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THE BRITISH INTERWAR STEEL INDUSTRY*

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Abstract

This study investigates the impact of joint-stock banks on the rationalisation of the British interwar steel industry. A new panel data set of steel firm characteristics covering 1920 to 1938 is used to document rationalization and bank involvement, including interlocking directorships, with both found to be more extensive than previously thought. A set of all potential amalgamation pairs is created and used in a logit analysis of the determinants of mergers. Bank involvement with firms increased the probability that a particular merger occurred. Furthermore mergers with bank involvement did not increase the involved firm's profitability, while those without did.

I.

The interwar period featured some of the most persistent pleas for industrial consolidation in Britain's history.[1] Against a backdrop of industrial decline coupled with persistently high unemployment, many commentators at the time and since saw an increased rate of rationalisation, primarily through industry-wide horizontal amalgamations, as the solution to the deficiencies of British staple industries.[2] Since the firms themselves were seemingly unable to achieve this successfully, an external agency was searched for to coordinate the process. Given their enlarged commitment to industry following free lending during the post-war boom, joint-stock banks were considered the ideal candidate.[3]

However, critics claim that unlike their continental counterparts, British commercial banks failed to use their acquired leverage to take sufficient responsibility over the process of rationalisation and instead withdrew from industry during the 1930s, ultimately harming Britain's long-term competitive performance.[4] Bankers, placed on the defensive, insisted that they were not accountable for the problems of industry and maintained that creditworthy borrowers were always accommodated.[5] Modern authors are similarly divided, with some arguing that banks failed to seize the opportunity to promote consolidation while others insist that banks did, on occasion, promote rationalisation among their industrial clients.[6]

This study investigates the involvement of banks in the rationalisation of the British steel industry. This particular sector provides the archetypal example of an industry affected by

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[1] For examples in the press see *The Economist*, 22 December 1928, p. 1149 and *The Times*, 12 July 1934, p. 22

[2] One prominent proponent of this approach was the Balfour Committee, *Committee on Industry and Trade 1929.*

[3] For example the Macmillan Committee came to this conclusion, *Committee on Finance and Industry 1931*; regarding other candidates see for example Tolliday, *Business, Banking and Politics,* p. 270 and Garside and Greaves, *The Bank of England and industrial intervention in interwar Britain*, on why the Bank of England did not take on this role.

[4] The Macmillan Committee made this charge; for treatment in the press *The Economist*, January 18, 1930, pp. 103-4.

[5] See evidence presented by various bank representatives to the Macmillan Committee.

[6] On the side of the critics Best and Humphries, *City and Industrial Decline*, Payne*, Colvilles and the Scottish Steel Industry,* in support of bank involvement Thomas, *The Finance of British Industry,* pp. 60-75, Ross*, The Clearing Banks and Industry.*

structural deficiencies and, alongside cotton, was the area in which banks had the greatest commitment.[7] We document the extent of this involvement and test whether it was associated with more amalgamations among affected steel firms.

This study utilises a new purpose-built firm-level data set comprising financial characteristics and banking relations of the 80 publicly listed steel firms across the interwar period between 1920 and 1938. Although only containing listed companies, these firms represent almost the complete steel sector in Great Britain as shown by Coase *et al.*'s survey of the industry.[8] The data set tracks these firms over the time frame in question and records when and which amalgamations took place in the industry.[9] Recorded financial characteristics comprise in particular return on equity, size, growth, liquidity and leverage.[10] Such balance sheet data is recorded for each third year during the period. Another balance sheet item, the extent of bank financing, is also used as an indicator of bank involvement. Additionally, the data set lists steel firms' banking relationships and records direct involvement of executive personnel through the listing of interlocking directorships between steel companies and their banks.[11] Summary statistics about the whole data set are provided in the appendix.

Section 2 describes the development of the interwar steel industry and gives an insight into firm-level performance, which closely matches aggregate steel production. Furthermore, the rationalisation of the sector during the time period is documented. In total 20 amalgamations are observed which involved the acquisition of 31 firms.

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[7] Tolliday, *Business, Banking, and Politics: The Case of British Steel, 1918-1939*, p. 177
[8] Coase, Edwards and Fowler, *The Iron and Steel Industry, 1926-1935: An Investigation Based on the Accounts of Published Companies,* p. 3
[9] The information about amalgamations is taken from the annually published *Stock Exchange Official Intelligence* and its successor the *Stock Exchange Official Yearbook.* Further information was provided by the *Register of Defunct Companies.*
[10] Their characteristics are taken from the individual companies' balance sheets as well as from the *Stock Exchange Official Intelligence* and the *Stock Exchange Official Yearbook.*
[11] Banking relationships are taken from the *Stock Exchange Official Intelligence* and the *Stock Exchange Official Yearbook,* and interlocking directorships are determined based on information from the *Directory of Directors.*

Simple descriptive statistics about the involvement of banks in the industry are presented in Section 3. These show that bank involvement was more extensive than previously thought since, for example, 36% of steel firms shared a director with one of their own company banks at some point during the interwar period accounting for as much as 41% of the total market capitalisation among publicly listed steel firms.

The empirical analysis addressing the question of whether bank involvement led to more mergers starts with demonstrating that the usual predictors of the financial literature to explain takeover targets also apply to the British steel sector in the interwar period. Financial characteristics are additionally shown to explain which firms are acquiring others, so a new approach is developed that combines the two. A set of all potential amalgamations is derived, which also allows the development of a number of variables indicating bank involvement with each possible pair of firms. Empirical tests then demonstrate that bank involvement, either measured as having a common banker or as having an interlocking directorship, had a significant influence on the likelihood that a particular pair of firms merged.

An essential subsequent question examined is whether the process of rationalisation was in fact optimal for the industry for, if the perceived lack of bank promotion of mergers is to be seen as negative, an amalgamated steel firm should outperform similar firms that did not amalgamate. The results indicate that amalgamations in general were not profitable, though a more detailed analysis reveals that this result only holds for mergers connected with bank involvement, while organic ones without such involvement actually had a positive impact on profitability.

Although the British steel industry lost its technological leadership in the decades before the First World War, it still had consistently extended production during this time.[12] After the war and a short-lived post-war boom the structural problems in the industry, reinforced through the changes to the general economic environment, emerged in full sight. Figure 1 shows the development of production during the interwar period with massive slumps in 1921 and 1926 as well as the recovery during 1930s.

Figure 1. Total annual Steel Production in the United Kingdom, 1920-38
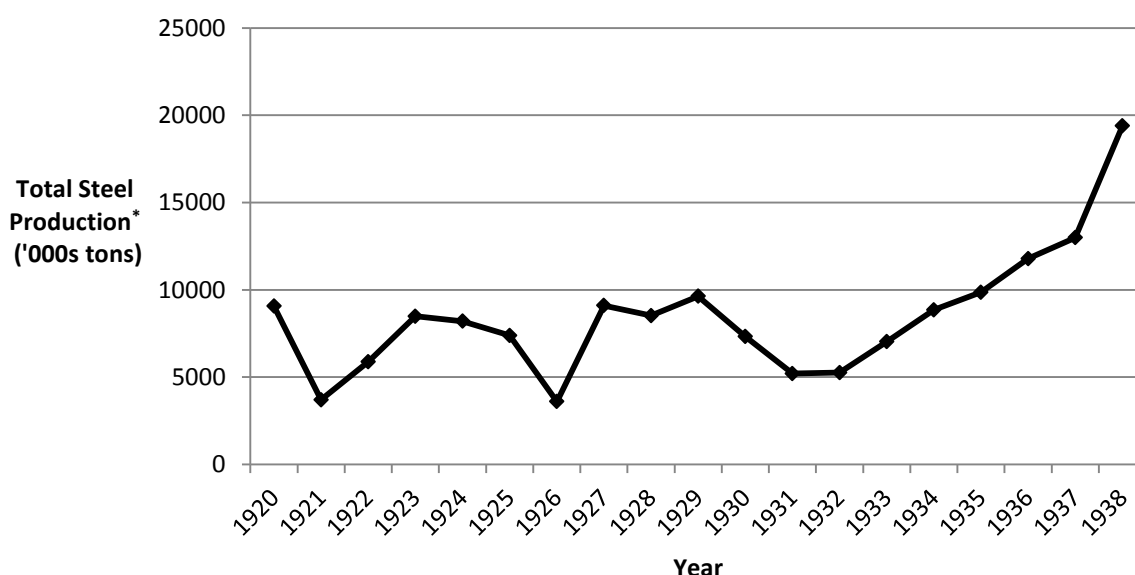
Sources: National Federation of Iron and Steel Manufacturers (Great Britain) (Issues 1920 to 1933)
British Iron and Steel Federation, *Statistical Year Book* (Issues 1934 to 1938)
[*] Production has been calculated as the sum of Basic and Acid Bessemer and Open-hearth steel and electric ingots and castings

These aggregate production figures are consistent with the performance of firms in the sector. Figure 2 shows the average return on equity for all 80 steel firms in the data set as an indication of company performance. The effects of the post-war boom are clearly evident,

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[12] See for example Burn, *The Economic History of Steelmaking,* or Elbaum, *The Steel Industry before World War 1.*

with an average return of over 16% in 1920. After this point average company performance drastically deteriorates with negative returns reported in 1926 before recovering by 1929 to over 3% and again declining following the Great Depression. By 1935, average return on equity rose to over 6%, above the 1929 level, but remained below the heights achieved in 1920. Tolliday's series of return on equity is also shown and, while only based on 9 large steel companies, closely matches the trend yielded by this data set.

Figure 2. Average Annual Return on Equity, 1920-38
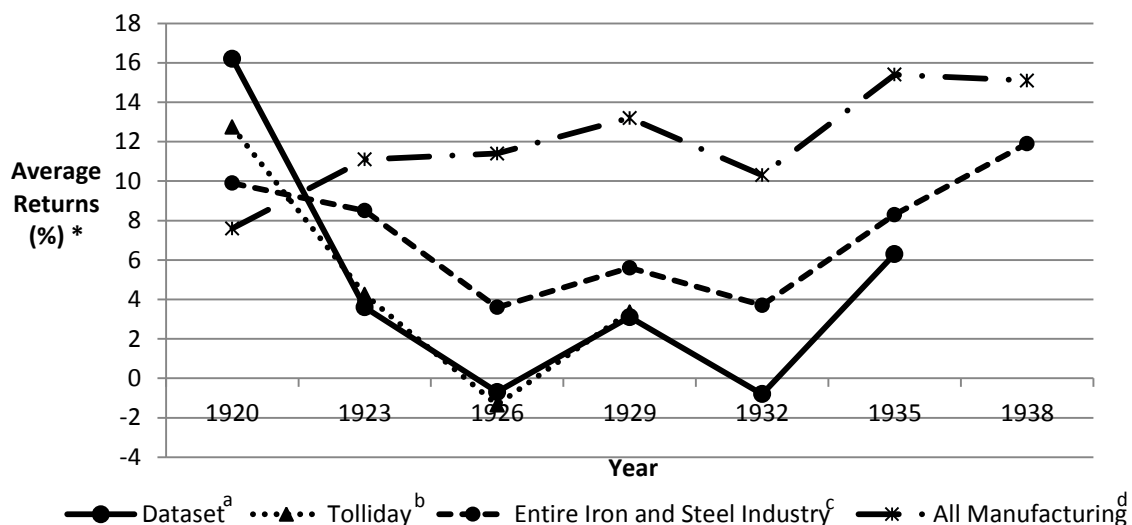
Sources: a) Company Balance sheets of 80 steel firms
b) S. Tolliday, *Business, Banking, and Politics*, Table 2, pp.26-28
c) P. E. Hart and J. A. Bates, *Studies in Profit*, Vol. II, Table 18.A.2, p.274
d) P. E. Hart and J. A. Bates, *Studies in Profit*, Vol. II, Table 18.2, p.231

*'Returns' expressed as ratio of net income to common and preferred equity for series a), b) and c) and the ratio of gross profit to the first cost of all fixed assets for d).

The comparison of these numbers with the results of Hart and Bates' study of trends in key financial variables during the interwar period shows the poor performance of the steel sector.[13] Although the magnitude of these series differs markedly due to a different calculation method, the trend comparison with returns across the entire manufacturing sector

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[13] Hart and Bates, *Studies in Profit, Business Saving and Investment in the U.K. 1920-62,* pp. 271-2

shows first that the post-war boom in company performance as well as the subsequent decline was very much concentrated in the steel and other staple industries. [14] The figure further shows that, thanks primarily to rearmament, recovery in firm performance from 1935 onward was more pronounced in the steel industry than in the whole of manufacturing, which actually experienced a plateau in returns between 1935 and 1938.

Contemporaries were the first to argue that rationalisation and mergers would be useful tools in the fight against the decline of staple industries. A famous example is the so-called Balfour Committee, a parliamentary committee on Industry and Trade established in 1924 to investigate the "conditions and prospects of British industry and commerce."[15] The Final Report published in 1929 concluded that the economy required a shakeout of inefficient and unprofitable firms, a view in line with the common perception that rationalisation and mergers were absent from the British steel industry, while its continental counterparts achieved a much higher concentration.

Table 1. Firms acquired by Region and Period

Year	Scotland and North-East Coast	Sheffield and Yorkshire	Lancashire	South Wales and West Midlands	South England	Total Data set
1921-23	3	1	0	2	0	6
1924-26	1	0	0	0	0	1
1927-29	5	2	0	3	0	10
1930-32	2	1	1	3	1	8
1933-35	3	0	0	1	0	4
1936-38	2	0	0	0	0	2
1921-38	16	4	1	9	1	31

Sources: *Stock Exchange Official Intelligence* (Thomas Skinner & Co., Issues 1920-33)
     Stock Exchange Official Yearbook (Thomas Skinner & Co., Issues 1934-38)
     Register of Defunct Companies, 2nd Edition, Macmillan, 1990

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[14] The different calculation methods are described in the footnote of Figure 2.
[15] Committee on Industry and Trade, p. 1

To see whether this charge was really justified, we utilize the data set to determine the actual amalgamations of steel firms within the major British regions during the interwar period. The web appendix describes the regional consolidation of the industry and graphically illustrates it with a set of consolidation maps. In total, the data set identifies 20 mergers involving 31 firms taken over, distributed over periods and regions as shown in Table 1.

These numbers and the maps in the appendix show that mergers and amalgamations were not really absent from the British steel industry. In fact, the results suggest that other studies have underestimated the progress of this element of rationalisation. For example, in reference to concentration on the North-East Coast, Tolliday writes, "Various mergers were discussed at some length but only one, that between Dorman Long and Bolckow Vaughan in July 1929, actually took place."[16]

By surveying all public listed steel firms, this study has identified no less than 6 mergers on the North-East Coast with the discrepancy perhaps stemming from the fact that in the most comprehensive parts of his account, Tolliday includes a maximum of only 38 firms. Even studies that directly address firm amalgamations in the steel industry appear not to have captured all of the mergers identified from the firm-level sources utilised here.[17]

III.

Contemporaries demanded that British interwar joint-stock banks should play a strong role in this process based on the belief that more extensive amalgamation was required to combat the decline of British industry. This view was expressed most notably by the Macmillan committee, which was set up by Parliament to investigate how the financial sector might boost economic activity. It considered a number of external institutions as potential

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[16] Tolliday, *Business, Banking and Politics*, p. 65
[17] For example see Carr and Taplin, *History of the British Steel Industry.*

coordinators of rationalisation and argued that commercial banks were the preferred candidate to achieve the desirable amalgamations, which in the committee's view were blocked by "sectional and individual opposition", which "should not be allowed to stand in the way of re-organisations which are in the national interest."[18]

A specific point of the criticism levelled at the banks in this context is that they did not take an active interest in their industrial clients by, for example, having a representative on their board of directors, a practice often observed in Germany and viewed as a positive indication of bank involvement in industrial performance.[19] However, some authors, like Ross, defend the banks by insisting that they indeed had on occasion representatives on the boards of such clients during the interwar period.[20] Due to the huge increase in banking concentration witnessed at the beginning of the twentieth century, the entire banking business of all 80 firms in the sample was conducted by 16 joint-stock banks, with roughly one third of steel firms having multiple bankers listed.

Table 2. Number of Steel Firm Clients by Bank in 1932

English Banks		Scottish Banks	
National Provincial Bank Limited	19	Bank of Scotland	4
Midland Bank Limited	14	National Bank of Scotland	4
Barclays Bank Limited	7	Royal Bank of Scotland	4
Lloyds Bank Limited	7	Union Bank of Scotland Limited	4
Williams Deacon's Bank Limited	6	Commercial Bank of Scotland Limited	3
Westminster Bank Limited	4		
District Bank Limited	3		
Martins Bank Limited	3		
British Linen Bank	2		
Clydesdale Bank Limited	2		
Glyn, Mills & Co.	2		

Source: Stock Exchange Official Intelligence (Thomas Skinner & Co., 1932)

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[18] Committee on Finance and Industry, *Final Report,* pp. 165-6
[19] Best and Humphries, 'City and Industrial Decline', p. 224
[20] Ross, 'Industrial and commercial finance in the interwar years', p. 411

The number of steel firm clients by bank for 1932 is shown in Table 2, with National Provincial and Midland being responsible for the largest numbers of clients in this industry.

Director lists contained in the *Directory of Directors* are used to determine interlocking directorships between these banks and the steel firms, again done for every third year during the period. 98 bank directors were found to have served on a steel firm board and 36 even had multiple positions. Figure 3 shows the result of this exercise on the firm side by displaying the percentage of steel firms, both by number and market capitalisation, in each year which had an interlocking directorship with at least one of their company banks.

Figure 3. Percentage of steel firms with an Interlocking Directorship
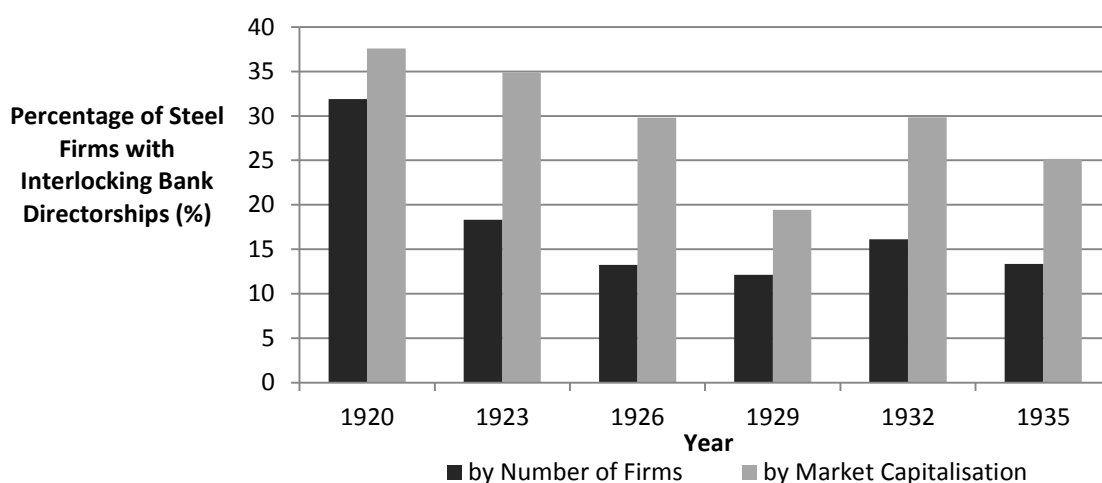
This measure of bank involvement peaked at the beginning of the interwar, with 32% of firms having a bank director on their board in 1920, accounting for 41% of market capitalisation. This then drops to 18% of firms in 1923 while still accounting for 36% of the market capital. From 1926 onwards roughly 14% of steel firms had a director from one of their bankers on their board, but there is a considerable drop in their share of market capitalisation in 1929 due

to bank directors leaving the boards of two large steel firms, Baldwins and Cammell Laird. In total, 36% of steel firms in the sample were found to have an interlocking directorship with one of their company bankers at some point during the interwar period. This indicates that banks did indeed have representatives on company boards, which is usually thought to imply that they were also more likely to be involved in the affairs of those industrial clients. In fact, one interlocking director identified between Midland Bank and the steel firms of John Brown and Company and David Colville and Sons was Lord Pirrie, who had submitted a scheme for amalgamation involving the creation of a huge holding company for various firms in Scotland and on the North-East Coast. According to Payne, the proposal was seriously discussed until Lord Pirrie's death in June 1924.[21]

In addition to these banking relationships, firm's bank debt is another indicator of bank involvement. Much of the commentary to date on the suitability of joint-stock banks as potential merger promoters has centred on their increased advances to industry. As bank overdrafts and other forms of bank debt were often quoted on the steel firms' balance sheets, the data set gives a firm-level insight into the dynamics of this increased commitment. Coase *et al.* find that iron and steel firms were extremely likely to include specific information on bank liability on their balance sheets and so the error from non-disclosure can be considered minimal.[22] Figure 4a shows the average overdraft and other bank exposure of the 80 steel firms sampled across the interwar while Figure 4b expresses the series as a percentage of equity, thereby controlling for the effect of firm growth, and shows average bank leverage. The findings match the history of bank involvement in the industry as bank overdrafts account for a higher proportion of total bank debt in 1920 compared to the rest of the interwar period, capturing the increase in overdraft lending during the post-war boom. There was then a rapid increase in bank provision throughout most of the interwar period with potentially

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[21] Payne, *Colvilles and the Scottish Steel Industry,* p. 158
[22] Coase *et al.*, *The Iron and Steel Industry,* p. 15

frozen loans peaking at 7% of total firm equity in 1932. This was followed by a marked decrease of 46% by 1935 when banks are reported to have escaped their commitments as the industry recovered.

Figure 4a. Average Bank Debt, 1920-35
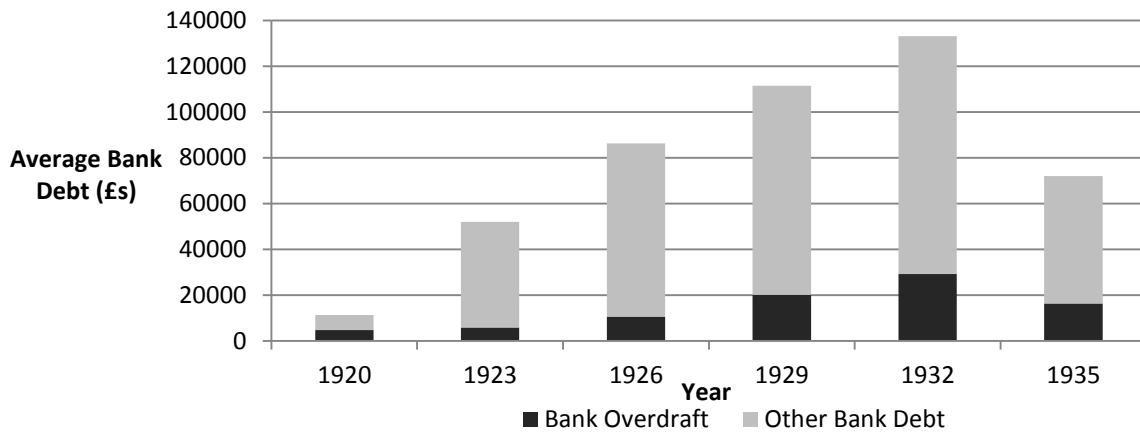
Figure 4b. Average Bank Debt as a Percentage of Equity, 1920-35
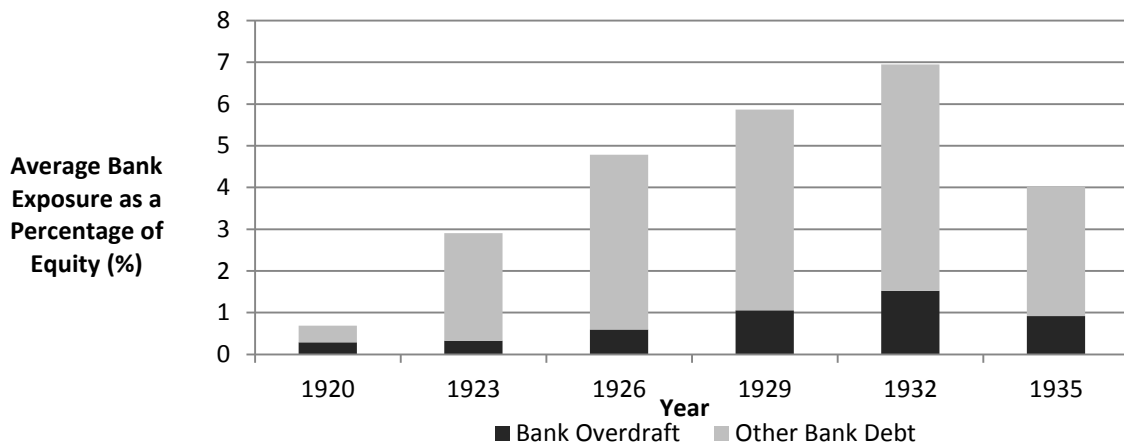
Source: Company Balance Sheets

This final observation is consistent with academic accounts of bank lending during the recovery of the 1930s. For example, Capie and Collins found that bank assets advanced to industry were greater in the 1920s, since in the 1930s they started to lose market share to non-

bank financial intermediaries.[23] Thomas suggests that the growth of alternative sources of funding such as foreign banks and retained earnings exaggerates the decline in advances during the 1930s.[24] Coase *et al.* argue that the increase in steel firms' profits, which were used to reduce bank indebtedness, was the most important explanation for this decline in bank advances.[25] Finally, Tolliday agrees that during the recovery of the 1930s companies found it cheaper to decrease their bank debt and look for other forms of accommodation such as undistributed profits, new capital issues and security sales. [26]

IV.

The previous two sections demonstrate that amalgamations happened in the interwar steel industry and that banks had indeed some involvement with these firms. This section combines the two and investigates statistically whether the identified common directorships, bank debt and other variables capturing bank involvement actually had an effect on the probability of a steel firm being involved in a subsequent amalgamation. The results illuminate whether banks were a conduit promoting rationalisation.

In order to test the independent effect of these variables it is necessary to control for other factors which influence the probability of a firm being involved in a merger or acquisition. The general framework adopted to provide the required controls is derived from the finance literature on the determinants of takeovers. A number of quantitative studies have demonstrated that publically available financial information can be used to predict acquisition targets.[27] Palepu summarises the explanatory variables used in such acquisition likelihood models and explicitly links them to underlying financial hypotheses on the types of firms

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[23] Capie and Collins, *Have the Banks Failed British Industry?,* pp. 92-9
[24] Thomas, *The Finance of British Industry*, pp. 67-70
[25] Coase *et al.*, *The Iron and Steel Industry,* p. 31
[26] Tolliday, *Business, Banking, and Politics*, p. 184
[27] See for example Hasbrouck*, The Characteristics of Takeover Targets,* Jensen*, Takeovers: Their Causes and Consequence ,*Levine and Aaronvitch*, The Financial Characteristics of Firms and Theories of Merger Activity.*

likely to become takeover targets.[28] In particular, three main hypotheses are formulated and used to construct a logistic probability model which is then applied to a sample of 163 targets and 343 non-targets listed on the New York and American Stock Exchange in the manufacturing and mining sector during 1970s.[29] Palepu's model has been used as the basis for many similar econometric studies, most notably Ambrose and Megginson's study of nonregulated American industries in the 1980s and Powell's work on British takeovers.[30]

The first hypothesis relates to inefficient management, whereby a takeover is seen as a mechanism in which managers who are not able to maximise the market value of a firm are replaced. Therefore accounting profitability, as calculated by return on stockholders' equity, is used here as a proxy for management performance. A decrease in the return on equity, representing an intensifying of management inefficiency, would be expected to increase the likelihood of a firm being subsequently acquired.

The second hypothesis is that a mismatch between growth and financial resources available will increase the likelihood of a firm becoming a takeover target. Therefore growth in assets, controlling for dividend payments, is included as an explanatory variable. Liquidity, as measured by the ratio of liquid to total assets, and leverage, represented by a firm's debt to equity ratio, are used to proxy for financial resource availability. Finally, following Palepu's method, a dummy variable has been constructed to indicate a growth-resource mismatch, and takes the value of 1 for combinations of low growth, high liquidity, low leverage and high growth, low liquidity, high leverage. These values are defined as high if they are above the sample average and low if they are below.

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[28] Palepu, *Predicting Takeover Targets: A Methodological and Empirical Analysis*, pp. 16-9
[29] Palepu, *Predicting Takeover Targets: A Methodological and Empirical Analysis*, p. 20
[30] Ambrose and Megginson, *The Role of Asset Structure, Ownership Structure and Takeover Defences in Determining Acquisition Likelihood,* p. 575 and Powell, *Modelling Takeover Likelihood*, p. 1016

The third hypothesis tested is that the likelihood of a firm being acquired will decrease with the size of the firm. According to this theory, there are several transaction costs, such as higher resistance to takeover, which cause the acquisition of larger firms to become more expensive. Therefore firm size, measured as total assets, is included in the model.

Palepu applies a regular logit model, which adjusted for the data set here has the following specification:

$$p(i,t) = \frac{1}{1+e^{-\beta x(i,t)}}$$

where $p(i,t)$ is the probability that firm i is a target during the succeeding 3 years from time t exclusive, $x(i,t)$ is a vector of firm attributes i at time t and β is the unknown parameter vector. The dependent variable takes the value of 1 if the firm was acquired by another in the sample in the succeeding 3 years exclusive and 0 if it was not.

By way of demonstrating the suitability of these controls and the model in general, Table 3 shows the results of applying Palepu's acquisition likelihood model and approach to the entire data set of interwar steel firms. The results shown in column 1 are consistent with Palepu's findings. First, as with his results, growth and leverage are both statistically significant, although Palepu also found size to be significant. Second, with the exception of size which is shown here to have a small positive effect, all variables have the same sign as predicted by the financial hypotheses and as found by Palepu.

As an extension, Ambrose and Megginson have argued that a higher proportion of fixed tangible assets in a firm's total asset structure makes a firm a more attractive target and therefore increases the likelihood of it being acquired.[31] Therefore, tangibility[32] is included as

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[31] Ambrose and Megginson, *The Role of Asset Structure, Ownership Structure and Takeover Defences in Determining Acquisition Likelihood*, p. 585

[32] Tangibility is measured as the ratio of a firm's fixed assets to its total assets.

an explanatory variable in the second specification and, as predicted, it has a positive sign but, unlike in Ambrose and Megginson's study, it is not statistically significant.

Table 3. Estimates of Logit Acquisition Likelihood Model

Dependant Variable: Target (1 and 2), Acquirer (3)

Variables	Estimates [a, b]		
	(1)	(2)	(3)
Return on equity	-1.847	-1.900	4.705
	(1.592)	(1.657)	(2.885)
Growth	0.632**	0.628*	-0.447
	(0.32)	(0.323)	(0.469)
Liquidity	-0.027	-0.231	0.089
	(1.044)	(1.742)	(2.541)
Leverage	0.180*	0.171	-0.070
	(0.106)	(0.113)	(0.256)
Growth-resource Mismatch	0.560	0.566	-3.454**
	(0.513)	(0.521)	(1.685)
Size	0.001	0.001	0.019***
	(0.003)	(0.004)	(0.004)
Tangibility		0.336	1.435
		(1.878)	(2.833)
Constant	-2.984***	-3.191**	-4.337**
	(0.641)	(1.287)	(2.110)
Year Dummies	Y	Y	Y
n	373	373	373
Likelihood ratio statistic [c]	0.060	0.060	0.184
Prob > chi2 [d]	0.190	0.250	0.002
c-statistic [e]	0.719	0.718	0.861

[a] Two-Tailed p-value test, *10% significance, **5% significance, ***1% significance

[b] Robust standard errors displayed in parentheses

[c] The log likelihood ratio index is defined as (1-log likelihood at convergence/log likelihood at zero). It is similar to the R^2 statistic in a multiple regression model and provides an indication of the logit model's explanatory power

[d] p-value of hypothesis that all parameters in the model are simultaneously equal to zero

[e] The c statistic measures the area under the ROC curve and measures a model's predictive accuracy. A good c-statistic is 0.8 or above.

Probit specification did not considerably change results in any model

Specification (3) explains the probability of a firm acquiring another rather than being a target using the same financial characteristics as explanatory variables as specification (2). The results suggest that additional elements of amalgamation probability can be explained by

looking beyond target firms. For example, the variables of growth-resource mismatch and size are shown to have a significant effect and the explanatory power of the model is considerably improved.

Approaches such as Palepu's only consider the financial characteristics of the target firms and not those of the acquiring firm. The reason for this is that although target firms could be easily linked to the corresponding acquiring firm, this is impossible for non-targets. As will be demonstrated in the following section, this results in some important explanatory variables being unspecified. In addition, current acquisition likelihood models only explain the probability of a firm being *acquired* and not the probability of a firm *acquiring* another. Finally, from a practical point of view, the framework does not allow certain banking relationship variables such as a common banker between the two potential amalgamating firms to be coded. This study overcomes these obstacles by creating a pool of potential amalgamations in a target-acquirer approach that is based on three assumptions derived from all mergers recorded in the data set.

The first step is the restriction that only steel firms are involved in potential mergers. This implies that a company could only be acquired by another steel firm listed in the data set. Non-sector firms are therefore assumed not to be involved as direct actors other than facilitating agents in the rationalisation of the steel sector.

The second step of this approach is to arrange the firms into the five regional groups. The extent of these is listed in the consolidation maps shown in the appendix. As is evident from these maps, all concluded mergers occurred within these groups and in fact most rationalisation plans called for regional production centres to be established in these areas.[33]

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[33] Burn, *The Economic History of Steelmaking,* pp. 436-7

Next, based on the observations that for each concluded amalgamation the acquiring firm was larger than the firm it took over, a potential amalgamation is defined as a combination of two firms from the same region in a given period, where the larger firm, as measured by the book values of the firms' total assets, is designated as the acquirer and the smaller as the target.

To illustrate this, in 1920 Vickers Limited was the largest steel firm in the Sheffield and Yorkshire area and therefore had the potential of acquiring any of the other 17 listed firms from this region during the following three years. Cammell Laird was the third largest firm and so could not have acquired Vickers, but could have acquired any of the other 15 firms that were smaller than it and Tinsley Rolling Mills Company Limited, as the smallest, could not have acquired any other firm but was a legitimate target for any Sheffield or Yorkshire steel company.

The pool of potential amalgamations is created using these three observed regularities. Furthermore, once a successful acquisition was observed, it was dropped as a potential amalgamation for all subsequent periods and the acquired firm was dropped as a potential acquirer from all future pairings.[34] This results in 3005 potential amalgamation pairs; summary statistics as well as period and regional details are described in the appendix.

Arranging the data in this way allows the creation of three variables capturing increasingly intimate degrees of banking relationships. The first is a variable that takes the value of 1 if the potential acquirer and target were both clients of the same bank with the assumption being that banks would be better positioned to promote an amalgamation if both firms involved happened to be their clients. Tolliday similarly observed that amalgamation was made less likely if clearing banks had interests in rival firms as they attempted to preserve 'neutrality'.[35]

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[34] This is necessary since some acquired firms retained separate balance sheets despite being wholly owned subsidiaries of other steel firms.
[35] Tolliday, *Steel and Rationalisation Policies, 1918-1950*, p. 87

Common banks are observed in 784 instances across the entire pool of potential amalgamations. The second variable takes the value of 1 if both firms had a common directorship with one of their own respective banks, as presented in the descriptive results, which occurred in 70 cases. The final and most involved banking relationship variable takes the value of 1 if both firms had common directorships with the same common bank and is observed among only 15 of the potential amalgamation pairs. The consolidation maps in the appendix indicate whether observed amalgamations exhibited any of these bank involvement traits and reveal that 45% of concluded mergers in the interwar steel industry were preceded by one of the three banking relationships.

V.

The results of the quantitative analysis determining the effect of the three banking relationships on the probability to amalgamate are displayed in Table 4. In all regressions the dependant variable takes the value of 1 if the potential amalgamation was actually concluded at any time during the succeeding 3 years. The first four specifications draw on the controls from the traditional acquisition likelihood approach, whereby amalgamation probability is explained in terms of the acquired firm's financial characteristics and the controls used are therefore the same as those in Table 3. Specification (5) adds identical financial characteristics for the potential acquirer to the model which results in additional significant explanatory variables being identified and a considerable improvement in both the model's explanatory and predictive power. Finally, the target-acquirer approach adopted here enables some further insightful extensions to be made by generating new variables in terms of ratios of acquiring to target firm characteristics, and those found to be statistically significant displayed in specifications (6), (7) and (8).

Table 4. Logit Acquisition Likelihood Model with Bank Relationships on Potential Amalgamations Data set

Variables	Estimates [a, b]							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Common Bank	1.258**			1.025*	1.086*	1.437***	1.046*	1.110*
	(0.518)			(0.531)	(0.574)	(0.514)	(0.585)	(0.578)
Interlocking Directorships		2.388***		1.657**	1.902**	2.083**	2.086**	1.908**
		(0.592)		(0.768)	(0.918)	(0.834)	(0.939)	(0.859)
Common Int. Directorships			3.754***	1.611	1.239	1.122	1.357	0.760
			(1.001)	(1.215)	(1.212)	(1.216)	(1.186)	(1.293)
Target:								
Return on Equity	-1.693	-1.061	-1.362	-1.108	0.021	-1.278	-0.362	0.109
	(1.635)	(1.347)	(1.354)	(1.408)	(1.520)	(1.463)	(1.620)	(1.522)
Growth	0.593**	0.511*	0.769***	0.723**	0.875***	0.899***	0.924***	0.939***
	(0.262)	(0.269)	(0.297)	(0.283)	(0.306)	(0.288)	(0.309)	(0.307)
Liquidity	0.781	0.050	0.430	0.270	-0.060	1.345		-0.302
	(1.882)	(1.517)	(1.657)	(1.615)	(2.013)	(1.726)		(2.011)
Leverage	0.309***	0.316***	0.308***	0.372***	0.516***	0.531***	0.514***	0.514***
	(0.092)	(0.090)	(0.093)	(0.096)	(0.123)	(0.120)	(0.106)	(0.121)
Growth-resource Mismatch	0.156	0.082	-0.162	-0.061	-0.826	-1.086*	-0.806	
	(0.597)	(0.563)	(0.584)	(0.561)	(0.632)	(0.612)	(0.641)	
Size	0.023***	0.027***	0.028***	0.025***	0.017*		0.017**	0.018**
	(0.006)	(0.006)	(0.005)	(0.006)	(0.009)		(0.008)	(0.009)
Tangibility	-0.063	-1.032	-0.672	-0.977	-2.894	-1.811	-2.907**	-2.725
	(2.096)	(1.839)	(1.933)	(1.880)	(2.428)	(2.094)	(1.253)	(2.366)
Acquirer:								
Return on Equity					7.184**	3.790	6.758**	7.675*
					(3.653)	(3.346)	(3.130)	(4.117)
Growth					-0.134	-0.311	-0.032	0.184
					(0.318)	(0.332)	(0.336)	(0.290)
Liquidity					4.850	5.779**		5.414
					(3.928)	(2.598)		(3.525)
Leverage					-0.817	-0.363	-0.647	-0.645
					(0.924)	(0.787)	(0.923)	(0.824)
Growth-resource Mismatch					-1.081	-0.804	-1.272*	
					(0.680)	(0.559)	-0.709	
Size					0.007		0.008**	0.006
					(0.004)		(0.004)	(0.005)
Tangibility					5.481	4.087	0.580	6.749*
					(4.111)	(2.620)	(1.499)	(3.981)
Ratios:								
Size Ratio						-0.035**		
						(0.016)		
Liquidity Ratio							-0.048**	
							(0.020)	
Consistent Growth-resource								0.338
								(0.701)
Constant	-6.402***	-5.729***	-6.059***	-6.454***	-11.050***	-9.905***	-7.518***	-12.843***
	(1.249)	(1.219)	(1.301)	(1.302)	(3.350)	(2.111)	(1.858)	(3.276)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Year Dummies	Y	Y	Y	Y	Y	Y	Y	Y
N	2864	2923	2923	2726	2726	2726	2720	2726
Likelihood ratio statistic [c]	0.130	0.143	0.142	0.172	0.220	0.195	0.221	0.202
Prob > chi2 [d]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
c-statistic [e]	0.842	0.848	0.850	0.878	0.911	0.875	0.906	0.889

[a] Two-Tailed p-value test, *10% significance, **5% significance, ***1% significance

[b] Robust standard errors displayed in parentheses

[c] The log likelihood ratio index is defined as (1-log likelihood at convergence/log likelihood at zero). It is similar to the R2 statistic in a multiple regression model and provides an indication of the logit model's explanatory power

[d] p-value of hypothesis that all parameters in the model are simultaneously equal to zero

[e] The c statistic measures the area under the ROC curve and measures a model's predictive accuracy. A good c-statistic is 0.8 or above.

Probit specification did not considerably change results in any model

Crucially, the results show that if two firms had a common bank or interlocking directorships with their own banks they were more likely to merge. Specification (3) uses the most intimate banking relationship, that the potential amalgamating pair shared interlocking directorships with a common bank, and shows that it to have had a positive and highly significant effect on the probability of a merger taking place. Specification (4) includes all three banking relationships as explanatory variables and finds only a common bank and interlocking directorship to be significant at the 10% and 5% levels respectively. This suggests that either a common bank or interlocking bank directorship was sufficient to promote amalgamation, with the combination adding no significant increase in likelihood. Therefore, the result from (3) simply reflects the fact that the third bank involvement variable partly captures, though is not perfectly correlated with, the common bank and interlocking directorship variables

Specification (5) includes characteristics of both the potential target and acquiring firm as control variables while the impact of the common bank and interlocking directorship variables remain essentially unchanged. For the target, the variables of growth, leverage and size are all found to be positive and statistically significant. This suggests that steel firms which were relatively large, growing and highly leveraged were more likely to be acquired by

another publicly listed firm during the interwar. The fact that the leverage of the target firm is statistically significant at the 1% level in all displayed models supports Burn's argument that amalgamations in the interwar years were often a result of the critical indebtedness of one or more of the firms involved, as well as Holland and Hodgkinson's finding that leverage was an important independent factor in determining UK takeover targets.[36] Regression (5) additionally suggests that the profitability of the acquiring firm had a positive and significant effect on amalgamation likelihood with high performing firms more likely to acquire others. It is worth noting that including the characteristics of the acquiring firm in regressions (5) and following leads to a significant increase in the likelihood ratio statistic and c-statistic, measures of the model's explanatory and predictive power respectively, confirming that additional elements of amalgamation probability can be explained by looking beyond target firms.

As one might expect, it has been shown here that amalgamations became more likely as the size of the acquiring firm increased but, in contrast to Palepu's analysis, the likelihood of amalgamation also increased with the size of the target firm. This suggests that for interwar steel, larger companies tended to be involved in industrial consolidation. To further investigate the relationship between the sizes of the two companies, the ratio of the acquiring to the target firm's total assets are added to specification (6). This variable is shown to have a negative effect which is significant at the 5% level suggesting that firms were more likely to acquire those that were closer to their own size than those that were considerably smaller. Specification (7) instead adds a liquidity ratio in the same way. This variable has a negative effect which is significant at the 5% level, indicating that acquisitions were made more likely when the acquiring firm was relatively less liquid than the target firm and implies that the advantage of the excess cash flows and other liquid assets of the target may have been a

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[36] Burn, *The Economic History of Steelmaking,* p. 438 and Holland and Hodgkinson, *The Pre-Announcement Share Price Behaviour of UK Takeover Targets*, pp. 467-89

motivating factor in an acquiring firm embarking on a takeover. Building on this, specification (8) tests a speculation advanced by Powell in which he hypothesises that firms with opposite growth-resource mismatches will be more likely to merge.[37] Because of the limitations of the acquisition likelihood approach discussed above, Powell is unable to investigate this factor. To test it on this sample, a new variable was constructed to reflect this consistent growth-resource mismatch. This dummy variable takes the value of 1 if the acquiring firm was a high growth, low resource type and the target a low growth, high resource type, or the acquiring firm was a low growth, high resource type and the target a high growth, low resource type, and 0 otherwise. The resulting variable is insignificant at the 10% level which suggests Powell's assertion does not hold in this case.

Banking leverage was a key mechanism through which banks were seen to have been presented with the ideal opportunity to promote industrial consolidation which they failed to exploit.[38] To investigate this charge, firm bank debt, as presented in Section 3, is included in the target-acquirer model as an additional indication of bank involvement in a steel firm. The results of this analysis are shown in Table 5.

In these regressions, a variable is used to indicate any of the three types of aforementioned banking relationships and control variables for both the target and acquirer identical to those used in Table 4 regression (5) are included but not reported. Specification (1) includes the bank debt of both the target and acquiring firm and reveals the former to have a positive and statistically significant effect at the 5% level suggesting that the likelihood of a firm being acquired increased with the level of bank debt owed by the company. Regression (2) adds interaction terms with bank relationship to both bank debt variables, and neither is found to be significant at the 10% level. This implies that the effect of the level of firm bank debt on

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[37] Powell, *Modelling Takeover Likelihood*, p. 1015
[38] Best and Humphries, *City and Industrial Decline*, p. 230

the probability of a subsequent amalgamation did not consistently change depending on whether there was also a banking relationship in place.

Table 5. Logit Acquisition Likelihood Model with Bank Debt

Dependant Variable: Amalgamation

Variables	Estimates [a, b]		
	(1)	(2)	(3)
Bank Relationship	1.547**	1.843**	1.149
	(0.626)	(0.738)	(0.885)
Target:			
Bank Debt	0.307**	0.340**	0.354**
	(0.150)	(0.163)	(0.157)
Bank Debt * Bank Relationship		-0.095	-0.127
		(0.322)	(0.354)
ROE * Bank Relationship			-4.335
			(2.780)
Target Controls	Y	Y	Y
Acquirer:			
Bank Debt	0.057	0.109	0.062
	(0.052)	(0.074)	(0.087)
Bank Debt * Bank Relationship		-0.073	-0.007
		(0.077)	(0.095)
ROE * Bank Relationship			14.524*
			(7.609)
Acquirer Controls	Y	Y	Y
Constant	-10.296***	-10.583***	-11.039***
	(2.819)	(2.754)	(3.002)
Year Dummies	Y	Y	Y
n	2726	2726	2726
Likelihood ratio statistic [c]	0.215	0.218	0.228
Prob > chi2 [d]	0.000	0.000	0.000
c-statistic [e]	0.900	0.901	0.900

[a] Two-Tailed p-value test, *10% significance, **5% significance, ***1% significance

[b] Robust standard errors displayed in parentheses

[c] The log likelihood ratio index is defined as (1-log likelihood at convergence/log likelihood at zero). It is similar to the R^2 statistic in a multiple regression model and provides an indication of the logit model's explanatory power

[d] p-value of hypothesis that all parameters in the model are simultaneously equal to zero

[e] The c statistic measures the area under the ROC curve and measures a model's predictive accuracy. A good c-statistic is 0.8 or above.

Probit specification did not considerably change results in any model

Regression (3) reveals a further insight. In this specification, an additional interaction term between firm profitability and the banking relationship dummy is included for both the potential target and acquiring firm. The interaction term for the acquiring firm is shown to have a positive statistically significant effect at the 10% level, implying bank promotion of amalgamation was more pronounced among acquiring firms that were well performing. Whereas the results of the first regression suggest that bank promotion of mergers was more intense among cases which involved a potential loss of bank assets held by the target firm, this regression suggests that banks tried to mitigate the risk by encouraging a merger with a successful acquirer.

An implicit assumption of much of the criticisms aimed at interwar joint-stock banks is that an increased rate of rationalisation was preferable. A first indication of the validity of this charge can be derived by comparing the success of amalgamated and non-amalgamated firms across the sample. In fact, of the 60 firms still publishing annual reports in 1935, 24 had been involved in an amalgamation with another firm in the sample during the interwar years. In that year, the average profitability as measured as rate of return on equity of the group of firms that had amalgamated was 8.3% while the corresponding figure for those who had not was only 5.0%. However, given the finding in the preceding analysis that more profitable steel firms tended to be involved in industrial concentration, these numbers might reflect a selection effect rather than the impact of amalgamations.

The data set allows a more formal test for this hypothesis. The control variables for this analysis are again provided by the financial literature with the specification employed similar to that utilised in Braggion's study of the influence of freemasonry on Victorian firm performance.[39] In this case, future accounting profitability is regressed on a dummy variable capturing whether a firm had amalgamated with another firm in the sample during the

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[39] Braggion, *Managers and (Secret) Social Networks: The Influence of the Freemasonry on Firm Performance*

previous 3 years. The control variables include other firm characteristics deemed to affect future profitability, namely, the current profitability, growth, size and tangibility.

The results of this analysis are displayed in Table 6. Specifications (1) and (2) use a pooled OLS and random effects specification respectively and indicate that amalgamation did not have a statistically significant effect on future performance. This is consistent with the general finding among the financial literature that mergers and acquisitions tend to provide insignificant or even negative returns.[40]

Many commentators on interwar steel similarly maintain that despite the criticisms of the slow pace of British rationalisation, observed mergers rarely led to optimal outcomes. Burn suggests that interwar steel firms formed by amalgamation could suffer from internal divisions which offset economies of scale and adds that improved performance in the industry in the 1930s did not directly result from concentration.[41] Hannah claims that even larger British firms resulting from amalgamations continued to pursue defensive strategies.[42] Likewise, Tolliday claims that even when amalgamation was achieved, it did not always lead to modernisation. He argues that in Scotland, where the highest level of consolidation was observed, "amalgamation did not provide a context for a radical resolution of underlying structural problems of a declining resource base, outdated locations, and restricted markets."[43] Even Best and Humphries question the realised effect of horizontal amalgamations, claiming that witnessed mergers did not improve the reorganisation of business enterprise or productive capacity because, "such amalgamations ensured continued family dominance of management positions, and offered growth through undigested

[40] Agrawal and Jaffe, The *Post-merger Performance Puzzle*
[41] Burn, *The Economic History of Steelmaking,* p. 483
[42] Hannah, *Management strategy and Business Development: An Historical and Comparative Study*, p. 199
[43] Tolliday, *Business, Banking, and Politics*, p. 81

acquisition rather than internal expansion. Instead of promoting modernization, such organizations became another element in the structural logjam constraining rationalisation."[44]

Table 6. Pooled OLS and Random Effects estimates of Future Profitability

Dependant Variable: Return on Equity (t+2)

	Estimates [a, b]		
	POLS:	RE:	RE:
Variables	(1)	(2)	(3)
Amalgamation t-1	0.025	0.019	
	(0.017)	(0.019)	
Bank Amalgamation t-1			-0.003
			(0.020)
Non Bank Amalgamation t-1			0.068***
			(0.025)
Return on Equity	0.015	-0.080	0.090
	(0.058)	(0.058)	(0.067)
Growth	-0.011	-0.007	-0.019
	(0.011)	(0.012)	(0.027)
log(Size)	0.0004	-0.001	0.002
	(0.004)	(0.005)	(0.004)
Tangibility	-0.056**	-0.034	-0.010
	(0.024)	(0.031)	(0.027)
Age in 1920	-0.001***	-0.001***	-0.001**
	(0.0004)	(0.001)	(0.0003)
Constant	0.055**	0.064**	0.044*
	(0.025)	(0.030)	(0.023)
Year Dummies	Y	Y	Y
Regional Dummies	Y	Y	Y
n	221	221	165
R-squared	0.170	0.152	0.257
Prob > F (POLS) / Prob > chi2 (RE) [c]	0.000	0.000	0.000

[a] Two-Tailed p-value test, *10% significance, **5% significance, ***1% significance
[b] Robust standard errors displayed in parentheses

[c] p-value of hypothesis that all parameters in the model are simultaneously equal to zero
Breusch-Pagan Lagranian multiplier test for random effects fails to reject the null hypothesis that parameter estimators for (1) and (2) are significantly different
Hausman test fails to reject the null hypothesis of a significant difference between the parameter estimates of the random effect and equivalent fixed effects models

However, regression (3) offers an alternative interpretation. In this specification, the amalgamation variable is split into mergers in which banks had been directly involved with

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[44] Best and Humphries, *City and Industrial Decline*, p. 232

the firms during the preceding time period and those in which they had. The non-bank amalgamation variable is shown to be positive and statistically significant at the 1% level while the bank involvement amalgamation variable is negative and insignificant. This result suggests that whereas a merger preceded by bank involvement did not significantly change the future performance of the steel firms involved, other mergers increased future returns by an average of 7 percentage points. This may be the result of the fact, demonstrated earlier, that bank promoted mergers tended to involve more indebted target firms which were paired with a well performing acquirer, which served to depress the new entities future performance. The result however does not allow us to distinguish whether these mergers simply had no impact or if the involved firms would have performed significantly worse than average were they not involved in an amalgamation.

VI.

The results presented by this study suggest that varying definitions of bank involvement, which appear to have been more prevalent than previously thought, did promote amalgamation among steel firms during the interwar period. This influence was most pronounced when the target firm had a high level of bank debt and when the acquiring firm was relatively profitable. Put simply, banks were more likely to promote mergers when their own assets were at risk. As a result, bank-promoted mergers did not lead to considerable improvements in the future performance of steel firms, while organic mergers did lead to significant improvements in future returns. Consequently, the industrial concentration in the industry as a whole did not result in general improvements in firm performance predicted by contemporary champions of rationalisation. The evidence presented here therefore suggests that although bank involvement did increase the likelihood of a subsequent amalgamation occurring, this influence was generally detrimental to the steel industry.

The framework adopted by this study could easily be extended across a wider range of industries employing the same approach and drawing on identical sources. In particular, the cotton industry could be investigated as this sector experienced similar post-war lending patterns, with spinning mills bought with bank credit at inflated prices during the post-war boom and banks supporting loans after the boom in the hope of an upturn.[45] In addition, a comparison to industries in which rationalisation was seen to have been more successful, such as chemicals and electrical engineering, could lead to some interesting results. The model could also be applied to other industrialised countries during the period, with the view of investigating the varying influence of commercial banks across these nations.

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[45] Bamberg, *The rationalization of the British cotton industry in the interwar years*

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Appendix

A1. Summary Statistics of Collected 80 Steel Firms Data set, 1920-38
-Used in Tables 3 and 6

	(1)		(2)		(3)		(4)	
	Full 396 Company Year sample		Target Firms		Non-Target Firms		Acquiring Firms	
Target	0.06							
	0.25	, N = 396						
Acquirer	0.04							
	0.20	N = 396						
Amalgamated	0.11							
	0.31	, N = 396						
Interlocking Directorship	0.13		0.16		0.13		0.30	
	0.34	, N = 396	0.37	, N = 31	0.34	, N = 372	0.47	, N = 20
Return on Equity	0.05		0.04		0.05		0.06	
	0.11	, N = 393	0.08	, N = 24	0.11	, N = 369	0.09	, N = 19
Growth	0.10		0.22		0.09		0.16	
	0.46	, N = 374	0.57	, N = 23	0.45	, N = 351	0.45	, N = 19
Liquidity	0.30		0.31		0.30		0.29	
	0.24	, N = 393	0.26	, N = 24	0.24	, N = 369	0.18	, N = 19
Leverage	0.33		0.45		0.32		0.34	
	0.85	, N = 396	0.45	, N = 24	0.87	, N = 372	0.42	, N = 19
Growth-resource Mismatch	0.28		0.35		0.28		0.06	
	0.45	, N = 373	0.49	, N = 23	0.45	, N = 350	0.24	, N = 19
Size	33.54		39.19		33.18		77.70	
	50.12	, N = 395	43.1	, N = 24	50.6	, N = 371	50.6	, N = 19
Tangibility	0.52		0.49		0.53		0.53	
	0.51	, N = 394	0.22	, N = 24	0.53	, N = 370	0.2	, N = 19
Age in 1920	26.81		26.69		26.82		31.65	
	15.37	, N = 396	14	, N = 29	15.49	, N = 372	14.9	, N = 19

Sources: Company Balance Sheets

A2. Summary Statistics of Potential Amalgamations Data set
-Used in Tables 4 and 5

	(1)			(2)			(3)		
	Target Firms (from potential targets)			Non-target Firms (from potential targets)			Acquiring Firms (from potential acquirers)		
Common Bank	0.60			0.27			0.60		
	0.50	,	N = 20	0.44	,	N = 2896	0.5	,	N = 20
Interlocking Directorships	0.20			0.02			0.20		
	0.41	,	N = 20	0.15	,	N = 2985	0.41	,	N = 20
Common Int. Directorships	0.15			0.02			0.15		
	0.37	,	N = 20	0.13	,	N = 2985	0.37	,	N = 20
Return on Equity	0.04			0.05			0.06		
	0.08	,	N = 20	0.12	,	N = 2985	0.09	,	N = 20
Growth	0.24			0.09			0.13		
	0.60	,	N = 20	0.45	,	N = 2903	0.35	,	N = 16
Liquidity	0.32			0.29			0.35		
	0.25	,	N = 20	0.25	,	N = 2985	0.2	,	N = 20
Leverage	0.46			0.24			0.25		
	0.52	,	N = 20	0.8	,	N = 2985	0.19	,	N = 20
Growth-resource Mismatch	0.30			0.29			0.25		
	0.47	,	N = 20	0.45	,	N = 2903	0.45	,	N = 16
Size	34.70			10.77			107.75		
	32.5	,	N = 20	17.1	,	N = 2985	58.3	,	N = 20
Tangibility	0.48			0.48			0.50		
	0.21	,	N = 20	0.22	,	N = 2985	0.22	,	N = 20

Sources: see sources for Table A1

A3. Potential Amalgamations by Region

Year	Scotland and North-East Coast	Sheffield and Yorkshire	Lancashire	South Wales and West Midlands	South England	Total Data set
1921-23	378	153	28	36	15	610
1924-26	337	177	28	44	10	596
1927-29	311	177	21	43	3	555
1930-32	244	180	21	28	6	479
1933-35	232	143	21	21	3	420
1936-38	167	144	15	18	1	345
1921-38	1,669	974	134	190	38	3,005

Sources: see Table A1

Appendix Consolidation structure

Using the *Stock Exchange Official Intelligence* and the *Stock Exchange Official Yearbooks* as well as the *Register of Defunct Companies* it was possible to produce complete consolidation maps of the steel firms included in the data set. These maps are displayed under five regional headings and together show the merger and acquisition activity of the 80 public steel firms across the entire interwar period.[46] This appendix provides these mentioned maps, which combined also contain the full list of all included firms, as well as a more detailed description of the events in each of the regions.

As is evident from the first consolidation map, a steel monopoly did in fact emerge in Scotland in spite of the institutional obstacles highlighted by both Payne and Tolliday, with Colvilles Limited producing 80% of Scottish steel output in 1936.[47] However, during the 1920s such rationalisation was not forthcoming. For example, the Brassert report of 1929, where American consultants recommended reconstruction of the Scottish steel industry toward the establishment of one integrated works at Erskine Ferry, and proved to be desirable in retrospect, was not pursued.[48] Despite this, Colvilles Limited was eventually created in 1930 with the merger of David Colville and Sons, who had already acquired Smith and McLean at the start of the 1920s, with James Dunlop and Company. This new company then embarked on several large acquisitions during the rest of the decade, taking over Stewarts and Lloyds in 1934, who had themselves acquired the Scottish Tube Company in 1931, and William Beardmore and Company, also in 1934, followed by both Lanarkshire Steel and Steel Company of Scotland in 1936.

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[46] Firm regions were taken by combining the 10 areas listed by the BISF in the *Statistical Yearbook.*
[47] Tolliday, *Business, Banking, and Politics*, p. 82
[48] Warren, *Iron and Steel*, p. 121

Unlike in Scotland, where consolidation was concentrated in the 1930s, most amalgamations on the North-East Coast occurred during the 1920s. The biggest merger in this region took place between Dorman Long and Bolckow Vaughan in 1929. These two firms had dominated concentration in the preceding years, the former acquiring both Bells Brothers and North Eastern Steel Company and the latter the Scottish firm Redpath Brown and Company in 1923, while Weardale Steel, Coal and Coke Company took over Steel Developments one year later. Along with Dorman and Bolckow, the other two major steel producers of the region were South Durham Steel and Iron Company and Cargo Fleet Iron Company and, given that they had also merged in 1928, it seemed that comprehensive regional concentration was within reach. However, although a merger plan between Dorman Long and South Durham was drawn up and terms announced, the amalgamation was eventually terminated as the £247,000 loss incurred by Dorman Long on the Sydney Harbour Bridge Contract meant that South Durham shareholders felt their financial position was significantly superior.[49] According to Tolliday, this incomplete rationalisation reinforced overcommitment of the regional industry to existing plant and institutional structures.[50]

Turning to the next consolidation map, the first merger in the Sheffield and York area occurred between the munitions firm Cammell Laird and Company and Leeds Forge Company in 1923, and the resulting firm then merged with Vickers in 1929 to form the English Steel Corporation in 1929. Another major merger took place in the same year between Thomas Firth and Sons and John Brown and Company. One of the largest firms in this area was the United Steel Company and, although there was a degree of internal reconstruction in the company during the interwar, the few amalgamations it was involved in occurred before 1920. However, this firm was involved in the most significant anti-competitive arrangement observed across the sample when, in 1932, it entered an agreement

[49] *The Times*, Thursday, Dec 14, 1933; p. 21
[50] Tolliday, *Business, Banking, and Politics*, p. 51

with the Scottish firm Stewarts and Lloyds to extend production and avoid duplication of plant, sales policy, research, technical development and production methods.[51]

According to Tolliday, the South Wales Tinplate industry did see both structural and productive reorganisation during the interwar period.[52] The consolidation map of this region reveals that small producers were gradually replaced by two giant industrial firms in Richard Thomas & Company and Baldwins Limited. Richard Thomas first acquired Grovesend Steel & Tinplate Company in 1923 and then Ebbw Vale Steel, Iron and Coal Company in 1935. Baldwins, who as of 1918 owned Briton Ferry Steel Company, acquired the British Mannesmann Tube Company and then Port Talbot Steel Company during the 1920s before merging with Guest Keen and Nettlefolds, who had already acquired John Lysaght in 1920, to form Guest Keen Baldwins in 1930. This area also witnessed one of the few examples of modernisation in the British interwar steel industry as the old pack-mill was replaced by the continuous strip, allowing mass production which was partly facilitated by growing domestic demand for sheet and tinplate.

As evident from the remaining consolidation maps, industrial concentration was far less prominent in Lancashire and South England when compared to the other more major steel producing areas. Across these two regions the only major amalgamation to occur was the formation of the Lancashire Steel Company in 1930 from the Partington Steel and Iron Company and other small unlisted firms.

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[51] *Stock Exchange Official Year Book* (Thomas Skinner & Co., 1935), p. 2599
[52] Tolliday, *Business, Banking, and Politics*, p. 124

The following key is applicable to all maps included in this appendix

Key:

———	Firm in Existence	**CB** (yellow)	Common bank between merging firms
·–·–·–	Pre-1920 Subsidiary of firm above	**ID** (blue)	Both merging firms had at least one interlocking directorship with their banks
○	Merger	**FR** (green)	Both merging firms had interlocking directorships with a common bank
N (grey)	No bank relationship in merger	**L** (red triangle)	Firm liquidated
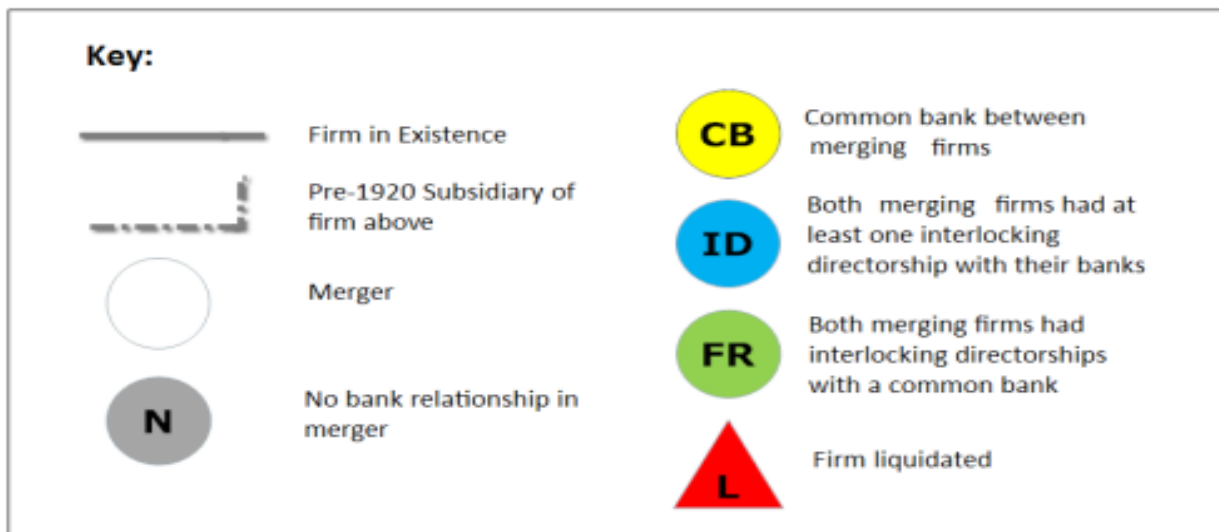
The following consolidation maps also contain the full list of firms used in the data set.

Map A.1: Consolidation map for Scotland and Scotland and the North-East Coast

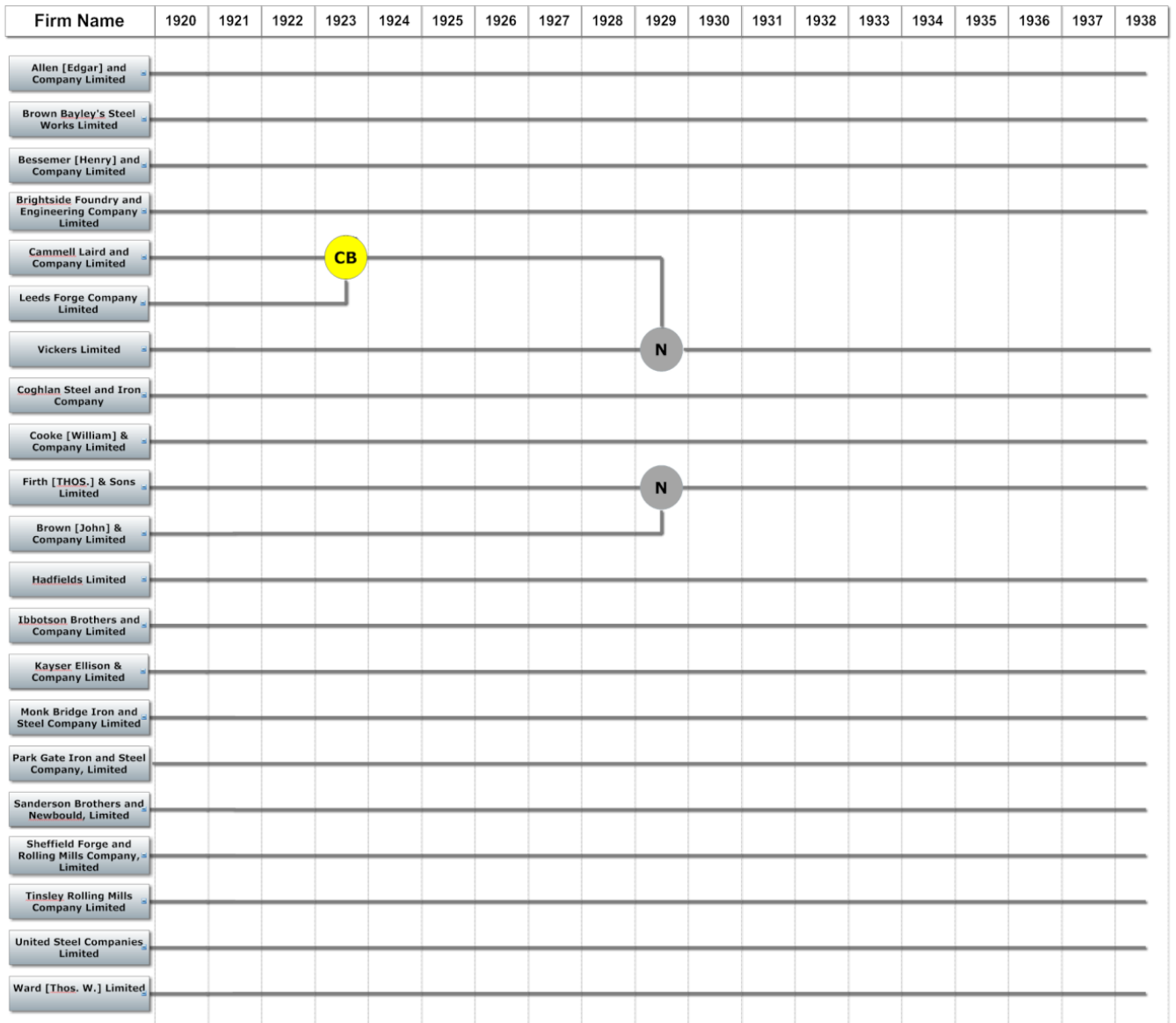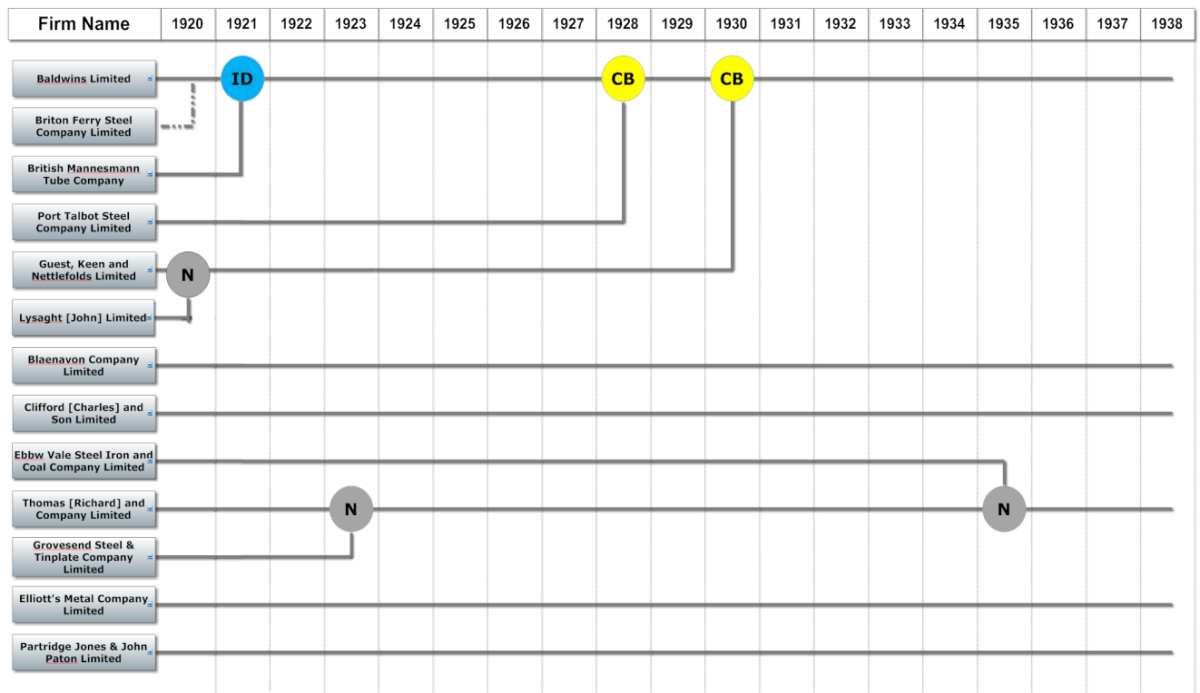| Firm Name	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Anderston Foundry Company Limited																			
Atlas Steel Foundry and Engineering Company Limited																			
Bells Brothers Limited																			
Dorman, Long and Company Limited				CB	FR					CB									
North Eastern Steel Company Limited																			
Bolckow, Vaughan Company Limited			N																
Redpath, Brown and Company Limited																			
Cargo Fleet Iron Company Limited																			
South Durham Steel and Iron Company									N										
Cleveland Bridge and Engineering Company																			
Consett Iron Company Limited																			
Coltness Iron Company Limited																			
Dickson and Mann Limited																			
Dunlop [James] and Co. Limited																			
David Colville and Son Limited / Colvilles Limited											N			N	N		N	CB	
Smith and McLean Limited																			
Beardmore [William] and Company Limited																			
Scottish Tube Company Limited																			
Stewarts and Lloyds Limited												CB							
Lanarkshire Steel Company Limited																			
Palmers Shipbuilding and Iron Company													L						
Steel Company of Scotland Limited																			
Scott [Walter] Limited														L					
Hill [Richard] and Company (1899) Limited																			
Pather Iron and Steel Company Limited																			
Scottish Iron and Steel Company Limited																			
Spencer [John] & Sons Limited																			
Summerson [Thomas] & Sons Limited																			
Steel Developments Limited																			
Weardale Steel, Coal and Coke Company Limited					FR														

38

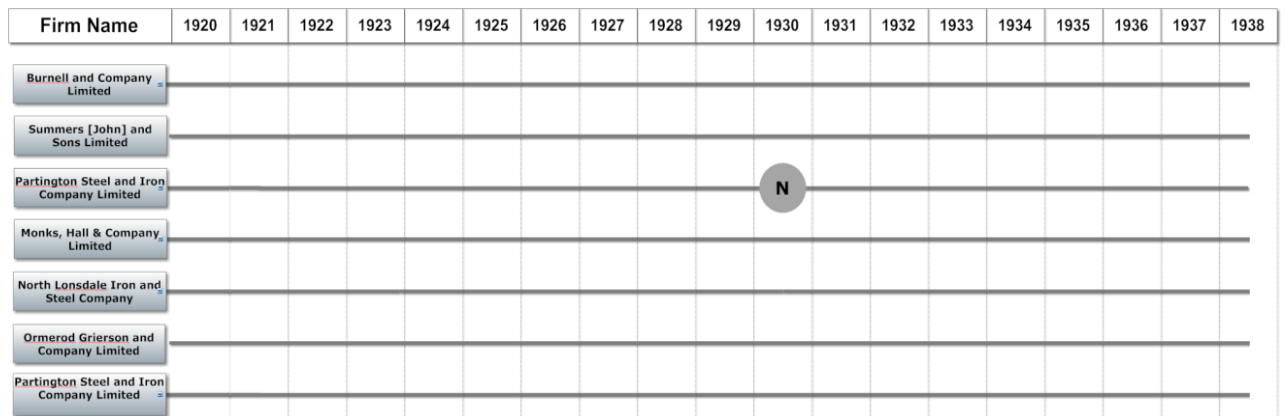## Map A.2: Consolidation map for Sheffield and Yorkshire

Map A.3: Consolidation map for South Wales and West Midlands

Map A.4: Consolidation map for South Wales and West Midlands

Map A.5: Consolidation map for South England

Firm Name	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Ashton Vale Iron Company Limited																			
Channel Steel Company Limited																			
Chesterfield Tube Company																			
Churchill Machine Tool Company Limited																			
Frodair Iron and Steel Company Limited																			
London Foundry Company Limited					L														

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