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## Knowledge and Power in the Mechanical Firm: Planning for Profit in Austrian Perspective

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**Abstract.** This essay draws on the transaction costs model of the firm and an Austrian perspective on the knowledge problem in centrally planned orders to propose an empirically useful Austrian theory of central planning. After an initial review of existing theories of the firm, part two develops insights from the calculation debate to sketch a theory of planning centered on the interrelated problems of purpose, information and control in both individual and central planning. Part three joins this theory to the basic framework of the transaction cost model to produce an Austrian theory of the private firm that addresses the relation between knowledge and power in planned orders, and illustrates its principal themes through a discussion of the historical development of American manufacturing in the fifty years prior to World War I.

**Key Words:** theories of the firm, production contracts, central planning systems, scientific management

**JEL classification:** B5, D23, P11.

### 1. Theories of the Firm

From the beginning, economists of every persuasion have struggled with the problem of the firm. In his *System of Moral Philosophy* (1755), Francis Hutcheson, Adam Smith's teacher at Glasgow and his predecessor in the chair of moral philosophy, described the division of labor as a *method* and the various tasks it encompassed as being *assigned* to one person or another, words that suggest a conscious design executed by someone with the authority to issue orders and move workers about to increase productivity or profit (Cannan 1937:xliv–xlv). This brings to mind a factory or an office and, Smith observes at the outset of his own luminous discussion of the subject, it is in just such places that most people mistakenly suppose the division of labor is developed to its fullest extent. So he begins with a “trifling manufacture,” the celebrated pinmaking firm in which “the whole number of workmen must necessarily be small; and those employed in every different branch of the work can . . . be collected into the same workhouse, and placed at once under the view of the spectator” (Smith 1937:4). There, thousands of pins are produced each day by workers using simple machines to perform eighteen distinct operations, all done in close proximity under the watchful eye of a supervisor, in exchange for piece rates or a daily wage. But Smith does not explain why this relatively simple allocation of tasks should come to be administered within a firm, while the infinitely more complex, global division of labor within which it is embedded is created spontaneously by free exchange in markets. Almost a century later, observing the development of the English factory system and the inequalities of wealth and power it produced, Karl Marx described the capitalist

firm as a harsh arena of authority and exploitation. In his ineluctable teleology, firms grow without limit, continuously transforming artisans and merchants into an expanding army of immiserated workers and laying the organizational foundation for what Lenin called “the first phase of Communist society.” Then, “the whole of society will have become one office and one factory,” with the requisite tools of control “within the reach of anybody who . . . knows the first four rules of arithmetic.”<sup>1</sup>

We may be thankful for the demise of Lenin’s political vision, but the image of strict hierarchy and straightforward calculation in production has been preserved in the neoclassical theory of the firm, the dominant paradigm of the twentieth century. The centerpiece of the neoclassical edifice is its theory of the consumer, which depicts consumption as the transformation of goods into utility and living people as single-minded, rational maximizers. As a description of real human behavior, this model of constrained optimization is at best a caricature. Still, for all its abstraction, it is possible to recognize in it the actions of real people making purposeful choices in everyday life. But the neoclassical theory of the firm, equally formal and abstract, seeks to portray not people but organizations, more or less tightly knit associations of individuals bound together for the purpose of making and selling goods. Organizations do not act like people, even unusually focused or single-minded people. Yet despite the obvious differences in their subjects, the neoclassical theories of the consumer and the firm are virtually identical in form and in the story their common mathematical substance tells. Like the consumer, who decides what to purchase by solving a set of equations relating marginal utility to marginal cost, the firm decides what to produce by solving similar equations relating marginal revenue to marginal cost. Like the consumer, always in disciplined pursuit of utility, the firm is a creature of unitary mind and will in full control of its actions, a single brain directing a perfectly responsive body in an undeviating search for maximum profit. As it does, the firm, like the consumer, is assumed to command a great deal of relevant knowledge. It knows the state of the technological art and the price of every input, so it can choose from among all possible technologies the one that minimizes the cost of producing output and thus calculate the most favorable array of marginal costs, and it knows the price at which it can sell every unit of output it produces, so it can superimpose a marginal revenue function on those marginal costs. In this powerful light, the firm can see exactly how much profit it will earn by employing every possible technology at every possible level of output, so that achieving its objective becomes, as Hayek (1945:519) noted in the analogous case of central economic planning by the state, a simple matter of mathematics.<sup>2</sup>

I call this model the *mechanical firm*, and will have more to say about it here. But in an important sense, this is not a theory of the firm at all. Though it does offer a rudimentary picture of what the firm is supposed to *do*, it tells us almost nothing about what the firm *is*, why and how production might come to be committed to firms in the first place, why any firm is organized in the way it is, or why it has expanded to just the extent that it has. Indeed, in the still more rarefied atmosphere of general equilibrium theory, there *are* no firms. There are only “agents,” discrete mathematical objects that are simultaneously consumers and producers, turning income into goods to maximize utility and inputs into outputs to maximize income. Projecting the array of changing prices that the market transmits instantly and accurately to them on the constantly shifting background of their own

incomes, preferences and technologies, all of which they know perfectly, they calculate just what they must do to achieve both these objectives, and then effortlessly seek out and trade with other agents like themselves, who are waiting to buy what they have and sell what they want. In a world like this, there is no rationale for firms at all.<sup>3</sup>

A powerful alternative to the neoclassical theory, rooted in the institutional economics of John R. Commons (1934a) and drawing on Herbert Simon's (1957:198) concept of bounded rationality, has developed alongside it. Commons began with the smallest observable unit of economic activity, the transaction that allocates control over resources to individuals or collectives. He identified three types of transactions, one (the bargaining transaction) based on voluntary exchange between equals and two (rationing and managerial transactions) involving allocation by command. All three take place within a universe of overlapping social systems, large and small, ranging from the family, the firm and the labor union to the state and the economy itself, that Commons called *going concerns*. Within each concern, transactions are governed by working rules that constrain individual behavior, and as long as the rules are generally acceptable to its members, the concern will function smoothly and there will be little change in the rules. But as conditions within and around the concern change, conflicts over the conduct of transactions arise that threaten the continued operation of the concern unless they are resolved by some adaptive alteration of the rules. Commons, however, was unable to specify precisely how this evolutionary mechanism operates. He portrayed the modern firm as a going concern in which arms-length bargaining between input owners is supplanted by the inequality and command characteristic of managerial transactions. But he could not say why this shift from markets to hierarchy might occur, why there are firms at all.<sup>4</sup>

While Commons was still alive, Ronald Coase (1937) addressed this question by joining the idea of transaction cost to the concept of substitution at the margin. Coase defined the firm as a long-term contract among previously independent input owners, in which all sides agree that allocation among them will no longer be left to free exchange at flexible prices, but will, within limits, be governed by command of an entrepreneur committed to pay fixed prices to his subjects in exchange for their submission. Why would anyone sacrifice the freedom of action enjoyed in the market for the discipline of the firm? Coase's answer was that "there is a cost of using the price mechanism" (1937:390), especially to organize complex processes of production. In the market, potential trading partners must constantly be sought out and prices negotiated, and the same free agency that permits individuals at every moment to seek the most favorable terms simultaneously creates uncertainty over the supply of the resources they need and demand for those they own, making the precise coordination necessary in some kinds of production hard to achieve. But if this is so, as Lenin might have asked, "why . . . are there any market transactions at all? Why is not all production carried on by one big firm?" (1937:394). Again, the answer is cost, this time the costs of organizing production within a firm, which are primarily the result of bounded rationality: "it may be that as the transactions which are organised increase, the entrepreneur fails to place the factors of production in the uses where their value is greatest" (1937:394–395). Coase drew the necessary conclusion: "a firm will tend to expand until the costs of organising an extra transaction within the firm become equal to the costs of carrying out the same transaction by means of an exchange on the open market" or within another

firm (1937:394). “In a competitive system,” he noted with a hint of surprise, “there is an ‘optimum’ amount of planning!” (1937:389).

For thirty years, Coase’s essay lay dormant. The reason, Oliver Williamson (1975:3) believes, was that while Coase properly put transaction costs at the center of his theory, they “are not operationalized in a fashion that permits one to assess the efficacy of completing transactions as between firms and markets in a systematic way.” Accordingly, Williamson’s project has been to “align transactions, which differ in their attributes, with governance structures, which differ in their costs and competence, in a discriminating (mainly transaction cost-economizing) way” (Williamson 1996:356). He identifies three critical dimensions of production transactions that, in combination with the opportunism and bounded rationality of “contractual man” (1985:43–67), generate an array of costs that renders particular forms of governance more or less functional in various transactional environments. The first is uncertainty, especially regarding the opportunistic behavior of others, which generally militates for the security of contract as against the freedom of markets. But the second dimension, the frequency with which similar transactions between the same parties recur, and the third, asset specificity, receive greater emphasis. The specificity of physical capital and the idiosyncratic knowledge of people makes them much more valuable in some circumstances than in others. The time and effort needed to negotiate terms of trade in such cases and the opportunities they present for strategic behavior are potent inducements to contract. If such bilateral monopolists must deal with each other on a regular basis, the pressure to replace the cost and acrimony of recurrent bargaining with the once-and-for-all negotiation of a long-term contract will be stronger still. In this way, the typical business enterprise gravitates from market to contract, extending itself backward and forward along the chain of production by offering the free agents who provide its inputs and buy its outputs the chance to join the contract themselves. As long as the relationship between the firm and a still independent trading partner is a recurrent bilateral monopoly, the line separating them is likely to vanish. But where the goods traded across the firm’s boundary are sufficiently homogeneous to support effective competition on one side or the other, the firm’s growth will stop (cf. Adelstein 1998:62–63).

This is very persuasive, particularly in its characterization of the firm as a multilateral contract intended to govern economic relations over long periods of time and the opening it affords to understand hierarchy as a response to transaction costs, points to which I return in part three. But Williamson’s formulation of the contractual model is open to serious criticism. He is inconsistent in his treatment of the knowledge available to potential participants in the firm at the moment of contractual choice. Despite the centrality of bounded rationality and impacted information to his argument, markers of the radical ignorance at the core of Austrian analysis, Williamson’s actors nonetheless have enough foresight to anticipate the consequences of the choices they confront to enable them to decide whether or not to join the contract, even where there is no way to predict these consequences until they occur.<sup>5</sup> And like Commons (and Marx), Williamson’s theory has a strong teleological flavor, in his case, a *causa finalis* of efficient adaptation to transaction costs. As Gregory Dow (1987:26) aptly summarizes Williamson’s argument, “governance structure *X* exists because efficiency requirements dictate *X* for transactions of type *Y*.” But Williamson proposes no effective process driven by purposive action of individuals that registers conditions

in the exchange environment and causes joint-cost-minimizing contractual forms to emerge in response to them. Without such a process, as Dow's functionalist slogan suggests, the analysis is reduced to describing the problem-solving character of particular forms at given moments, and collapses cause and effect into tautology.<sup>6</sup>

In a slightly different key, both of these criticisms have been made by Austrian economists as well.<sup>7</sup> In recent years, several Austrian writers have cited the lament of O'Driscoll and Rizzo (1985:123) that "there is no subjectivist or Austrian theory of the firm . . . even though the subjectivist approach is particularly appropriate for analyzing firms as evolved social institutions." But each of the complainants has gone on to make a contribution of his own to the field, with the happy consequence that there is now a range of provocative and potentially illuminating Austrian theories of the firm on offer. All of them are different, sometimes importantly so, but all share the distinctive virtues of the Austrian approach. Each begins with the open-endedness of the economic universe and the essential unknowability of the relevant future, and takes as given the subjectivity and dispersal of knowledge, often in tacit or immanent forms, across individuals. They recognize production as a process taking place in real time, and thus avoid the debilitating problems created by the artifice of equilibrium. And they place the Kirznerian entrepreneur at center stage, linking the emergence of firms to the discovery of new opportunities for profit and the entrepreneur's need for the close cooperation of others to exploit them.

They fall into several broad categories. One (Witt 1999, Yu 1999:29–31) stresses the *cognitive* aspect of entrepreneurship and leadership in organizations, arguing that firms come about when entrepreneurs succeed in persuading others to share their new way of conceiving the production and sale of some good, so that associating to execute the entrepreneur's plan serves all their interests. A second group (Dulbecco and Garrouste 1999, Yu 1999:32–38, Lewin and Phelan 2000) focuses on the *time dimension* of production and the complementarity of inputs and sees the firm as a specific capital structure organized by the entrepreneur. The third approach (Ioannides 1999, Sautet 2000) incorporates the first and understands the firm as an *organization* created by consent, a *planned* social order<sup>8</sup> within which an ongoing process of entrepreneurial discovery is organized. Finally, a "near-Austrian" approach, the *capabilities* theory (Nelson and Winter 1982, Foss 1993, Langlois and Robertson 1995), agrees that firms are planned orders but shifts the analytical focus by extending the cognitive perspective from the entrepreneur to the organization itself. It describes the firm as a repository of collective, tacit knowledge and capacities embodied in firm-specific routines that are created internally and evolve over time in a competitive environment.

There is much to be learned from this stimulating new work. But none of these theories, even those that (correctly, in my view) depict the firm as a planned order, satisfactorily addresses the central feature of real firms, particularly the early manufacturing firms emblematic of industrial capitalism, the internal allocation of resources through some form of hierarchical planning. Firms are but one of many past and present examples of successful central planning, public and private, in the modern world. As Alanson Minkler (1993:582–583) points out, the ubiquity of successful allocation by command poses a serious dilemma for Austrian economists. If they take the lesson of the calculation debate to be that central planning is simply impossible because the planner can never call forth all the knowledge

or information he needs from the people who have or can get it, they are left with nothing more to say about it. The remainder of the Austrian project is thus necessarily confined to analysis of spontaneously ordered systems, so that firms, if they are to be addressed in detail at all, must somehow be portrayed, at least in major part, as spontaneous orders.

Some Austrians, like Cowen and Parker (1997:15, emphasis in original), embrace this conclusion and argue forthrightly that “firms and markets are not exactly the same, but . . . refer to different means of organizing economic activity, albeit means that *do not differ substantially in kind*. . . [There is] no clear-cut distinction between firms and markets.”<sup>9</sup> Stavros Ioannides (1999) and Frédéric Sautet (2000) reject this view in favor of a depiction of the firm as a distinctive locus of consensual planning. But for them, the principal problem facing the firm’s planners is how to preserve or expand *within the firm* the process of entrepreneurial discovery that led to the firm’s emergence in the first place and must continue in some form if it is to compete successfully in the future, a problem that both claim can be addressed only by the nurturing of spontaneously ordered discovery processes within the firm (Sautet 2000:98–132). Ioannides’s theory illustrates the dilemma this creates. He sees the formation of the firm as the imposition of the entrepreneur’s production plan, which may include hierarchical authority, on the firm’s participants, but argues that once the profit opportunity addressed by this initial plan has been won, and the firm’s original entrepreneurial vision revealed for others to see and imitate, the firm must change or die. At this point, the firm becomes a “typical optimiser” (1999:90), and if it persists in this mode in the face of its inability to acquire and deploy essential knowledge, it will soon perish at the hands of entrepreneurial competitors better equipped to discover and act on new opportunities for profit. So it must make its planned order more spontaneous by promoting what Ioannides (1999:91–93) calls *inward entrepreneurship*, the purposeful creation of a system of abstract rules or an organizational culture that spreads the incentive and opportunity to discover new profit opportunities broadly across the firm’s participants in the hope that they will use it in the firm’s interest. But the capabilities theory teaches that organizational forms or cultures of this kind cannot easily be designed; they must evolve over time. And Kirznerian theory seems to imply that if an employee is in fact able to perceive a profit opportunity on her own and has a chance to act on it in her own interest, she will leave the firm to do so unless her personal attachment to the organization is very strong. So the need for continuous entrepreneurial activity creates a powerful centrifugal force within Ioannides’s firm, the reverse of the centripetal force that Marx saw driving firms to expand. If Marx could not say why firms would ever stop growing, Ioannides cannot easily say why they ever grow at all.

Neither Ioannides nor Sautet draws the unwarranted conclusion from the calculation debate to which Minkler alludes, that the knowledge problem will inevitably defeat any attempt at central planning. But while both accept the idea that firms are planned orders, their hearts are not in it. Their appeal to spontaneous order as the hallmark of the successful firm makes clear that, for them, the knowledge problem remains an insuperable obstacle to long-term success in firms governed wholly or in large part by command. They acknowledge that the capitalist firm is always directed toward a governing objective set by the entrepreneur, and often organized in hierarchies through which a few can exert power over many. But they do not extend the Austrian perspective to ask how, or under what circumstances, or through

what kinds of institutions a central planner might in fact succeed in gaining the information he needs and exercising the control he must to realize his objective. They do not, that is, offer an Austrian theory of planning, and thus cannot offer an Austrian theory of the firm sufficiently general to account for the successful hierarchical planning characteristic of the great manufacturing firms that dominated the American economy in the century following the Civil War.

It is a commonplace that knowledge is power. But knowledge does not exist in a vacuum. It is discovered (or manufactured) and communicated within and through a host of overlapping social institutions, only one of which is free exchange in markets. And how it is used in those institutions, by whom and in whose interests, are questions intimately tied to the phenomenon of power. In their intuitively satisfying depiction of firms as contracts governing the process of production over time, Coase and Williamson tell us what firms are and offer reasons to expect them to expand or contract in various environments, and suggest plausible rationales for the emergence of hierarchical authority as well. But Austrian analysis, with its focus on the enormous demands on cognitive capacity and the ability to gather essential information required for central planning, exposes the incompleteness of the institutional perspective and offers a promising opening to explore the relationship between knowledge and power in planned orders. My purpose here is to join these two approaches to propose an Austrian theory of central planning and show how its principal themes are illustrated by the development of American manufacturing firms in the fifty years before World War I. I argue in part two that there is a different, more empirically robust lesson to be drawn from the calculation debate, one that identifies conditions under which central planning may indeed succeed for long periods of time in the face of one form or another of the knowledge problem. The conclusion of the debate, I suggest, is best seen not as a definitive, negative answer to the question of whether central planners can ever hope to gather and deploy the information they need to ensure the success of their plans, but rather as a paradigmatic series of questions that, taken together, I call the *planner's problem*. In the face of the knowledge problem, how can the planner select a governing purpose for the plan, acquire the information he needs to formulate a strategy to pursue it, and gain the control he must exercise over his subjects to achieve the plan's objective? I briefly consider several different ways in which the planner's problem can be solved in practice, and thus propose an empirical component to a theory of planning centered on the existence and successful solution of the knowledge problem in organizations.

In part three, I join this theory of planning to the basic framework of the transaction cost model to offer a more complete Austrian theory of the firm, one with something to say about hierarchical authority in firms. The institutional component of this theory is substantial, but I nonetheless call it Austrian because the answer it suggests to the question of why there are firms is not the answer given by Coase and Williamson, that firms emerge and persist because it is less costly to organize production by contract than in markets. Rather, firms emerge because the entrepreneur needs the close cooperation of others over time in complex production environments to realize her vision (as the cognitive theories of the firm suggest), and persist because she has succeeded in discovering and implementing a long-term solution to the planner's problem around which the firm can be organized. I add an historical component to the analysis by discussing the system of inside contracting



that was common in small factories prior to 1870, and the link between the ideal of profit maximization and the entrepreneurial role played by engineers in the development of American manufacturing in the last years of the nineteenth century. Finally, I consider Frederick Winslow Taylor's (1967) system of scientific management in light of the previous discussion to suggest how the integration of Austrian and institutional themes might illuminate the relationship between knowledge and power in planned orders.

## 2. Toward an Austrian Theory of Planning

Humans are purposive creatures, constantly trying to comprehend the world and manipulate it in their own interests. In this sense, planning is universal, a fact of life. Purposive action requires visualization and will, the ability to imagine a specific future and then intend that it actually come about. People have these powers, and undertake hundreds of purposive acts every day, from simple, almost automatic acts like getting out of bed to complex ones like getting married.<sup>10</sup> Though we often speak of planning as something done by abstract collectives, the purpose and cognition it demands make it clear that planning is done by people, not by groups or organizations as such. So let me define *individual planning* as what men and women do when they are free to pursue their own purposes, and *central planning* as the subordination, by whatever means and to whatever extent, of one or more individuals' purposes to those of the central planner. Then, the question posed by the opposition of spontaneous order to central planning is not whether there will be planning or not, but rather who will plan, and for whom.

The act of planning is composed of three elements. The first is the formulation of a purpose or objective, envisioning some future and intending it. Next, the planner must conceive a strategy, a series of actions that she believes will serve to realize the objective. This second step necessarily involves the use of two different kinds of knowledge or information, *theory* and *data*. By theory I mean simply a mental picture of how that part of the world relevant to the planner's objective works, how its various components are related to one another and thus what the results of particular actions taken under specific circumstances are likely to be. Given the abstract knowledge provided by such a theory, the planner must then gather concrete data about the actual state of these components at the moment action is to be taken, so she can apply the theory to the problem at hand and devise a course of action to achieve the objective. Finally, the strategy must be implemented, which requires the planner to exert sufficient control over all the actors contemplated in the strategy to ensure that the prescribed actions are in fact undertaken. With this last step, the interior act of planning is made manifest in the exterior world; the mental construct of the plan becomes purposive action in the realm of human affairs.

These three elements suggest what I call the *planner's problem*. Every act of planning, individual or central, must overcome a series of obstacles associated with the three elements that we may summarize as *purpose*, *information* and *control*. First, an objective must be established, an outcome or set of criteria against which the success of the plan can be tested. Then, enough information to construct a useful theory and apply it to the particular conditions of the moment must be collected and used to devise a strategy for reaching the goal. Finally, effective control over events and behavior must be gained, so that the

planner's wishes are carried out. The three parts of the planner's problem are generally interrelated. The nature and quantity of the information needed to form a strategy, and the planner's ability to rely upon or control the behavior of the people who have it or whose cooperation is essential in other ways to the success of the plan, will often depend on the objective at stake, even where the plan is executed by a single person in his own interest. It is pointless to choose an objective so complex or sophisticated that the information necessary to plot an effective strategy is inaccessible. And insofar as I must, say, get the money to buy a car by inducing other people to give it to me in exchange for goods or services of my own, a plan to purchase a car beyond my means will fail for want of control over others. Such is the case in central planning as well. A plan to redistribute income may so divide a population that the planner's efforts to determine how much income there is to be redistributed, where it is and how to get it from one person to another may be frustrated by the refusal of opponents to cooperate. But if even millions of otherwise independently-minded people believe themselves to be in imminent danger of conquest, they may be prepared to reveal everything they know, and do whatever they are told, to ensure the success of their government's plan to defeat the enemy.

Every planner must somehow solve all three parts of the planner's problem. But the questions of purpose, information and control are posed very differently for individual and central planners. In spontaneous orders, every person plans for herself, in pursuit of her own interests, informed by her own values. The function of the order is not to subordinate their many interests to a single purpose, or to organize their interaction so as to create a preconceived outcome, but to mediate among interests and reconcile all the plans in a larger pattern that is not part of any plan. By placing the authority to plan and responsibility for the results in individuals, it addresses the planner's problem in the style of Descartes, replacing one big problem with many small ones and giving every person the incentive to acquire the knowledge she needs to solve the small problem for which she has chosen to be responsible. In central planning, when the success of the plan requires specific information held by individuals, the planner has no choice but to turn to those people for the information he needs, if he can determine who they are. But if the people do not trust the planner to act in their interests, if they do not agree with his objectives or if they suspect he will use what they know for purposes they do not share, it will be very hard to pry the needed information from them. Even if he resorts to violence or coercion, the planner can never be sure that the information he is receiving is reliable; like confessions beaten out of suspects in the stationhouse, it is hard to tell whether what he hears is true or merely whatever the suspect thought would stop the beating. All of these problems are compounded when the information in question is subjective or interpretive, not expressible as "facts" or numbers. And without giving individuals the power to use what they know for their own purposes, it is all but impossible to discover new knowledge not already possessed by the planners (Hayek 1978).

Consider the calculation debate in this light. At issue was what the debaters called the feasibility of a rather peculiar form of socialism, in which a central planner would try to allocate a nation's resources efficiently to individual preferences just as the market did, at the same time that she used her ownership of capital to redistribute income more equally than the market could. Efficient allocation in this sense is perhaps as difficult an objective

for central planning as can be imagined, and that the socialists allowed the debate to be contested on this ground is what determined the outcome in favor of the Austrians. Once the formal equations defining efficient general equilibrium were in place, the socialists believed, the allocation problem facing the central planner would be no different in principle from the one facing individual consumers: maximizing welfare by allocating the resources at hand on the basis of marginal equalities, the problem Lenin (1943:84) described as demanding nothing more than “arithmetic.” But as Hayek (1945) brilliantly argued, their mistake was to conflate the distinct categories of knowledge represented by theory and data and to think that in articulating a theory of efficient allocation, they had also solved the problem of applying it in practice. The quantity of data, subjective information about values and costs, required for efficient allocation to individual preferences in even a hypothetical economy with fixed preferences, technology and endowments is staggering. Markets unlock this information from the minds of individuals with the key of self-interest, but without them, central planners must ultimately trust those individuals to reveal what only they can know for certain, if they know it at all. Hayek saw this division of knowledge as an inescapable part of the human condition that only the market order, with the incentives created by its corresponding division of the power to plan, could overcome. The inability of comprehensive state planning to produce even a tolerable level of efficiency in practice meant that it must eventually fail, not because the planners were necessarily villains, but because their subjects would starve. The chaotic economic collapse of Eastern Europe he lived long enough to see proved him right.

The clear lesson of the debate is that the hardest central planning problem imaginable, efficiently allocating resources to subjective individual preferences across an entire economy by fiat, cannot be solved because the objective requires information that the planner cannot obtain. Note that this result obviates the question of control; because the planner cannot formulate the commands he must issue for want of essential data, how much control he might be able to exert in enforcing them is moot. But this hardly implies that central planning itself is always impossible or invariably doomed to failure. For if the planner’s objective does not demand vast quantities of subjective information he has no way to obtain, or if his subjects can somehow be made to identify with his purpose or cooperate in achieving it, he may well succeed in solving all three parts of the planner’s problem. The twentieth century is replete with examples of successful, large-scale state planning for purposes other than efficient allocation to individual preferences on both sides of the Iron Curtain, from the planned economies of the combatants in two world wars to the rapid industrialization of the Soviet Union between them. More pertinently, the debate’s exclusive focus on state planning draws attention from the ubiquity of planning in the private sector and toward an unrealistically simple world of just two alternative modes of economic organization, the polar cases of perfectly atomistic markets and comprehensive state planning.

But modern capitalism is more complex than that, and as the success of large private firms makes clear, it is a mistake to associate central economic planning solely with the state or to assume that its goal is always efficient allocation defined in terms of freely formed individual preferences. Thousands of firms, some with internal economies comparable to those of small countries, have found ways to achieve the coordination and control needed to harness the human and material resources at their disposal to the efficient pursuit of their

own specific and often complex objectives. It is true, as the entrepreneurial and capabilities theories of the firm point out, that under the pressure of competition large modern firms, particularly those in services as opposed to manufacturing, have successfully introduced an element of spontaneity into their operations by decentralizing decisionmaking and encouraging initiative in the discovery of new methods and profit opportunities. But hierarchical authority remains to some degree a characteristic feature of even these firms, and one cannot understand the historical development of manufacturing firms since 1870 at all without taking full account of the central planning within them.

The planner's problem, then, is not one that simply defies solution, even at the scale of a national economy. Governments able to coerce and corporations requiring active consent have each confronted the planner's problem in pursuit of a range of purposes and managed to address it successfully. Their achievement is best seen as political rather than economic. Hayek's unspoken assumption was that the objectives of the planner and the interests of at least a significant part of his subjects would always be in opposition, and in such a case, particularly if the planner needs tacit or subjective information held by the subjects, the plan is indeed likely to fail. But if the purposes of the planner and the incentives of his subjects can be aligned, if the people actively *want* to tell the planner what they know, the requisite information and control may be secured even where the object of the plan requires them to surrender closely held information to the planner. This is why the socialism of Lange (1938) and his allies, with its Procrustean attempt to build a collective society on the radical individualism implicit in the ideal of market efficiency, seems so strange. A socialism whose noblest vision is efficient allocation to individual preferences is pretty thin broth, hardly likely to fire a people with the commitment and collective spirit necessary to make effective planning possible on a national scale. Socialism must mean something more than this. If it doesn't, there is little reason to replace the market order at all, and the task of socialism is reduced to merely ameliorating the harsher distributive outcomes of free exchange. But if it does, the problem of efficient allocation to individual preferences is replaced by, or subordinated to, the problem of efficiently realizing some other end, one generally defined in collective terms and requiring different kinds of information than is needed to allocate efficiently to the desires of individuals.

Where central planning is animated by purposes other than efficient allocation to individual ends, the cast of the planner's problem changes as well. Planners whose politics or ideology demand that their subjects act in specific ways must offer a vision that can seize people's imaginations and inspire them to identify their own interests with those of the planner and submit willingly to her direction. This unifying principle might be equality, nation, race, religion, victory or something else altogether. Where it already exists within the people themselves, or where it can be manufactured and imposed from above, a compelling *common purpose* may even pose the planner's problem in such a way as to avoid the need for information held by individuals entirely and thus reduce the problem to one of control alone. A lieutenant charged with taking a hill has little need for bits of idiosyncratic knowledge his troops might have; for him, the problem is persuading them to act, and infusing them with a willingness to sacrifice for a common purpose is an effective way to solve it. Even where the success of the plan does depend on the readiness of individuals to volunteer what they know, as in the war economy that produces the bullets the soldiers fire,

the common purpose may suffice to induce millions of people to suppress their personal interests and march in step behind their leaders.

The advantages of a common purpose in solving the planner's problem can be realized in other ways. A charismatic leader may unify a people by sheer force of personality, inspiring their trust in him as the embodiment of their interests and their submission to his leadership as such rather than to any specific purpose or objective. Or, as Mao Zedong believed, a sustained campaign of exhortation, persuasion and education from above may in time produce a New Man, one "with no selfish interests, heart and soul for the people," who would instinctively know what he must do to advance the interests of the collective and do it on his own initiative, without the prodding, or even the knowledge, of the planner himself.<sup>11</sup> Lindblom (1977:52–62) calls such leadership *preceptorial*, and the psychological reconstruction of the population it entails is a political manifestation of the cognitive leadership Witt (1999) and Yu (1999) see as the entrepreneur's principal role in the firm. But there is still another way to information and control, one that fits more comfortably into the landscape of individualism and has been used by American planners with far greater frequency and success. Both the strength and the weakness of a common purpose as a solution to the planner's problem lie in its creation of a single *end* toward which every person strives. If the people's acceptance of such an end makes the task of planning in a free society significantly easier, articulating a common purpose simple and cogent enough to win that acceptance is a political problem of great difficulty. But if people can be persuaded to pursue what might be called a *purpose in common*, so that every individual sees the realization of the planner's objective as a *means* to her own personal ends, they can freely acquiesce in the plan without surrendering the autonomy of their interests or identifying the planner's purpose as their own. In a sense, the creation of a purpose in common turns the political element of the planner's problem into an economic one, a question of organizing the pursuit of individual ends, not of pursuing the interests of the whole. We should not be surprised to find, as I shall discuss presently, its exemplar not in a state or a political party, but in the modern profit-seeking firm.

All of this points to the promise of an Austrian theory of planning as an analytical and empirical tool. The multitude of potential solutions to the planner's problem, both in theory and in a broad range of political and economic contexts in practice, suggests that the planner's problem be seen as a scientific paradigm in the more modest of the two senses in which Kuhn (1970:175, 187–191) uses that term, as a concrete, shared "exemplar" that provides a unifying focus for research and a basis for analogy in the study of various manifestations of central planning in social life. Isolating and generalizing the three elements of the planner's problem allows us to ask how and in what circumstances it has been successfully (or unsuccessfully) addressed in practice in the past, which in turn enables us to refine and enrich the theory itself. Normal science (Kuhn 1970:23–42) of this sort must, of course, be pursued within the boundaries created by the unknowability of the future; we cannot use the theory as a predictive tool, for we cannot anticipate novel conditions or environments within which the planner's problem might arise, or the myriad solutions to it that the human imagination might propose in response. But we can use it as a window on the past, a way to organize what we do know and understand it more deeply or fully than we could without it. It is to this task that I now turn, to examine the nature and history of inside contracting

and scientific management as successive solutions to the planner's problem in the specific context of American manufacturing.

### **3. The Planner's Problem and the Mechanical Firm**

#### *3.1. An Austrian Theory of the Private Firm*

The cardinal virtues of the transaction cost model are its recognition of the firm as a contract and the plausible reasons it offers for the willingness of individuals to join it and the organizational forms they choose to govern it. For centuries before the emergence of the modern corporation in the mid-nineteenth century, the common law of business was entirely subsumed in the law of contract.<sup>12</sup> The typical American enterprise before the Civil War was a sole proprietorship or small partnership, legal forms closely bound to easily identifiable individuals who were fully responsible as such for the conduct and obligations of the business. Entrepreneurs made employment contracts with workers and sales contracts with customers and suppliers, and it was in and through these contracts that "the firm" was made manifest and took action in the world. Large investments were seldom required, so ordinary men could realistically aspire to their own small business or shop, and easily shut down and open again as conditions warranted. Business relationships were fluid, new partnerships constantly formed and reformed, and though failures were frequent, their consequences were rarely devastating. Much of this changed with the advent of new production technologies after 1870 and the emergence of the limited liability corporation to take advantage of them, but as Coase saw clearly, the essential nature of the firm remained the same. The modern firm too is a contract, a set of more or less well defined rules and procedures that govern a limited range of activities and circumstances and regulate the behavior of the people who agree to it, distinguished from its predecessors only by the number of its participants and the duration and complexity of its terms.<sup>13</sup>

The subject of this contract is how input resources will be combined to produce goods for sale, and like any other contract, people enter into it expecting their interests to be served in specific ways and prepared to accept the burdens imposed on them in return. And as in other contracts, participation is based on consent; anyone may enter the contract if the opportunity presents itself, and once her obligations under it have been met, anyone is free to leave it. This visualization of a relevant future and intention to realize it, in this case through the exchange of behavioral obligations, are the hallmarks of planning. They suggest that the multilateral contract that constitutes the firm is a constructed coordinator of individual plans, consensually brought together in a formal organization whose function is to implement a central plan that serves the interest of every participant. The relocation of production from market to contract thus confronts the contractors with the planner's problem, in much the same form that the calculation debate posed it in the context of state planning. Without free exchange to direct resources to the various aspects of production, the firm must identify some explicit purpose toward which production is to be organized, devise a strategy to allocate the participants' resources, and coordinate their efforts to achieve it. Before anyone can decide whether the relative security against the vagaries of supply and demand to be gained by joining the contract is worth the sacrifice of the freedom of action

she enjoys in the market, she must know generally how the firm proposes to address the planner's problem. How will order be achieved without the invisible hand? Toward what end will production be undertaken? How will the participants' resources be allocated without prices, and how will the information needed to do this be gathered and used? And without free exchange, how will control over behavior be achieved and regulated?

The answers to these questions are the subject of the contract itself, and all are within the power of every contractor to refuse or accept. The range of potential purposes the parties might assign to production is broad. Maximizing profits is only one, if perhaps the simplest one. Subject to some positive profit condition, the participants might also try to maximize sales, or wages, or some other quantitative measure of the firm's performance; make the best product possible; create a sense of social equality or solidarity in the firm; maximize the enjoyment or satisfaction they take from the joint enterprise itself; or more. And the rules and procedures embodied in the firm may organize the pursuit of this objective in many ways: by consensus, requiring (as in the market) that every participant concur in whatever decisions are made, or through some form of hierarchy, vesting in some a limited power of command over others, as the contractors wish. In large, profit-driven firms, where the costs in lost production of achieving consensus on every operating decision are apt to be high, or where an open-ended future makes it impossible to reduce the possibilities to a set of probabilities known in the present, Williamson argues persuasively that hierarchical authority is likely to emerge. But where it does, it is because the parties themselves have agreed to the contract that makes it so, reflecting their willingness to sacrifice the intangible benefits of consensus and small scale for the higher income made possible by large-scale planning and the cooperation by subordination it requires. Driven by the interests and legitimated by the consent of its participants, the contract itself determines the political (or moral) quality of the order it creates.

The characterization of the firm as a complex multilateral contract fits comfortably within both the entrepreneurial and capabilities theories of the firm and opens interesting new questions for each. The contract does not arise, as it were, from nowhere; it is, in the first instance, proposed by an entrepreneur who is able to visualize, at least in large part, its operation in the future as a solution to the planner's problem and persuade others to cast their lot with this vision. And how, precisely, any firm solves the planner's problem, which is the substantive content of the contract itself, is the first and most important of the idiosyncratic capabilities of that firm. Coase and Williamson argue that it is the relative costs, pecuniary or otherwise, of organizing the marginal transaction by market or contract, costs that vary with time and place and change, often rapidly, with shifts in knowledge, preferences and technology, that tip the balance one way or the other. Where previously independent traders see the benefits of governing their relations by contract as greater than those of flexible dealing in markets, firms will grow; otherwise, they will stop expanding, or shrink. To this extent, the theory proposed here accords with the institutional approach. But the difficulty of transforming this broad proposition into a testable hypothesis invites a reformulation of the problem of the firm in Austrian terms, and the informational problem it poses to the potential contractors themselves as they try to reckon the relative costs of organizing production by contract or in markets in an open-ended universe is a focal point of Austrian analysis. By casting the problem not as an ongoing comparison of organizational alternatives at the margin but

as an entrepreneurial search for effective solutions to the planner's problem, the Austrian approach highlights qualitative, continuously variable aspects of form and structure that offer a basis for empirical analysis based on historical observation. The constant adjustment in the scope and terms of existing production contracts and the creation of new ones thus becomes the crucial entrepreneurial activity that creates the variety of organizational forms and cultures that are the visible outcomes of the evolution posited by the capabilities theory.

The open-endedness of events and the radical ignorance (or bounded rationality) it creates preclude the assertion that these evolved forms are in some sense optimal. But we may presume that individuals will pursue their interests as best they can under the circumstances, which is sufficient to drive the evolutionary process. Under the constant pressure of competition, innovative contractual experiments in the organization of production proposed by entrepreneurs in changing environments are continuously conducted and evaluated. The relative success of some of these solutions to the planner's problem in enabling their participants to advance their own interests is observed; these are copied or adapted by others with similar problems in similar environments and survive to provide the raw material for "mutations" yet to come, while those that fail in this sense are abandoned. The purposeful actions of individuals propel this process, and their knowledge and preferences, superimposed on the particular circumstances in which they must act, shape its outcomes. Where they see their own interests as better served by the discipline of mutual obligation than by the freedom of markets, there will be contracts. And where the value they place on personal autonomy in the workplace is less than the rewards of limited submission to the commands of a planner, there will be authority. So, in the evocative words of Dennis Robertson, there come to be hierarchical firms, "islands of conscious power in this ocean of unconscious co-operation like lumps of butter coagulating in a pail of buttermilk."<sup>14</sup>

Even in Adam Smith's time, production contracts could and did encompass large numbers of participants. In the textile industry, for example, the system of *putting-out*, in which an entrepreneur would buy supplies of raw yarn or cloth, deliver them to workers who would turn them into finished goods in their homes in exchange for piece rates, and then arrange for the sale of the completed products, was common. Before the end of the eighteenth century, putting-out had become big business in Europe, and its methods were imitated by scores of smaller but similarly organized ventures in America that were producing clothing, furniture and household goods by the 1790s. But despite their many workers, coordinating labor and the movement of goods in these enterprises posed few problems for entrepreneurs and left workers with a considerable degree of personal autonomy. The work itself rarely required complicated or costly machinery and was generally done at home by workers who owned their own tools, so there was little need to tie up capital in expensive equipment or a central workshop. Where Smith had counted eighteen stages of production separating ingots from pins, the distance from inputs to outputs in these ventures was typically closed in many fewer steps. And with production committed in any case to men and women who combined it with farming or housework, the timing and pace of work, within limits, were necessarily left to them as well.<sup>15</sup>

But through the nineteenth century, industrialization and a factory system based on simple design and interchangeable parts spread across the country. After 1870, an interlocking array of new production technologies made it possible to provide Americans with an



unprecedented range of consumer goods at prices that fell every year. Small, traditionally organized businesses were absorbed by huge industrial concerns, and as the workshop gave way first to the small factory and then to the manufacturing corporation, burgeoning production contracts demanded the conscious administration of entire domains of economic life. Large-scale production was not unique to the United States, or even to the industrial giants of the late nineteenth century. A single state porcelain plant at Meissen in Saxony, for example, employed 730 workers as early as 1765, and 243 collieries, almost all of them owned by the state or the great feudal landlords, were operating in Upper Silesia by 1785 (Henderson 1975:25–26). But the engagement of the state in most of these enterprises and the continuing influence of feudal ties in the others suggest the strains imposed on the production contract as it expands. The rough equality of authority and consensual decisionmaking possible in small groups must, for reasons much like those that bring about the contract in the first place, yield to more hierarchical forms as the enterprise grows. If every operating decision requires the concurrence of most or all of the firm's participants, the monopoly each has in his own consent simply reproduces the opportunities for strategic bargaining that induce the contract itself, especially in environments where the relevant future is uncertain. With free exchange no longer mediating the conflicting interests of large numbers of people, some degree of command is the only alternative to chaos.

### 3.2. *Inside Contracting and the Mechanical Firm*

The choice between consensus and command as general approaches to the planner's problem in the firm is thus closely tied to the question of size. Where only a few people must adhere to a common production schedule, they may decide that the sense of equality and solidarity fostered by a regime of consensus make its costs worth bearing. But even a pinmaking firm of eighteen will find such an atmosphere very hard to sustain without crippling losses in efficiency, and a porcelain plant employing over seven hundred will surely find it impossible. The state as entrepreneur may look to the army or the court as a model for a practical system of authority in an organization of this size, and the erstwhile feudal lord may be able to rely on old habits of obedience and submission to enforce order in his mining enterprise. But American entrepreneurs had no recourse to such methods. In the small factory at midcentury, a common solution was *inside contracting*, an organizational form in which semi-independent foremen, or contractors, assumed the role of intermediary between capital owners and workers. As Buttrick (1952:205–206) describes the system, owners

provided floor space and machinery, supplied raw material and working capital, and arranged for the sale of the finished product. The gap between raw material and finished product, however, was filled not by paid employees arranged in the descending hierarchy so dear to the hearts of personnel experts but by contractors, to whom the production job was delegated. They hired their own employees, supervised the work process, and received a piece rate from the company for completed goods. The income of a contractor consisted of the difference between his wage bill and his sales to the company, plus the day pay he earned as an employee himself. The company's largest single expense was the amount paid to the contractors for finished goods.

Inside contracting enabled owners with little technical knowledge to deploy their capital effectively by limiting their involvement in the actual process of production and devoting their energies instead to the business side of the enterprise, to which their talents were better suited. As setters of wages or piece rates for their workers, foremen generally favored a loose approach based on informal comparisons and time-tested rules of thumb. But as supervisors inside the factory, they drove their charges hard. As it was, factory labor entailed a discipline and subordination to the demands of the clock and the machine that were foreign to workers accustomed to the more relaxed rhythms of the sun and the seasons that governed the workshop. When this was combined with the favoritism, physical abuse and insecurity bred by the foreman's nearly absolute control of his men, the result was a more or less constant state of antagonism in the workplace that resulted in strikes, violence, sabotage and the informal conspiracies of workers to slow the pace of work that came to be called *soldiering*.

As a way of organizing production, inside contracting was a curious mixture of authoritarianism and decentralization. Capital owners delegated the task of management to the foremen, so the firm was no longer the small production contract among rough equals that the older workshop had been, and not yet the huge hierarchical contract between the few with power and wealth and the many without that the corporations would become. It was a confederation of small firms, a nexus of production contracts between owners and foremen, and foremen and workers. While foremen managed labor with an iron hand, hiring and firing at will, they left management of the work itself, decisions about how to perform each job, which tools to use, and how much output constituted a fair day's work, to the workers. This meant that control of the craft knowledge essential to the firm's operation was also decentralized; the specific skills and experience required to perform every task at every stage of production in a given shop resided largely in the heads of the workers who performed them, a point to which I will return. One result was haphazard, highly inefficient production. Labor was sullen and poorly utilized, record keeping and cost tracking were nonexistent or inadequate, procedures across departments were uncoordinated, and deeply entrenched but wasteful shop practices pervaded every industry. When markets were small and localized, and business dealings governed as much by habit and convention as by rational calculation and strict price competition, much of this could be tolerated. But in the sharply competitive environment of rising output and falling prices after 1870, cutting production costs became a matter of life and death for firms, none more urgently than the small manufacturing enterprises that were potential fodder for the growing corporations. To many, the answer lay in more systematic thinking about how the factory was organized and run. As early as 1832, Charles Babbage had warned that "in order to succeed in a manufacture, it is necessary not merely to possess good machinery, but that the domestic economy of the factory should be most carefully regulated." Someone, Andrew Ure wrote in 1835, had to *manage*, to organize "the different members of the apparatus into one co-operative body, impelling each organ with its appropriate delicacy and speed, and above all, training human beings to renounce their desultory habits of work and to identify themselves with the unvarying regularity of the complex automaton."<sup>16</sup>

In the United States, in the forty years after 1870, it was the engineers who stepped forward to do the job. The growth of the engineering profession during this period was

spectacular.<sup>17</sup> The nature of the profession changed as well, as men with formal university training in engineering gradually replaced the mechanics and tinkers of the earlier era. They brought a greater emphasis on formal science in engineering itself and an attitude of professionalism to the shop floor. Increasingly, they became managers themselves. In 1886, Henry Towne's influential appeal to engineers to rationalize the operations of the machine shop, "The Engineer as an Economist," appeared in the *Transactions of the American Society of Mechanical Engineers*, and in the next thirty years, engineering journals became the primary forum for the emerging discipline of management science.<sup>18</sup>

The new managers' first targets were the obvious ones. By introducing job cards and time clocks, they were able to allocate costs to specific jobs and keep closer track of inventories. Rational accounting procedures made it possible to estimate overhead, and centralized purchasing and careful planning in moving parts and materials allowed them to exert tighter control over all aspects of production. These early attempts at "systematic management" broke the power of the foreman by narrowing his discretion and eliminating many of his supervisory duties. But it was the complexity of the new production technologies, the close coordination and scheduling they required and the rapid growth of operational scale they propelled that made the decentralized system of inside contracting itself too costly to sustain. First in the railroads, and soon in all the great manufacturing and distributing firms, salaried managers assumed the functions of monitoring and coordination that fifty years before had passed from the market to the foremen. Arm's length bargaining between owners and contractors and the petty tyranny of the foreman's arbitrary rule over his workers were replaced by formal procedures and a strict hierarchy of authority that ran from manager to worker and staff to line. Information now flowed upward through the hierarchy as commands flowed down, and day-to-day operations were increasingly managed by specialists whose job was to design and construct the firm and direct the actions of people and the movement of materials within it according to plan.<sup>19</sup>

With their accumulating experience in small manufacturing firms and their professional aspirations, men trained as engineers stepped easily and confidently into this new managerial role. From the start, as Towne's appeal implied, engineers saw themselves as a breed apart from the "financiers" who had built the great corporations, possessors of scientific knowledge and a disinterested, rational outlook that made their work not just a profession, but a calling. "We are," George Morison told the American Society of Chemical Engineers in 1895, "the priests of material development, of the work which enables other men to enjoy the fruits of the great sources of power in Nature, and of the power of mind over matter. We are the priests of the new epoch, without superstitions." A generation before Thorstein Veblen's call for the passing of economic leadership from the captains of finance to an elite soviet of technicians, Morison argued that engineers were destined to replace businessmen at the helm of American industry. "Accurate engineering knowledge must succeed commercial guesses," he maintained. "Corporations, both public and private, must be handled as if they were machines."<sup>20</sup>

This last remark encapsulates the engineers' distinctive entrepreneurial vision. The intellectual style engineers brought to management, the way they perceived problems and thought them through, had a deep and lasting impact on economic organization at the dawn of the twentieth century. Their business was designing machines, purposefully applying

scientific theory to practical problems. They had little patience for the economics of Smith, with its prescription of humility in the face of natural processes. For them, the proper metaphor for social life was mechanical, and formed the basis for the solution they proposed to the planner's problem. Like Ure, they saw the industrial firm as a machine as well, its operation reflecting the purposes of its designer and its parts, human beings accustomed to exercising at least some degree of judgment and initiative in the workplace, constrained to move in concert at the command of a single will.<sup>21</sup> The raw materials might be different, but the objective of control and the commitment to science were the same. As engineers, they had used science to manipulate nature in the interests of men. As managers, they would use science to manipulate men in the interests of firms.

But what were those interests? Toward what end was managerial control in the mechanical firm to be directed? For the engineers, the answer was "efficiency," but in the hard light of commercial reality, efficiency was just another name for profits. The more there were, the more could be distributed to owners, managers and workers alike, so it could plausibly be said that increasing the firm's profits was in the individual interest of every one of its many constituents, a common means to a host of different ends. In this sense, the pursuit of profit as the governing objective of the mechanical firm represented a brilliant solution to all three elements of the planner's problem. As noted in part two, the question of what the purpose of production was to be was addressed by a purpose in common rather than a common purpose. Because the income that greater profits could provide enables every recipient to get more of whatever she wants in the market, owners and workers could each willingly surrender their freedom of action to management, owners by relinquishing active control of the firm to managers and workers by submitting themselves to their direction, in their *own* interests, without committing themselves to any common purpose at all. And in this lay the key to the problems of information and control. Because greater profits for the firm were in the interest of every participant, their incentive to reveal to management what it needed to know to plan toward that end, and then do what they needed to do to help the plan succeed, was the same self-interest at the base of the market order itself, despite the surrender of personal autonomy entailed in submission to the production contract.

Equally significant was the ease with which profits could be visualized and, with increasingly sophisticated techniques of cost accounting, quantified. Reducing the purposes of a large, complex organization to the maximization of a single number offered a perfect complement to the mechanical image of the firm and a basis for the development of an applied science of management built on the model of Newtonian mechanics and the creation of professional schools of business to teach it. Independently, but equally in tune with the spirit of the age, the mechanical image found its way into the emerging economic theory of the firm as well. As the new century unfolded, theorists conflated the idiosyncrasies of human knowledge and experience, the peculiarities of machines and the subtle value of relationships between colleagues into an abstract production function that transformed faceless, perfectly substitutable inputs into homogeneous outputs with mathematical precision. Its parts moving in harmony toward the unifying purpose of maximum profit, the firm became both an object and an instrument of control, an imaginary personality of concentrated purpose through which the behavior of real men and women could be disciplined. The commanding influence of this mechanical vision in the neoclassical theory of the firm

continues to the present day. A hundred years ago, in the practical world of people and machines, its epitome was Frederick Winslow Taylor's system of scientific management.

### 3.3. *The Hammer of Science*

Born in 1856 to a prominent Philadelphia family that hoped to send him to Harvard, Taylor concluded that his future lay in engineering, the field in which he thought his talent for mathematics could best be expressed.<sup>22</sup> Though he would later enroll at the Stevens Institute of Technology, his initial training was on the job, as an apprentice machinist in Philadelphia. In 1878, he joined the Midvale Steel Company as a subforeman in the machine shop, quickly rising to shop foreman and, by 1884, to master mechanic and chief engineer. It was as a subforeman that Taylor first encountered the phenomenon of soldiering and, eager to please his superiors, he immediately set himself to eliminating it, the mission that would dominate his working life. His philosophy of management bore the deep imprint of this first experience, and his reflections upon it thirty years later are worth quoting at length.

Almost all of the work in this shop had been done on piece work for several years. As was usual then . . . the shop was really run by the workmen, and not by the bosses. The workmen together had carefully planned just how fast each job should be done, and they had set a pace for each machine throughout the shop, which was limited to about one-third of a good day's work. Every new workman who came into the shop was told at once by the other men exactly how much of each kind of work he was to do, and unless he obeyed these instructions he was sure before long to be driven out of the place by the men.

As soon as the writer was made gang-boss [he told the men] that he was now working on the side of the management, and that he proposed to do whatever he could to get a fair day's work out of the lathes. This immediately started a war . . . which as time went on grew more and more bitter. The writer used every expedient to make them do a fair day's work, such as discharging or lowering the wages of the more stubborn men who refused to make any improvement, and such as lowering the piece-work price, hiring green men, and personally teaching them how to do the work, with the promise from them that when they learned how, they would do a fair day's work. While the men constantly brought such pressure to bear (both inside and outside the works) upon all those who started to increase their output that they were finally compelled to do about as the rest did, or else quit. No one who has not had this experience can have an idea of the bitterness which is gradually developed in such a struggle. . . .

After about three years of this kind of struggling, the output of the machines had been materially increased . . . . For any right-minded man, however, this success is in no sense a recompense for the bitter relations which he is forced to maintain with all of those around him. Life which is one continuous struggle with other men is hardly worth living.<sup>23</sup>

Ioannides (1999:92) describes shirking as a kind of entrepreneurial behavior, a "discovery by some agents that, given the difficulty in the detection of reduced effort, they can reap a

profit” in the form of leisure. But Taylor (1967:14) called organized soldiering “the greatest evil with which the working-people of both England and America are now afflicted,” and laid responsibility for it squarely on management, whose ignorance of the “proper time in which work of various kinds should be done” (1967:18) and opportunistic cutting of piece rates or wages when workers worked harder made soldiering a rational way for workers to protect their own interests.

After a workman has had the price per piece of the work he is doing lowered two or three times as a result of his having worked harder and increased his output, he is likely entirely to lose sight of his employer’s side of the case and become imbued with a grim determination to have no more cuts if soldiering can prevent it. Unfortunately for the character of the workman, soldiering involves a deliberate attempt to mislead and deceive his employer, and thus upright and straightforward workmen are compelled to become more or less hypocritical. The employer is soon looked upon as an antagonist, if not an enemy, and the mutual confidence which should exist between a leader and his men, the enthusiasm, the feeling that they are all working for the same end and will share in the results is entirely lacking.<sup>24</sup>

Taylor thought this antagonism unnatural and insisted that eliminating it would bring moral as well as pecuniary rewards. Increased productivity meant both higher profits for employers and higher wages for workers, a unity of interests that should encourage both sides to “take their eyes off the division of the surplus until this surplus becomes so large that it is unnecessary to quarrel over how it shall be divided.”<sup>25</sup> And if soldiering made men deceivers and hypocrites, an honest system of compensation that prodded them to maximum output would not just raise their incomes but give them the satisfaction that comes with doing their best and make them “better men in every way” (1967:74). The key to discovering such a system was to make management itself “a true science, resting upon clearly defined laws, rules, and principles” (1967:7).

As noted above, inside contracting took the traditional division of craft knowledge as given and did little to disturb its equalizing effect on the division of power on the shop floor. Workers owned not only their own tools but the skills needed to use them, and with this knowledge came a share of real power over the pace and organization of work. They possessed the specialized information needed to determine how, and how much, work was to be done in their shop, knowledge strongly conditioned by local circumstance. They came to this idiosyncratic knowledge not by formal instruction but through observation and learning by doing, and passed what they knew on to others by example and word of mouth on the job. The workers’ monopoly on this knowledge was not total. The foremen, who had themselves begun as workers, typically had experience in a few of the specialized tasks and a general knowledge of the rest (Nelson 1995:43). But few could master every aspect of a complex production process, and none knew what his position in the contracting system made it most valuable for him to know, the maximum sustainable pace and output every worker could achieve. It was workers, individually and collectively, who owned this valuable asset and controlled its use, and they were understandably reluctant to share it with management for fear it would be used against them. This is what made soldiering possible, and forced

firms to adopt what Taylor called the “management of initiative and incentive” to solve the planner’s problem. To get workers to do work only they knew exactly how to do, managers had to offer them incentives, a system that left ownership of the knowledge in the workers and which Taylor saw as not just inefficient and poisoned by hostility but the cause of a steady deterioration of the moral fiber of the workers themselves (Taylor 1967:30–36).

Taylor’s alternative solution to the planner’s problem in the shop was to break the workers’ monopoly with the hammer of science and replace the decentralization of power based on craft knowledge with a hierarchically organized workplace in which expert managers told ignorant workers precisely what to do and how to do it. Every task in the shop would be reduced to a series of minute “elementary operations” performed by a man on a machine, and with the aid of a stopwatch and a strong, agile worker, the time needed to complete each such operation would be computed. Then, with allowances for unexpected variations in the speed of machines or the peculiar qualities of the materials at hand, these times would be added together to produce the standard on which piece rates would be based. In this way, Taylor and his associates derived “sciences” of lifting pig-iron, shoveling, lathe work and much else, each characterized by the rejection of craft knowledge and the adjustment of human performance to the pace and operational requirements of machines to create a single, smoothly integrated productive unit.<sup>26</sup> With the information provided by the time-and-motion studies, management could discover the optimal way to do every job and thus gain possession of all the knowledge needed to control the shop. It could then systematize and codify it, and return it to workers in the form of detailed instructions. The conflict of the decentralized shop would disappear, and no special inducements to win the cooperation of workers in the new regime would be needed, for the unity of interests represented by the greater productivity and revenue Taylor’s system would bring the firm would underwrite harmony in the shop without intimidation or coercion.

Much of this strikes us today as primitive or naive. But Taylor himself never claimed that his was the last word on the science of work or that the essence of his system lay in any of the specific methods or conclusions he or his colleagues might adopt. “Scientific management,” he wrote, “fundamentally consists of certain broad general principles, a certain philosophy, which can be applied in many ways, and a description of what any one man or men may believe to be the best mechanism for applying these general principles should in no way be confused with the principles themselves” (1967:28–29). It was this underlying philosophy, not the specific method of time-and-motion studies, that Taylor hoped would be his lasting legacy, and he was not coy in explicating it. It was about control in the workplace, exercised by professional managers for the benefit of all the firm’s constituents. Taylor would seize ownership of the workers’ most valuable asset and, with the power over the organization of work this gave managers, solve the planner’s problem in the interests of workers and owners alike.<sup>27</sup> His writing is sprinkled with expressions of solicitousness for the working man and confident assurances that the increased income and dignity that come with an honest day’s work made his acquiescence to scientific management a simple matter of self-interest. But the ownership of knowledge, in whatever form, is a potent weapon in the struggle for control of the workplace, and though he never spoke to the matter explicitly, Taylor clearly understood that his system entailed not just “a complete revolution in the mental attitude and the habits of all those engaged in the management, as well as the workmen” (1967:131) but

a substantial transfer of power as well. In his view, the realities of industrial life and labor in an age of science, unpleasant though some might find them, made this transfer of power not just beneficial, but necessary. For though he insisted that “close, intimate, personal cooperation between the management and the men is of the essence of modern scientific or task management” (1967:26) and that “daily intimate shoulder to shoulder contact with the management” (1967:27) would go far toward inoculating workers against soldiering, Taylor was convinced that

in almost all the mechanic arts the science which underlies each act of each workman is so great and amounts to so much that the workman who is best suited to actually doing the work is incapable of fully understanding this science, without the guidance and help of those who are working with him or over him, either through lack of education or through insufficient mental capacity.

... The development of a science ... involves the establishment of many rules, laws, and formulae which replace the judgment of the individual workman and which can be effectively used only after having been systematically recorded, indexed, etc. The practical use of scientific data also calls for a room in which to keep the books, records, etc., and a desk for the planner to work at. Thus all of the planning which under the old system was done by the workman, as a result of his personal experience, must of necessity under the new system be done by the management in accordance with the laws of science; because even if the workman was well suited to the development and use of scientific data, it would be physically impossible for him to work at his machine and at a desk at the same time. It is also clear that in most cases one type of man is needed to plan ahead and an entirely different type to execute the work.<sup>28</sup>

The physical separation of thinkers from doers and the more general subordination of the knowledge and initiative of the worker to the expertise and command of the planner were closely reflected in the day-to-day experience of factory work under scientific management. In the planning room, “every laborer’s work was planned out well in advance, and the workmen were all moved from place to place by the clerks with elaborate diagrams or maps of the yard before them, very much as chessmen are moved on a chess-board” (1967:69).<sup>29</sup> As Taylor described them, foremen on the floor were to be teachers, gently imparting the findings of science to their charges and open to the worker’s own suggestions for improving methods and tools, but in practice they generally did little more than make sure that workers followed instructions from the planning room to the letter. When Taylor’s early experiments in the science of shoveling suggested different optimal shovel loads for different types of shoveling jobs, “instead of allowing each shoveler to select and own his own shovel, it became necessary to provide some 8 to 10 different kinds of shovels,” all of them owned by the company (1967:66). It is hardly surprising that outcomes like this served only to stiffen the resistance of workers to any production contract that required them to surrender their traditional prerogatives and submit to Taylor’s lockstep. The realities of scientific management on the shop floor made Taylor’s repeated insistence that the moral development and material interests of working people were the primary objectives of his system ring hollow in their ears.<sup>30</sup>



If inside contracting was an uneasy mix of decentralization and authoritarianism, Taylor's alternative symbolized the equally paradoxical juxtaposition of individualism and hierarchy with which the emergence of the great corporations confronted the America of his time. In its call for universal adherence to a common body of scientific knowledge and a general willingness to accept central control, it is a harbinger of the twentieth century's varied experiments in collective identity and central planning. Yet at the same time, in its commitment to the moral development of the worker and its reliance on rational self-interest as the universal basis for participation, scientific management as Taylor conceived it remained rooted in individualism. As he saw it, the firm was not an organism, but a machine. What bound its participants together was a common interest in greater profits, not some deeper solidarity based on class, ethnicity or nationality that reduced individuals to cells in the body of a greater social being. Unapologetically authoritarian though his system was, Taylor never lost sight of the ultimate source of this authority, a production contract based on free consent. He did not demand that workers identify themselves with a firm conceived as an organic whole or submerge their own interests in its independently defined purposes. All they had to do was submit to the command of management so that the purpose in common, the maximization of profit, could be realized. But the puppet strings that controlled the worker's every movement from the planning room made clear that individual autonomy and initiative based on informal, personal knowledge were dangers that had to be closely contained. In his more candid moments, Taylor did not shrink from the clearest implications of his system and the engineer's metaphor of the firm as a machine that was its foundation. Workers must "do what they are told promptly and without asking questions or making suggestions. . . . [I]t is absolutely necessary for every man in an organization to become one of a train of gear wheels."<sup>31</sup>

It is easy now to see the pretense in Taylor's attempt to use the methods of physical science to extract knowledge essential to maximizing profits from workers and the deeply subjective, sometimes ugly judgments about the capacities of workers and the value of their knowledge and experience that lay at the heart of his philosophy. But though his specific "discoveries" and prescriptions were never widely adopted in their original form by American manufacturers, the influence of Taylor's entrepreneurial vision, not just in production but in the broader culture as well, has been pervasive and lasting. The general principles of "working smarter" at the practical core of scientific management—the institutionalization of systematic analysis in the workplace, the division of mental as well as physical labor, the emphasis on planning and the separation of thinkers from doers, the substitution of theory for intuition and rules of thumb—quickly took root in American industry and formed the conceptual basis for the nation's emerging system of mass production. Beyond the factory gate, Taylorism helped to inspire the efficiency craze that swept the country in the years before World War I and played a crucial role in the broader postwar effort to legitimate central planning by experts in all aspects of life. It was, moreover, eagerly embraced by the new schools of business administration and the men who led them. The early leaders of the movement to train professional managers, men like Edwin Gay of the Harvard Business School and Harlow Person of the Amos Tuck School at Dartmouth, recognized what Taylor was trying to do as precisely what they wanted their institutions to teach. Person organized a conference on scientific management at Dartmouth in 1911, and in the years before Taylor's

death in 1915, Gay made his system a focal point of the first-year curriculum and regularly invited its author to Harvard to lecture on it. To the present day, decades after Taylor's own methods have been supplanted, the essence of his vision, the ideal of an objective science of work and the training of a cadre of professional managers to practice it, continues to permeate American business.<sup>32</sup>

#### 4. Conclusion

I hope to have shown here that the joining of the institutionalists' concern with the emergence and internal structure of formal organizations in a larger environment of spontaneous order to an Austrian approach to the acquisition, transmission and deployment of dispersed knowledge in centrally planned orders can produce a robust theory of central planning with great analytical and empirical potential. I have trained this theory on the problem of central planning in private, profit-seeking firms, but it seems clear that systematic application of the planner's problem paradigm has much to teach us about the phenomenon of central planning in a range of other contemporary and historical contexts, including not just the many forms of state planning directed at various economic and political objectives but the equally numerous manifestations of private or consensual planning for purposes other than economic profit in social life as well. Further work along these lines is sure to expose errors and weaknesses in my own analysis, and to refine the paradigm in more productive ways than I have been able to achieve here. But if so, this has been one of my purposes in writing this essay. It is meant as a first word on an Austrian theory of central planning, not the last.

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#### Notes

1. See Marx (1977:300–304, 448–451) for his description of the capitalist firm, and (1977:775–781) for its continuing expansion. The quotations are from (Lenin 1943:83–84).
2. Kirzner (1973:32–43) calls this “Robbinsian economizing.”
3. As Brian Loasby (1990:222–224) and Nicolai Foss (1994a:36–37; 1994b:49–52) have noted, the *nexus of contracts* theory of the firm, originated by Alchian and Demsetz (1972) and developed by Jensen and Meckling (1976), leads to this oxymoronic result as well. It depicts agents as possessing all relevant information before contracting begins, and firms as complex sets of market contracts distinguished from ordinary market exchanges only by the continuity of association over time of input owners. Like market exchanges, the terms of these contracts are governed solely by movements in relative prices, leaving no room for the activity of entrepreneurship or the hierarchical allocation of resources characteristic of real firms. Fama (1980) and Cheung (1983) reach these conclusions explicitly, calling for the abandonment of the concepts of the entrepreneur and the firm, respectively.
4. On Commons, see Commons (1934b), Rutherford (1983), Ramstad (1990) and Vanberg (1994).
5. Compare Loasby (1990:226–227).
6. Dow (1987:25–33) and Ramstad (1996). On functional explanation in institutional economics generally, see Adelstein (1981:71–96).

7. See, for example, Foss (1994a:49–55 and 1997:182–183) and Sautet (2000:16–47, 69–71).
8. Thus, for Sautet (2000:6, 82), the firm is “an island of planning in which individuals are end-related, rather than means-related as in the marketplace . . . . The distinctive nature of the firm [rests] on the fact that the firm is an organization, that is to say, a division of labor that serves only one goal: that of the entrepreneur.”
9. In this, they resemble the nexus of contracts theorists discussed at note 3, *supra*. Cowen and Parker’s view is criticized by Sautet (2000:81, 125, 161 n.65) and Foss (2001).
10. Purposive action remains purposive, and continues to require effective use of knowledge and control over events and behavior, even when one no longer has to think consciously about how to execute the plan once the intention is formed. I discuss this point in the context of language in Adelstein (1996:230–234).
11. Mao quoted in Lindblom (1977:277).
12. On the legal history of the American corporation, see Hurst (1970) and Horwitz (1985).
13. On such *relational contracts* generally, see Macneil (1980).
14. Quoted in Coase (1937:388).
15. On putting-out in Europe and America, see Nussbaum (1968:208–211) and Chandler (1977:53–54, 62–64).
16. On inside contracting, see Buttrick (1952) and Nelson (1995:35–49). Babbage quoted in Copley (1923:220); Ure quoted in Viljoen (1974:181).
17. As the nation’s work force grew by some 115% between 1880 and 1910, the number of engineers rose by 485%, and by 1920 by almost 2,000% (Lebergott 1984:349).
18. On the entry of engineers into management, see Calvert (1967:225–243).
19. On systematic management, see Litterer (1961). On the development of managerial hierarchy, see Chandler (1977:381–500).
20. Morison quoted in Layton (1971:58–59). On Veblen and the engineers, see Veblen (1921) and Layton (1962).
21. Compare Calvert (1967:235).
22. On Taylor’s life, see Kanigel (1997).
23. Taylor (1967:48–52).
24. Taylor (1967:23–24).
25. Quoted in Haber (1964:27).
26. Taylor (1967:40–48, 53–68, 77–114), Haber (1964:2–3, 20–24) and Aitken (1960:21–28).
27. This argument is a striking point of contact between the Austrian perspective presented here and the Marxist Harry Braverman’s (1974:85–138) similar discussion of the “deskilling” of workers in scientifically managed firms some thirty years ago.
28. Taylor (1967:25–26, 37–38).
29. Compare Adam Smith’s (1976:233–234) use of the same simile in his discussion of “the man of system” in *The Theory of Moral Sentiments*.
30. On the resistance of workers and unions to Taylorism, see Nadworny (1955) and Aitken (1960).
31. Quoted in Haber (1964:24).
32. On the efficiency fad, see Haber (1964:51–74); Jordan (1994:44–55). On planning by experts, see Haber (1964:75–116); Jordan (1994:68–90). On the influence of Taylorism on advocates of central planning in the economy at large during the 1920s and 30s, see Tugwell (1932:86–88). On business schools, see Chandler (1977:466–468); Jordan (1994:42, 51–52).

## References

- Adelstein, R. (1981) “Institutional Function and Evolution in the Criminal Process.” *Northwestern University Law Review*, 76: 1–99.
- Adelstein, R. (1996) “Language Orders.” *Constitutional Political Economy*, 7: 221–238.
- Adelstein, R. (1998) “American Institutional Economics and the Legal System.” In: Newman, P. (Ed.) *The New Palgrave Dictionary of Economics and the Law*, Vol. I, pp. 61–66. London: Macmillan.
- Aitken, H. G. J. (1960) *Taylorism at Watertown Arsenal: Scientific Management in Action, 1908–1915*. Cambridge: Harvard University Press.
- Alchian, A. A. and Demsetz, H. (1972) “Production, Information Costs, and Economic Organization.” *American Economic Review*, 62: 777–795.

- Braverman, H. (1974) *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century*. New York: Monthly Review Press.
- Buttrick, J. (1952) "The Inside Contract System." *Journal of Economic History*, 12: 205–221.
- Calvert, M. A. (1967) *The Mechanical Engineer in America, 1830–1910: Professional Cultures in Conflict*. Baltimore: The Johns Hopkins University Press.
- Cannan, E. (1937) "Editor's Introduction." In: Smith, A. (Ed.) *An Inquiry into the Nature and Causes of the Wealth of Nations* (1776), pp. xxiii–lx. New York: Modern Library.
- Chandler, A. D. (1977) *The Visible Hand: The Managerial Revolution in American Business*. Cambridge: Harvard University Press.
- Cheung, S. N. S. (1983) "The Contractual Nature of the Firm." *Journal of Law and Economics*, 26: 1–22.
- Coase, R. H. (1937) "The Nature of the Firm." *Economica* (n.s.), 4: 386–405.
- Commons, J. R. (1934a) *Institutional Economics: Its Place in Political Economy*. New York: Macmillan. Reprinted, 2 vols. Madison: University of Wisconsin Press, 1961.
- Commons, J. R. (1934b) *Myself*. New York: Macmillan. Reprinted, Madison: University of Wisconsin Press, 1964.
- Copley, F. B. (1923) *Frederick W. Taylor: Father of Scientific Management*, Vol. I. New York: Harper and Company.
- Cowen, T. and F. Parker (1997) *Markets in the Firm: A Market-Process Approach to Management*. London: Institute of Economic Affairs.
- Dow, G. K. (1987) "The Function of Authority in Transaction Cost Economics." *Journal of Economic Behavior and Organization*, 8: 13–38.
- Dulbecco, P. and Garrouste, P. (1999) "Towards an Austrian Theory of the Firm." *Review of Austrian Economics*, 12: 43–64.
- Fama, E. (1980) "Agency Problems and the Theory of the Firm." *Journal of Political Economy*, 88: 288–307.
- Foss, N. J. (1993) "Theories of the Firm: Contractual and Competence Perspectives." *Journal of Evolutionary Economics*, 3: 127–144.
- Foss, N. J. (1994a) "The Theory of the Firm: The Austrians as Precursors and Critics of Contemporary Theory." *Review of Austrian Economics*, 7: 31–65.
- Foss, N. J. (1994b) "The Two Coasian Traditions." *Review of Political Economy*, 6: 37–61.
- Foss, N. J. (1997) "Austrian Insights and the Theory of the Firm." *Advances in Austrian Economics*, 4: 175–198.
- Foss, N. J. (2001) "Misesian Ownership and Coasian Authority in Hayekian Settings: The Case of the Knowledge Society." *Quarterly Journal of Austrian Economics*, 4: 3–24.
- Haber, S. (1964) *Efficiency and Uplift: Scientific Management in the Progressive Era, 1890–1920*. Chicago: University of Chicago Press.
- Hayek, F. A. (1945) "The Use of Knowledge in Society." *American Economic Review*, 35: 519–530.
- Hayek, F. A. (1978) "Competition as a Discovery Procedure." In: Hayek, F. A. (Ed.) *New Studies in Philosophy, Politics, Economics and the History of Ideas*, pp. 179–190. Chicago: University of Chicago Press.
- Henderson, W. O. (1975) *The Rise of German Industrial Power: 1834–1914*. London: Temple Smith.
- Horwitz, M. J. (1985) "Santa Clara Revisited: The Development of Corporate Theory." *West Virginia Law Review*, 88: 173–224.
- Hurst, J. W. (1970) *The Legitimacy of the Business Corporation in the Law of the United States, 1780–1970*. Charlottesville: University Press of Virginia.
- Ioannides, S. (1999) "Towards an Austrian Perspective on the Firm." *Review of Austrian Economics*, 11: 77–97.
- Jensen, M.C. and Meckling, W. (1976) "The Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure." *Journal of Financial Economics*, 3: 305–360.
- Jordan, J. M. (1994) *Machine-Age Ideology: Social Engineering and American Liberalism, 1911–1939*. Chapel Hill: University of North Carolina Press.
- Kanigel, R. (1997) *The One Best Way: Frederick Winslow Taylor and the Enigma of Efficiency*. New York: Viking Penguin.
- Kirzner, I. M. (1973) *Competition and Entrepreneurship*. Chicago: University of Chicago Press.
- Kuhn, T. S. (1970) *The Structure of Scientific Revolutions*, 2nd edn. Chicago: University of Chicago Press.
- Lange, O. (1938) "On the Economic Theory of Socialism." In: Lippincott, B. (Ed.) *On the Economic Theory of Socialism*, pp. 57–142. Minneapolis: University of Minnesota Press.
- Langlois, R. N. and Robertson, P. L. (1995) *Firms, Markets, and Economic Change: A Dynamic Theory of Business Institutions*. London: Routledge.

- Layton, E. T. (1962) "Veblen and the Engineers." *American Quarterly*, 14: 64–72.
- Layton, E. T. (1971) *The Revolt of the Engineers: Social Responsibility and the American Engineering Profession*. Baltimore: Johns Hopkins University Press.
- Lebergott, S. (1984) *The Americans: An Economic Record*. New York: W. W. Norton.
- Lenin, V. I. [1943 (1917)] *State and Revolution*. New York: International Publishers.
- Lewin, P. and Phelan, S. E. (2000) "An Austrian Theory of the Firm." *Review of Austrian Economics*, 13: 59–79.
- Lindblom, C. E. (1977) *Politics and Markets: The World's Political-Economic Systems*. New York: Basic Books.
- Litterer, J. A. (1961). "Systematic Management: The Search for Order and Integration." *Business History Review*, 35: 461–476.
- Loasby, B. J. (1990) "The Firm." In: Creedy, J. (Ed.) *Foundations of Economic Thought*, pp. 212–233. Oxford: Basil Blackwell.
- Macneil, I. R. (1980) *The New Social Contract: An Inquiry into Modern Contractual Relations*. New Haven: Yale University Press.
- Marx, K. [1977 (1867)] *Capital*, Vol. I. Translated by B. Fowkes. New York: Vintage Books.
- Minkler, A. P. (1993) "The Problem with Dispersed Knowledge: Firms in Theory and Practice." *Kyklos*, 43: 569–587.
- Nadworny, M. J. (1955) *Scientific Management and the Unions, 1900–1932: A Historical Analysis*. Cambridge: Harvard University Press.
- Nelson, D. (1995) *Managers and Workers: Origins of the Twentieth-Century Factory System in the United States, 1880–1920*, 2nd edn. Madison: University of Wisconsin Press.
- Nelson, R. R. and Winter, S. G. (1982) *An Evolutionary Theory of Economic Change*. Cambridge: Harvard University Press.
- Nussbaum, F. L. [1968 (1933)] *A History of the Economic Institutions of Modern Europe*. New York: Augustus M. Kelly.
- O'Driscoll, G. P. and Rizzo, M. J. (1985) *The Economics of Time and Ignorance*. Oxford: Basil Blackwell.
- Ramstad, Y. (1990) "The Institutionalism of John R. Commons: Theoretical Foundations of a Volitional Economics." *Research in the History of Economic Thought and Methodology*, 8: 53–104.
- Ramstad, Y. (1996) "Is a Transaction a Transaction?" *Journal of Economic Issues*, 30: 413–425.
- Rutherford, M. (1983) "J. R. Commons's Institutional Economics." *Journal of Economic Issues*, 17: 721–744.
- Sautet, F. E. (2000) *An Entrepreneurial Theory of the Firm*. London: Routledge.
- Simon, H. A. (1957) *Models of Man*. New York: Wiley.
- Smith, A. [1937 (1776)] *An Inquiry into the Nature and Causes of the Wealth of Nations*. Cannan, E. (Ed.). New York: Modern Library.
- Smith, A. [1976 (1759)] *The Theory of Moral Sentiments*. Raphael, D. and Macfie, A. (Eds.). Oxford: Clarendon Press.
- Taylor, F. W. [1967 (1911)] *The Principles of Scientific Management*. New York: W. W. Norton.
- Tugwell, R. G. (1932) "The Principle of Planning and the Institution of Laissez Faire." *American Economic Review*, 22: 75–92.
- Vanberg, V. J. (1994) "Carl Menger's Evolutionary and John R. Commons's Collective Action Approach to Institutions." In: Vanberg, V. J. (Ed.) *Rules and Choice in Economics*, pp. 144–163. London: Routledge.
- Veblen, T. (1921) *The Engineers and the Price System*. New York: B. W. Huebsch.
- Viljoen, S. (1974) *Economic Systems in World History*. London: Longman.
- Williamson, O. E. (1975) *Markets and Hierarchies: Analysis and Antitrust Implications*. New York: The Free Press.
- Williamson, O. E. (1986) *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting*. New York: The Free Press.
- Williamson, O. E. (1996) *The Mechanisms of Governance*. New York: Oxford University Press.
- Witt, U. (1999) "Do Entrepreneurs Need Firms? A Contribution to a Missing Chapter in Austrian Economics." *Review of Austrian Economics*, 11: 99–109.
- Yu, T. F. (1999) "Toward a Praxeological Theory of the Firm." *Review of Austrian Economics*, 12: 25–41.