTINGS						very highly cored average uncored			please tick 0-50____ 51-100____ 101-200____ 201-500____ 501-1000____ over 1000____
OTHER PLEASE SPECIFY									

* Note: If this classification does not apply to your foundry please complete under 'other'.

6. What is the age of the following assets?

(Note: Different proportions of your plant and equipment may have been replaced by new or second hand equipment at different periods of time. Can you indicate, approximately, the age of each proportion of your plant and equipment - <u>in terms of tonnage output from each item of equipment</u>)

EXAMPLE:

	less than 5 years old	6-10 years old	11-20 years old	over 20 years old
melting plant	1/3			2/3

<u>Proportion of tonnage output produced from assets of different age</u>

	less than 5 years old	6-10 years old	11-20 years old	over 20 years old
melting plant				
annealing plant				
moulding machines				
moulding boxes				
sand plant				
core making machines				
mechanical handling equipment				
fettling plant				

7. What finishing processes does your foundry provide?
eg fettling, measuring, machining, etc

____

____

____

8. An expansion of the output of your plant over and above your present optimum output by introducing new mechanised plant and equipment will generally mean that costs of production can be reduced. Given your type of output, what do you think is the minimum output necessary for you to introduce equipment to allow you to produce at minimum possible cost? *

minimum output (tons) per year __________

9. What is the optimum output of your present plant, ie that output which allows you to produce at minimum cost per unit? *

optimum tonnage output per year __________

* NOTE: Please indicate if your estimates are based on 1, 2 or 3 shifts and the number of working days per week.

shifts __________

days per week __________

10. Can you provide the following financial information? *

Note: If you could supply your accounts for these years, we could extract this information and return copies to you.

Accounting year ending	1970	1969	1965	1964
Sales turnover All foundry sales including inter-company sales				
Materials (all materials bought out including metal, flux, sand, patterns, tools and other indirect materials)				
Net profit before tax (excluding all other income and expenses other than foundry trading)				
Total employee remuneration				
Total assets				
Fixed assets				
Investments				
Current assets (total)				
Current liabilities (total)				
Bank overdraft				

Accounting year end date ____________________

Have your assets been revalued during this period? YES NO

If yes, which year? ____________________ How much was added on? ________

*Note: If your accounts include other activities besides foundry production, but foundrywork is the principal activity please use these figures, if separate figures for the foundry plant are not kept. If the foundry does not trade, please can you, as far as possible provide estimates, noting that the figures are estimates. If cost figures only are kept please provide those.

The University of Aston in Birmingham

Department of Industrial Administration

Telephone 021-359 3611

THE EFFICIENCY OF IRON FOUNDRY PRODUCTION

This questionnaire forms part of a wider research project on the efficiency of iron foundries.
Questions are asked on competition and growth and other aspects of foundry production.

If you find any questions impossible to answer, please ignore them.

We guarantee not to disclose the identity of firms. If you would like to receive the results of the study, however, would you please insert your firm's name and address.

Name of Firm ....

Address ....

....

....

....

....

The completed questionnaire should be returned to:-

D Hitchens
Industrial Administration Research Unit
The University of Aston in Birmingham
82 Coleshill Street
BIRMINGHAM
B4 7PG

COMPETITION III

1. Do you compete with any products outside the ironfounding industry? YES NO

If yes, please specify:

____

____

____

2. What are the important aspects of competition, relative to your firm in the iron founding industry?

Please give each a score by circling 1, 2, 3, 4, or 5.

1 = extremely important
2 = very important
3 = moderately important
4 = not very important
5 = not at all important

The extent to which most firms compete with each other depends on:

(a) price	1 2 3 4 5
(b) reliable delivery	1 2 3 4 5
(c) quality	1 2 3 4 5
(d) location of the firm or plant(s)	1 2 3 4 5
(e) other (please state) ____________	
______________________	1 2 3 4 5

3. What are your competitive advantages? (please score as above)

(a) low prices	1 2 3 4 5
(b) reliable delivery	1 2 3 4 5
(c) high quality (requiring technical and scientific quality control)	1 2 3 4 5
(d) location of your firm or plant(s)	1 2 3 4 5
(e) other (please state) ____________	
______________________	1 2 3 4 5

4. The extent to which you compete with other firms depends on whether (please rate 1 = extremely important, 2 = very important, 3 = moderately important, 4 = not very important, 5 = not at all important)

(a)	they possess specialised equipment	1 2 3 4 5
(b)	they possess suitable box sizes for particular castings	1 2 3 4 5
(c)	they accept the same length of run, batch size or numbers off as you	1 2 3 4 5
(d)	they are located near you	1 2 3 4 5
(e)	they provide the same finishing processes as you	1 2 3 4 5
(f)	they are as versatile and flexible as you	1 2 3 4 5
(g)	they provide proof machining	1 2 3 4 5
(h)	other (please state) ______________ ______________________________	1 2 3 4 5

5. How many firms compete directly with you? ________

6. Are your competitors mainly of the same size as you? (size here is defined as the number of employees: 1-25, 26-50, 51-100, 101-300, 301-500, 501-1000, over 1000) YES NO

7. If competition is not between firms of the same size, which size group do you mainly compete with?

size (employees) ________

8. If you compete with firms of larger size and/or smaller size, what are your main advantages and disadvantages? Continue over the page if necessary.

Competing with larger firms	Our advantages are	Our disadvantages are
Competing with smaller firms	Our advantages are	Our disadvantages are

GROWTH OF THE FOUNDRY

9. Over the last ten years has the output capacity of your foundry (in tons) grown by

(please tick)

%	
0 - 5	____
6 - 10	____
11 - 20	____
21 - 50	____
51 - 100	____
over 100	____

10. IF YOUR FOUNDRY HAS NOT GROWN, has the output capacity (in tons) contracted in this period (1962-1972)? YES NO

(a) We have contracted by (please tick)

%	
0 - 5	____
6 - 10	____
11 - 20	____
21 - 50	____
over 50	____

(b) Have you contracted because markets have dried up? YES NO

because you have lost work to other firms? YES NO

Other (please state) ________________________

____

____

11. If you have grown by merger or takeover, was this to (please score by circling as before - 1 = wholly for this reason, 2 = mainly for this reason, 3 = partly for this reason, 4 - slightly for this reason, 5 = not for this reason)

(a) expand facilities to supply markets already supplied 1 2 3 4 5

(b) expand into new markets with

(i) the same techniques 1 2 3 4 5

(ii) new techniques 1 2 3 4 5

(c) other (please state) ____________

________________________ 1 2 3 4 5

12. If you have grown by expansion other than merger or takeover was this to (please give each category a score by circling 1, 2, 3, 4, or 5. 1 = wholly by this method, 2 = mainly by this method, 3 = partly by this method, 4 = slightly by this method, 5 = not in this way)

(a)	expand facilities to supply markets already supplied	1 2 3 4 5
(b)	expand into new markets	
	(i) with new techniques	1 2 3 4 5
	(ii) with the same techniques	1 2 3 4 5
(c)	other (please state) ______________ ______________________________	1 2 3 4 5

13. Have you gained more orders over the last ten years mainly at the expense of other firms, or is the market expanding?

(please tick) generally at the expense of other firms ______

generally because the market is expanding ______

14. Is your new investment, over the last ten years, made mainly for the production of castings from special irons, eg S-G iron, malleable iron, alloy irons, and other materials other than grey iron?

YES NO

15. Has your investment, over the last ten years, been used mainly to expand facilities for jobbing or repetition casting?

(please tick) mainly jobbing ______

mainly repetition ______

16. Has your investment policy defined a movement away from certain methods of production and types of casting? Please state.

Methods of production and types of casting from:	Methods and types of casting to:

17. How has your growth been financed over the last ten years? (please rate 1 - 5, 1 = mainly by this method, to 5 = not by this method)

(a)	retained profits	1 2 3 4 5
(b)	long term loans	1 2 3 4 5
(c)	new issues of shares	1 2 3 4 5
(d)	short term loans (ie loans ordinarily repayable within five years)	1 2 3 4 5
(e)	bank overdraft	1 2 3 4 5
(f)	group finance	1 2 3 4 5
(g)	reduction in working capital, ie less stock, debtors and cash	1 2 3 4 5
(h)	other (please state) ______________ ______________________________	1 2 3 4 5

ORGANISATION AND ACTIVITIES OF THE FIRM

18. Status of the firm (please tick)

independent ______

member of group ______

closed company ______

18. If your firm is a member of a group of firms, what do you see to be the main advantages and disadvantages of group organisation?

Advantages	Disadvantages

19. What was the average number of employees for 1971? _______

If this is not the norm, what is? _______

20. What proportion of your foundry work is:

repetition casting	______ %
jobbing	______ %

21. What proportion of your foundry work is:

grey iron casting	______ %
malleable iron	______ %
S-G iron	______ %
other (please state) __________________________	______ %

22. What weight of casting do you produce

	Proportion (in terms of numbers) of each category produced
heavy (over 5 tons)	______ %
medium (up to 5 tons)	______ %
low (1cwt - 5 cwt)	______ %
light (up to 1 cwt)	______ %

COSTS

23. Given your type of output, do you consider, in times of good trade when all firms are producing at their best output, that larger firms are able to produce your type of castings at lower cost?

YES NO

24. If yes, what size of firm do you consider is necessary to be able to produce your type of output at absolutely minimum cost

	size of firm (employees)	_______
and	size of firm (tons output per annum)	_______

THE EFFICIENCY OF SMALL FIRMS

25. Many small firms in the industry are going out of business. How important are the following factors in putting a firm out of business? * (please rate 1 = extremely important, 2 = very important, 3 = quite important, 4 = of some slight importance, 5 = not important at all). Please circle the appropriate number.

(a)	inefficiency (ie poor management and organisation of resources)	1 2 3 4 5
(b)	high costs in comparison with bigger firms	1 2 3 4 5
(c)	disappearing or diminishing markets, generally, for their products	1 2 3 4 5
(d)	out of date technical equipment	1 2 3 4 5
(e)	the difficulty small firms find in raising finance to tide them over difficult periods	1 2 3 4 5
(f)	quality control requiring scientific and technical staff which these firms cannot afford	1 2 3 4 5
(g)	legislative requirements, eg pollution control	1 2 3 4 5
(h)	difficulty in passing on rising material and labour costs	1 2 3 4 5
(i)	other (please state) ________________ ________________________________	1 2 3 4 5

26. With these problems in mind, what do you think is the minimum size of foundry (in terms of the number of employees and tonnage output) which avoids most of these disadvantages (eg is able to raise finance to keep pace with new methods, etc) *

minimum number of employees ________

tonnage output ________

* Note: If you are only able to answer questions 25 and 26 for your sector of the industry, please provide that information.

Which sector of the industry does your answer apply to? ________

THANK YOU FOR YOUR CO-OPERATION.

The University of Aston in Birmingham

Department of Industrial Administration

Telephone 021-359 3611

THE ORGANISATION AND PERFORMANCE OF IRON FOUNDRY ACTIVITIES

Please answer as far as possible all questions, except those on pages 15 and 16, unless the foundry is part of a group of firms, in which case please answer all questions.

If you find some questions impossible to answer, please ignore them.

We guarantee not to disclose the identity of firms. If you would like to receive the results of the study, however, would you please insert your firm's name and address.

Name of firm ____________________

Address ____________________

____

The completed questionnaire should be returned to:

D Hitchens
Industrial Administration Research Unit
The University of Aston in Birmingham
82 Coleshill Street
Birmingham
B4 7PG

ALL RESPONDENTS ARE REQUESTED TO ANSWER THE FOLLOWING QUESTIONS

Competition

1. Do you compete with any products outside the iron founding industry? YES NO

If yes, please specify:

____

____

____

2. What are the important aspects of competition relative to your firm in the iron founding industry? Please give each a score by circling 1, 2, 3, 4, or 5.

1 = extremely important
2 = very important
3 = moderately important
4 = not very important
5 = not at all important

The extent to which most firms compete with each other depends on

(a) price 1 2 3 4 5

(b) reliable delivery 1 2 3 4 5

(c) quality 1 2 3 4 5

(d) location of the firm or plant(s) 1 2 3 4 5

(e) other (please state) ______________________________

______________________________ 1 2 3 4 5

3. What are your competitive advantages? (please score as above)

(a) low prices 1 2 3 4 5

(b) reliable delivery 1 2 3 4 5

(c) high quality (requiring technical and scientific quality control) 1 2 3 4 5

(d) location of your firm or plant(s) 1 2 3 4 5

(e) other (please state) ______________________________

______________________________ 1 2 3 4 5

4. The extent to which you compete with other firms depends on whether
(please rate 1 = extremely important, to 5 = not at all important, as before)

(a) they possess specialised equipment 1 2 3 4 5

(b) they possess suitable box sizes 1 2 3 4 5

(c) they accept the same length of run, batch size or numbers off as you 1 2 3 4 5

(d) they are as versatile and flexible as you 1 2 3 4 5

(e) they are located near you 1 2 3 4 5

(f) they provide the same finishing processes as you 1 2 3 4 5

(g) they provide proof machining 1 2 3 4 5

(h) other (please state) ______________________________

____ 1 2 3 4 5

5. How many firms compete directly with you? ____________

6. Are your competitors mainly of the same size as you? YES NO
(size here is defined in terms of the number of employees: 1-25, 26-50, 51-100, 101-300, 301-500, 501-1,000, over 1,000)

7. If competition is not between firms of the same size, which size group do you mainly compete with?
size (employees) ____________

8. If you compete with firms of larger size and/or smaller size, what are your main advantages and disadvantages?

Competing with larger firms	Our advantages are	Our disadvantages are
Competing with smaller firms	Our advantages are	Our disadvantages are

Characteristics of the firm

9. Status of the firm (please tick)

independent	________
member of group	________
closed company	________

10. How many foundry plants does your firm operate? (Firm is defined as the legal entity and does not include the relationship of the holding company to the subsidiary companies or the subsidiary company to the other companies in the group) ________

11. Does your firm provide other products besides castings? YES NO

If YES, please specify which:

____

____

____

12. What percentage of total sales of the firm does iron castings account for? ________%

13. How many employees are working at each of your foundry plants?*
(If you operate only one plant, please complete under 1)

Plants		1	2	3	4
average number of employees for accounting year ending	1970				
	1969				
	1965				
	1964				

* Note: Please count two part-time employees as one full-time employee.

Characteristics of the foundry and foundry output

14. What was the tonnage output for the following years?

Accounting year ending	Output in tons
1970	
1969	
1965	
1964	

15. What proportion of your foundry work is (tons)

grey iron casting ______%

malleable iron ______%

S-G iron ______%

Other (please state) ____________________ ______%

16. Can you provide the following breakdown of your foundry output?

	% production per annum (tons)	approximate % production for 1964 (tons)	average weight per piece	minimum weight per piece	maximum weight per piece	complexity of casting %	average number off	average number of different patterns used per month
Hand * Moulded Pieces						very highly cored ____ average ____ uncored		please tick 0-50 ____ 51-100 ____ 101-200 ____ 201-500 ____ 501-1000 ____ over 1000 ____
Machine Moulded Pieces						very highly cored ____ average ____ uncored		0-50 ____ 51-100 ____ 101-200 ____ 201-500 ____ 501-1000 ____ over 1000 ____
Special Castings						very highly cored ____ average ____ uncored		0-50 ____ 51-100 ____ 101-200 ____ 201-500 ____ 501-1000 ____ over 1000 ____
Other: please specify								

* Note: If this classification does not apply to your foundry please complete under 'other'.

17. What is the age of the following assets?
(Note: Different proportions of your plant and equipment may have been replaced by new or second hand equipment at different periods of time. Can you indicate, approximately, the age of each portion of your plant and equipment - in terms of tonnage output from each item of equipment.)

EXAMPLE:

	less than 5 years old	6-10 years old	11-20 years old	over 20 years old
melting plant	1/3			2/3

PROPORTION OF TONNAGE OUTPUT PRODUCED FROM ASSETS OF DIFFERENT AGE

	less than 5 years old	6-10 years old	11-20 years old	over 20 years old
melting plant				
annealing plant				
moulding machines				
moulding boxes				
sand plant				
core making machines				
mechanical handling equipment				
fettling plant				

18. What finishing processes does your foundry provide? eg fettling, measuring, machining etc.

____

____

19. An expansion of the output of your plant over and above your optimum output by introducing new mechanised plant and equipment will generally mean that costs of production can be reduced. Given your type of output, what do you think is the minimum output necessary for you to introduce these cost saving schemes and equipment to allow you to produce at the minimum possible cost?*

minimum output (tons) per year ______________

20. What is the optimum output of your present plant, i.e. that output which allows you to produce at minimum cost per unit?*

optimum tonnage output per year ______________

* NOTE: Please indicate if your estimates are based on 1, 2, or 3 shifts and the number of working days per week.

shifts ____________

days per week ____________

<u>Growth of the Foundry</u>

21. If your foundry has NOT grown in the last ten years, have you contracted

because markets have dried up YES NO

because you have lost work to other firms YES NO

other (please state) ________________________________

____

22. If you have grown by merger and takeover, was this to (please score by circling as before - 1 = wholly for this reason, 2 = mainly for this reason, 3 = partly for this reason, 4 = slightly for this reason, 5 = not for this reason)

(a) expand facilities to supply markets already supplied 1 2 3 4 5

(b) expand into new markets with (i) the same techniques 1 2 3 4 5

(ii) new techniques 1 2 3 4 5

(c) other (please state) ________________________

____ 1 2 3 4 5

23. If you have grown by expansion other than merger or takeover was this to: (please score by circling as before: 1 = wholly for this reason, 2 = mainly for this reason, 3 = partly for this reason, 4 = slightly for this reason, 5 = not for this reason.)

(a) expand facilities to supply markets already supplied 1 2 3 4 5

(b) expand into new markets

(i) with new techniques 1 2 3 4 5

(ii) with the same techniques 1 2 3 4 5

(c) other (please state) ____________________

____________________ 1 2 3 4 5

24. Have you gained more orders over the last ten years mainly at the expense of other firms or is the market expanding?

(please tick) generally at the expense of other firms ________

generally because the market is expanding ________

25. Is your new investment, over the last ten years, made mainly for the production of castings from special irons, e.g. S-G iron, malleable iron, alloy irons, and other metals other than grey iron?

YES NO

26. Has your investment over the last ten years been mainly to expand facilities for jobbing or repetition casting?

(please tick) mainly jobbing ________

mainly repetition ________

27. What do you see to be the main growth areas in foundry production?

____

____

____

____

____

28. Has your investment policy over the last ten years defined a movement away from certain methods of production and types of castings? Please state.

Methods and types of casting from:	Methods and types of casting to:

Market and customer aspects

29. How many different customers, on average, do you supply during one year?

____

30. Over the last ten years, have you moved away from certain markets?

Away from:	to:

31. How important is your largest customer?
(please tick)

The largest customer is our

sole outlet (100% output)	__________
major outlet (50-99% output)	__________
medium outlet (10-49% output)	__________
minor outlet (0-9% output)	__________

32. Degree of dependence of our largest customer on our firm for iron castings (please tick)

We are	sole supplier (100% purchases)	____
	major supplier (50-99% purchases)	____
	medium supplier (10-49% purchases)	____
	minor supplier (0-9% purchases)	____

33. Is your output to your largest customer increasing over time? YES NO

34. If it is, does this indicate an increasing share of the market? YES NO

35. Is the work you receive from your customers generally in the form of

	% (tons)
irregular contracts	____
regular long-term contracts	____
single orders not repeated	____
regular short-term contracts	____
sales to members of our group of firms	____

36. Can you indicate the proportion of your firm sales in the following markets.

	%
Pressure pipes and fittings and malleable fittings	_______
Other pipes and fittings (including rainwater, water and soil pipes and gutters)	_______
Hot-water boilers (including washing boilers), radiators and radiator fittings, not elsewhere specified	_______
Stoves, fires, ranges and cooking apparatus, other than hollow-ware:	
using gas (including gas radiators)	_______
using electricity (including electrical radiators)	_______
using oil (including oil radiators)	_______
using solid fuel	_______
Baths, sanitary cisterns and other sanitary goods	_______
Bedsteads and furniture trades' castings (including piano frames)	_______
Other domestic appliances, i.e., refrigerators, irons, etc.	_______
Builders' ironmongery, not specified elsewhere	_______
Hollow-ware	_______
Manhole and coal covers, gratings and other castings for roads and drainage, etc., excluding pipes	_______
Marine:	
ships' engines and parts (excluding small marine)	_______
deck and hull auxiliary machinery, propellers, etc.	_______
Prime movers:	
turbines and parts	_______
gas, oil and steam engines (including small marine) and parts	_______
Pumps and compressors	_______
Boilers and boiler-house plant	_______
Colliery castings (excluding colliery tubs and parts and tunnel segments)	_______
Electrical engineering and generating industry	_______
Cases for small switch and fuse boxes, meter cases, etc.	_______

	%
Chemical and gas plant	______
Textile machinery	______
Agricultural implements and machinery, lawn mowers - (excluding tractor castings)	______
Food and drink preparation, processing and sterilising machinery	______
Machine tools (including wood-working) and jigs, tools and dies	______
Printing, bookbinding, paperworking, etc., machinery	______
Motor and cycle industry:	
tractors (engine, transmission, power take-off and chassis)	______
cars, commercial vehicles and engines therefor	______
motor-cycles, cycles and engines therefor	______
Rolls for metal-rolling mills (including steel base rolls)	______
Rolls for machinery other than metal working (sugar, flour, etc.) mills	______
Railways:	
locomotives (including colliery)	______
tunnel segments (including colliery, power stations etc)	______
chairs, plates, sleepers and other castings for permanent way	______
carriages and wagons (including colliery tubs and parts)	______
railway materials, not elsewhere specified	______
Crane and lifting and conveying appliances	______
Ingot moulds and bottoms for steel and non-ferrous metals	______
Iron and steel-works including foundries plant and equipment (other than rolls)	______
Valves, valve bodies and covers	______
Other iron castings, not elsewhere specified	______

The efficiency of small firms

37. Many small firms in the industry are going out of business. How important are the following factors in putting a firm out of business? *
(Please rate 1 = extremely important, 2 = very important, 3 = quite important, 4 = of some slight importance, 5 = not important at all)

(Please circle appropriate number)

(a)	inefficiency (i.e. poor management and organisation of resources)	1 2 3 4 5
(b)	high costs in comparison with bigger firms	1 2 3 4 5
(c)	disappearing or diminishing markets, generally, for their products	1 2 3 4 5
(d)	out of date technical equipment	1 2 3 4 5
(e)	the difficulty small firms find in raising finance to tide them over difficult periods	1 2 3 4 5
(f)	quality control requiring scientific and technical staff which these firms cannot afford	1 2 3 4 5
(g)	legislative requirements, e.g. pollution control	1 2 3 4 5
(h)	other (please state) ____________________	

____

____

____

38. With these problems in mind, what do you think is the minimum size of foundry (in terms of the number of employees) which avoids most of these disadvantages (e.g. is able to raise finance to keep pace with new methods, etc.) *

minimum number of employees ________

39. Can you answer this question in terms of *

(a) capital employed — minimum capital employed £ ________

(b) output capacity — minimum output capacity ________ tons

* Note: If you are only able to answer questions 37, 38 and 39 for your sector of the industry, please provide that information.
Which sector of the industry does your answer apply to? ____________________

Financial information

40. During unfavourable economic conditions do you

(a) lower your prices, to cut most of your profit margin in order to raise your capacity utilised YES / NO

(b) lower prices, below your costs to increase the number of orders YES / NO

(c) accept what you can get at your usual prices YES / NO

(d) other (please state) ______________________________

____

____

41. When the costs of materials and labour are rising:

(a) when are you able to pass on these costs:-

please tick

	immediately	within 3 months	3 - 6 months	more than 6 months
labour costs				
material costs				

(b) do you wait until larger firms raise their prices?

labour costs YES / NO

material costs YES / NO

(c) Other (please state) ______________________________

____

III 14A

A 1 Can you provide the following financial information for the FOUNDRY for the four accounting years 1970, 1969, 1965, 1964.

Note: If your accounts include other activities besides foundry production, but foundrywork is the principal activity please use these figures, if separate figures for the foundry plant are not kept. If the foundry does not trade, please can you, as far as possible, provide estimates, noting that the figures are estimates. If cost figures only are kept please provide these.

If you could supply your accounts, we could extract the information and return copies to you.

Accounting year ending	1970	1969	1965	1964
Sales turnover (all sales including inter-company sales)				
Materials (all materials bought out including metal, flux, sand, patterns, tools and other indirect materials)				
Total employee remuneration				
Net profit before tax				
Other income besides income from trading				
Interest paid on loans				
Profit retained in business				
Total assets				
Fixed assets (net of depreciation)				
Investments				
Current assets (total)				
Current liabilities (total)				
Creditors				
Bank overdraft				
Loans (over 5 years) long term				
Loans - short term (1-5 years)				

Accounting year end date ______________________

Have your assets been revalued during this period? YES NO

If so, which year? ______________

How much was added on? £______________

IF YOUR FIRM IS A MEMBER OF A GROUP OF FIRMS, i.e. YOUR FIRM IS A SUBSIDIARY OF ANOTHER FIRM AND/OR OTHER FIRMS ARE SUBSIDIARY TO YOUR FIRM, PLEASE CAN YOU ANSWER THE FOLLOWING QUESTIONS

42. What percentage of group sales does founding account for (please tick)

less than 10% ____________

11 - 20% ____________

21 - 50% ____________

51 - 80% ____________

81 - 100% ____________

43. If founding is not the main activity of the group (more than 50% of sales) what activity is?

____

44. Is your firm mainly responsible for supplying castings to other members of the group? YES / NO

45. In what year did your foundry become a member of the present group? ____________

IF IRON FOUNDING IS THE MAIN ACTIVITY OF THE GROUP THEN

46. Are all the other firms also foundries? YES / NO

47. How many foundries are members of the group? ____________

48. Can you indicate approximately when these foundries were taken over?

Number of firms brought into group in following years:

1971, 1972 ____________

1966-1970 ____________

1961-1965 ____________

Before 1960 ____________

The University of Aston in Birmingham

Department of Industrial Administration

Telephone 021-359 3611

IV

THE ORGANISATION AND PERFORMANCE OF IRON FOUNDRY ACTIVITIES

This questionnaire forms part of a wider research project on the efficiency of iron foundries. Please answer, as far as possible, all questions except those on pages 15 & 16 unless the foundry is part of a group of firms, in which case please answer all questions.

If you find some questions impossible to answer, please ignore them.

Name of firm: ______________________________

Address: ______________________________

____

____

The completed questionnaire should be returned to:

D Hitchens
Industrial Administration Research Unit
The University of Aston in Birmingham
82 Coleshill Street
BIRMINGHAM
B4 7PG

ALL RESPONDENTS ARE REQUESTED TO ANSWER THE FOLLOWING QUESTIONS

Competition

1. Do you compete with any products outside the iron founding industry? YES NO

   If yes, please specify:

   ____

   ____

   ____

2. What are the important aspects of competition relative to your firm in the iron founding industry? Please give each a score by circling 1, 2, 3, 4, or 5.

   1 = extremely important
   2 = very important
   3 = moderately important
   4 = not very important
   5 = not at all important

   The extent to which most firms compete with each other depends on

   (a) price 1 2 3 4 5

   (b) reliable delivery 1 2 3 4 5

   (c) quality 1 2 3 4 5

   (d) location of the firm or plant(s) 1 2 3 4 5

   (e) other (please state) ____________________

   ______________________________________ 1 2 3 4 5

3. What are your competitive advantages? (please score as above)

   (a) low prices 1 2 3 4 5

   (b) reliable delivery 1 2 3 4 5

   (c) high quality (requiring technical and scientific quality control) 1 2 3 4 5

   (d) location of your firm or plant(s) 1 2 3 4 5

   (e) other (please state) ____________________

   ______________________________________ 1 2 3 4 5

4. The extent to which you compete with other firms depends on whether
(please rate 1 = extremely important, to 5 = not at all important, as before)

(a)	they possess specialised equipment	1 2 3 4 5
(b)	they possess suitable box sizes	1 2 3 4 5
(c)	they accept the same length of run, batch size or numbers off as you	1 2 3 4 5
(d)	they are as versatile and flexible as you	1 2 3 4 5
(e)	they are located near you	1 2 3 4 5
(f)	they provide the same finishing processes as you	1 2 3 4 5
(g)	they provide proof machining	1 2 3 4 5
(h)	other (please state) ______________________________ ______________________________	1 2 3 4 5

5. How many firms compete directly with you? ________________

6. Are your competitors mainly of the same size as you? YES NO
(size here is defined in terms of the number of employees: 1-25, 26-50, 51-100, 101-300, 301-500, 501-1,000, over 1,000)

7. If competition is not between firms of the same size, which size group do you mainly compete with? (size employees) ______________

8. If you compete with firms of larger size and/or smaller size, what are your main advantages and disadvantages?

Competing with larger firms	Our advantages are	Our disadvantages are
Competing with smaller firms	Our advantages are	Our disadvantages are

Characteristics of the firm

9. Status of the firm (please tick) independent ________
member of group ________
closed company ________

10. How many foundry plants does your firm operate? (Firm is defined as the legal entity and does not include the relationship of the holding company to the subsidiary companies or the subsidiary company to the other companies in the group) ________

11. Does your firm provide other products besides castings? YES NO

If YES, please specify which:

____

____

____

12. What percentage of total sales of the firm does iron castings account for? ____%

13. How many employees are working at each of your foundry plants?* (If you operate only one plant, please complete under 1)

Plants		1	2	3	4
average number of employees for accounting year ending	1970				
	1969				
	1968				
	1967				

* Note: Please count two part time employees as one full time employee. If your firm operates more than four plants please attach figures for the rest.

Characteristics of the foundry and foundry output

14. What was the tonnage output for the following years?

Accounting year ending	Output in tons
1970	
1969	
1968	
1967	

15. What proportion of your foundry work is (tons)

grey iron casting ______%

malleable iron ______%

S-G iron ______%

Other (please state) ______________________ ______%

16. Can you provide the following breakdown of your foundry output?

	% production per annum (tons)	approximate % production for 1967 (tons)	average weight per piece	minimum weight per piece	maximum weight per piece	complexity of casting	%	average number off	average number of different patterns used per month
Hand* Moulded Pieces						very highly cored			please tick 0-50 ____ 51-100 ____ 101-200 ____ 201-500 ____ 501-1000 ____ over 1000 ____
						average			
						uncored			
Machine Moulded Pieces						very highly cored			0-50 ____ 51-100 ____ 101-200 ____ 201-500 ____ 501-1000 ____ over 1000 ____
						average			
						uncored			
Special Castings						very highly cored			0-50 ____ 51-100 ____ 101-200 ____ 201-500 ____ 501-1000 ____ over 1000 ____
						average			
						uncored			
'Other' Please Specify									

* Note: If this classification does not apply to your foundry please complete under 'other'

17A. What is the age of the following assets?
(Note: Different proportions of your plant and equipment may have been replaced by new or second hand equipment at different periods of time. Can you indicate, approximately, the age of each portion of your plant and equipment - in terms of tonnage output from each item of equipment.)

EXAMPLE:

	less than 5 years old	6-10 years old	11-20 years old	over 20 years old
melting plant	1/3			2/3

PROPORTION OF TONNAGE OUTPUT PRODUCED FROM ASSETS OF DIFFERENT AGE

	less than 5 years old	6-10 years old	11-20 years old	over 20 years old
melting plant				
annealing plant				
moulding machines				
moulding boxes				
sand plant				
core making machines				
mechanical handling equipment				
fettling plant				

17B. What finishing processes does your foundry provide? eg fettling, measuring, machining etc: ______________________

____

____

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18. An expansion of the output of your plant over and above your optimum output by introducing new mechanised plant and equipment will generally mean that costs of production can be reduced. Given your type of output, what do you think is the minimum output necessary for you to introduce these cost saving schemes and equipment to allow you to produce at the minimum possible cost?*

minimum output (tons) per year ______________

19. What is the optimum output of your present plant, ie that output which allows you to produce at minimum cost per unit?*

optimum tonnage output per year ______________

* Note: Please indicate if your estimates are based on 1, 2, or 3 shifts and the number of working days per week.

shifts __________

days per week __________

Growth of the foundry

20. If your foundry has NOT grown in the last ten years, have you contracted

because markets have dried up YES NO

because you have lost work to other firms YES NO

other (please state) ____

____

21. If you have grown by merger or takeover, was this to (please score by circling as before - 1 = wholly for this reason, 2 = mainly for this reason, 3 = partly for this reason, 4 = slightly for this reason, 5 = not for this reason)

(a) expand facilities to supply markets already supplied 1 2 3 4 5

(b) expand into new markets with (i) the same techniques 1 2 3 4 5

(ii) new techniques 1 2 3 4 5

(c) other (please state) ____________________________

____ 1 2 3 4 5

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22. If you have grown by expansion other than merger or takeover was this to: (please give each category a score by circling 1, 2, 3, 4, or 5. 1 = wholly by this method, 2 = mainly by this method, 3 = partly by this method, 4 = slightly by this method, and 5 = not in this way.)

(a) expand facilities to supply markets already supplied 1 2 3 4 5

(b) expand into new markets

(i) with new techniques 1 2 3 4 5

(ii) with the same techniques 1 2 3 4 5

(c) other (please state) ______________________

______________________________________ 1 2 3 4 5

23. Have you gained more orders over the last ten years mainly at the expense of other firms or is the market expanding?

(please tick) generally at the expense of other firms ______

generally because the market is expanding ______

24. Is your new investment, over the last ten years, made mainly for the production of castings from special irons, eg S-G iron, malleable iron, alloy irons, and other metals other than grey iron? YES NO

25. Has your investment over the last ten years been mainly to expand facilities for jobbing or repetition casting?

(please tick) mainly jobbing ______
mainly repetition ______

26. What do you see to be the main growth areas in foundry production?

____

____

____

____

____

27. Has your investment policy over the last ten years defined a movement away from certain methods of production and types of castings? Please state:

Methods and types of casting from:	Methods and types of casting to:

Market and Customer Aspects

28. How many different customers, on average, do you supply during one year? ____________

29. Over the last ten years, have you moved away from certain markets?

Away from:	To:

30. How important is your largest customer? (please tick)

The largest customer is our	sole outlet (100% output)	____________
	major outlet (50-99% output)	____________
	medium outlet (10-49% output)	____________
	minor outlet (0-9% output)	____________

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31. Degree of dependence of our largest customer on our firm for iron castings (please tick)

We are	sole supplier (100% purchases)	________
	major supplier (50-99% purchases)	________
	medium supplier (10-49% purchases)	________
	minor supplier (0-9% purchases)	________

32. Is your output to your largest customer increasing over time? YES NO

33. If it is, does this indicate an increasing share of the market? YES NO

34. Is the work you receive from your customers generally in the form of

	% (tons)
irregular contracts	________
regular long term contracts	________
single orders not repeated	________
regular short term contracts	________
sales to members of our group of firms	________

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35. Can you indicate the proportion of your firm sales in the following markets.

	%
Pressure pipes and fittings and malleable fittings	______
Other pipes and fittings (including rainwater, water and soil pipes and gutters)	______
Hot water boilers (including washing boilers), radiators and radiator fittings, not elsewhere specified	______
Stoves, fires, ranges and cooking apparatus, other than hollow ware:	
using gas (including gas radiators)	______
using electricity (including electrical radiators)	______
using oil (including oil radiators)	______
using solid fuel	______
Baths, sanitary cisterns and other sanitary goods	______
Bedsteads and furniture trades' castings (including piano frames)	______
Other domestic appliances, ie, refrigerators, irons, etc	______
Builders' ironmongery, not specified elsewhere	______
Hollow ware	______
Manhole and coal covers, gratings and other castings for roads and drainage, etc, excluding pipes	______
Marine:	
ships' engines and parts (excluding small marine)	______
deck and hull auxiliary machinery, propellers, etc	______
Prime movers:	
turbines and parts	______
gas, oil and steam engines (including small marine) and parts	______
Pumps and compressors	______
Boilers and boiler house plant	______
Colliery castings (excluding colliery tubs and parts and tunnel segments)	______
Electrical engineering and generating industry	______
Cases for small switch and fuse boxes, meter cases, etc	______

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	%
Chemical and gas plant	______
Textile machinery	______
Agricultural implements and machinery, lawn mowers (excluding tractor castings)	______
Food and drink preparation, processing and sterilising machinery	______
Machine tools (including wood working) and jigs, tools and dies	______
Printing, bookbinding, paperworking, etc, machinery	______
Motor and cycle industry:	
tractors (engine, transmission, power take-off and chassis)	______
cars, commercial vehicles and engines therefor	______
motor cycles, cycles and engines therefor	______
Rolls for metal rolling mills (including steel base rolls)	______
Rolls for machinery other than metal working (sugar, flour, etc) mills	______
Railways:	
locomotives (including colliery)	______
tunnel segments (including colliery, power stations etc)	______
chairs, plates, sleepers and other castings for permanent way	______
carriages and wagons (including colliery tubs and parts)	______
railway materials, not elsewhere specified	______
Crane and lifting and conveying appliances	______
Ingot moulds and bottoms for steel and non-ferrous metals	______
Iron and steel-works including foundries plant and equipment (other than rolls)	______
Valves, valve bodies and covers	______
Other iron castings, not elsewhere specified	______

The efficiency of small firms

36. Many small firms in the industry are going out of business. How important are the following factors in putting a firm out of business?*
(Please rate 1 = extremely important, 2 = very important, 3 = quite important, 4 = of some slight importance, 5 = not important at all)

(Please circle appropriate number)

(a)	inefficiency (ie poor management and organisation of resources)	1 2 3 4 5
(b)	high costs in comparison with bigger firms	1 2 3 4 5
(c)	disappearing or diminishing markets, generally, for their products	1 2 3 4 5
(d)	out of date technical equipment	1 2 3 4 5
(e)	the difficulty small firms find in raising finance to tide them over difficult periods	1 2 3 4 5
(f)	quality control requiring scientific and technical staff which these firms cannot afford	1 2 3 4 5
(g)	legislative requirements, eg pollution control	1 2 3 4 5
(h)	other (please state) ________________	

____

____

____

37. With these problems in mind, what do you think is the minimum size of foundry (in terms of the number of employees) which avoids most of these disadvantages (eg is able to raise finance to keep pace with new methods, etc)*

minimum number of employees ________

38. Can you answer this question in terms of*

(a) capital employed   minimum capital employed   £________

(b) output capacity   minimum output capacity   ________tons

*Note: If you are only able to answer questions 36, 37 and 38 for your sector of the industry, please provide that information. Which sector of the industry does your answer apply to? ________________

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Financial information

39. During unfavourable economic conditions do you

(a) lower your prices, to cut most of your profit margin in order to raise your capacity utilised YES NO

(b) lower prices, below your costs to increase the number of orders YES NO

(c) accept what you can get at your usual prices YES NO

(d) other (please state) ______________________________

____

____

40. When the costs of materials and labour are rising:

(a) when are you able to pass these costs on to your customers? (please tick appropriate box)

	immediately	within 3 months	3-6 months	more than 6 months
labour costs				
material costs				

(b) do you wait until larger firms raise their prices?

labour costs YES NO

material costs YES NO

(c) other (please state) ______________________________

____

____

IF YOUR FIRM IS A MEMBER OF A GROUP OF FIRMS, ie YOUR FIRM IS A SUBSIDIARY OF ANOTHER FIRM AND/OR OTHER FIRMS ARE SUBSIDIARY TO YOUR FIRM, PLEASE CAN YOU ANSWER THE FOLLOWING QUESTIONS

41. What percentage of group sales does founding account for (please tick)

less than 10% ________

11-20% ________

21-50% ________

51-80% ________

81-100% ________

42. If founding is not the main activity of the group (more than 50% of sales) what activity is?

____

43. Is your firm mainly responsible for supplying castings to other members of the group? YES NO

44. In what year did your foundry become a member of the present group? ______

IF IRON FOUNDING IS THE MAIN ACTIVITY OF THE GROUP THEN

45. Are all the other firms also foundries? YES NO

46. How many foundries are members of the group? ______

47. Can you indicate approximately when these foundries were taken over?

Number of firms brought into group in following years:

1971,1972 ______

1966-1970 ______

1961-1965 ______

Before 1960 ______

48 What do you see to be the main advantages and disadvantages of group organisation?

Advantages	Disadvantages

THANK YOU FOR YOUR CO-OPERATION

49. What do you see to be the main advantages and disadvantages of group organisation?

Advantages	Disadvantages

Thank you for your cooperation.

APPENDIX B

CHANGED METHODS OF PRODUCTION, TYPES OF CASTINGS AND MARKETS BY SIZE OF FIRM (EMPLOYEES)

This appendix simply lists changes in product markets and changes in methods of production for individual firms over the ten year period 1962-1972.

Size (employees)	Markets	Method
0-25 (Jobbing)	-	Complicated castings with many cores to heavier castings without cores.
	-	Green sand to air setting sand.
	-	Coke to oil fired.
	-	Machine moulding to floor moulding.
	-	Green sand to air set + CO_2.
	-	Black sand to air set + CO_2.
	-	Hand moulding to shell moulding.
	-	Loose pattern to machine moulding.
	-	Green sand to green sand, CO_2 + resin.
	Printing machines to machine tools.	Green sand to no bake boxless moulding.
	-	Heavy to repetition.
(Repetition)	-	Cupola to rotary hearth, oil bonded to air set, CO_2, sand conventional methods to core assembly.

Size (employees)	Markets	Method
26-50 (Jobbing)	-	Large/heavy to small/light because of improved design in small motors and alternators.
	-	Introduction of moulding machines and CO_2 process for jobbing work.
	Building to civil engineering.	-
	Building and domestic to engineering and electrical.	Hand mould to machine mould, low grade to higher.
	Gas and water engineering.	Green sand to self setting and CO_2.
	Furniture to conveying appliances and miscellaneous castings.	-
	Mining to general jigs and tools.	Green sand/dry sand to CO_2 silicate.
	Machine tools to more common castings.	-
	Heavy engineering to repetitive municipal castings.	Green sand to CO_2.
(Repetition)	-	Green sand to dry sand, CO_2 to air set.
	-	Green sand to air set, green sand to steel, CO_2 to cold box, coke fired furnace to oil fired rotary, rotary to indirection melting, hand shot to automatic, skilled moulders to semi-skilled operators.
	-	Box pattern moulding to machine moulding.
	Large casting users to smaller users.	Floor and bench to machine.
	Light to heavy castings.	Floor mould to open cast, heavy moulding.
	Gas fittings to hospital fittings.	-
	Builders to engineering.	Bench and floor to machine moulding.

Size (employees)	Markets	Method
51-100 (Jobbing)	-	Non-mechanised to semi-mechanised, non-ferrous to S.G.
	-	Green sand and dry sand to CO_2 + air setting.
	-	Loam moulding + dry sand to self setting sands.
	Stores, domestic to wider range.	Loam moulding + dry sand to self setting sands.
	Heavy engines to smaller engines.	Green sand to CO_2 + air set sand.
	-	Conventional wooden patterns + sand moulds to polystyrene, air set, core ass. not using moulding boxes.
	Furnace work to machine tools.	Green sand to synthetic, better finish and quality.
	-	Loose pattern green, loose pattern resin.
(Repetition)	-	Normal sand mould to steel moulding.
	-	Jobbing to long runs, hand mould to repetitive.
	-	Green + dry sand moulds + oil sand to CO_2 moulds + air set cores by continuous mixing.
	-	Dry sand, loam, green + self setting sands, oil coremaking to self setting sands: obsolete moulding machines to semi automatic.
	Markets in developing countries to those in developed countries.	Green sand machine to shell moulding.
	Road castings to general engineering.	Cheap, simple castings to quality, intricate, difficult ones.
	-	Green sand to furnace sand, loose moulding to moulding machines.
	-	Green sand to CO_2 sodium silicate process.
	Sanitary to engineering.	Hand mould to mechanised.
	Lock industry to general engineering.	Floor mould, green sand to CO_2: jobbing to machine.
	-	Jobbing to machine moulding.
	Steel (nat.) to food and machine tools.	Craft job to air setting sand, mechanised repetition.

Size (employees)	Markets	Method
101-200 (Jobbing)	-	Green sand to CO_2 process.
	-	Green sand to CO_2 + air set sand.
	-	Green sand moulding to CO_2 + furnace sand moulding.
	Press tool to machine tool, railway permanent way to compressors and turbines.	Light mechanical to medium heavy jobbing.
	Engineering to building trade.	-
	Press tool to machine tool, railway to compressors, turbines.	Light mechanical to medium heavy jobbing.
	-	Loam, , jobbing to accurate jobbing castings.
	Machine tools to general engineering.	Dry sand to furnace and CO_2.
	Solid fuel to machine tools.	Floor moulding to sand slinger.
(Repetition)	-	Small batch floor work to full automation: some gun metal to cast iron only.
	-	Facing and backing sand to unit sand.
	-	Heavy machine moulding to pattern flow.
	-	Jobbing + short runs, heavily cored to medium batch repetition.
	-	Jobbing to mass production.
	-	Green sand (mechanised) to shell (manual).
	Shipbuilding to public water utility.	Hand moulding + green sand, full pattern + CO_2.
	-	Hand moulding to mechanised jobbing, S.G. pattern, flow system.
	-	Heavier floor moulded to short series complex machine moulded.
	Machine tools to diesel engine parts, hydraulic + pneumatic casting.	Green sand, skilled moulding to self setting sands, semi-skilled moulders: green sand machine moulding to shell moulding.
	Railway to general iron castings, low quality.	-
	-	Rainwater, continuous burning fires.
	-	Dry sand to air setting.

Size (employees)	Markets	Method
201-300 (Jobbing)	-	Dry sand to self setting sand, grey iron to alloy S.G.
	-	Loose jobbing loam to silicate and resin bonded sands.
(Repetition)	-	Hand moulding, manual operated to mechanised/automatic: oil sand cores to shell core making.
	-	Cupola melted iron to electric furnace melted iron.
	-	Oil sand moulds to shell moulding.
	-	Hand moulding to machine moulding.
	Aerospace + gas turbine components; medical (surgical instruments); domestic to engineering.	Solid moulds to spirit based shell moulds + vacuum casting.
	Specially S.G.	-
	General engineering to general engineering + auto.	Conventional to high pressure moulding.
	-	Small repetition on conventional machines to semi-automation.
301-500 (Jobbing)	None.	None.
(Repetition)	-	Hand, oil sand, hand assembly, hot box coremaking, machine assembly: manual machines to automatic.
	-	Hand moulding and one off to semi production and production.

Size (employees)	Markets	Method
501-1,000 (Jobbing)	None.	None.
(Repetition)	-	Conventional coremaking to hot box coremaking; cold blast cupola melting to part electric melting.
	-	Hand mould to mechanised.
	-	Floor moulding to machine moulding.
	-	Conventional moulding to fluid sand moulding.
	Textile, switch, valve to Autos + gas.	Manual to mechanical.
1,000+ (Jobbing)	None.	None.
(Repetition)	-	Machine moulding to automatic moulding + pouring; short run to batch type runs.
	-	Oil sand cores to wet mix and shell mould resin cores; low pressure moulding machines to high pressure + high output moulding units.