

Chandler's Living History: *The Visible Hand* of Vertical Integration in Nineteenth Century America Viewed Under a Twenty-First Century Transaction Costs Economics Lens

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ABSTRACT Alfred Chandler's recent passing is cause to review and celebrate his many contributions to business history. It also presents an opportunity to highlight links between his rich historical analyses concerning organizational and industrial innovation and contemporary management studies of the firm and industrial organization. We illustrate this point by applying transaction costs theory to several case studies from his 1977 masterwork narrating the emergence of vertically-integrated firms in nineteenth-century America, *The Visible Hand*. Vertical integration, organizational control, and innovation in manufacturing at McCormick Harvester and Singer Sewing Machines, and in transportation and distribution at Swift and United Fruit reflect managerial responses to classic transaction costs considerations including commercial relationships requiring the creation of specialized equipment and knowledge. Transaction costs analysis provides complementary historical insight on organizational innovation at these and other firms in the nineteenth century, and suggests when and where we might expect vertical integration strategies in emerging industries of the twenty-first century.

INTRODUCTION

This article applies transaction costs theory to several case studies from Chandler's (1977) masterwork narrating the emergence of vertically-integrated firms in nineteenth-century America. We submit that vertical integration, organizational control, and innovation in manufacturing and in transportation and distribution reflect managerial responses to transaction costs considerations including commercial relationships requiring the creation of specialized equipment and knowledge. This research article is motivated by the view that transaction costs analysis provides *complementary* historical insight on

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organizational innovations in the nineteenth century, and suggests when and where we might expect vertical integration strategies in emerging industries of the twenty-first century. Moreover, we elaborate existing theory via Chandler's (1977) rich historical account, and we evaluate the reach and explanatory value of transaction costs analysis.

The enduring legacy of Alfred D. Chandler (1918–2007) is first-rate scholarship, which joins the 'logic-in-use' of business decision makers with 'reconstructed logic' (Kaplan, 1964) derived from social scientific theory. Porter (1992) maintains that Chandler's influence within business history has been enormous and that virtually every contemporary work on the history of the large-scale business enterprise must come to grips with Chandler's analytical frameworks. Similarly, Galambos informs us that: '[t]he dominant paradigm in business history has for many years been the synthesis developed by Alfred D. Chandler' (Galambos, 1997, p. 287). In our judgment, Chandler's distinctive competence is best expressed in his own words. Chandler was interested in understanding 'how the historian can take what he needs from the concepts of the other disciplines without in any sense being captured by them' (McCraw, 1988, p. 1). Of course, Chandler did much more than simply borrow a few concepts from management research as he chronicled the development of American business in the nineteenth and twentieth centuries. Williamson (1985, p. 11) made that clear in assessing Chandler's (1962) first masterwork, *Strategy and Structure*:

In many respects [Chandler's] historical account of the origins, diffusion, nature, and importance of the multidivisional form of organization ran ahead of contemporary economic and organization theory. Chandler clearly established that organization form had important business performance consequences, which neither economics nor organization theory had done (nor, for the most part, even attempted) before. The mistaken notion that economic efficiency was substantially independent of internal organization was no longer tenable after the book appeared.

Chandler wholly recast business history with a crucible of social science theory derived from economics, sociology, management, and organization studies. The scholarly results included compelling narratives about the evolution of business organization over the past 150 years. They also included sharply critical analyses of current social science theory and theorists, as this excerpt from Chandler's second masterwork, *The Visible Hand*, illustrates (Chandler, 1977, p. 490):

Economists have often failed to relate administrative coordination to the theory of the firm. For example, far more economies result from the careful coordination of flow through the processes of production and distribution than from increasing the size of producing or distributing units in terms of capital facilities or number of workers. Any theory of the firm that defines the enterprise merely as a factory or even a number of factories, and therefore fails to take into account the role of administrative coordination, is far removed from reality.

Here is Chandler at his best. In chronicling American business organization in the nineteenth and early twentieth centuries, Chandler shows how history can inform, refine,

and in this case, debunk popular theoretical assumptions about how and why firms are organized in the late-twentieth (and early twenty-first) century.

Indeed, Chandler (1977) shows how well-researched, detailed treatises of firms can not only inform management theory at the time they were written, but can also inform management theory at a later date as scholars return to these works and reinterpret the evidence presented in these works. Further, the same interplay of theoretically-grounded historical narrative and critical commentary found in Chandler (1977) pervades Chandler's (1962) *Strategy and Structure* and Chandler's (1990) third masterwork, *Scale and Scope*.

We regard deductive economic theorizing as complementary and reinforcing to Chandler's (1977) relatively more inductive theory-building approach, and for this purpose, we use *The Visible Hand* to critically review the organizational evolution of American business in the nineteenth and early twentieth centuries viewed under a single theoretical lens, namely transaction costs economics (Coase, 1937, 1960; Williamson, 1975, 1985, 1996). By transaction costs we mean the costs of producing *and* overseeing the exchange of goods and services over time. By transaction costs theory, we mean an analytical perspective for evaluating alternative regimes for such production and exchange transactions based on their prospective costs. In this perspective, some individuals and firms are assumed to be opportunistic (i.e. self-interested with guile). One key factor in the transaction can be a 'small-numbers bargaining problem' (Williamson, 1975). Other key factors include: bounded rationality, the uncertainty surrounding such transactions, the frequency of such transactions, and the extent to which individuals must invest in specialized goods and services – what Williamson (1985) refers to as transaction 'asset specificity'.

The descriptive aim of the transaction costs perspective is to compare the costs of producing and exchanging goods and services over time between individuals in a market versus alternative regimes where individuals 'internalize' aspects of transactions by employing rather than contracting with individuals, by merging rather than selling at arm's length to firms, and by otherwise replacing markets with bureaucratic hierarchies. The primary normative aim of this perspective is to define the circumstances when internalization is more cost-efficient than leaving transactions in the market. Thirty years of theoretical and empirical research, reviewed in Mahoney (2005), highlights small-numbers bargaining and high asset specificity as important factors increasing the likelihood of shifting transactions from markets to bureaucratic hierarchies.^[1]

We use transaction costs theory to review, explain, and critically analyse trends in vertical integration by American businesses from 1840 to 1920, the approximate time-period covered in *The Visible Hand* (1977). In the spirit of Chandler, we also use the historical experience of American business during this bygone era to anticipate emerging organizational arrangements in twenty-first century business. In the process, we show how transaction costs theory informs business history even as the resulting narrative informs current thinking about effective business organization (Gourvish, 1995; Lazonick, 2002; Robertson, 2003).

We are not the first to use transaction costs analysis to reconsider Chandler's work. Williamson (1975, 1985), Hill (1988), Mahoney (1992, 2005), Poppo (2003), and Mayer and Whittington (2004) have also drawn on transaction costs perspectives to reconstruct

Chandler's work, but that work has been *Strategy and Structure* (1962), Chandler's history of organizational evolution in the early to mid-twentieth century. By contrast, there has been comparatively little transaction costs analysis of *The Visible Hand*, even though its influence on business history has been judged to be substantial (John, 1997). Our approach would likely receive at least partial support from Chandler, who also appreciated transaction costs theory and theorists: 'Because of his concern with firm-specific assets and skills, I, as an economic historian, have learned much from Williamson' (Chandler, 1992, p. 85). Our analysis of *The Visible Hand* therefore extends recent research efforts to illuminate and inform business history with transaction costs analysis that Chandler himself read broadly and incorporated.

While the current article emphasizes the common ground between Chandler (1977) and Williamson (1985), it should be noted that there are differences: Chandler writes that: 'The basic difference between myself and Williamson is that for him the transaction is the basic unit of analysis. For me it is the firm and its specific physical and human assets. If the firm is the unit of analysis, instead of the transaction, then the specific nature of the firm's facilities and skills becomes the most significant factor in determining what will be done in the firm and what will be done in the market' (1992, pp. 85–6). However, in maintaining an emphasis on common ground, we highlight the strong connections between transaction costs theory and dynamic capabilities. Indeed, Teece (1976, 1980) has been a contributor to the transaction costs theory, and later, Teece et al. (1997) became the seminal paper in the dynamic capabilities literature. Further, both Foss (1996) and Mahoney (2001) make the case that market frictions (e.g. asset specificity) are the critical concepts to both transaction costs theory and dynamic capabilities theory. Indeed, Mahoney (2001) suggests that dynamic capability differences between firms and markets are due to transaction costs. If this is so, then Chandler's (1992) emphasis on capabilities can potentially be embedded and reconstructed within transaction costs theory.

Reliance on a single theoretical lens gives coherence and consistency to historical review, but this analytical strategy may also raise concerns (Lamoreaux et al., 2003, 2008). It is reasonable to ask whether a transaction costs perspective will underplay or wholly ignore certain factors important to the explanation of vertical integration in American business during the nineteenth century. Other commentators have noted alternative explanations, including: market foreclosure, market power and competition (antitrust) policy, quality signalling, entrepreneurial talent, (internal) capital market development, product life-cycles, path dependency, and oligopolistic preferences (Argyres and Liebeskind, 1999; Bain, 1968; Bittlingmayer, 1996; Duguid, 2008; Livesay, 1989; Marglin, 1974; O'Sullivan, 2006; Stack, 2002; Stigler, 1951; Vernon, 1966).

That said, examining the historical record, Williamson states that: 'It is noteworthy, however, that a number of large firm/concentrated industry groups are included among those non-integrators: breakfast cereals, hand soaps, soup, and razor blades, to name a few. Those industries would presumably be prime candidates for forward integration if oligopolistic preferences rather than efficiency were driving the organizational outcomes' (1985, p. 125). Furthermore, Chandler finds that Stigler's (1951) life-cycle explanation for vertical integration does not hold up to historical evidence: 'Such [a life-cycle analysis] has validity for the years before 1850 but has little relevance to much of the

economy after the completion of the transportation and communication infrastructure' (1977, p. 490). The history of vertical integration in the aluminium industry also is well documented as not following the life-cycle theory (Stuckey, 1983). Chandler also explicitly rejects explanations based on differences in entrepreneurial talent, availability of capital, and public policy (1977, pp. 373–4).

With due allowance for these aforementioned limitations, we maintain that our single theoretical lens is well-suited to the analysis of vertical integration and, specifically, trends in internalizing market transactions by 'backward' acquisition of basic inputs and 'forward' acquisition of final output channels. As our case narratives will show, such acquisitions often involved the small-numbers bargaining and high asset specificity that are so central to transaction costs theory. In any case, transaction costs theory has intellectual roots in many disciplines, including economics, strategic management, organization theory (broadly conceived to include sociology, political science, and social psychology), cognitive psychology, marketing, and aspects of the law, especially property and contract law (Mahoney, 2005; Williamson, 2005). Therefore, our single theoretical lens is, in fact, the product of many lens crafters familiar to Chandler and the issues he sought to understand.

Mirroring the structure of *The Visible Hand* (1977), we organize this article into four subsequent sections. The next section uses transaction costs theory to analyse American business organization just before the 1840s when a 'putting-out' and inside-contracting system dominated. We show how and why these systems worked well with small business organizations producing low-cost goods with few technological inputs and little standardization. The third section then considers, from a transaction costs perspective, how and why many American businesses from 1840 to 1920 discarded the putting-out and inside-contracting systems in favour of larger and increasingly vertically integrated organizational forms. A transaction costs perspective is particularly well-suited to understanding this evolution in businesses producing and exchanging technologically complex and or perishable goods. The fourth section uses transaction costs logic to analyse more broadly differing rates of change from invisible hand-based (Smith, 1776) to visible hand-based business organization from 1840 to 1920. In the fifth and concluding section we summarize our key findings concerning parallels between Chandler's historical analysis and transaction costs theories and leading theorists. We then note several research conjectures about vertical integration and de-integration trends in emerging twenty-first century industry contexts.

THE PUTTING-OUT AND INSIDE-CONTRACTING SYSTEMS

Organizational innovation is an important but perhaps under-appreciated factor in economic development. As the business historian Arthur Cole observed: 'If changes in business procedure and practice were patentable, the contribution of business change to the economic growth of the nation would be (more) widely recognized . . .' (Cole, 1968, pp. 61–2). Consider, for example, innovations in cost accounting, collective bargaining, or the focus of this section, organizational forms. Here, we review and analyse, in transaction costs terms, a particular change in organizational form of American business. Specifically, an existing business organization based on extensive contracting and

market-like incentives for production by individuals or small groups gave way in the mid-nineteenth century to large-scale, more technology-intensive forms with bureaucratic control of every stage of production by salaried employees – the visible hand (Yao, 1988). We begin our review with a discussion of two important organizational forms before these organizational innovations: the putting-out and the inside-contracting systems.

The Putting-Out System

The putting-out system existed in America from approximately the 1790s to the early 1840s. In this business system, merchants purchased materials, delivered them to the workers in their homes, and arranged for the sale of the completed articles (Hudson, 1986; Lazerson, 1995). In contrast to handicraft manufacturing, the putting-out system was characterized by a separation of tasks – a classic example of Adam Smith's (1776) maxim that 'the division of labor was limited by the extent of the market' (i.e. by demand). In the 1790s, metal goods, furniture, clothing, hats, gloves, and shoes were produced through the putting-out system (Gras and Larson, 1939; Hudson, 1981; Landes, 1969; Ware, 1931; Zakim, 1999).

The American shoe industry is illustrative. Hazard describes the work of New England shoemakers as 'simply to manufacture the boots and shoes, which a capitalist-entrepreneur marketed at their own risk and profit, supplying in whole or in part the tools and materials' (Hazard, 1913, p. 244). After 1820, such capitalist-entrepreneurs often worked out of a centrally-located shop (Thomson, 1989). Workers did shoe fittings and they were then returned to the central shop so that 'makers' could sew the boots and shoes. After makers finished their work, it was inspected at the central shop before delivery to customers (Chandler, 1977; Hazard, 1921).

The putting-out system fit the times. In a world lacking low-cost capital, technology, transportation, and communications, the putting-out system permitted localized, low-technology, and extensive production, and preserved substantial worker autonomy. Furthermore, workers were compensated based on their individual productivity linked to piece-work rather than hourly wages or monthly salaries. But the putting-out system also meant separate work locations, substantial inventory accumulation, loss of materials in transit (both inadvertently and particularly through embezzlement), time-lags in production related to unreliable transportation, and uneven product quality between and even within local systems (Babbage, 1835; Braverman, 1974; Freudenberger and Redlich, 1964; Kirkland, 1961; Pollard, 1965).

Consistent with this assessment, economic analysis suggests that the piece-rate system inhibited the development of high quality (Cheung, 1983; Lazaer, 1981; Roumasset and Uy, 1980). Indeed, Goldin (1986) maintains that, in general, production of luxury goods is more vulnerable to shirking by workers, leading to quality problems – the so-called 'quality-shading problem'. For example, in early nineteenth-century America, high-quality coats were made by wage-earners, while lower quality coats were made by piece-rate workers, and the putting-out system for shoes, which was centred in Lyon, Massachusetts, was mostly used to produce cheaper shoes for growing southern and western markets rather than eastern markets requiring higher quality (Faler, 1981).

The strengths and weaknesses of the putting-out system lend themselves well to reanalysis in transaction costs terms. The putting-out system is largely decentralized and market-based rather than centralized and bureaucratic. The central shop capitalist-entrepreneur exerts only loose network coordination, relying more on workers acting largely as independent contractors doing piece-work with their own tools. The putting-out system resembles Williamson's (1985) default transaction regime. Many individuals were available to do the work and there was little need for specialized training, reciprocal investment, and employer–employee relationships.

The Inside-Contracting System

We described the putting-out system as a general contracting nexus, which also summarizes another important early nineteenth-century organization. The inside-contracting system was widely used by New England and Middle Atlantic manufacturers, especially in metal fabrication and machine-tool production. It was also common in trades like typography, watch-making, mule-spinning, paper-making, glass-blowing, boiler-making, coal-mining, iron-moulding, stoves, pipe-fitting, shipbuilding, locomotives, and arms manufacturing (Clark, 1984; Clawson, 1980; Englander, 1987; Gillette, 1988; Litterer, 1963; Nelson, 1975; Stone, 1974).

Harold Williamson (1952, p. 87) describes the inside-contracting system at the Winchester Repeating Arms Company of the nineteenth century:

The operations involved in manufacturing gun components and ammunition were delegated to super-foremen who hired and fired their own workers, set their wages, managed the job, and turned over the finished parts to the company for assembly. The company supplied raw materials, the use of floor space and machinery, light, heat, and power, special tools, and patterns for the job. The management credited the account of the contractor so much for every hundred pieces of finished work that passed inspection, and debited his amount for the wages paid to his men and the cost of oil, files, waste, and so on, used in production. Anything left over was paid to the contractor as a profit. In addition, the company paid him day wages at a foreman's rate as a guarantee of minimum income.

The inside-contracting system at Winchester, following other early manufacturers, descended from craft industries. Rewards for production were some combination of basic wage and sub-contractor payment based on piece-work. As Edwards noted, wages were often minimal so that worker survival and success depended on profits from piece-work under sub-contract (Edwards, 1979, p. 32).

The inside-contracting system also lends itself well to transaction costs analysis. Again, the system reflects a choice between markets and hierarchies with a transaction regime based on market-based incentives dominating, but not completely. Workers at Winchester and other manufacturers gathered at central locations, largely so that they could collectively benefit from some power-source like a water-wheel. But a central power source alone did not lead to the dominance of managerial hierarchies over market-based contracting. Time-based wages were minimal. Compensation was still largely based on

piece-work as a subcontractor. Space within factories was rented. Mechanization of the factory floor did not necessarily undermine this market-based system (Uselding, 1972). As Deyrup notes, 'inside contractors were paid by the piece and hired their own labor, they benefited directly from increases in production or reductions in labor cost brought about by mechanization' (Deyrup, 1948, p. 149). Williamson's (1985) default regime of market-based incentives worked well in the early nineteenth century where there were many individual workers and owner-foremen to negotiate and renegotiate contract rates efficiently, and the demands for specialized reciprocal investment were low.

So what weaknesses in the internal contracting system led to its replacement later in the nineteenth century? There were several disadvantages, including: misuse of machinery; quality shading; problems of employee discipline; and high absenteeism (Lane, 1973; Navin, 1950). The largely contractual and piece-work basis of compensation created incentives to overuse and wear out prematurely the production equipment as the contract period wound down. Equipment repairs were deferred near contract termination dates, thus magnifying the misuse problem. Pollard notes that: 'In mines or quarries [using the inside-contracting system], permanent damage was done to property by men interested in short-term returns only' (Pollard, 1965, p. 38). Similarly, contract workers had incentives to slow revelation of productivity-enhancing use of machinery until a new contract was established. Williamson notes that at Winchester: 'any discovery of how to speed up operations or to substitute unskilled labor for skilled labor by the use of some new jig or fixture could be carefully guarded from management' (Williamson, 1952, p. 89). It was also difficult to regulate the flow of components from each contractor and inventory control procedures were inadequate (Buttrick, 1952). Also severe quality shading problems that accompanied the putting-out system continued to plague internal organization under the inside- contracting system. North (1981, p. 168) notes that:

[W]here quality was costly to measure, hierarchical organization would replace market transactions, the putting-out system was in effect a 'primitive firm' in which the merchant-manufacturer attempted to enforce constant quality standards at each step in the manufacturing process. By retaining ownership of the materials throughout the manufacturing process, the merchant-manufacturer was able to exercise this quality control at a cost lower than the cost of simply selling and buying at successive stages of the production process. The gradual move toward central workshops (inside contracting) was a further step in efforts at greater quality control and presaged the development of the factory system (hierarchy) that was in effect the direct supervision of quality throughout the production processes.

These disadvantages have a transaction costs interpretation. Merely transferring transactions from the market and to the firm does not fully align economic incentives across production activities (Eccles, 1981; Mahoney, 2005; Williamson, 1980, 1985). It also requires comprehensive change in transaction compensation, oversight, and mutual commitments. Inside contracting took American business part of the way towards that change by bringing workers together physically, by combining them with standardized capital equipment, by paying in some small part fixed wages, and by instituting systematic oversight of production quality with foremen on the factory floor. Yet, inside

contracting does not resemble a standard employment relationship that imposes managerial fiat to settle occasional disputes.^[2] An employee rather than independent (internal) contractor relationship would provide greater security to workers asked to invest more in specialized training with factory equipment and procedures. It would more likely put them in a 'zone of acceptance' (Simon, 1947) regarding asset specific investments, if for no other reason than that such investments would no longer be limited by contract periods. When inside contractors become employees, they are less likely to have claims to the semi-independent profit streams. Consequently, workers have a greater sense of commitment to the firm rather than a particular project. They are more cooperative, and willing to be supervised and audited, consistent with a sense of greater mutual commitment between employees and their firm (Williamson, 1975).

Such transaction costs factors help explain the demise of inside contracting beginning in the late 1870s. For example, Singer Sewing Machine ended the inside-contracting system in 1883 (Hounshell, 1984). Winchester reduced the number of contractors in the latter half of the nineteenth century. By 1914 inside-contracting system was no longer significant in gun production (Williamson, 1952, p. 136). Factors related to transaction costs prompted the development of new organizational forms from 1840 to 1920. The next section considers some of these factors and their contribution into the transformation of many American businesses in large, vertically-integrated firms utilizing Chandler's visible hand (Chandler, 1959, 1969, 1977, 1984).

THE RISE OF VERTICALLY-INTEGRATED FIRMS

The 1840s marked the beginning of organizational innovation in American business to accommodate rapid changes in production, distribution, and overall administration. The chief result was large vertically-integrated firms similar to many of today's modern corporations. At the beginning of the 1840s, markets were still small and regional if not local, and both large-scale power sources and transportation were expensive (Taylor, 1968). Such factors kept transaction frequency low in putting-out and inside-contracting systems. There were few middle-level managers in American businesses where capitalist entrepreneurs and piece-work contractors dealt directly and infrequently with each other. The most advanced accounting methods to keep track of transactions looked remarkably similar to Italian double-entry bookkeeping techniques developed five centuries earlier (Chandler, 1977).

So much had changed so quickly. Rapid expansion of railroads in the 1840s, 1850s, and 1860s dramatically decreased unit transportation costs. The telegraph achieved commercial practicability in the same period with coverage reaching Chicago, St Louis, New Orleans, and San Francisco (DuBoff, 1980). This innovation reduced costs of communication and coordination on a national rather than merely local or regional market basis. Water and later steam power sources were fuelled by discovery of new coal seams and enabled utilization of massive iron ore, lumber, and related natural resources in the west, and manufacturing firms in the east. Production innovations led to other scale- and scope-sensitive cost decreases (Atack, 1986; Chandler, 1990; O'Brien, 1988; Teece, 1980). The increasing sophistication of demand also prompted firms to seek higher volume and speedier production runs, and more adaptive distribution systems

(Barger, 1955; Higgs, 1971). In two decades, essential infrastructure as well as new production and distribution technologies became available to accommodate growth and innovation in American business (Chandler, 1977, p. 77; Davis and North, 1971; Rosenberg, 1972; Temin, 1964).

In terms of the timing of vertical integration, Chandler writes: 'The visible hand of management replaced the invisible hand of market forces where and when new technology and expanded markets permitted a historically unprecedented volume and speed of materials through the process of production and distribution. Modern business enterprise was thus the institutional response to the rapid pace of technological innovation and increasing consumer demand in the United States during the second half of the nineteenth century' (1977, p. 12). While the differential in 'economies of speed' explanation helps us to make sense of historical patterns observed, there are a number of anomalous results. For example, despite new technologies and expanding markets, manufacturers did not fully integrate into distribution for the sale of cigarettes, beer, and branded packaged goods. This article maintains that transaction costs theory has something of value to offer for explaining these anomalies. Fungible human capital was employed for the retail and service of these packaged goods. With low human capital asset specificity, vertical integration was not needed (Williamson, 1985).

Vertical Integration by Firms Producing Technologically Complex Goods

The 1870s to the 1890s saw advancements in production and administration responding to these changes (Chandler, 1977, p. 145). Enterprises began to integrate mass production with mass distribution (Peterson, 1945; Schmitz, 1995). Enterprises manufacturing technologically complex goods are illustrative. Singer Sewing Machine pioneered the development of mass distribution channels. Indeed, it pioneered many consumer appliances, the consumer instalment plans that financed their sale, and the franchised agency system that distributed the appliances and plans (Jack, 1957). These innovations enabled Singer to both ramp up production and distribution on a national scale and, through the franchised agency system, adapt to local market niches with different social and economic characteristics (Carstensen, 1984).

Wilkins contrasts the franchised agency system's advantage with the alternative independent agency system: 'The independent agent did not pay sufficient attention to the product; he did not bother to instruct the buyer on how to use the machine; he did not know how to service it; he failed to demonstrate it effectively; and he did not seek new customers aggressively. Independent agents were not prepared to risk their capital to sell goods on installment, nor would they risk carrying large stocks' (Wilkins, 1970, p. 43). Singer's product innovations required distributional innovation in order to demonstrate, instruct, and assist sewing-machine users (Hennart, 1994). By the mid-1950s, Singer had internalized the transaction further with its own salesrooms to market the product, deliver the machines, assist consumers with trained personnel, maintain attractive outlets, carry on adequate stock of machines, parts and accessories, and repair the machines. These sales outlets provided information on market trends and competition so that product development advanced rapidly (Jack, 1957). Singer's innovation path led

from independent agents to franchised agents to proprietary sales force employees. Travelling this path increased transaction efficiency and effectiveness (Davies, 1969).

Chandler maintained that Singer's economic advantage followed from travelling this path of organizational innovation: 'That managerial hierarchy recruited, trained, and carefully supervised the canvasser-collector, provided long-term consumer credit; assured continuing service of the machine sold; and, finally, permitted a smooth and reliable distribution of the 20,000–25,000 machines shipped each week to all parts of the world' (1977, p. 405). The merchandising efforts of Singer's own outlets proved so successful that, by 1880, Singer severed their relations with all independent merchants, and its distribution network maintained 530 retail outlets (McCurdy, 1978). By 1905, Singer employed twice as many workers in marketing vis-à-vis production (Godley, 2006). Singer also devised new types of accounting and statistical controls. Management accounting systems developed by Singer enabled extensive vertical integration since these systems lowered internal integration measurement costs. In transaction costs terms, Singer's economic advantage followed from its ability to induce specialized investments in training and knowledge-development by Singer and its employees. Internalization of formerly market-based exchange paired with new incentives and oversight innovations permitted mutual commitment and the development of human and organizational capital.

Vertical integration and coordination was also significant to the success of McCormick Harvesting Company, which produced and distributed complex mechanical (grain-cutting) reapers. It also developed nationwide product advertising, warranty and instalment financing plans (McCormick, 1931). McCormick appointed responsible agents to storage warehouses that it built at various locations. Agents were also trained mechanics who assembled machines when they arrived from the factory and demonstrated their operations to customers. McCormick agents were experts at adjusting machines to local conditions and at making repairs 'on the fly' (Hutchinson, 1930). McCormick's agents comprised a nationwide franchising system with exclusive-dealing arrangements (Casson, 1909). By the mid-1880s, McCormick was converting some of their establishments to vertically-integrated stores with salaried managers, but not to the same extent as Singer (Chandler, 1962; Kramer, 1964).

Vertical integration was also prominent in electrical manufacturing systems. Changes in the scale and complexity of operations in electrical manufacturing prompted organizational innovation. A significant characteristic of the market for electrical products was that a customer firm's activities and requirements had to be known to the electrical manufacturers' sales agents if the latter were to do an effective job of selling. In addition, the sales agents had to make sure that the equipment bought by the customer firm was properly installed and that it operated satisfactorily. In effect, then, the electrical products sales agents were sales engineers (Passer, 1952). In the late nineteenth century, successful firms in electrical manufacturing included Westinghouse and General Electric (Broderick, 1929; Hammond, 1941). They made investments in and induced additional investments by their proprietary sales force, the result of which included creation of substantial human and organizational capital (Passer, 1953).

Centralization of marketing in these firms enabled sales forces to obtain information on consumer needs. Communication between production and marketing departments

enabled extensive coordination between customers with increasingly complex requirements and manufacturers with increasingly dynamic production and distribution capabilities. Marketing electrical lighting, power machinery, and traction equipment became so technologically complex that trained sales agents with expertise in engineering were essential. Vertical integration and close coordination of manufacturing and marketing enabled the development of firm-specific reports, plans, and forecasts that sped transmission and communication. In markets where such factors were less critical, vertical integration was less necessary. For example, General Electric and Westinghouse continued to market simple consumer products such as light bulbs through independent wholesale distributors. Standardized machinery, such as stationary steam engines, standard boilers, lathes, and other similar machinery were sold in the market without reliance on vertical integration (Chandler, 1977; Porter and Livesay, 1971).

Extensive marketing organizations were also necessary for new machines to be sold in high volume. National Cash Register Company dominated its industry by setting up networks of branch retail outlets administered by regional offices. National Cash Register gave its agents exclusive territories (Johnson and Lynch, 1932; Rosenbloom, 2000), and grew rapidly after 1885 when it first provided credit and repair services to agents and then began limiting these services to trained sales agents (Crowther, 1924; Friedman, 1998). Similar developments in marketing organizations occurred at Burroughs Adding Machine, Eastman Kodak, and Remington Typewriter (Ackerman, 1930; Chandler, 1977; Jenkins, 1975; Porter and Livesay, 1971).

American firms producing sewing machines, cash registers, cameras, and typewriters invested extensively in retail outlets, and in sales force training and support. These same firms demanded reciprocal training and specialization of these players as franchise agents, exclusive franchise agents, or employee–sales agents. In each case, the products and related distribution and marketing were complex and only recently developed (Chandler, 1977). Firms succeeding in overcoming the challenges of inducing such specialized investments achieved economic advantage compared to less vertically-integrated rivals. Independent distributors were confronted by contractual difficulties in securing adequate demonstration, in making timely repairs, and in providing consumer credit plans (Porter and Livesay, 1971). From a transaction costs perspective, independent distributors found it more costly to make specialized investments using market-based arrangements. They were reluctant to place themselves in a potentially weak bargaining position. Once the investments were made, producers could opportunistically renegotiate the distribution agreement with the knowledge that the next best use of independent distributors' specialized training and knowledge was substantially lower (Helper, 1991; Klein et al., 1978). Accordingly, independent distributors were likely to become increasingly less knowledgeable, less well-trained, and less interested in selling and servicing complex products compared to employee sales agents.

Vertical Integration by Firms Producing Perishable Goods

Not all vertical integration involved complex products. Perishable goods like meats and fruits might be 'generic' but still required vertical integration for reasons related to transaction costs. Meat-packing and fruit businesses in the late nineteenth and twentieth

centuries illustrate this point. By 1880, Boston, New York, Philadelphia, and other American cities were demanding more meat than could be supplied locally (Arnould, 1971). The new technology of refrigeration (Anderson, 1953; Kujovich, 1970) enabled a supply of meat from cattle on the western plains to satisfy this growing demand in the east. Gustavus F. Swift hired a leading refrigeration engineer to design a railroad car with circulated cool air to carry Swift's dressed beef from Chicago to Boston (Swift, 1927). Armour, Cudahy and Morris and other meat-packers soon followed Swift's lead.

The Grand Trunk and B&O Railroads agreed to haul the meat, but would not build the refrigerated cars (Chandler, 1977; Leech and Carroll, 1938). Their reluctance follows transaction costs economics logic. A refrigeration car was expensive at approximately \$1000 a car in the late nineteenth century, and maintenance costs were high. Finally, a refrigeration car was designed to carry a limited range of cargo (Chandler, 1977, p. 397). With limited alternative uses, an investment in a refrigeration car entailed high asset specificity. Railroads that built these cars would be in a weak bargaining position with meat-packers to provide sufficient volumes of meat to utilize fully this expensive equipment. In contrast, railroads did own their own general service cars, for when not in use to transport stock, these cars could be used for other freight (Clemen, 1923). Large meat-packers also found it difficult to negotiate the grading of meat with independent branch house dealers (Armour, 1906; Rhoades, 1929). As in the case with complex goods, the *trans*-action costs solution was to train a specialized proprietary dealer group. Therefore, transaction costs hazards led packers in Chicago to build their own refrigeration cars and to establish their own ice stations and branch houses in the east where representatives aggressively sold their product. To the best of our knowledge, the current article is the first to interpret the descriptive evidence of the meat packers provided by Chandler (1977) in terms of high asset specificity concerning refrigerated railroad cars and their impact on the vertical integration choice.^[3] From 1880 to 1900, major packers created huge vertically-integrated industrial enterprises. Economic costs savings were not due primarily to economies of scale in production, but rather to transaction costs economies in marketing and distribution (James, 1983).

The banana business encountered more difficulties than the meat-packing industry for at least three reasons: first, bananas cannot be produced in the continental United States; second, they cannot be frozen; and third, they spoil very quickly. Since the late nineteenth century, when Americans started consuming bananas, close coordination between different stages of the business has been crucial for successfully transporting bananas from Central America and the Caribbean to the final consumer in the United States. Banana consumption in North America evolved from being a luxury good in the 1880s and 1890s, to being considered an inexpensive fruit for the working class by 1910 (Bucheli, 2005; Jenkins, 2000). Banana importation from the Caribbean began in the late 1860s at the ports of New Orleans and New York (Reynolds, 1921); the bananas often arrived quite ripe after a slow journey in sailing ships. In the 1870s, steamboats brought bananas more quickly from the tropics (Wilson, 1947). Most of these early importation attempts failed because of the lack of coordination between growers, transporters, and distributors. From 1870 to 1899, 114 banana import companies were created, but only 22 survived by 1899 (Read, 1983). Since the fruit perished quickly, many shipments were lost.

Before the integration of the independent banana companies, most of the coordination difficulties and losses of these perishables resided in problems of coordination among the production centres, the transporters, and the final distributors in the United States (Bucheli, 2005). These coordination problems were largely solved only with the establishment of the United Fruit Company in 1899 (Chandler, 1977, p. 313). United Fruit arose from the merger of interests controlled by Minor Keith and Andrew Preston. Keith owned an extensive railway system in Central America and several banana plantations, and controlled America's south-west banana market. Andrew Preston owned a steamship company (the Great White Fleet), banana plantations in the West Indies, and controlled America's north-east banana market (Bucheli, 2005). The merger created a company with both extensive backward and forward vertical integration. Porter and Livesay note that: 'Middlemen played almost no role in this [upstream] end of United Fruit's operations, so thorough was the process of backward integration' (Porter and Livesay, 1971, p. 176). The merged company continued its expansion to other sectors in order to unify steps in the production, transportation, and distribution of bananas under one company. United Fruit established the Fruit Dispatch Company, which was a subsidiary in charge of distributing bananas in America. Fruit Dispatch also organized campaigns to educate Americans on the nutritional benefits of bananas. United Fruit became a major shareholder of the Hamburg Line and Elders & Fyffes shipping lines, thus assuring control of German and British banana markets. In 1913, United Fruit created the Tropical Radio & Telegraph Company to maintain constant communication with its ships and plantations. The lack of basic infrastructure in some of the producing areas led the company to build hospitals, roads, and housing facilities for its employees (Bucheli, 2005). This infrastructure helped assure a steady flow of bananas by producing on its own plantations as did exclusive contracts requiring local providers to sell all their bananas to United Fruit (Bucheli, 2004). In sum, United Fruit internalized most aspects of banana production, transportation, and distribution to minimize transactions costs related to highly perishable goods (Chandler, 1977).

THE SELECTIVE NATURE OF VERTICAL INTEGRATION IN NINETEENTH-CENTURY AMERICAN BUSINESS

Our narrative might lead some to conclude that organizational innovations based on vertical integration swept through all American industries in the nineteenth and early twentieth centuries. They did not. Older processes of production and distribution based on some mix of contract workers, independent wholesalers, and/or independent retailers continued in many industries. Goods sold through independent outlets included: breakfast cereals, soups, drugs, liquor, razor blades, hand soaps, jewellery, shoes and other leather products, textiles, hardware, plumbing and building materials, furniture, millwork, and other wood products (Becker, 1971; Chandler, 1969; Thorp, 1924). For these goods, market-based regimes worked quite well. Independent sales forces could master product specifications sufficient to sell and provide after sales services within the scope of their limited wholesale purchasing agreements with manufacturers. It was relatively cheap for retailers dissatisfied with manufacturers or wholesalers to end

contractual relationships and shift to one of many other alternative manufacturers and wholesalers providing very similar products. In transaction costs terms, there were no small-numbers bargaining issues, nor were there any specialized investment requirements that might lead one party to an agreement to seek renegotiation of terms opportunistically. Transaction asset specificity was low, thus the default market-based regime was less costly than an alternative hierarchy-based regime related to transaction internalization.

Our historical narrative of organizational innovation focuses on American businesses in the nineteenth century facing challenging circumstances often related to marketing and distribution. They were circumstances requiring: faster distribution as in the case of bananas at United Fruit; deep knowledge of product specifications and repair techniques as in the case of reapers at McCormick; deep knowledge of consumer credit risk and financing as in the case of sewing machines at Singer; and the replacement of short-term contract workers paid on piece-work with long-term employees paid hourly as in the case of Winchester. In each case, circumstances required workers and management to make specialized investments in training and equipment. These human capital and organizational capital investments required shifts away from market-based regimes. These firms found existing marketing and distribution channels and production arrangements inadequate to meet these requirements, so they integrated forward and backward to create their own internally (Chandler, 1977, pp. 287–8).

In transaction costs terms, the visible hand of vertical integration forward and backward led to economic advantages in these challenging circumstances. Advantages followed from better incentives, adaptability, monitoring, dispute-settling, and reward-refining attributes (Mahoney, 2005; Williamson, 1985). The success of United Fruit, McCormick, Singer, and Winchester, among others, illustrates the value of forward vertical integration into marketing and distribution and backward integration into production (Lamoreaux, 1985; Livermore, 1935; Nelson, 1959).

Conversely, when small-numbers bargaining issues and asset specificity were low, experiments into vertical integration proved financially unsuccessful. In the late nineteenth and early twentieth centuries, American Tobacco and American Sugar Refining became large players in the tobacco and sugar beet processing industries. In contrast to our earlier narrative, these commodities had neither the complexity nor the extreme perishability requiring specialized investments. When these firms nonetheless tried to integrate forward into distribution, the results were large financial losses (Porter and Livesay, 1971). Large brewers in the late nineteenth century attempted to develop a system of tied-houses, along the lines of the English system, with taverns having exclusive relationships with one brewer's product. The system offered little strategic advantage and proved very costly. By the mid-twentieth century, most brewers had returned to the older system of using markets and selling through independent distributors (Baron, 1962; Cochran, 1948). Chandler's visible hand of vertical integration and internalization in the nineteenth and early twentieth centuries was therefore still the organizational exception to a rule that markets governed by Adam Smith's (1776) invisible hand were more efficient. In reanalysing the rise of vertically-integrated firms with a transaction costs lens, we reach the same general conclusion.

LINKING CHANDLER TO TRANSACTION COSTS YESTERDAY AND TODAY

Linking Chandler to Transaction Costs Theories and Theorists

We highlight here the close connection between Chandler and transaction costs theorists like Coase, Williamson, and others (e.g. Klein et al., 1978). Chandler's (1977) historical analysis of transition in worker production practices at Winchester in the nineteenth century lends itself well to transaction costs models explaining team production challenges in the mid-twentieth century. Models proposed by Alchian and Demsetz (1972) and Barzel (1982) deal with problems of shirking and quality shading where production takes place in teams and managers are unable to assess with precision the marginal contributions of individual members. Mid-twentieth century examples include team production of services rather than manufacturing, but the motivating insights are similar. High transaction costs related to negotiating and enforcing exchange agreements among team members might lead managers to replace a market-based regime with a simpler employment relationship. The team of employees – e.g. in management consulting or legal services – are paid a fixed hourly or daily rate and held collectively liable for the mistakes of any team member, thereby putting all members in the role of quality auditor and guarantor. Team members are thus properly motivated to invest in firm-specific and, indeed, team-specific assets and training.

At Winchester a century earlier, a similar team-production problem involved inside-contracting craftsmen assembling an increasingly complex firearm. We see a transaction-related organizational response replacing short-term contracts and independent contractors with longer-term wage rules and quite dependent (on firm coordination) employees organized along production lines with mutual responsibilities. Given these parallels in time and theoretical perspective, it is not surprising to find Chandler (1991) and transaction costs theorists like Williamson (1991) often bibliographically side by side, liberally cross-referencing each other's logic and research.

Linking Chandler to Emerging Transaction Costs Issues

These close links between people and ideas also remind us of the broader benefits to business history scholarship from reasonable revision and reanalysis using current theoretical lenses. The compelling intuition, cogent evidence, and eloquent narrative of Chandler's *Visible Hand* leave readers with no doubt about the first-rate *historical* scholarship this book represents. Recasting that history in the crucible of transaction costs only enhances that historical scholarship with greater timelessness. Economists (Langlois, 2003) and business historians (Lamoreaux et al., 2003) held that Chandler's narrative of American business organization in the nineteenth and twentieth centuries would benefit from deeper theoretical development, with Williamson's (1985) transaction costs theory providing one such source. Fundamental changes in the economic environment can lead to dramatic changes in transaction costs, and thus the relative advantages and disadvantages of alternative organizational forms related to either invisible hand markets or visible hand managerial hierarchies (Brynjolfsson et al., 1994). Our

article built on these insights to recast history, and can be used elsewhere to explain current trends in certain industries towards vertical de-integration (Langlois, 2003; Robertson and Verona, 2006).

Shapiro and Varian maintain that: 'Even though technology advances breathlessly, the economic principles we rely on are durable. The examples may change but the ideas will not go out of date' (Shapiro and Varian, 1999, p. x).^[4] Indeed, transaction costs principles that help explain Chandlerian vertical integration are the same principles needed to understand contemporary vertical de-integration. First, asset specificity and small-numbers bargaining problems have been reduced in many industries in which information technology can allow firms to 'quick-connect' with several potential suppliers and assuage concerns about small-numbers bargaining (Clemons and Row, 1992). Second, even when small-numbers bargaining persists, relationship-specific information technology systems (such as those employed by consumer goods giant Procter & Gamble and retail giant Walmart) provide mutual sunk cost commitments that enable electronic integration to mitigate hold-up problems sufficiently (Kim and Mahoney, 2006). Third, information technology and standardized interfaces with exchange partners and suppliers reduce the non-separability problems of measuring individual productivity inputs from team production as well as the measurement of output quality (Alchian and Demsetz, 1972; Barzel, 1982). Such improvements in measurement technologies have facilitated recent trends toward vertical de-integration in industries ranging from retail department stores to commodities extraction and processing to computers (Lajili and Mahoney, 2006).

However, general trends toward de-integration can occasionally reverse themselves, particularly in emerging technology-intensive industries. Pioneering firms seeking to commercialize new products and services may require highly coordinated research, manufacturing, distribution, and after sales service relationships that a single, vertically integrated firm can provide. For example, to commercialize a generation of new agricultural herbicides in the 1980s, Monsanto internalized most, if not all of these capabilities (Leonard-Barton and Pisano, 1990). In the 2000s, Monsanto seeks market leadership in a new generation of genetically-modified plant varieties where the basic science may be mastered, but where new product development, manufacturing processes, and marketing practices around the world are still not standardized and widely diffused across related industries. Monsanto's commercial challenge in the early twenty-first century is not unlike Swift's, McCormick's, or United Fruit's in the mid nineteenth century: vertical integration, corporate control, and internal innovation to build new markets. In this and other current business contexts, Chandler's *Visible Hand* is more than historical narrative of bygone business times. It is a timeless tale of organizational innovation informing both academic scholars and innovative practitioners.

Conclusion

This article makes several contributions to management research. Broadly speaking, it contributes to stronger ties between business history and contemporary management studies. It joins Chandler's (1977) historical analyses concerning organizational and industrial innovation with contemporary management theory explaining efficient

and effective organizational structure and inter-organizational exchange. We chose transaction costs theory developed substantially in the late twentieth century to explain the emergence of vertically-integrated firms in the United States during the mid nineteenth and early twentieth centuries. Our choice followed in part from an intuitive sense of the close correspondence between transaction costs and Chandlerian historical analyses. It also followed in part from suggestions by other management scholars that historical trends in vertical integration might be explained by organizational innovation and the costs of inter-firm exchange (Teece, 1976; Williamson, 1985). It even followed from Chandler's (1977) own comments about the relevance of transaction costs logic to historical research. In presenting a more complete analysis of the *Visible Hand* in transaction costs terms, this article responds to cues from multiple sources.

In responding to those cues, this research article makes additional contributions to our understanding of specific industries and firms during the mid nineteenth and early twentieth centuries. We re-cast the corporate histories of iconic firms like McCormick Harvester, Singer Sewing Machines, Swift, and United Fruit. We showed how their innovations in vertical integration and organizational control reflected rational responses by senior managers to transaction costs considerations. We showed that these considerations followed from relationships with customers, suppliers, and employees requiring more expensive and complex investments in specialized equipment and knowledge. We also showed how these same considerations enable us to better understand why many (but not all) contemporary firms have reversed these trends for achieving efficient and effective exchange.

Thus, our article makes several broad and more specific contributions to management research. But our study also has limitations that future research might address. Most notably, we rely exclusively on historical narratives and case studies to illuminate transaction costs trends in US firms of the mid nineteenth and early twentieth centuries. Future research should re-examine these historical trends based on broad sample statistical analyses. Corporate historical records present both challenges and opportunities for management scholars. Compared to standardized records from the present, corporate records from the mid nineteenth and early twentieth centuries are often less detailed and less consistently presented across firms in an industry and within a firm over time. Even with these limitations, innovative researchers can still utilize historical records for basic information on sales, expenses, employment levels, and capital expenditures indicative of increasing or decreasing vertical integration (e.g. see Chandler, 1977, appendix A).

Researchers might begin with the utilization of corporate records for a single industry (e.g. meat-packing) with a few dominant firms (e.g. Swift, Amour) to understand, say, how increase in vertical integration by one dominant firm in a given year changes the near-term likelihood of vertical integration by other dominant firms. Statistical studies for individual industries might then lead to broader sectoral and economy-wide work confirming or questioning provisional findings based on historical narratives and case studies. These future research avenues should enable students of business history and contemporary management to work together to extend the many fundamental insights that Alfred Chandler generously bequeathed.

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NOTES

- [1] The importance of asset specificity in explaining and predicting vertical integration is supported by a large body of research literature (Lajili et al., 2007). Corroboration includes formal modelling (Gibbons, 2005; Riordan and Williamson, 1985) and empirical testing, which has been corroborative for: (a) site specificity (Joskow, 1985); (b) human capital specificity (Monteverde and Teece, 1982); (c) physical asset specificity (Lieberman, 1991); and (d) temporal specificity (Masten et al., 1991).
- [2] The concept of authority is often contested. A 'complete' contract renders authority irrelevant since all contingencies in an agreement are anticipated *ex ante* (Alchian and Demsetz, 1972). Parties simply refer to the contract for guidance on adjustments necessary to continue or wind up a transaction relationship as contingencies reveal themselves. But as Grossman and Hart (1986) make clear, contracts are rarely complete, thus some authority with 'decision control rights' is a necessary reality in transaction relationships. The history of economic thought provides much useful commentary on the concept of authority (see Arrow, 1974; Coase, 1937; Commons, 1934; Simon, 1947; Williamson, 1975). Perhaps the business practitioner and theorist, Chester Barnard, understood this point best when he noted that '[e]ither as a superior officer or as a subordinate, however, I know nothing that I actually regard as more "real" than "authority"' (Barnard, 1938, p. 170).
- [3] In addition to asset specificity arguments, producers and distributors may not achieve coordination due to a lack of 'convergent expectations' (Malmgren, 1961). Indeed, Chandler (1977) frequently emphasizes that innovative firms may be forced to undertake activities that they would like to outsource since these firms may have difficulty in conveying unfamiliar knowledge to others because the concepts are new and because they are hard for others to comprehend (Silver, 1984; Stigler, 1951; Teece, 1993). For this reason, we anticipate that nascent high technology sectors of the economy may still require vertical integration as we move forward.
- [4] There are a number of more modern case studies that support the transaction costs approach, including: Acheson (1985); Allen and Lueck (1992); Alston and Higgs (1982); Argyres (1996); Crocker and Masten (1988); Crocker and Reynolds (1993); Dyer (1996); Gallick (1984); Galunic and Anderson (2000); Globerman and Schwindt (1986); Goldberg and Erickson (1987); Hallagan (1978); Hennart (1988); Joskow (1985); Lafontaine (1992); Leffler and Rucker (1991); Libecap and Wiggins (1984); Masten (1984); Masten and Crocker (1985); Mayer and Argyres (2004); Nickerson and Silverman (2003); Oxley (1997); Palay (1984); Pirrong (1993); Richardson (1993); and Teece (1976). The current paper contributes to this literature by researching primary and secondary sources listed in Chandler (1977) and providing a 'reconstructed logic' (Kaplan, 1964) concerning changing processes of production and distribution in the United States in the 1840–1920 period based on transaction costs theory.

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