Alfred Chandler's Speed: Monetary Transformation

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In *Scale and Scope* Alfred Chandler abandoned the term "economies of speed" which he used throughout *The Visible Hand* [5; 2]. Though he abandoned the term, he did not abandon the idea that speed of throughput was important in explaining the rise of the large, vertically integrated, bureaucratic firm. To quote Chandler quoting himself in 1992:

> The new firms were far more capital-intensive, and able to exploit the potential of economies of scale and scope made possible by the new technologies of production far more effectively. Nevertheless, as I wrote in *Scale and Scope*: These potential cost advantages could not be fully realized unless a constant flow of materials through the plant or factory was maintained to assure effective capacity utilization. If the realized volume of flow fell below capacity, then actual costs per unit rose rapidly. They did so because fixed costs remained much higher and "sunk costs" (the original capital investment) were also much higher than in the more labor-intensive industries. Thus, the two decisive figures in determining costs and profits were (and still are) rated capacity and throughput . . . . The economies of scale theoretically incorporate the economies speed, as I use that term in *The Visible Hand*, because the economies of scale depend on both size-rated capacity--and speed--the intensity with which the capacity is utilized. In the capital-intensive industries the throughput needed to maintain minimum efficient scale required careful coordination not only of the flow through the processes of production but also the flow of inputs from suppliers and the flow of inputs through intermediaries to final users [7, p. 81].

By abandoning explicit use of the concept of "economies of speed" in favor of the more traditional economies of scale and scope Chandler truncates the power of his explanation of the rise of the large, bureaucratic firm. We

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say this in spite of the fact that "economies of speed" seems a somewhat awkward concept. It was never fully and adequately defined by Chandler in *The Visible Hand* and has not been used by others; so that reviewers of *Scale and Scope* have greeted its disappearance with silence [11; 12; 13]. Our argument proceeds from the contention that Chandler introduced the idea of "economies of speed" in order to deal with the importance of changes in the pace--and in control over pace--with which firms *were able to realize proceeds* from their productive processes. The concept of the firm as an organization dedicated to transforming money into products (or services) and back into more money allows sensible incorporation of the Chandler's idea of economies of speed. What we suggest is adoption of a monetary theory of production, and for that purpose we use Marx's characterization of the firm as a process whereby Money --> Commodity --> Money'.[1] Scale and scope describe phenomena that deal primarily with the M --> C part of the M-->C -->M' process. Traditional treatment as well as recent innovations in the theory of the firm concentrate primarily on M -->C and slight the C-->M' transformation.

Economies of Scope, Scale, and "Running Full"

Some of the difficulty in using the phrase "economies of speed" with precision stems from confusion over the much more widely used ideas of economies of scope and of scale. These latter economies, strictly defined, are reductions in unit cost attributable solely to an increase in the number of products produced (in the case of scope) and an increase in the size of operation (in the case of scale). In common use, however, factors other than size of operation or number of goods produced are treated as contributing to economies of scope and scale.

A brief review of literature on economies of scale will illustrate the difficulty.[2] Such economies refer, of course, to change in unit costs associated with the firm's planning curve and depict the fall of long-run average costs with larger outputs. Although the idea is among the most commonly used propositions from the toolkit of economists, it is often loosely defined and loosely used; or, if rigorously defined, then hard to find evidence for in the real world. The reasons for this, as well as for the strong intuitive appeal of the idea that big firms with big plants have lower costs, have been well surveyed by Bela Gold [9]. Firms that produce on a large scale do often produce at lower unit cost than firms that produce on a smaller scale. What is often left unclear is why this is so and whether it is in any significant measure due to large size or whether the causes of cost-reduction (capital

[1]For an excellent discussion of the importance of this characterization of the firm, see Dillard [8].

[2]We will not deal with similar confusion about economies of scope because they seem less important than confusion about economies of scale; but see Scherer [12] for a suggestion that Chandler may have used the idea of economies of scope in a confusing way.

intensity and different technology, for example) cause *both* large size and unit cost reduction.

Gold provides extensive documentation in support of the argument, also advanced by Armen Alchian [1], that what are usually called economies of scale are in reality economies associated with different techniques of production and with different factor proportions. Gold finds little evidence that larger duplicates of smaller plants that are otherwise identical in all other important respects do, in fact, produce at lower cost. He describes the long struggle in economic thought to preserve the idea that size is cause, rather than consequence, of cost reducing changes in production, and he concludes that at least two concepts of scale economies have coexisted. The "restrictive" theoretical concept attributes scale economies to size and holds all else constant, technology as well as factor proportions. The "observational" concept attributes scale-related cost reductions to changes in (among other things) technology, factor proportions, and organization of production. The "observational" concept can be used to describe change over time because technology, factor proportions, and organization of production all change.

The economies of speed that Chandler describes in *The Visible Hand* can be described as a special case of observational economies of scale; they cannot be treated as cases of "restrictive" economies of scale. But, why did Chandler find it important to argue that *speed* should be included in the list of cost-reducing and size-increasing causes that are lumped loosely under the heading "economies of scale" observationally defined?

This question has become important because Armen Alchian has shown, as a matter of logic, that once a technique has been chosen as the least cost method for production for a particular output, increases or decreases in the *rate* of production from the technologically-related optimum will *increase* rather than decrease unit costs.[3] He finds support in the literature of

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[3]We will not summarize his argument. Suffice it to say that he attempts to disentangle speed of production from volume of production, two elements that he finds are often confused in discussions of economies of scale. He does not offer an explanation for economies of scale other than to say:

> the method of production is a function of the volume of output, especially when output is produced from basic dies--and there are few, if any, methods of production that do not involve 'dies'. Why increased expenditures on more durable dies should result in more than proportional increase of output potential is a question that cannot be answered, except to say that the physical principles of the world are not all linear (which may or may not be the same thing as 'indivisible') [p. 29].

In Alchian's hypothesized world where there are no sunk costs, the choice of "dies" becomes simply a matter of relative costs, and dies that are capable of producing large output in a specific period of time often do so at lower unit costs. In other words, if you want 300 copies of a letter in a day, it is cheaper to use a duplicating machine than to type 300 letters. You choose your die--your fixed plant capacity. You do not speed up or slow down production to vary output in Alchian's world because short and long-run are made the same by assuming that all inputs are variable at some price and all contracts recontractable. Even if the assumptions are dropped in

production management and engineering for his proposition that it is batch or lot size and production technique that firms vary, not rate of production.

Producers who conform to Alchian's estimate of how the world of production works would choose a batch or lot size and produce it in an economically appropriate manner, or choose a manner of production and produce a market-dictated volume. Either way, in Alchian's model, where short-period variation in demand for output is not relevant, firms vary both planned output and their chosen techniques of production, but they do not vary the rate at which they produce their planned output: they do not vary the speed with which they use their chosen plant. Even if demand varies in the short-run, Alchian's producers would produce different levels of output at the same speed, using the machinery for longer or shorter periods of time. Alchian notes a common confusion of rate of output and batch size--a confusion of volume with speed--and a common mistaken attribution of both to changes in size of plant.

However, Chandler's emphasis on speed--the rate of throughput--is not the rate incorporated in Alchian's model. The cost reduction that Chandler describes results from what might be called "economies of running full" [10]. In many passages Chandler gives importance to economies of speed and equates them to "running full:"

> Economies [of speed] come much less from adding more production factors than by increasing the output of existing ones. To illustrate, until total capacity is reached, the flow though a tunnel can be increased at much less cost by speeding up and scheduling traffic than by widening the tunnel [3, p. 402].

Use of the phrase "economies of speed" to emphasize capacity operation is understandable since these sources of cost reduction do not get much play in the standard treatment of costs. Strategic action to ensure capacity utilization -- action such as trust creation and mergers or other forms of industry control -- are well documented [10]. Tactical measures in the form of inventory control and demand manipulation are also obvious. However, none of these measures is treated as part of cost management in the standard theory of the firm.

If, however, what Chandler argued in *The Visible Hand* and again in *Scale and Scope* was that capacity-utilization became increasingly important in the late 19th century with the growth of capital intensive industries, then--as at least one reviewer of *Scale and Scope* has noted--he is restating an old proposition [12]. It is our contention that he was indeed restating the importance of using capacity, but was saying much more as well.

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recognition of the reality of sunk costs, Alchian's point that variation in speed from the optimal rate given by the die at hand will increase costs is still valid.

Chandler's Monetary Theory of Costs: M -- > C -- > M'

It is difficult to incorporate what Chandler says about the importance of economies of speed into the usual theories of the firm, for emphasis in the standard models is upon production. To the economies of production cost associated with scale and scope it is commonplace to add speed of transformation of money into goods and back into money as affecting the costs and revenues of a firm, but this speed refers only to variations in holding costs. Chandler offers evidence of changes in broader and more general processes than inventory management. Throughout his work Chandler presents evidence that it became possible in the late 19th century for firms to gain better control over both the volume of output and the *vents* for that output. This allowed them to manage throughput from acquisition of inputs through disposal of outputs. The large plants that new technology and organization made possible made exercise of this control of such enormous advantage that, in an industry where any firm seized such control, other firms were not likely to survive unless they exercised similar control.

Although true (and corresponding to Alchian's point that there is a best output for a given plant), Chandler's point is not simply that costs would be increased by not "running full." Throughout his descriptive material Chandler shows how the construction of new plants with new technologies depended on the ability of firms to control input, output, and markets--to integrate and coordinate the flow of materials through delivery. There is also evidence that such control was vital even where technological change did not give advantage to larger plants.[4]

This evidence can be more clearly appreciated by making explicit use of the M -- > C -- > M' model of the firm. Over time the excess of M' over M is a consequence of the markups involved in each transformation and the number of transformations completed: thus the importance of speed. Control over sale of output would add to the speed of transformations.

Consider Chandler's description of the production and sale of textiles early in the 19th century by the firm of Almy, Brown, and Slater [4]. Little effort was made to produce in quantities that bore a close relationship to market demand in the short period. (In Alchian's terms, the firm chose its planned volume of production with regard to something other than short-term market demand.) Slater produced what the capacity of his mill allowed, and then turned the output over to Almy and Brown, who disposed of the output as best they could. When large inventories built up, stock was disposed of at auction. At that point the mill might cease production for a period; no other control was possible.

For Almy, Brown, and Slater there was little possibility of control over the rate of disposal other than through auctions. If control over the rate of C-->M' was unsatisfactory, it was not too damaging, for no other firm could do better. As Chandler tells us, a change of critical importance occurred following the

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[4]Which may explain why Sherer doubts (and is correct in doubting) that scale economies can explain the development of oligopoly [12, pp. 693-4].

advent of the railroads and the telegraph. Information and transportation improved; the cost of both fell. Of greatest importance for firm organization was the possibility of better control over the rate of disposal. Information about distant markets and the ability to move goods to alternative markets increased the power of firms to control the time at which they acquired inputs and the time when they disposed of goods. Firms might still be caught with goods they could not move at the desired price or as rapidly as they wished, but greater control was possible--a distinct advantage to those firms that managed these possibilities well. Chandler puts it this way:

> . . .effective scheduling of flows achieved a more intensive use of facilities and personnel employed in the processes of production and distribution and so increased productivity and reduced costs. In addition, administrative coordination provided a more certain cash flow and more rapid payment for services rendered. The savings resulting from such coordination were much greater than those resulting from lower information and transaction costs [2, p. 7].

What Chandler is saying is different from what Gold, Lamoreaux, and others have said about the relationship between economies of scale and capacity utilization.[5] Chandler's emphasizes the importance of managing the *entire* transformation of M--> C--> M'; he does not focus simply on acquiring the market power to be able to operate a plant at the optimum level of output.

The contrast between the important but more traditional arguments about the importance of capacity utilization and that of Chandler is perhaps most clearly made by thinking about the role that size of plant usually plays in explanations of the increased importance of market power in the late 19th century. It is often argued that in many industries increased size of optimum output of new plants made such control of critical importance. Relatively high fixed costs and excess capacity are described as the driving force behind mergers. The temptation, already noted, is to understand Chandler's emphasis on economies of speed in transforming money into money as a variation on this well-known story. However, Chandler's emphasis on management of throughput *would be equally valid even in an industry that had little fixed capital.*

William Doyle's study of the meatpacking industry--an industry in which a few firms gained dominance--show it to have been an industry where working capital was of great importance relative to fixed capital. It was, however, an industry where speed of throughput (M--> C--> M') was a dominant concern and where financial resources--both retained earnings and short-term borrowing--were greatest for those firms that could speedily process cattle into meat into money. These financial resources then paved the way to

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[5]See pp. 344-45 in [2] on the National Biscuit Company, for example, and Gold [9. p. 28]. Lamoreaux's [10] case studies vividly illustrate the importance of operating at full capacity to firms newly committed to large-scale production (and lower costs of output).

a market control that allowed greater speed and so on and on [8]. The rise to dominance of a few firms depended, therefore, upon effective management of M--> C--> M' rather than upon full use of fixed capital; and thus may have been true even in those industries where fixed capital was of greater importance.

A substantial barrier to acceptance of the idea that it was speed in transforming M into M' that gave firms with effective management of throughput such great advantage is the reluctance of economists to fully incorporate the C --> M' part of the transformation into analysis. Or, for that matter, to deal fully with M --> C. The standard economics of the firm is, with a few exceptions, the economics of C, which is to say, the economics of production. The exceptions are obvious: analyses of price control allowed by market-power and the impact of vertical integration (whether backward or forward) on costs. What are not dealt with are advertising, creation of brand-loyalties, product demonstration, repair, and other marketing services [6, p. 88].

A second substantial barrier to incorporation of the idea of speed in transforming M to M' into the normal language of economics derives from what the late Dudley Dillard described as the exorcism of money from the theory of production:

> Like God in Unitarian theology, money is there, but it does not do very much. This is ironical because capitalism is above all a monetary economy, yet it [is] presumed to behave as if it were a barter economy [7, p. 256].

The importance of the management of a monetary production process in which money does play a key role is, however, central to Chandler's story. To that story we can add no further evidence, but we do offer a corroborating interpretation from a turn-of-the century observer of the emerging business firm. Thorstein Veblen's account of the emergence of large firms is remarkably similar to Chandler's and captures some elements of the processual character of the economies that most concern Chandler. Before the machine age, Veblen argued, the business management of industrial processes proceeded by businessmen taking "advantage of the conjunction offered by the course of the seasons and the fluctuations of demand and supply." With the advent of the machine age the businessman found that he could manipulate the "conjunctions arising from the interplay of the industrial" rather than "staking his values on the dimly forseen conjunctions of the seasons and the acts of God" [14, pp. 17-18]. The "great business coalitions and industrial combinations" that Veblen noted as characteristic of this time were, he thought, a consequence of the "concatenation of [industrial] processes" that had "given rise to a class of pecuniary experts whose business is the strategic management of the interstitial relations of the system." Veblen illustrated his point by citing iron and steel production, oil production, and oil refining. About these he observed that "industry depends closely on receiving its supplies from certain, relatively few, industrial establishments whose work belongs earlier in the process of elaboration. And it may similarly depend on certain other,

closely defined, industrial establishments for a vent of its own specialized and standardized product. It may likewise depend in a strict manner on special means of transportation" [14, p. 12]. In short, Veblen described the importance of control over the entire process of M --> C --> M', *and* he insisted on the pecuniary nature of this process.

Economies of Speed and Transactions Costs

Does transaction cost analysis capture the processes described by Chandler and Veblen? Chandler includes reductions in transaction costs among his causes of firm transformation in *Scale and Scope*, and it seems to fit his description of economies of speed as a result of "routinized transactions between interdependent activity cells." On the other hand, in his recent article in *The Journal of Economic Perspectives* [6], Chandler is more cautious in equating his own approach with that of the transaction-cost theorists. He identifies the basic difference between himself and Oliver Williamson as disagreement over the basic unit of analysis. For Williamson it is the transaction; for Chandler it is the firm [6, p. 85]. We think there are other differences as well.

Reductions in the costs of transfer of property rights associated with the transfer of goods or performance of services were certainly partially responsible for the decreased average costs of goods at the end of the last century. However, the difficulty with treating Chandler's descriptions of the efficiencies of new firms in the late 19th century as a consequence of reductions in transactions costs is that Chandler focuses on a managerial process rather than on the costs of acquiring inputs.

Although transaction cost analysis is, as Williamson says, about contracting rather than production, the framework of analysis remains the framework used to analyze costs of production [15]. It is the cost of producing output that is reduced by reducing transaction costs. The focus shifts from physical transformation of ore to iron (for example), but remains on costs to the firm. While transaction cost analysis broadens the focus to include cost of transactions necessary to move from M --> C and from C --> M', it does not incorporate management of the process into the analysis. This is of critical importance because what Chandler offers evidence for is the importance of control over the repeated process. This control insures speed, and it is the speed of transforming M into M' (via the usually necessary step of producing C) that is of the essence for the success of the firm.

Conclusion

Economies of scale and scope rigorously defined are not well-suited for analysis of firm transformation over time; if loosely used, they are more suitable terms to summarize the process of transformation that Alfred Chandler has described for us than if restrictively (and logically) defined. What is puzzling, however, is that the speed of throughput upon which Chandler has placed so much emphasis--explicitly in *The Visible Hand* and implicitly in subsequent work--is not among the major causes that contribute to economies

of scale and scope as loosely, that is observationally, defined. Given plant, and granting the importance of "running full," speed is not important if the focus is, as it usually is, on the costs of the intermediate C-producing step. Transaction-cost analysis does not escape the traditional emphasis on this middle step. If, however, we adopt a monetary theory of production--if we view the firm as an organization seeking to turn M into a greater M'--then the entire process vital to firm operation and survival is open to analysis. Such a theory of production allows the concept of "economies of speed" to be reinstated to the place of prominence that it had in *The Visible Hand.*

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