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Manufacturing 1871-81**

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By James Foreman-Peck¹ and Leslie Hannah²

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Abstract

We analyse a new dataset of 483 manufacturing firms in 1881 either that employed at least 1000 or had done so a decade earlier. Among these firms the majority were partnerships, but public corporations attained higher capital/ labour ratios and stronger employment growth than other business forms. The divorce of ownership from control was most effective where it was most thoroughly practised, as by public, in contrast to private, corporations. Engineers were frequently encountered in all business forms and associated with expanding employment. But the large public manufacturing corporations employed almost twice the proportion of engineers and professionals in top management as other enterprises. We find that family firms, proxied by heirs, were present in management of three quarters of partnerships but in only one third of public corporations, and did indeed reduce the employment growth of the firm, whereas engineers boosted it by more. Lords, mayors and landed wealth in management were also associated with faster employment growth of enterprises. These results suggest some stereotypes in the literature need to be more precisely defined or seriously questioned.

Keywords: Business performance, corporations, partnerships, manufacturing, engineers, Victorian economy

Business Forms and Business Performance in UK Manufacturing 1871-81.

The UK was the first industrial nation but no longer so clearly a leader by the late Victorian period. Most recent discussion on the strengths and weakness of the manufacturing economy of those years has focussed on publicly quoted businesses and their managers.³ Some of these were closely held, family firms or partnerships, often accused of being responsible for supposed British economic decline⁴ Victorian industrialists in these enterprises allegedly diverted their energies into country estates and their gentrification.⁵ These generalisations, when not covering public corporations, are based on case studies or small samples⁶. A new database of all large British manufacturers employing 1,000 or more employees in 1871 or 1881⁷ provides sounder evidence. We show that among the largest manufacturing businesses in 1881 the most common legal form of enterprise was the unquoted partnership not the public corporation. Yet these have not received the attention of public corporations, that Shannon⁸ criticised for a high failure rate. We find that family firms, proxied by heirs, present in management of three quarters of partnerships but in only one third of public corporations, did indeed reduce the employment growth of the firm.

³ Acheson, et al. 'Corporate ownership and control'; idem, Corporate ownership, control and firm performance; Aldous et al., 'Was Marshall Right?'

⁴ Aldcroft, 'Entrepreneur'; Chandler, *Scale*; Lazonick, *Organization and technology*; Levine, *Industrial retardation*; Wilson, *British business history*, pp. 117-8.

⁵ Wiener, *English culture*.

⁶ For example, Chandler (Scale, p242) focussed on Cadbury and Imperial Tobacco for his account of the shortcomings of British business. Cadbury was too small to enter the present data set and the British firm, (also too small to be in the employers of 1000 or more in 1881 or 1871) that was to become Imperial Tobacco, subsequently, was sufficiently speedily innovative to obtain the first licence for the fundamental Bonsack cigarette machine (Alford, *Wills*, p170), ahead of Duke's American Tobacco, which Chandler's case study grossly mischaracterises (Hannah "'Whig fable.'')

⁷ On our source, the British Business Census of Entrepreneurs and its enhancement, see Hannah and Bennett, 'Large-sale Victorian manufacturers;', the population of which is here supplemented by 45 other firms, which employed 1,000 or more in 1871 but fewer than that by 1881 A full list of the firm names with all their data used later in this article is available on request. See also Appendix A.

⁸ 'The Limited Companies of 1866-1883.'

Of the manufacturing firms in our population in 1881 only one quarter were widely held public corporations. Nine percent were, in effect, private companies, by the legal definition current from 1907 (had no more than 50 shareholders nor a public issue). Even so the UK had substantially more corporations per capita than most European countries and, though fewer than the US, a higher portion of UK companies were listed on stock exchanges.⁹

In the decade after 1871 the largest public corporations in British manufacturing increased in number and mean sizes at the expense of partnerships¹⁰. These public corporations attained higher capital labour ratios than other types of business, reflecting cheaper access to capital and achieved stronger employment growth (when a range of controls are utilised), relative to partnerships, private corporations, and sole traders.

Most large manufacturing businesses in whatever legal form derived some advantage from human capital in top management, by employing graduates and a substantial proportion of engineers. With these, and also when the enterprises were vertically integrated outside manufacturing, they grew employment faster. But large public corporations employed almost twice the proportion of engineers and professionals in top management as other enterprises. They were therefore likely to be better managed and grow faster. Even so, after controlling for human capital, public corporations expanded employment faster than other types of big firms. The large closely held manufacturing corporations did not match the employment growth of public

⁹ Hannah, 'Corporations in the US and Europe 1790-1860;' idem 'A global corporate census 1910.' There is no reason to believe 1871-81 differed from 1860 or 1910.

¹⁰ In British English, the term corporation was more commonly used of municipal bodies than business firms ("corporation stocks" on the LSE were municipal bonds). We adopt the common American usage of the term "corporation" here as a synonym for what in British English was more fully described as the joint stock limited liability company. Simply using the word "company" would fail to distinguish such entities from the many UK (and some US) companies that were unincorporated partnerships.

corporations; their performance reflected the weaker divorce of ownership from control than in public corporations. Although the management of private corporations had five times more landed wealth than average, there is no direct evidence that management interest in landed wealth discouraged employment growth in any business type. On the contrary the indications are consistent with resources flowing from land to manufacturing business.

In the following section we outline the distribution and evolution of different legal forms of large manufacturing enterprises in 1871-1881. Next the categories are considered in more detail to explain the pattern of change. We examine the human capital in management teams of these large firms and then the characteristics and distribution of founders, family managers and professionals. Having established the different characteristics of legal forms of enterprises in the period we assess whether these stimulated or permitted different behaviours. Finally, we quantify and test the alleged nepotism of the family firm and the power of landed wealth that have been at the root of many criticisms of the late Victorian economy.

THE STAGES OF CORPORATE EVOLUTION

Output growth required, and legislative change facilitated, shifts in organisational and legal forms by large British manufacturing firms. Sometimes sequential, the possible forms were sole proprietorship > family > partnership > private company > public company, and usually later > multidivisional/ international. Across the British economy at any time firms were in different stages of this notional progression. Transitions by 1881 were generally in the anticipated directions.¹⁵ of the 52 sole traders of 1871 were partnerships by 1881, 28 of the 328 partnerships of 1871 were private corporations in 1881 and 32 were public corporations, while 12 of the 23 private corporations of 1871

were public corporations in 1881 (Table 1). However, of 72 public corporations in 1871 none had reverted to private corporation or partnership form in 1881, though one (James Shaw) had reverted to sole trader and one was municipalised; another company, Merry & Cunninghame (a long-established Scottish coal and iron giant), recorded in the table as a partnership in both years, had incorporated and gained a stock exchange listing during the decade, but reversed this by 1881. The reason for both (market) exceptions were similar and clearly demonstrated how not to go public. In order to unload their shares on the public at IPO, the owners had guaranteed 10% annual dividends on the ordinary shares, notionally removing the downside risk for new public holders while leaving them, absurdly, with all of any upside. This unequal bargain proved unsustainable: the former owners refused to honour their guarantees when profits fell in the 1870s depression, but offered instead to repurchase the firm. Hence both public companies' temporary¹¹ reversion to partnership or sole proprietor status by 1881, depended on whether one or more guarantors (or other intervening venture capitalists) acquired control during the fraught default discussions.

Table 1 Manufacturing employers with 1000 or more employees in 1871 and 1881

| | | 1881 | | | | | Total |
|------|---------------------|-------------|-------------|------------|---------------------|--------------------|-------|
| | | Sole trader | Partnership | Government | Private corporation | Public corporation | |
| 1871 | Sole trader | 29 | 15 | 0 | 5 | 3 | 52 |
| | Partnership | 10 | 258 | 0 | 28 | 32 | 328 |
| | Government | 0 | 0 | 5 | 0 | 0 | 5 |
| | Private corporation | 0 | 0 | 0 | 11 | 12 | 23 |
| | Public corporation | 1 | 0 | 1 | 0 | 73 | 75 |
| | Total | 40 | 273 | 6 | 44 | 120 | 483 |

Source: our database.

¹¹ The firms were more sensibly refloated to the public in 1889 and 1891.

Thus the proportion of organisational forms changed among the manufacturing firms employing 1000 or more, as Table 1 shows. In both years, partnerships were most frequent but both types of corporations were increasing their share strongly at the expense of partnerships. Government and municipal entities in the large manufacturing employer category also increased slightly. All these governmental entities had access to bond finance (whether through central government or municipal issues) on stock exchanges, and/or to tax revenues.¹²

Family firms were not a well-defined category because there was no clear dichotomy between family ownership and professional management in nineteenth century Britain. Families hired professional managers and professional managers (and their sons) bought or negotiated ownership stakes or profit-related bonuses from established families. Thus, a family firm might be a family-only partnership, or it might admit outsiders as partners. The average age of our 483 manufacturing firms in 1881 was around 50 years, which implies typically they existed for around a quarter century of life before general incorporation legislation¹³. Inevitably - given the nature of capitalist ownership - they were initially structured around partners and their families, with a legacy in 1881 of inherited business. But the shift from the traditional forms to the greater efficiency of joint stock companies was rapid – by other countries' standards - and professionalisation was proceeding apace. In the 1881 US, by contrast, major manufacturers such as the Du Ponts, Carnegie, and the owners of Baldwin Locomotive, Standard Oil and Singer Manufacturing were still far from their future NYSE listings. On the rate of change of business form for the large firms we

¹² Usually London. Glasgow Gas was an exception being only locally listed; Manchester and Birmingham Gas had securities listed both locally and on London. Municipalities could go bankrupt or have some assets foreclosed by quoted bondholders.

¹³ Thanks to Peter Solar for help with this calculation.

measure between 1871 and 1881, partnerships and sole traders fell by about 15% of the total, being replaced by corporations. Extrapolating this rate forward, as suggested by the rising numbers of new incorporations and public offerings of shares, it would be seriously misleading to describe British manufacturing industry by the beginning of the twentieth century as Chandler's 'family capitalism,' based on partnerships, sole proprietorships and private companies allegedly unwilling to admit outside shareholders and professional managers.

PARTNERSHIPS

With a small number of owners, partnerships might reduce the agency problems of widely held joint stock enterprises, though perhaps with limited managerial skills pools. Partnerships were prohibited from having more than twenty partners (exceptionally banks were legally restricted to eight). Partnerships with more partners were required to incorporate (usually registering under the Companies Acts) even if they did so with unlimited liability. Some partnerships, though not registered, remained in place despite their excess partner numbers. Mutual trust within families or between long-standing colleagues facilitated such arrangements. Moreover, since the 1865 Partnership Act, liabilities of sleeping partners who shared profits, rather than making fixed-interest loans, could more securely be limited¹⁴.

Unfortunately, partnership agreements are normally only accessible if they are preserved in firm archives. However, Scottish agreements in the Register of Deeds

¹⁴ The *Economist* predicted the 1866 extension of limited liability to sleeping partners would be a "dead letter", if not accompanied by publicity requirements similar to the Companies Acts or continental *commandites*, (16 August 1866 p. 94). Arguably it was: the private limited company was much preferred as a contractual form perhaps because it limited the liabilities of active managers as well as passive investors.

show examples of managers being offered a 5% share of profits to acquire a capital interest.¹⁵

A potential problem of partnerships was the succession, which could require some legal and managerial ingenuity. Normally liability ceased with death unless agreed otherwise: as in some deed of settlement partnerships and other ad hoc cases. When the last surviving partner in the large Sheffield coal and iron firm, Newton Chambers & Co, died in 1869 during a long, bitter strike against a wage reduction, the executors decided to continue operating under the 1863 partnership agreement. The company recovered under George Walker (managing on behalf of the widow and sons), incorporated and made a public issue twelve years later in 1881. By then the firm had achieved a greater output and employed 3,500 with wages 57.5% higher.

By contrast, James Edward, proprietor of A D Edward & Co – a Dundee flax manufacturer returning 1,700 employees in 1871 - failed to ensure orderly succession when he died in 1876 and his executors were less successful than Walker. They closed the Logie Works, laid off all employees and struggled for more than a decade to realise some value by leasing or selling the properties. They retained physical assets, but they lacked organizational capabilities and were no longer a significant employer by 1881.¹⁶ Failure to address a partnership's problems of succession might raise the cost of capital and reduce the prospects for enterprise planning.

¹⁵ Morgan and Moss, 'Listing the Wealthy.'

¹⁶ Dundee Courier 10 March 1879, 2 October 1882, 4 October 1888. The *Scottish Dictionary of Business Biography*, says the firm was the third largest in Dundee, employing 2,500.

Some partners were possibly less interested in expansion than were corporations. Those in brewers Whitbread at their 26 July 1866 meeting were divided between family members loath to expand the capital and internally promoted professional partner families advocating growth.¹⁷ It is unlikely that partnerships failed to convert to corporations because of unfamiliarity with the corporate form. The norm was for one (or more) partners in our firms to have considerable experience as shareholders - indeed often as directors - in publicly-quoted businesses, usually a local bank, insurance company, railway and/or gas/water utility.¹⁸ The likelihood then is that management preferences, rather than knowledge limitations, were decisive in determining choices of enterprise form.

CORPORATIONS

Before the 1907 act clearly defined it, the term “public company” was widely used to mean one with a public share issue and/or with numerous equity holders. However, it was sometimes more narrowly construed to mean statutory companies (typically railways, tramways, gas companies), formed by private act of parliament, rather than registered under the Companies Acts.¹⁹

The rising proportion of corporations is in keeping with a growing recognition that they were superior to other ways of organising big business in providing entity shielding and perpetual succession, attracting and locking in both capital and professional managers.²⁰ Access to stock markets may have reduced their capital costs. The 1855 facilitation of limited liability by simple registration and its

¹⁷ Ritchie, *An Uncommon Brewer*, p. 63

¹⁸ As shown by Skinner's *Directory of Directors* (1881) entries for all our identified partners and sole proprietors.

¹⁹ See the 1866 Bill to alter and improve the Law relating to voting in Public Companies, Second Reading, <https://hansard.parliament.uk/Commons/1866-04-18/debates/2e45b22f-4f46-4f39-b014-d429f5eb3539/SecondReading>.

²⁰ Blair, 'Locking in capital.'

consolidation in the acts of 1856 and 1862 – for the average large firm at about one-tenth of the former cost - accelerated adoption in the next generation, particularly for the modestly-sized. A majority of the top 100 manufacturing employers were already incorporated by the 1881 census, though partnerships still dominated lower down; and were even more dominant among firms employing fewer than 1,000.

Yet some contemporaries noting the high failure rate of new limited companies still could decry the advantages of corporations.²¹ Merry & Cunninghame, a Scottish coal and iron company with £850,000 paid-up capital and 4,535 employees, was one of only two of our companies actually reversing incorporation and stock exchange listing. In 1875 the enterprise gained the reluctant consent of hundreds of shareholders to repurchase by managers as a private partnership.²² The mean employment growth of the two reversing companies was 9 percent compared with 26 percent growth for those who switched to public corporations and 22 percent for our companies in total. Hence, as Table 1 shows, by 1881 the direction of travel in the late Victorian economy was generally from partnership to public company, wider shareholding and stock exchange listing, though the pace of movement varied.

PRIVATE CORPORATIONS

The distinction between private and public companies was not statutory until the 1907 Companies Act. Then all existing registered companies were by default classified as public (and legally required to publish balance sheets) unless they declared no more than fifty shareholders and no public share issue. The distinctive nature of private

²¹ Shannon, 'The Limited Companies of 1866-1883.'

²² Some former partners and managers guaranteed shareholder dividends of 10% and were unable or unwilling to redeem that guarantee in the 1870s slump. The Sheffield steelmaker, Brown Bayley Dixon, made a similar mistake, but in that case its 1880-82 voluntary liquidation and reconstruction resulted in a new incorporation.

companies had long been recognised de facto; we have applied the 1907 definition retrospectively in separating public companies from private ones on the census days of 1871 and 1881, though the distinction was then merely conventional.

One characteristic of the UK corporate form was the exceptional ability of private limited companies to mimic features of partnerships while avoiding some of their liabilities and inconveniences²³. Consequently between 1871 and 1881 they were numerically the fastest growing of our categories (Table 1). Until 1900 there was no requirement for private companies to expose their finances (other than the size of their share capital) to public gaze. They could raise capital privately or on the stock exchange without losing control by the existing ownership. Illustrative is medical supplier Southall Bros & Barclays' 1898 share issue and incorporation, ensuring the Southall and Barclay families continued to hold all voting rights.²⁴

In 1881 27 percent of our large manufacturing (public and private) corporations were private. Intermediaries advertised that incorporation facilitated but did not necessarily require divorcing ownership from control. Some standouts maintained the personal liability of partners was superior. James Templeton, the Glasgow carpet manufacturer who returned 1,120 employees in 1881, passionately denounced limited liability companies, especially public ones. He asserted that all the alleged advantages of private companies could be achieved by the right partnership contracts²⁵. Johnson²⁶ suggests private corporations had a propensity to impose unconscionable costs on innocent third party creditors. Control could be maintained with dummy shareholders,

²³ Given this flexibility Guinnane et al ('Putting the corporation in its place') overstate the importance of separate legal forms such as the German GmbH or French SARL, while underrating the ubiquitous acceptance of de facto private companies in Britain before they received formal legal recognition in 1907.

²⁴ Foreman-Peck, *Smith & Nephew*, pp. 30-31.

²⁵ Glasgow Herald 31 May 1898

²⁶ Johnson, *Making the Market*, (pp. 103–233)

bypassing the legal requirement of an initial seven shareholders. Full or part-time company secretaries and accountants experienced in auditing were readily hired, solicitors developed a lucrative side-line in drawing up corporate articles of association, while specialist agents, like London's Jordan & Co, offered streamlined registrations. With compliant fellow-directors, owners could obtain limited liability - and the right to issue debentures to provide more acceptable collateral for a private or bank loan - while retaining full de facto control. Partible shares enabled the giving or selling of participation to heirs, relatives, or senior managers without the disruption and expense of a new partnership agreement with every change. These private conveniences may have rendered the closely held private corporation less beneficial for the British economy than the public corporation. In the financially decentralized US, informally traded shares not listed on major national exchanges were more common than in the UK and possibly were competently supervised locally²⁷. However, financial econometricians have recently demonstrated that there may have been distinct advantages to firms submitting to the demanding listing requirements of a formal exchange such as London's.²⁸ Rutterford and Hannah²⁹ have also shown the effectiveness of British shareholders' committees of investigation in overcoming agency and free rider/rational apathy problems and holding directors to account for poor performance.

MANAGERIAL HUMAN CAPITAL AND MANAGEMENT TEAMS

Firms of 1000 or more employees were not generally run exclusively by one individual, but by a team – or by managerial hierarchies. Ideas on the manageable

²⁷ See for example Lamoreaux et al ('Financing innovation') on Cleveland.

²⁸ Fjesme, Galpin and Moore, 'British IPO directors;' 'An efficient market?;' 'Rejected stock exchange applicants;'; Fjesme, Hannah and Moore, 'Informed investors, screening and sorting.'

²⁹ The unsung activists.'

average number of subordinates to superiors have changed, possibly because information processing machinery has now reduced the demand for middle managers. In 1881 lower managers (overseers and foremen) might supervise dozens, so a firm employing 1000 in total might have as few as 20 at that level. Graiciunas³⁰ theorised that a manager should not have more than five direct subordinates, which would imply at least four middle managers in a firm employing 1000, with 20 lower managers. From 1928 the director of the International Management Institute in Geneva, Lyndall Urwick, stretched that to 6, drawing on military experience. In senior management especially, relations with subordinates and duties are more complex and not reducible to arithmetic ratios. But in firms employing 1000 we sometimes found only two partners in senior active roles, so the total managerial personnel at all levels in such firms might be only 25/26. In larger partnerships, like Salts of Saltaire, with 3,200 employees in integrated worsted and alpaca spinning/weaving, there were, just before they incorporated privately in 1881, hundreds of managers.³¹ It was quite normal for lower managers or foremen to be promoted to higher positions where their local knowledge trumped the possibly wider experience of external recruits. Joseph Armstrong (1816-77), after apprenticeships to various engineers, eventually rose to become responsible for employing 12,900 in operations and manufacturing in our period in all GWR railway workshops³².

We have defined the top managerial team to be ideally at least two for the smaller firms and no more than six for the larger³³. Scaling to treat all possible determinants

³⁰ Graiciunas, *Relationship in Organization*.

³¹ Reynolds, *The Great Paternalist*, p. 285

³² Institution of Civil Engineers 1877 obituary in Grace's Guide. Our statistics include only employees in manufacturing.

³³ Though the number assessed also depends on the availability of information for some relevant individuals. A very few firms are represented by only one sole proprietor, even though we know the person is likely to have had some managerial help. www.getflow.com/blog/optimal-team-size-workplace-productivity. '5 person teams find the balance between members and communication

of performance equally, we assume a firm with two engineers among four assessed persons is as “engineer-intensive” as a team of two with one engineer. For partnerships the focus is on senior partners and/or those with large shares. For corporations it is typically the chairman and his deputy or the managing director. Occasionally a director identified as a dominant shareholder and sometimes a senior manager in none of those roles is chosen: for example, the locomotive superintendent responsible for a railway workshop; or a manager, said to run the company while the senior partner was away as, say, an MP or government minister in London.

Chartered accountants have been described as Britain’s “priesthood of industry” in the late 19th and 20th centuries, providing auditing, liquidation, consulting and management services.³⁴ There were Scottish and regional English self-regulating accountancy bodies before the Institute of Chartered Accountants of England & Wales received its royal charter in 1880. Our firms include many accountants as directors, managers and partners but in 1871-81 it would be more accurate to describe engineers as the industrial ecclesiasts: they outnumbered accountants/bookkeepers in our population of business leaders by four to one. Some broader literature suggests this would have stimulated growth, praising engineers as increasing the economic pie, while stigmatising lawyers, accountants and their like as mainly concerned with dividing it.³⁵ It is not hard to identify Victorian lawyers and accountants thirsty for profitable business growth, but our findings are consistent with the more positive interpretation of engineers.

connections’ and ‘When asked for their optimal team size, experts usually settle somewhere on the low end of 4-20.’

³⁴ Matthews et al. *Priesthood of Industry*.

³⁵ Murphy et al. ‘Allocation of Talent.’

By the middle of the nineteenth century, engineers constituted around 20 percent of all *Oxford Dictionary of National Biography* noteworthy individuals associated with science or technology³⁶ and were the most prominent patenting occupational category then and into the twentieth century³⁷. 39 percent of the engineers in our 1881 manufacturing leader population were in public corporations, though public corporations themselves were only one quarter of the total number of our enterprises. One third of engineers in our population were in the industrial category of coal, iron and steel and almost half in four other categories: shipbuilding, railway engineering, other engineering and machinery. By contrast the 90 cotton textile firms (the second largest sector by number of large enterprises) employed only four percent of our engineers. This may be because, unlike iron and steel, by now the textile industry had lost its position at the cutting edge of technology³⁸, or simply because the textile machinery industry was sufficiently well established and innovative to provide solutions by trained installers without textile management's technical input.

Engineers, like accountants, showed versatility in spreading managerial ideas from successful firms through interfirm and inter-industry mobility and consulting.

Alexander Carnegie Kirk (1830-1892), was manager of a major Clyde shipyard's engine works in 1874. His earlier career began with being apprenticed to Napier (a pioneer Clyde shipbuilder), then he served as a draughtsman for six years with Maudslay, Sons and Field (in London precision engineering), subsequently he was manager at Young's paraffin oil and chemical works for nearly six years, next he was manager to James Aitken & Co, and then he came to John Elder's³⁹.

³⁶ Hanlon, 'Rise of the engineer.'

³⁷ Bergeaud and Verluise, 'A new dataset.'

³⁸ Mokyr, *Lever of Riches*, p. 143.

³⁹ https://gracesguide.co.uk/Alexander_Carnegie_Kirk. Napiers was a leading light in Clyde shipbuilding at the Vulcan Foundry Glasgow.

Many self-identify as engineer in census returns, while others have been identified as members of the Institute of Mechanical Engineers, the Institution of Civil Engineers or smaller societies of gas or telegraph engineers etc.⁴⁰ Until around the 1880s typically, membership of such institutions was not by examination at the end of training, but from mid-career peer assessment of the railways or bridges built or steam engines made.⁴¹ 40 percent of our firms recorded at least one engineer in their top management team. Gourvish⁴² finds similar professionalism in his study of the general managers of British railways (whose manufacturing workshops are also included in our population). There were more than six times as many engineers in our top management teams as lawyers, which should have been good for economic growth according to Murphy et al.

The great majority of these top managers left school aged 14-16. Then, they either took a job (often a pupillage or premium apprenticeship with fees) or went to university (often at age 15-17 with graduation before 21) or joined the family firm. Kirk probably paid a substantial fee for his premium apprenticeship training at Napiers (after an Edinburgh University arts degree and evening study at Leith Mechanics Institute) but by 1877 he had returned to Napiers as a senior partner. Very few top managers went to (generally free) board schools or their own factory schools. Also, not many went to “public” (ie elite fee-paying) schools. Those that did, favoured Harrow and Rugby more often than Eton. Commonly top managers went to local grammar schools (then fee-paying mainly), but the dominant description in obituaries was “privately educated”. This was usually not home tutoring but a small

⁴⁰ From mention in obituaries from those institutions in Graces Guide substantially, not from full institute membership lists.

⁴¹ Guagnini, A, ‘World part: academic instruction and professional qualifications.’

⁴² ‘A British business elite.’

proprietary school (some boarding) run by a teacher with a reputation among local bourgeois networks. Some explicitly offered commercial subjects and or science/maths, as well as classics.

The dominant position in the literature is that all universities were better than no university, and they are sometimes implicitly ranked: continental European best, provincial or London UK next and Oxbridge worst.⁴³ In some cases, our managers attended university without graduating but it is not always possible to tell and our measure is minimally a record of attendance, though frequently with evidence of graduation. Many future managers were sent as juveniles to France or Germany for some secondary or tertiary education, industrial/mercantile experience or to learn the language for commercial or other purposes. Most UK businessmen had not been to university. Up to 1886 64.2% of Oxbridge graduates became clergymen and only 0.6% businessmen.⁴⁴ It is therefore perhaps surprising that in the present sample 15% had attended Oxbridge, if less so that 19% attended other UK universities⁴⁵. These percentages compare with the later but similar US figure of 39% for about 300 CEOs with university education in 1900.⁴⁶ In both cases the group is mainly second and third generation businessmen, who were given options only available to an elite.

FOUNDERS, HEIRS AND PROFESSIONALS,

The managerial top team could consist of founders, heirs and/or “professionals” (by which we mean all others: internal promotions or external recruits). There are totals of 483 firms and 1,666 individuals running them, with a mean of nearly 3.5 leaders per

⁴³ Chandler, *Scale*, p. 293; Pollard, *Britain's Prime*, pp. 182-188.

⁴⁴ Anderson and Schnaper, *School and Society in England*.

⁴⁵ Honorary degrees were common but not counted by us as degrees.

⁴⁶ Newcomer, *The Big Business Executive*.

firm, hardly consistent with Chandler's,⁴⁷ 'personal capitalism' classification of British business. There are also fewer founders (223) than heirs (629) or "professionals" (814). All individuals are identified by one of these three labels. In this classification we have tried to follow economic not legal realities. In practice most partnerships were founded by existing partners since each change of partner was legally, but not in economic terms, a new firm. Also, it is not always clear whether a son merely followed his father in the same firm or essentially transformed it. Someone with the same surname as a founder might be a professional not an heir: for example, a nephew recruited because of his skills and with no expectation of inheriting (though where distant relatives *have* inherited, they are classed here as heirs). Public companies were not invariably managed by professionals. Where a founder of a firm converted to a public company, remaining a large shareholder and chairman or managing director, they are here counted as a founder. A sole proprietor is not necessarily a founder or heir: the individual may have been recruited as a professional and provided with a form of management buy-in, enabling the paying off of the founders' heirs out of profits.

Table 2 Business Forms and Management in 1881

| | Founder | Heir | Professional | Total top | Employees | Management intensity |
|---------------------|---------|------|--------------|-----------|-----------|----------------------|
| Private Corporation | 1.16 | 1.59 | 1.68 | 3.77 | 2098 | 556 |
| Public Corporation | 1.34 | 0.63 | 3.23 | 4.21 | 2611 | 620 |
| Partnership | 1.33 | 1.64 | 1.03 | 3.22 | 1734 | 539 |
| Sole Trader | 1 | 0.87 | 1.49 | 2.56 | 1765 | 689 |

Note: Average number of top management team per firm by institutional form in manufacturers employing over 1000 in 1871 and/or 1881. Management intensity is average employees/total top management team

⁴⁷Chandler, *Scale*, p. 286.

As Table 2 shows there were fewer founders among sole trader leaders than in any other of the business forms.⁴⁸ Private corporations contrasted with public corporations in their lower number of professionals in the top management team and the greater likelihood of including an heir (Table2). Partnerships had the smallest number of professionals among their leaders and the greatest number of heirs. For the paucity of professionals, the average size of the enterprise cannot be the whole explanation because partnerships averaged similar employee numbers to those of sole traders. Table 2 implies public corporations were less management intensive (620 workers per manager), than sole traders (689 workers per manager),⁴⁹ perhaps a reflection of the effectiveness of the greater proportion of professionals in public corporations.

PERFORMANCE

It is apparent that enterprise legal forms had different characteristics, but did these stimulate or permit different behaviours? The widespread diffusion of commercial knowledge might imply that entrepreneurs and firms, knowing all the options, chose their business form to optimise profits, efficiency and growth so that enterprise form at the date we observe made no difference to profits, efficiency or growth; no entrepreneur or manager could improve performance by operating with a different form.

⁴⁸ Perhaps counter-intuitively: but note that sole traders could be former partners who had not replaced deceased or retiring founding partners or managers who had bought control from sole traders, partners or their heirs. Sometimes they bought with leveraged loans from family owners or others, akin to modern management buy-ins.

⁴⁹ This suggests we have not been misled by the better availability of leaders' names for public corporations to have overestimated their top team size.

Alternatively, entrepreneurs and managerial teams had diverse objectives and managers and entrepreneurs who wanted an easy life would cluster in forms that did not drive them harder than they wanted, so some forms will be associated with less strong growth. Then we would expect to find public corporations, working on behalf of shareholders, performing more strongly than partnerships, at least if agency problems were avoided. In this respect private corporations would be an intermediate case, between partnerships and public corporations. Sole proprietors' policy would be least constrained by the enterprise form but perhaps most constrained in their management capacity.

Since we lack output data for all this population, we approximate it by employment. In a competitive economy like Victorian Britain in 1871-81 the growth of a firm's employment is a fair indicator of sales growth and therefore of competitiveness. Labour productivity is unlikely to decline, therefore output growth is usually equal to, or greater than, employment growth. Table 3 shows partnerships and sole proprietors in the largest manufacturing firms expanded most slowly- perhaps being least able to cope with large scale management. Despite the 1881 distribution (more than double the partnerships than public corporations), there was greater 1871-1881 total employment expansion of public corporations (62,000 as against 56,000)⁵⁰.

Table 3 Large Manufacturing Business Performance 1871-1881

| Status 1871 | Employment Growth 1871-81 | £ Capital per employee (1881) |
|---------------------|---------------------------|-------------------------------|
| Private Corporation | 9% | 166 |
| Public Corporation | 17% | 261 |
| Government | 11% | 749 |
| Partnership | 11% | 91 |
| Sole | 3% | 88 |

⁵⁰ 119 public corporations in 1881 with a mean increase 1871-81 of 522 employees compared with 274 partnerships in 1881 on average increasing employees by 205.

Government employment growth in government-owned manufacturers and their high capital-labour ratio reflected primarily the performance of municipal gas enterprises and the royal dockyards. The two capitalist corporation forms differed in their growth rates and their capital per employee, most likely because ownership was more divorced from control in the public corporation. The private corporation employment growth rate was even less than that of partnerships.

The capital-labour ratio was higher for public corporations as would be expected if stock market finance cost less than other forms. But characteristics may have differed simply because the enterprise forms were not distributed randomly over industries: if public corporations were concentrated in the largest, capital intensive sectors, the high capital-labour ratios could be due to industry type rather than business form. The difference in growth sample means of corporation and non-corporation status does not necessarily indicate the effect of the corporation. Therefore, the regression analysis of Tables 5-7 is undertaken to control for industrial structure and other influences.

Table 4
Percentage employment growth of large manufacturing enterprises by management team

| | Heirs | Founders | Professionals | Engineers |
|------|-------|----------|---------------|-----------|
| Some | 17 | 30 | 22 | 30 |
| None | 32 | 18 | 22 | 18 |

Note: "Some" and "None" refer to firms with management categories listed along the top,

The family firm is rarely precisely defined but might be approximated by the presence of heirs in the total team and contrasted with (presumably dynamic) founders.

Measuring their performance by employment growth in the descriptive statistics of Table 4 heirs are indeed on average a drag on growth; enterprises with some heirs in management grew their employment on average by 17% whereas those with no heirs grew employment by 32%. Founders in management - 30% employment growth

compared with 18% growth for those with no founders - confer a boost. Professionals in total, appear to exercise no effect but some of them (engineers) do.

We hypothesise that legal status influenced the firm's capital-labour ratio; raising capital was cheaper with public corporation status. The regression model to test for the impact of legal form on capital-labour ratio (Table 5 equation 1) controls for industrial structure (18 types of industry). Equation 5.3 tests whether quotation on the London stock market and scale effects, measured by employment size, were additional significant determinants of the capital-labour ratio, independent of enterprise legal form. Also, the variable 'founders' in equation 3 might be expected to be a negative influence on capital if founders did not wish to lose control of equity.

Table 5 Log Capital-Labour Ratio 1881 OLS Regressions

| | (5.1) | (5.2) | (5.3) |
|----------------------|--------------------|--------------------|--------------------|
| Private Corporation | -0.0969 (-0.77) | -0.0980 (-0.78) | -0.0982 (-0.78) |
| Public Corporation | 0.268*** (3.65) | 0.238** (3.06) | 0.238** (3.05) |
| State | 0.215 (0.37) | 0.124 (0.22) | 0.133 (0.24) |
| Sole | -0.0730 (-0.51) | -0.0753 (-0.52) | -0.0725 (-0.50) |
| London Stock market | | 0.125 (1.21) | 0.129 (1.21) |
| Employees1881 (size) | | | -0.0271 (-0.12) |
| Founder | | | 0.00477 (0.09) |
| N | 306 | 306 | 306 |

| | | | |
|------|-------|-------|-------|
| r2_a | 0.376 | 0.376 | 0.372 |
| r2 | 0.419 | 0.421 | 0.421 |

Note: Robust t statistics in parentheses. Industries and constant included but not reported. Base industry coal, iron and steel. Partnership is the base business comparison. ** p<0.01, *** p<0.001.

Assuming exogeneity, public corporations averaged 31 (=100 (exp(0.268)-1)) percent more capital per worker than partnerships or other business forms in equation 5.1⁵¹.

This is consistent with public corporations giving better access to capital. The variable ‘founders’ was statistically insignificant when added to the regression, as was size and London stock market finance.⁵²

To assess what the public corporation coefficient might mean, suppose we could represent manufacturing production with a constant returns to scale Cobb-Douglas production function. Then a 31 percent rise in the capital labour ratio, comparable to the above magnitudes for public corporations, with a capital coefficient of 0.33, would increase labour productivity by ten percent, other things being equal. When combined with our estimates of employment growth the greater relative output could be substantial⁵³.

Adverse shocks affect firms differently by size so a control for enterprise size must be added to estimate the influences on employment growth of enterprise form. As part of the process of creative destruction, smaller survivors will tend to be faster growers than larger enterprises that can absorb more mistakes (deeper pockets), or missed opportunities, and remain in business. Larger firms may also be closer to managerial

⁵¹ For the calculation see Halvorsen and Palmquist, ‘Interpretation of dummy variables.’ Appendix B shows attempts to relax exogeneity assumptions do not change the conclusions of the simpler approaches.

⁵² The latter may simply be because closer regional stock markets like Manchester or Glasgow were a favoured substitute for distant London among many industrialists; fewer of our firms operated in southern English counties than in Scotland or Lancashire

⁵³ $\log(Y/L) = \log A + \alpha \log(K/L)$ where α is the output elasticity of capital, Y is output, K is capital and L labour. Suppose greater employment growth over the decade was 15% and labour productivity growth was 9% then relative output growth was 24%.

constraints on growth, given the relative novelty of managerial hierarchies in large enterprises.⁵⁴

We therefore adopt a pseudo-Gibrat specification.⁵⁵ Each firm's employment size this period, and therefore growth rate relative to the previous period, changes according to a random shock. The magnitude and frequency of past opportunities successfully exploited by an enterprise is measured by its current size. A run of positive shocks gives rise to a larger firm and conversely negative shocks create a smaller firm – or an exit.

This survivor bias implies that a dynamic industry population will show a growth rate of firms that is not simply random, dependent on the distribution of shocks, but also is faster the smaller the enterprise. Employment growth as a negative function of size is our basic equation, to which we add institutional, technological and economic features of the firms.

The proportionate growth effect is excluded or is undefined for enterprises that enter or exit during the observation periods. In our sample there are nine firms employing 1000 or more in 1871 and employing zero in 1881, with a total of 14208 jobs in 1871. There are seven firms with zero employment in 1871 but at least 1000 in 1881, with a total 13200 jobs. Three of the nine (apparently) exiting firms in 1871 were sole traders, five were partnerships, one was a private corporation and none were public corporations; public corporations had the most staying power (contrary to Shannon's⁵⁶ concerns) and sole traders the least. The partnerships' proportion of exits

⁵⁴ Booth ('Occupations,' p.336) noted the revolutionary growth in the professional occupations in such hierarchies in 1851-81.

⁵⁵ Sutton, 'Gibrat's Legacy;' Geroski et al. 'Are differences in firm size transitory?'

⁵⁶ Shannon, 'The Limited Companies of 1866-1883.'

was about equal to their share in the 1881 largest manufacturers population. Three of the exiting firms, but only one of the entrants, were founder managed; founder managed firms were 8% of the 1881 sample, broadly consistent with a similar performance to that of partnerships.

Table 6. Employment growth 1871-1881 OLS regressions

| | 6.1 | 6.2 | 6.3 | 6.4 |
|-------------------------|----------------------|----------------------|----------------------|----------------------|
| Private Corporation1871 | 0.225 (1.36) | 0.218 (1.53) | 0.205 (1.53) | |
| Public Corporation 1871 | 0.143* (2.09) | 0.140* (2.11) | 0.146* (2.20) | |
| State | 0.378 (1.37) | 0.265 (0.99) | 0.319 (1.13) | |
| Sole | -0.0114 (-0.14) | 0.000195 (0.00) | 0.00359 (0.04) | |
| Ln. employees1871 | -0.522*** (-8.15) | -0.553*** (-9.38) | -0.573*** (-9.86) | -0.572*** (-9.48) |
| Non-manuf | 0.463** (2.89) | 0.464** (3.13) | 0.425** (3.02) | 0.423** (3.03) |
| Eng.prop. | | 0.434*** (3.75) | 0.396*** (3.68) | 0.412*** (3.63) |
| Chem. Prop. | | 0.523** (2.68) | 0.457* (2.22) | 0.546** (2.79) |
| Sale. Prop. | | 1.285** (2.68) | 1.283** (2.75) | 1.238** (2.78) |
| Oxbridge | | | 0.146** (2.67) | 0.150** (2.64) |
| Other UK univ. | | | 0.0938* (2.11) | 0.0894* (2.04) |
| Date | | | | 0.0000662* (2.29) |
| N | 467 | 464 | 464 | 464 |
| r2_a | 0.424 | 0.468 | 0.482 | 0.483 |
| r2 | 0.452 | 0.498 | 0.513 | 0.511 |

Robust t statistics in parentheses. Industry dummies and constants included but not reported. * p<0.05, ** p<0.01,*** p<0.001. Partnership base case in (1). Public corporations and incorporation date instrumented with 'Professional proportion of top managements' and S and SE region dummies.

Management are assumed to have chosen or accepted their legal form because it was compatible with permitting or causing desired performance objectives. Apart from size and industrial structure that could affect employment growth and need controlling, management skills and personnel might be influences. The extent of

vertical integration out of manufacturing to retail services or extractive sectors may also be relevant.

Consistent with the descriptive statistics of Table 3, the OLS regression of Table 6 equation 1 shows 15 $(=\exp(0.143)-1) \cdot 100$ percent faster employment growth of public corporations relative to partnerships, significant at the five percent level, even when controlling for industry and firm size. The small number of state corporations displayed precocious but not statistically significant employment expansion. In table 6 private corporations did not distinguish themselves from the base case, partnerships, nor did sole traders. Vertical integration was a positive influence on manufacturing firms; we find non-manufacturing employment, as a proportion of manufacturers' total employment, statistically significant. Much of this was backward integration to coal, iron ore and limestone mining by iron and steel firms but some was forward integration to wholesaling in apparel.

Also significant is the variable 'engineers as a proportion of top management', indicating the importance of human capital (equations 6.2- 6.4). Public corporations employed almost twice the proportion of engineers and professionals in top management as other enterprises and therefore can be expected to reap the advantages⁵⁷. But public corporation form remains statistically significant even when the effect of engineers is controlled. Sales and chemist members of top management team also boost employment growth (assuming their exogeneity). No effect was found for bankers, lawyers or accountants in the management group (not reported). However, university graduates in the top team were associated with faster employment growth in manufacturing.

⁵⁷ 75 engineers in 119 public corporations compared with 118 in the remaining 364 firms.

Equation 6.4 uses an alternative measure of the impact of public corporations, the pre-1881 incorporation date. This shows that more recently incorporated businesses achieve a very slightly stronger impact on 1871-81 growth. Public corporations' employment since the 1856 Act grew about 12 percent faster over the decade from 1871 than that of other business forms, rather less than the simple 1871 dummy results which must average the age impact of incorporation⁵⁸.

LANDED WEALTH

The nepotism of the family firm and the power of landed wealth have been at the root of many criticisms of the late Victorian economy. We can test whether business heirs in company management retarded manufacturing growth, but we need to take into account the very high proportion of partnerships with heirs in top management by excluding business legal form from the regression.

The assumption in the literature is that Victorian owners and managers ensured that money flowed from business to land and often retarded the growth of firms and economic development.⁵⁹ Thompson⁶⁰ suggests gentrification may have resulted in successful business people becoming large landowners and therefore being given honorific positions. Others⁶¹ have maintained that there is little evidence from probate records of movement to suggest that wealthy businessmen became substantial landowners). In several cases the reverse flow can be seen; the Duke of Devonshire essentially bankrolled the three Barrow firms in our list using his landed wealth⁶².

⁵⁸ $0.000066*1856=0.123$, $0.000066*1875=0.124$

⁵⁹ Wiener, *English culture*.

⁶⁰ Thompson, 'Life after death.'

⁶¹ Nicholas 'Businessmen and land ownership;' idem, 'Clogs to Clogs in Three Generations?'; Smith, 'Land ownership and social change.'

⁶² In 1873, over 80 per cent of all Devonshire investments were concentrated in Barrow in Furness and some 90 per cent of dividend income came from that source. In that year the seventh Duke probably enjoyed the largest current income of any aristocratic millionaire (Cannadine 'Landowner as millionaire').

Many big landholders had enough money to invest in business as well as land. Moreover, numerous Scottish managers (whose assets are known at death from probate lists not generally available in England) had most of their money outside the returned firm, in other firms' shares rather than, or as well as, in land.⁶³

A basis for systematically testing the landed wealth caused retardation hypothesis are Bateman's (1876-1883) figures for all large landholdings. His numbers are derived from the government's New Domesday survey of 1874 updated to 1883, so they capture most management with large landholdings accumulated in 1871-81 or earlier. A qualification is that Bateman covers only estates with more than 2,000 acres: the acreage has usually been used in regressions of the diversion of business talent/money to landholding. It was common to have much smaller landholdings than 2000 acres, typically 50-250 acres, enough for a substantial country mansion perhaps with a hobby farm. Also available from Bateman are annual rentals in pounds sterling; grouse moors had lower rentals per acre than good farmland near cities, so rentals are a better measure of income or wealth.

A related potential diversion from business was legislating and ruling. It was the norm rather than the exception for top businessmen to be at least a councillor/alderman locally (or chairman of a water or dock board) and a magistrate (justice of the peace). We therefore control for whether in the intercensal period 1871/81 management who were also MPs, lords (defined as members of the House of Lords) or mayors (including a few proto-mayors: chairmen of local boards) influenced enterprise employment growth. The literature suggests MPs and lords in business were simply

⁶³ Morgan and Moss, 'Listing the Wealthy in Scotland,'

decorative⁶⁴ or that they were useful as legislators⁶⁵. Nine enterprises had lords in their top team and one firm had two. 132 MPs were distributed over about one quarter of the largest manufacturing firms.

Table 7 Other Associations with Employment Growth 1871-81, OLS Regressions

| | (7.1) | (7.2) | (7.3) | (7.4) |
|-------------------|----------------------|----------------------|-----------------------|-----------------------|
| Heir prop. | -0.185** (-2.87) | -0.159* (-2.26) | -0.144* (-2.44) | -0.122* (-2.08) |
| Founder prop. | -0.131 (-1.45) | -0.111 (-1.17) | | |
| Ln empl 1871 | -0.573*** (-9.40) | -0.573*** (-9.52) | -0.575*** (-11.09) | -0.542*** (-12.67) |
| Non-manuf. | 0.395** (2.86) | 0.397** (2.87) | 0.360** (2.77) | 0.327* (2.44) |
| Eng. Prop. | 0.410*** (3.64) | 0.407*** (3.67) | 0.365*** (3.79) | 0.337*** (3.73) |
| Chem. Prop. | 0.584** (3.07) | 0.561** (2.92) | 0.640** (3.15) | 0.615** (3.14) |
| Sale prop. | 1.109* (2.47) | 1.150* (2.57) | 1.184** (2.66) | 1.083* (2.50) |
| Oxbridge | 0.153** (2.59) | 0.150* (2.59) | 0.105* (2.04) | 0.111* (2.31) |
| Other UK univ | 0.0853* (2.00) | 0.0901* (2.13) | 0.0940* (2.22) | 0.0925* (2.18) |
| Partnerships 1871 | | -0.0593 (-1.04) | | |
| MP | | | 0.0677 (1.74) | |
| Lord | | | 0.403** (2.67) | |
| Mayor etc | | | 0.185* (2.51) | |
| Bateman rents | | | | 0.666** (2.76) |
| N | 464 | 464 | 464 | 462 |
| r2 | 0.513 | 0.514 | 0.532 | 0.530 |

Note: Robust t statistics in parentheses. Industry dummies and constant included but not reported. * p<0.05, ** p<0.01, *** p<0.001".

In table 7 we take the core manufacturing employment growth explanatory variables as lagged employment, human capital variables, and vertical integration, along with

⁶⁴ Armstrong, 'Company Promoter.'

⁶⁵ Braggion and Moore, 'Political Connections'; Cannadine, *Lords and Landlords*.

industrial structure. Assuming their exogeneity, we test in equation 7.1 whether heirs and founders as a proportion of top management (respectively averaging 0.4 and 0.16) debilitated firm growth. Heirs do seem to correlate with lower firm growth but their impact on employment growth is far less than the positive effect of the human capital variables. The beta coefficient of ‘engineers’ proportion in top management’ (0.22) is twice that of heirs’ proportion (-.11). Founders, also a negative influence, are not significantly so. The partnership variable is not significant when combined with the heirs that dominate it (equation 7.2). Thereafter the heirs variable subtracts as much from growth as the public corporation was shown to add (Table 6). The variable MPs in top management in equation 7.3 is not significant at the 5% level, but the presence of a mayor or equivalent is. The equation also shows a lord on the top management team is a very substantial boost to growth. Lords generally brought with them substantial landed wealth, so the indicator becomes insignificant when landed wealth measures are included. It was therefore dropped from equation 7.4. The rental measure of landed wealth is significant and shows a positive association with firm’s employment growth, consistent with resources flowing from large estate incomes into industry, rather than vice versa. Mayors and proto-mayors were also associated with faster employment growth of their firms.

CONCLUSION

Most recent work on the late Victorian British manufacturing economy has been concerned with public and private corporations’ characteristics and performance, deflecting attention from Chandler’s classification of British business. The wider database of this paper shows corporations in 1881 were still a minority among large firms and permits a more informed assessment of manufacturing performance with different business legal types and managerial human capital in the 1871-81 period. A

mean of nearly 3.5 top management leaders per firm for the large manufacturer public corporations in 1881 does not seem consistent with Chandler's 'personal capitalism', either in its presumed exiguous hierarchy or supposed effects. These public corporations in 1881 created more employment since 1871 than the more numerous large partnerships. But, a characteristic of 'family capitalism', heirs in management teams, present in three quarters of partnerships but in only one third of public corporations, appears more supportive of Chandler. Heirs did indeed reduce the employment growth of the firm and were responsible for some of the performance difference between corporations and partnerships. There were naturally more heirs in large firms in the early industrialiser (the UK) than in latecomer economies like the US, so there was more scope for the "Buddenbrooks" effect. In any case, the employment constraining effect of heirs in UK management was small compared to the positive impact of human capital.

Private corporations failed to match the employment growth of public corporations in this large firm population. Their performance, measured by UK employment growth, was no improvement on partnerships ; they managed to constrain the performance advantages of the divorce of ownership from control apparently delivered by public corporations. Yet they were a minority in the present sample of the largest manufacturing firms, far outnumbered by public corporations, the opposite of Chandler's presumed predominance in Britain of closely-held family firms.⁶⁶ In any case a prevalence of private corporations cannot readily explain differential national industrial expansion, because by 1910 most close (private) corporations and centrally

⁶⁶ Scale, p. 249

unlisted ones operated in what Chandler presumed was the high productivity US, not in Britain ⁶⁷.

Public corporations were more capital intensive than partnerships and sole traders, presumably because of their access to cheaper capital. This would have enabled large public corporations to expand relative to other business types.

Contrary to much literature, professionals were widespread in all the large enterprises but most common in public corporations. Engineers were especially frequently encountered and associated with expanding employment. The lower employment of engineers and professionals by partnerships compared with public corporations slowed their growth. Other human capital, such as in the form of university graduates, made separately identifiable and positive contributions to the growth of employment. Perhaps more surprising was the boost to business from the large landholders and those with time to chair local councils or water or dock boards and act as magistrates. Both lords and mayors were associated with faster employment growth of enterprises.

A limitation of this study is that the 483 large manufacturing employers of our database may not have been representative of the larger number of smaller enterprises – though the biggest firms are likely to have been close to the frontier of best practice. There is little international comparative evidence, so the findings can rarely be placed in an international context here, but university education of management personnel is an exception, as is size of firms and whether they were quoted. There is little evidence that the UK performed poorly on these dimensions in the 1870s, and some evidence its large quoted manufacturers predated similar scale, ownership dispersion or even

⁶⁷ Hannah, 'Global corporate census.'

labour productivity elsewhere around 1881⁶⁸. More quantitative research on industrial organisation in other countries in the same period would be helpful in clarifying the significance of our results for relative national economic performance.

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⁶⁸ Hannah and Bennett,'Large-scale Victorian Manufacturers.'

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Appendix A. Enterprise classifications by legal type.

Firm names do not always permit classification by legal form. A “Company” may be an entity incorporated by statute, royal charter or registration, but a few are also partnerships, sometimes issuing shares under a trust deed, sometimes not. The suffix Ltd (for limited) unambiguously denotes incorporation, though statutory and chartered corporations possessing limited liability were not required to use it, nor, of course, were registered *unlimited* companies. Stock exchange directories and numbers of shareholders published by the Companies Registry in the year after registration provide reasonable guidelines for distinguishing public from private corporations. Partnerships can only firmly be identified when partners chose to advertise changes in newspapers, or in other public statements (e.g at commercial trials or giving evidence to select committees or royal commissions) or, occasionally, in wills or census returns. Our classifications of any firm employing 1000 or more for the census dates of 1871 and 1881 are made on a “best efforts” basis from plausible evidence at various dates: they cannot be guaranteed but are broadly plausible.

Appendix B. Endogeneity

The associations of OLS regression might be due to reverse causality or third factors influencing both the dependent variable and the explanatory variable of interest. Of special concern in Table 5 and Table 6 are the public corporation dummies. Could high employment growth or high capital/ labour ratio firms select the public corporation form for their legal designation? Could unobserved factors affect both heirs and employment growth? In the following we attempt to allow for these considerations and establish that the simpler descriptive statistics and OLS regression provide indicative results for the sign and significance of public corporations, heirs and landed wealth

Whether a firm is or is not a public corporation may not be random. This implies that employment growth and corporation status are not necessarily independent. The difference in growth sample means of corporation and non-corporation status does not necessarily indicate the effect of the corporation because there may be unobserved variables that are correlated with the potential employment growth outcomes and the corporation status.

Instrumenting the potentially endogenous explanatory variable is a recognised solution for establishing a causal influence. The instrumental variable must be correlated with the explanatory variable of interest and independent of the equation disturbance term to create a suitable proxy explanatory variable purged of endogeneity influences. These are demanding criteria. To instrument the 1881 public corporation dummy we propose the 1871 public and private corporation dummies for equations 1.2-1.4.

****TABLE A1 ABOUT HERE****

Perhaps a firm’s capital-labour ratio determined the choice of legal form. We therefore estimate the average treatment effect of public corporation status on capital-labour ratio using a maximum likelihood endogenous binary treatment approach (Table A1). Comparing the resulting equation (1.2) with the OLS (1.1) shows little difference in the estimated public corporation effect. The estimated correlation in equation 1.2 between the treatment-

assignment errors and the outcome errors, atrho , is a low -0.0266 . This insignificant correlation between the error from the 1881 public corporation selection equation and the error from the outcome (capital labour ratio) equation indicates we cannot reject the null hypothesis of no correlation between the public corporation assignment errors and the log capital-labour errors. Hence as expected the ML estimates of the public corporation effect are very similar to the OLS estimate.

****TABLE A2** ABOUT HERE**

In Table A2 equations 2.2-2.4 are estimated by full maximum likelihood with Stata's `etregress` (linear regression with endogenous treatment effects, for public corporation 1871) and 2.5 with `eregress`, assuming two binary endogenous independent variables, public corporations 1871 and private corporations 1871. The correlation between the error from the 1871 public corporation selection equation and the error from the outcome (employment growth) equation is just significant at 5% level. We reject the null hypothesis that there is no endogeneity. The correlation is negative, so we conclude that unobserved factors that increase the likelihood of being in the public corporation sample tend to occur with unobserved factors that reduce employment growth. Other correlations are not significant so indicate no evidence of endogeneity for private corporations in 1871. But weakness of instruments for the private corporation suggests the correlation test may not be reliable. However, the result of the private corporation coefficient not being significantly different from zero is similar to the OLS estimate and the public corporation coefficient in 2.2-2.5 is larger and more precisely estimated than in 2.1.

In Table A3 we implement instrumental variables estimation to obtain asymptotic consistency, in return for higher estimator variance. The proportionality of the endogenous variable (proportion of heirs in top management) does not affect asymptotic consistency. We show that the proportion of heirs in top management is significantly associated with slower employment growth, and by more when estimation allows for endogeneity (3.1 and 3.2). The significance of firm type disappears with the inclusion of the heirs' proportion suggesting that inheritance is the key performance contributor (base: partnerships). The negative effect of heirs on growth persists when the measure is the numbers of heirs in the top team (3.3) and when a binary index for the presence of heirs in top management is utilised (3.4).

****TABLE A3 ABOUT HERE****

Major landholdings by management (Bateman rent) is associated positively with employment growth, by more when allowance is made for endogeneity (3.5 and 3.6), though 3.6 is the weakest IV estimate. 'j' in the diagnostics of Table A3 is Hanson's J and jp is the probability. In Equation 3.2 J fails to reject the null that the instruments are valid, the excluded instruments are appropriately independent of the error process. The high 'widstat' indicates a strong correlation of the instruments with the endogenous variable.

Three of the 64 cases where landed wealth was important for members of the management team were the Duke of Devonshire's and he was the largest receiver of landed rents in the sample. The coefficients imply that £1 a year extra rent for the land rich management was worth 6-9% faster employment growth.

Table A1 Log Capital-Labour Ratio 1881 Regressions

| | (1.1) | (1.2) | (1.3) | (1.4) |
|----------------------------------|--------------------|-----------------------|-----------------------|-----------------------|
| | OLS | ML | ML | ML |
| Outcome Equation In K/L | | | | |
| Public Corporation 1881 | 0.268*** (3.65) | 0.283** (2.81) | 0.241* (2.33) | 0.214* (2.07) |
| Private Corporation 1881 | -0.0969 (-0.77) | -0.0992 (-0.80) | -0.0985 (-0.80) | -0.119 (-0.94) |
| Government | 0.215 (0.37) | 0.215 (0.38) | 0.124 (0.23) | 0.161 (0.28) |
| Sole Trader | -0.0730 (-0.51) | -0.0749 (-0.54) | -0.0757 (-0.54) | -0.0767 (-0.55) |
| London S.E. | | | 0.125 (1.25) | 0.146 (1.41) |
| Ln Employment 1871 | | | | -0.0831 (-1.88) |
| Founder | | | | -0.00556 (-0.11) |
| Selection Equation PC1881 | | | | |
| Public Corporation 1871 | | 2.924*** (9.08) | 2.924*** (9.08) | 2.905*** (8.99) |
| Private Corporation 1871 | | 1.136*** (3.87) | 1.131*** (3.83) | 1.134*** (3.71) |
| athrho | | -0.0266 (-0.20) | -0.00520 (-0.04) | 0.00289 (0.02) |
| Insigma | | -0.574*** (-12.06) | -0.576*** (-12.11) | -0.577*** (-11.88) |
| N | 306 | 306 | 306 | 300 |
| r2_a | 0.376 | | | |

Note: Robust t statistics in parentheses. Industries and constant included but not reported. Base industry coal, iron and steel. Partnership is the base comparison. ** p<0.01, *** p<0.001.

Table A2. Employment growth 1871-1881

| Outcome Equation for Employment growth | (2.1) OLS | (2.2) ML | (2.3) ML | (2.4) ML | (2.5) ML |
|--|-----------|-----------|-----------|-----------|-----------|
| Public Corporation 1871 | 0.156* | 0.281*** | 0.243** | 0.246*** | 0.300*** |
| | (2.25) | (3.57) | (3.23) | (-3.39) | (3.46) |
| Private Corporation 1871 | 0.227 | 0.215 | 0.189 | 0.197 | 0.316 |
| | (1.26) | (1.24) | (1.35) | (1.52) | (1.53) |
| Government 1871 | 0.353 | 0.317 | 0.316 | 0.287 | 0.309 |
| | (1.32) | (1.23) | (1.37) | (1.05) | (1.21) |
| Sole owner 1871 | -0.0151 | -0.0178 | -0.00968 | -0.000714 | -0.0186 |
| | (-0.18) | (-0.21) | (-0.11) | (-0.01) | (-0.22) |
| Ln Employment 1871 | -0.498*** | -0.502*** | -0.535*** | -0.574*** | -0.501*** |
| | (-7.82) | (-8.09) | (-9.27) | (-10.20) | (-8.16) |
| Non-mfing | | | 0.405** | 0.410** | |
| | | | (2.78) | (3.03) | |
| Engineer propn. | | | 0.437*** | 0.394*** | |
| | | | (3.82) | (3.80) | |
| Chemist propn. | | | | 0.458* | |
| | | | | (2.33) | |
| Sales. propn. | | | | 1.253** | |
| | | | | (2.78) | |
| Oxbridge | | | | 0.146** | |
| | | | | (2.72) | |
| Other UK Univ. | | | | 0.0978* | |
| | | | | (2.29) | |
| First Stage Equation for Public Corporation 1871 | | | | | |
| Professional propn. | | 2.445*** | 2.439*** | 2.441*** | 2.382*** |
| | | (7.86) | (7.81) | (7.81) | (7.98) |
| SE Region | | -0.600* | -0.590* | -0.594* | -0.591* |
| | | (-2.24) | (-2.19) | (-2.21) | (2.27) |
| N | 467 | 464 | 464 | 464 | 464 |
| r2 | 0.438 | | | | |
| Rho | | -0.205 | -0.183 | -0.179 | |
| Sigma | | 0.443 | 0.426 | 0.412 | |
| First Stage Equation for Private Corporation 1871 | | | | | |
| London | | | | | -4.247*** |
| | | | | | (26.68) |
| Professional propn. | | | | | 0.643** |
| | | | | | (2.59) |
| Anglican | | | | | 0.260 |
| | | | | | (1.17) |
| corr (e.pub corp-e.growth) | | | | | -0.225* |
| | | | | | (-2.06) |
| corr(e. priv corp-e.growth) | | | | | -0.066 |
| | | | | | (-0.86) |

Table A3 The Effects of Heirs and Landed Wealth on Employment Growth

| | (3.1) | (3.2) | (3.3) | (3.4) | (3.5) | (3.6) |
|--|-----------------------|-----------------------|----------------------|-----------------------|-----------------------|-----------------------|
| | OLS | IV | IV | ML | OLS | IV |
| Outcome Equation | | | | | | |
| Heir propn. | -0.155* (-2.04) | -0.209* (-2.17) | | | | |
| Heir numbers | | | -0.0847** (-2.99) | | | |
| Heir binary | | | | -0.161* (-2.43) | | |
| Founder prop. | -0.101 (-1.06) | | | | | |
| Public Corp 1871 | 0.167 (1.39) | 0.157 (1.36) | | | | |
| Private Corp 1871 | 0.0748 (0.96) | 0.0626 (0.81) | | | | |
| Govt 1871 | 0.268 (0.92) | 0.262 (0.94) | | | | |
| Sole 1871 | -0.0109 (-0.13) | -0.0157 (-0.19) | | | | |
| Mayor etc | 0.205** (2.64) | 0.210** (2.81) | 0.232** (2.80) | 0.206** (3.05) | 0.161* (2.27) | 0.141* (2.01) |
| Non-mfing. | 0.404** (2.96) | 0.401** (3.06) | 0.393** (2.91) | 0.402** (3.23) | 0.356** (2.69) | 0.321* (2.51) |
| Eng. Propn. | 0.388*** (3.86) | 0.391*** (4.08) | 0.392*** (3.73) | 0.395*** (4.53) | 0.329*** (3.59) | 0.302*** (3.34) |
| Chem. Propn. | 0.503* (2.48) | 0.502* (2.56) | 0.579** (3.12) | 0.603** (2.62) | 0.637** (3.09) | 0.647** (3.20) |
| Sales. propn. | 1.205** (2.67) | 1.220** (2.82) | 1.149* (2.53) | 1.153** (3.06) | 1.091* (2.51) | 1.066* (2.54) |
| Oxbridge | 0.148** (2.76) | 0.156** (2.94) | 0.177** (2.99) | 0.148*** (3.41) | 0.106* (2.29) | 0.0883 (1.82) |
| Other UK univ. | 0.101* (2.40) | 0.105** (2.58) | 0.116** (2.76) | 0.0868* (2.00) | 0.0963* (2.24) | 0.0972* (2.34) |
| Ln. empl. 1871 | -0.578*** (-10.62) | -0.569*** (-11.11) | -0.540*** (-9.81) | -0.582*** (-19.99) | -0.547*** (-12.72) | -0.538*** (-13.38) |
| Bateman rents | | | | | 0.0631** (2.69) | 0.0894** (3.05) |
| Heir binary First Stage Equation (probit) | | | | | | |
| W Midland | | | | 0.820** (3.15) | | |
| Yorkshire | | | | 0.743** (2.90) | | |
| Profess propn. | | | | -2.548*** (-11.96) | | |
| var(e.grow) | | | | 0.172*** (14.48) | | |
| corr(e.heir2e.grow) | | | | 0.275** (2.66) | | |
| N | 464 | 464 | 464 | 464 | 462 | 462 |

| | | | | | |
|--------------------|-------|-----------------------------|-----------------------------|-------|--------------|
| r2_a | 0.493 | 0.491 | 0.446 | 0.504 | 0.500 |
| Excluded exogenous | | WMid, Yorks, Prof propn. | WMid, Yorks, Prof propn. | | LordAnglican |
| j | | 2.149 | 2.647 | | 2.066 |
| jp | | 0.342 | 0.266 | | 0.151 |
| idstat | | 120.2 | 133.3 | | 6.077 |
| idp | | 6.91e-26 | 1.07e-28 | | 0.0479 |
| widstat | | 115.8 | 94.11 | | 4.010 |

t statistics in
parentheses,
="* p<0.05

** p<0.01 *** p<0.001"