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**MANAGERIAL COMPENSATION,
CONTROL, AND INVESTMENT**

Sherwin Rosen

Center for the Study of
the Economy and the State

The University of Chicago

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ABSTRACT

This paper considers some market implications of organizational design. Recent literature has analyzed incentive structures within organizations. Here it is argued that open market competition between organizations and free entry are essential for efficient adoption of innovations and efficient decentralization of new information in the economy as a whole, as well as for disciplining managers and providing survival incentives of more efficient production units. The competitive battle of survival also serves as an information filter that reveals talent and helps move resources to their highest valued uses. The nature of the market for control is seen to include product market competition and potential entry of new products, in addition to the more commonly discussed financial devices. Elements of the optimal decentralization of information of executive talent and the market for control are discussed in terms of the workings of the labor market for business executives.

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Managerial Compensation, Control, and Investment

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Competition and the Market for Control

Recent political and economic events throughout the world provide ample evidence, if any is needed, of the benefits of decentralized economic organization. In many ways the organizational problems of modern corporations are microcosms of the entire economy. Coase, 1937, Williamson, 1985 and others have taught us that the limits to decentralized production and decision-making within firms are rooted in transactions costs, scale economies, specialized knowledge and the division of labor. This is just as true at the scale of the entire economy as at the level of the firm.

The chief difference between the micro- and macro- aspects of organizations lies at the interfaces between firms and consumers; as well as in the legal and institutional constraints affecting how the consequences of business decisions feed back into the economic system. Recent preoccupations with the detailed internal structures of incentives and the design of individual organizations has ignored the important role of interactions between units. These system-wide issues form the principle theme for what follows. The institutional structure and the nature of competition between units may be the most important determinant of performance of an economic system. Openness to external competition, to varieties of choice by consumers, and to new entry greatly affect the way in which economic systems evolve, innovate and adapt to change. These factors diminish the importance of the internal organizational and incentive structure within firms for achieving economic efficiency.

One of the most interesting recent macro-ideas about decentralization is a descendant of Hayek's

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observations on the role of specialized knowledge in the economy. How should economic information be processed from a systems point of view? Think of two extreme modes, serial and parallel processing, both related to problems of quality control, reliability theory and computer algorithms (Sah and Stiglitz, 1986, 1988). The nature of information processing affects the degree of backup and redundancy in an economic organization. Two separate issues arise here. (i) How is the control of resources allocated at different decision points between organizations? (ii) How are actions coordinated within organizations? By and large the recent economic literature has been concerned with the second problem. Perhaps the first is more important: the distribution and allocation of the control of resources crucially depend on the institutional arrangements and organizational aspects of the overall economic system.

Here is where the major differences arise between command economies and enterprise or market economies. More centralized control is associated with serial processing, with more isolated command of important decision nodes, and with less redundancy in the overall system. If an incorrect decision is made at some point in the global hierarchy, there is less chance to recover from its adverse consequences. Possibilities for change are limited by substantial concentration of authority and little redundancy in the system. Decentralization of control is associated with independent parallel processing at these nodes. It provides greater safeguards against error in the overall system, more "insurance" as it were. If one organization makes an error and fails at some point, it does not matter so much for the system as a whole because another independent trial by an unrelated unit in the economy may prove successful. When information is incomplete and outcomes are uncertain, independent trials are essential for efficient operation of the system.

Little analysis is available to assess the practical importance of these differences. One can find highly successful examples of both centralized and decentralized form of organizations. The Manhattan project is a stunning example of a successful, centrally planned and tightly controlled scientific operation. The organization of Russian biology under Lysenko is a well known failure. The dominance of large

firms in modern market economies long has been a source of concern about monopolist production inefficiencies, but this has to be set against the greater living standards these systems provide.

The benefits of centralized, serial processing tend to be larger in situations when substantial risk taking is desirable, and when the goals of projects are well defined and single-minded. Then it can be efficient to centralize control and concentrate resources, especially if the rewards to quick success are enormous. Spreading resources around in independent parallel organizations may enhance the ultimate chance of success. But by reducing the inputs of all parties at each decision point, it slows things down and is less likely to lead to extreme outcomes. Centralized control is more likely to result in either spectacular successes or spectacular failures. Decentralization, by itself, is more likely to lead to success, albeit possibly of the middling sort.

Many of the successful enterprises in market economies arose in an authoritarian fashion, with founders closely directing and building up their organizations around extremely risky projects associated with a product or process. In the nature of things, such organizations do not necessarily adapt well to change, or to subsequent turnover of control after the founder retires. Some persist, others expire. And we generally hear only of the small number of successful people who embark on these endeavors. Most ventures are unsuccessful because the risks of failure are large. One hundred years ago Alfred Marshall wrote about business organizations using intriguing analogies of firms with biological processes of birth, growth, maturity, decay and death. These ideas remain relevant to modern business organizations.

In economies where the government is not a substantial actor in production, it is practically inevitable, and somewhat ironic, that surviving firms are built up through the "central planning" of their founders. The market for control is so decentralized that no one can capture more than a minuscule fraction of it. It is easy to understand why the central government took charge of building the atom bomb, and why alternative, decentralized organizations probably wouldn't have worked very well for that project. But it is dangerous to extend such reasoning. What would happen were a central government

agency to take full charge of the women's clothing industry? Recall the stylishness of the Soviet fashion industry.

Bureaucracy and centralized control are less adaptable to change and to new ideas. The elaborate bureaucracies and endless chains of command needed for internal control of these organizations, precisely because of the absence of external pressure from outside competition, present formidable obstacles to deviate from established procedures (Tirole, 1986). It can be argued that the market socialists (Lange and Taylor, 1938 and Lerner, 1946) were largely correct in arguing the equivalence between centralized government control and market allocation mechanisms within the narrow and limited terms they set, namely known and unchanging technology and tastes. In an important sense there is no control problem in the economy in these circumstances. Competition is vital for overall systems discipline when the world is changing, as it always does.

In enterprise economies, it is not so much that central planning does not exist. The organization of almost every large firm resembles a government bureaucracy. Not many years ago General Motors had more employees than the entire manufacturing sector of several European economies. Competition among organizations, and increasingly among businesses all over the world, a constant striving among existing and potential future enterprises for greater control of resources, makes it possible to gain the risk-taking advantages of "centralized planning" within firms, while at the same time minimizing its potential disasters of lower reliability, unrecoverable error, excessive bureaucracy, slowness to adapt to change and lack of incentives to innovate.

Organizational problems within firms are in many ways the same in all economic systems, irrespective of social organization. The larger point I am making is that these are really details. The more important questions lie in whether resources can move freely between competing units and localized control authorities, and the extent to which entrants with new ideas are allowed to pursue them. How efficient is the process by which resources move to their highest valued uses?

Efficient allocations usually cannot be achieved by highly centralized agencies because knowledge and information are too specialized. As Hayek, 1960 emphasized, decentralization is virtually dictated by specialization and the division of labor. No identifiable group of persons can possibly know the best uses of all resources because knowledge is so specialized. To be sure, organizational design, internal compensation mechanisms, and corporate culture are important to the success of specific organizations. Yet the distribution of knowledge is so dispersed that they have to be second-order considerations for the economic system as a whole. Competition at the extensive margin, between existing organizations and potential and actual new entrants give the economic system the potential to evolve in efficient ways (Alchian, 1950, Hayek, 1960 Schumpeter, 1947). These systems-wide aspects of encouraging efficient mobility and transfers of control are paramount. If one firm is compensating its managers inefficiently, there are incentives for others to find a better way of doing it to increase their competitive advantage. How good is the social market economy in these systems-wide respects? Does its emphasis on insurance inhibit mobility and change?

The basic thrust of economic research on the individual enterprise was set in the work of Berle and Means, 1933, who appear to have coined the phrase "separation of ownership and control." What is missing from their account, and from much of the recent literature, is analysis of the market for control. An extraordinary aspect of modern decentralized economies is enabling large scale enterprises to bring vast resources to bear on projects from a wide variety of sources. The distribution of ownership claims on nonhuman resources generally is not closely related to the distribution of talents of people who can use and direct them most effectively. The scale of many of these projects is large relative to any person's wealth, and their outcomes are risky. We manage these risks in a socially acceptable manner by dividing claims to risky outcomes into little pieces and spreading them around. Control is specialized in entrepreneurs and managers. This allows resource owners to choose their exposure to risk by diversifying their holdings. Competition for control is the mechanism that gets resources into the proper

hands. This is not only a question of financial control in the sense of mergers, take-overs, voting rights and the like: open competition in the markets for goods and services is an essential part of the process. It tends to promote survival of the fittest.

Berle and Means' phrase refers to potential conflicts between owners and managers. When ownership is diffused, what guarantees that managers, who control and direct the owners' resources among alternative uses, make decisions in owners' collective best interests? Managers self-interests do not necessarily correspond to the interests of owners. How are the self-interests of all parties harmonized? Under certain conditions it is possible to provide formal economic answers to such questions. The other side of this point is just as important. Conflicts would not arise if there were no economic basis for specialization and division of labor between ownership and control. Differences in the distribution of resource ownership compared to the distribution of investment knowledge and control talent is why specialization, trade and markets for control are necessary in the first place. The discipline afforded by the market for control substitutes for internal contractual mechanisms in solving internal organization problems of firms. It provides the ultimate layer of monitoring that is always necessary to achieve efficiency when knowledge is specialized and information is incomplete.

The systems-wide aspects of organizational efficiency comes down to the question: How efficient is the market for control? An efficient market plays a key role in the evolutionary process sketched above. It has proven difficult even to fully describe the market for control, never mind to assess its overall efficiency. Nevertheless, these issues loom large in thinking about compensation and other incentive schemes in transition economies and elsewhere. They deserve more attention than they have been given.

Some Economics of Control

The most obvious fact about managerial compensation is that payments to top management in large companies are large. This is true in every country for which data exists. The ratio between top

executive pay and average pay varies across countries. So does the precise structure of control and monitoring, especially how it is split between open capital markets, the banking system, and concentration of private ownership (see the recent study by Kaplan(1994)). Since competition for management positions is extensive and open in most respects, an economist must conclude that the demand for and value of services rendered by high-ranking executives is large relative to the supply of talent available to provide them. The economic basis for these observations is the existence of complementarity between management talents and the size of resources controlled. Certain kinds of indivisibilities and scale economies inherent in control decisions reinforce these effects.

Consider complementarity first. Suppose control technology takes the typical economic form $x_i = F(T_i, K_i)$, where x_i is output, T_i is talent of the manager i , and K_i is the amount of resources the a manager controls. The marginal product of T and K are positive and there are diminishing marginal returns to K in management technology F . Management talent T_i is a fixed or at least partially indivisible factor embodied in the top manager or in the top management team. It cannot be subcontracted through a management services market. If K^* resources are available to be controlled we seek an allocation $K_i = K(T_i)$ that maximizes total output subject to the constraints of technology and resource availability $K^* = \sum_i K_i$.

The optimum allocation satisfies $F_K(T_i, K_i) = \lambda$, where λ is a multiplier associated with the resource constraint, so long as $F_{KK} < 0$. This condition implicitly defines the allocation function $K_i = K(T_i)$. Comparative statics reveal that $dK_i/dT_i = -F_{TK}/F_{KK}$ in the optimum allocation. Therefore K varies either positively or negatively with T as $F_{TK} \gtrless 0$. A positive cross derivative describes complementarity: a person of greater talent improves the marginal product of all resources he controls. Then $dK/dT > 0$ in the optimal allocation. More talented managers control more resources in larger firms. Let $R(T) = \max\{F(T, K) - rK - w\}$, where w is the opportunity cost of managers in other lines of work and r is the opportunity cost of capital. It follows that $dR/dT > 0$, irrespective of the sign of F_{TK} . However,

if $F_{KT} > 0$, more talented managers both create more rent and manage larger firms.

An efficient market for control achieves the optimum allocation through a price system. It works through a competitive bidding for both talent and resources that equalizes the marginal return to capital in all uses and transfers rents to the most talented managers. Think of an owner seeking to commit resources to the control of one of the available managers. If $F_T > 0$, value will be increased more if a more talented manager handles them than if a less talented one manages them. The owner is willing to pay extra for placement of his capital with the more talented manager, who can charge the owner larger management fees, an incremental amount is proportional to the extra value his control imparts to them. If in addition $F_{TK} > 0$, there is a kind of scale economy of concentrating control on larger T because more talented managers offer larger returns to owners the larger their control. In a market equilibrium, competition insures that resource owners are indifferent as to who manages their resources. Competitive bidding for more talented managers extracts all the rent and pays them what they are worth. This sustains the solution to the optimization problem above.

There are additional technological reasons to think that the competitive returns to talented managers might be large. Business historians (Chandler, 1977) have stressed the development of the technology of control of information and accounting systems that allowed private firms to achieve such large sizes in the 20th Century. Many aspects of management technology and control are inherently subject to scale economies because they are rooted in information, and many investments in information are subject to decreasing costs. For instance, if one person can manage one dollar's worth of resources better than another person, it is likely that the same will be true of a much larger quantities of dollars. Control decisions for each dollar have common elements and many decisions essentially can be duplicated.

Insofar as the costs of management and control decisions are independent of scale, there is an extra tendency for the market for control to assign substantially larger resources to more talented

managers. If it is not proportionately more costly to think on a large scale than on a small one, control decisions share the characteristics of public goods, and small differences in talent can be greatly magnified by these effects. If one manager is only slightly more able than another per unit of resources, the differences in social outcomes can be enormous when small differences in talent are parlayed into large differences in control by increasing the scales of operations of more able persons. Notice that not only are owners of capital willing to pay more for the services of such people. The same is true of workers and other resource owners because their personal labor productivity is enhanced by better top level decisions. This creates incentives for to adopt organizational structures that conserve on scarce managerial talents, and reinforces the tendency to concentrate greater control on more talented persons (this argument is spelled out in greater detail in Rosen, 1982).

The basic economics of the allocation of control are easiest to explain in a deterministic setting. In reality, the outcomes of control decisions have important random elements not predictable in advance. Uncertain prospects per se add nothing essential to the analysis above, so long as there are market or other efficient social mechanisms for distributing risks. The ability of individual capital owners to shift risks is the essential role of financial intermediaries, banks, and stock markets in these economies. If risks (unavoidable variance in returns) can be divorced from average returns, all that needs modification above is to treat the outcomes as random variables and replace them with their mathematical expectations. The competitive process remains essentially unchanged in its generalities. Only its details are affected.

Information and Control

The problem is more complicated when information and knowledge are specialized and incomplete. Several important elements must be added. There must be mechanisms for the public revelation of management and control talent so that resource owners can place their bets on who they perceive to be the best prospects. Potential managers require proper incentives to form and develop their skills. Management talent and outcomes have been treated so far as if they were inelastically supplied

and earn returns that are pure rents. But talents and personal motivations to acquire them aren't inelastically supplied in practice. (i) People who arrive at control positions must learn their trade. They also require proper motivation and incentives to enter into these lines of work instead of others. (ii) Exercising and focusing talent on specific tasks is hard work. It requires enormous personal effort. People in control positions need the proper motivations to utilize their talents to the fullest extent.

The division of labor and specialization of knowledge inevitably imply that the allocation of control is imperfect in any economic system. This is precisely why the redundancy built into open, competitive market economies is so important to their overall economic performance and why lack of redundancy in closed, tightly controlled economies eventually leads to problems. Specialization of control and technical knowledge makes identification of managerial talent difficult. The results of management decisions are uncertain and are revealed only slowly over time, adding lots of noise to the competition for control. People with ideas are always searching for capital from investors who have much more limited information about such things. The quality of ideas varies enormously and specialized knowledge is difficult and costly to transmit. The knowledge possessed by entrepreneurs itself is imperfect and incomplete, if not biased. They are prone to exaggerate the potential benefits of their proposals to gain advantage in the competition for control of available capital, and they are apt to reveal only limited aspects of their plans and information for fear that others will exploit them first.

When direct information on prospective productivity is noise ridden, control must be allocated rather more on the accumulated record of the past than simply on current data and future prospects. The market for control is conditioned on the historical record of previous personal accomplishments needed to assess a person's talent and knowledge. For this feedback system to work, those in control positions must have a stake in the outcome of their decisions. In equilibrium, past successes must improve one's competitive position in the market for control of resources and past failures must decrease it. Managers need strong personal incentives and motivation to exert great effort at accumulating a superior

performance record, and to increase their managerial skills and investment knowledge along the way. These reputational aspects of organizational structure also make the precise details of managerial employment contracts and specific short-term incentive schemes less important than they first appear.²

The basic structure is illustrated by slightly modifying the model above. To simplify, assume talents are given but not known precisely. Add randomness to production functions to reflect inherent uncertainty over project outcomes, given the talent of the person to whom control is entrusted. Suppose further that the technology is such that the talent of a potential manager can be written in stochastic terms as a fixed effect. If the previous amount of complementary resources the manager has controlled is known to all investors, we can think in terms of managerial valued added, written as $z = m + u$, where m is the person's unobserved managerial talent, distributed with mean m^* and variance σ_m and u is luck or other contributors to random outcomes, distributed with zero mean and variance σ_u . Observed outcomes reveal only the sum of a person's talent and the luck of the draw on the project that has been chosen.

At the beginning of a career outsiders have a priori assessments of a person's talent, say z_{0i} , based on such things as education, school credentials, and previous job performance. In addition, as time goes by they observe the outcomes of past decisions--the person's record up to now: $\{z_{1i}, z_{2i}, \dots, z_{t-1,i}\}$, which is used to update the assessment of a person's true talent (according to a well known result on signal-extraction in statistical decision theory--specifically, Bayes' Theorem--see DeGroot, 1971). An additional observation contributes more to reassessing the person's talent the larger is the signal-to-noise

²Much interesting recent work has investigated certain aspects of the control function of ownership in nonmarket transactions (Grossman and Hart, 1986 and Hart and Moore, 1990 are standard references). Other work (Hart, 1983 and Hermalin, 1992) has begun to evaluate the efficiency of competition in enforcing management incentives. Another tradition has examined the selection aspects of competition (Alchian, 1950, Nelson and Winter, 1982, Rosen, 1986). And yet another has investigated reputation and informational effects (Aghion and Tirole, 1994, Aron, 1988, Fama, 1983, Holmstrom, 1982, and for yet another angle, Radner, 1992). I am arguing here for a synthesis of all these approaches but one that is built-up from the requirements for decentralization based on specialization and division of labor as stressed by Hayek, 1960.

ratio σ_m/σ_v . If noise is relatively small, a person's "true" talent (m) is revealed quite quickly. If random events contribute more substantially to outcomes, it may take a long time to make accurate assessments.

The social optimum in these circumstances is an intertemporal version of the problem above. As a first approximation consider the allocation of control solution described there, conditioned on whatever information on personal talents is available at that time. Evidently this approximately solves the allocation problem among managers who have survived for a long time and who have accumulated long records. For as time goes on and a person's record gets longer, past history dominates new data that comes along and each person's talent is essentially known completely.

Things are different at the beginning of a career. The person's record is too brief to provide reliable information and there is value in experimenting to gain more timely information on young persons' talents and capacities. The social value of experimentation lies in improving subsequent allocations of control, and it is rational to assign some resources to young, unknown managers to see how well they perform. The amount of resources devoted to experimentation depends on the precise nature of scale effects and intertemporal linkages in the management technology. These complex issues cannot be pursued here, but it is intuitively clear how the optimal allocation of control generally changes over time. The selection and allocation process has a stopping property characteristic of sequential decisions: Managers who accumulate a sufficiently poor record are eliminated. For when one's record falls below a threshold that varies with past experience and exposure to control situations, expected gains from continuing as a manager do not cover the person's social opportunity costs in an alternative position. It is best to withdraw all control from that point forward, to "draw another sample" and find a replacement to be sampled anew, to see if the person can do better.

The quality of the existing talent pool also establishes a threshold on the a priori quality of people who are allowed to compete and enter the process. In fact there is a kind of option value of sampling a new entrant (this is the value of experimentation). The potential entrant may prove to have very great

talent or very poor talent. Especially in circumstances of complementarity described above, the beneficial consequences of the first possibility are very large. The disastrous possibilities of the second possibility are limited by the selection process itself, which assigns fewer resources to the relatively unsuccessful person's control as time goes on and, ultimately, eliminates him.

The Executive Labor Market

The labor market for business executives performs these selection and assignment functions through the way in which managerial careers are designed and organized over the life-cycle (see Rosen, 1992 for a survey of the literature on executive compensation). When there is extensive division of labor and specialized knowledge, economizing information and control within business firms inevitably requires organizational structures that contain important hierarchical elements and substantial delegation of authority. Control decisions generally have ever-widening organizational effects as control positions rise in the organizational pyramid.

There is a natural lifecycle in staffing these positions because control is awarded to top level managers for only limited spans of time. Not only are working lifetimes of finite duration, but the selection and information process required to assign control to a person generally must be filtered through many earlier observations of performance in less important positions. Most people achieve top-level control positions rather late in their working life. The overlapping life-cycles of turnover of personnel in these positions, with younger persons being sampled at lower positions and older, more experienced managers commanding control positions, partially serves to implement the selection and assignment process.

In most organizations, authority is, at least in part, attached to job or position. Control and responsibility typically increase when a person is promoted to higher level positions or is recruited to one by another firm. Control inevitably decreases when the person is demoted or shunted aside. Continual assessment and reassignment of positions present a convenient foil and feedback system between the two

aspects of information and human capital investments---the person learning management skills, and other's learning about the person's capabilities and talents. These linkages are reinforced by a reward structure in which pay increases with the level of a position, and with its "responsibility" and control potential. Then managers in the pipeline have strong incentives to learn their trade and improve their performance, in order to gain greater control and rewards over their careers.

The distribution of information on management talents and potential affect the social efficiency of this process. As demonstrated earlier, an open competitive labor market efficiently decentralizes control allocations when talents and technology are known. When talents and technology are not known, the problem becomes much more complicated because there are both common and private property elements in this kind of information. How the market implements the socially optimum experimental design in these cases has not been studied very much.

Market decentralization proceeds along reasonably conventional lines when information about talents, once revealed, is common property. In this case all rent are transferred to managers in a competitive equilibrium, conditional on available information. Since all gains from the selection process accrue to the "experimental subjects" themselves, there exist market mechanisms by which managers pay for additional sample information that may reveal valuable information to others. Potential earnings are determined by the same competitive bidding system in which resource owners are willing and able to pay more for the services of managers who are perceived to be more capable. Younger participants who have not accumulated lengthy records and for whom the value of information is positive, willingly spend part of their earning capacity to pay for experimental opportunities that will reveal additional personal information to the market. They generally do so by accepting lower level positions at lower pay to avail themselves of these opportunities. In this way the components of the socially optimal selection and reallocation process are correctly "priced" and decentralized.

A few qualifications are needed to complete the argument and indicate its limitations. The

willingness of people to pay for such positions depends on their own assessments of their worth, but the willingness of others to assign them such positions depends on the assessments of others (e.g., the histories $\{z_{it}\}$). These two sources of information often have disjoint elements. This by itself has no normative implications, in the same sense that the private reasons someone buys or sells something has no operational content in the standard competitive model: all that matters are supply and demand prices (willingness to pay) whatever their sources. Differences in assessments have interesting practical consequences, however. Optimistic persons, whose self-assessments perhaps are biased toward excessive self-evaluation of success, and persons who have greater tolerance for risk tend to participate with greater frequency than others (relative to their population proportions). Both traits increase the amounts aspiring managers are willing to pay for experimental opportunities, but do not affect the supply price of such positions offered by others, given the person's record. Timid persons tend to be deterred from entering these markets because there is much to lose as well as much to gain. It has been suggested that certain types of "insurance" institutions arise to accommodate risk aversion in these contexts, such as implicit long-term contracts and downward real wage rigidity (guarantees of no wage cuts) over careers (Harris and Holmstrom, 1982).

The analysis needs qualification if the supply prices of experimental opportunities are large compared to the personal resources of managers. Then imperfections in the financing of human capital investments may inefficiently constrain mutually advantageous assignments of potentially talented managers to positions. The supply prices of these positions fundamentally depends on the costs to firms of the ex post inefficiencies that inevitably arise from experimentation. When these costs are large, the amounts that job candidates have to pay in the form of lower wages may be larger than the person's earnings capacity. Then wealthier and well-connected candidates tend to gain a competitive advantage in staffing these positions, the search and information system is less open, and some talented people are excluded. Perhaps in a completely open society opportunities to develop human capital potential largely

would be independent of the financial circumstances of one's background and family position. Imperfections in human capital markets add inefficient constraints to these processes in all occupations. Whether they are of greater or lesser importance to the development of management skills than to other skilled professions is an open question.

Of course information of this kind does not automatically become common property, freely available to all. For one thing, its sequencing is tricky. Control and investment decisions require extensive planning and there are lags between the time a project is implemented and when its results are fully revealed: The precise connections between outcomes and specific, identifiable past decisions are noisy. In addition, the technology of control has many elements of joint production. It often is difficult to isolate the precise contributions of individual members of a management team (this is why the person at the top takes ultimate responsibility for outcomes, whatever their source).

The costs of error in experimentation are controlled largely by limiting the scale of resources committed to these purposes. Unknown beginners work on small projects that have limited repercussions on the organization as a whole and that serve as inputs into the overall management activities of the organization. Consequently much of the initial information generated about people early in their careers has private, firm-specific components that are difficult, if not impossible for outsiders to evaluate. Instead, such information is revealed to outsiders indirectly by the person's progress in the organization, as signaled by job assignments and responsibilities, titles and salaries paid. It has been pointed out (Waldman, 1984) that firms have incentives to maintain the privacy of their information about young managers and to conceal it from outsiders by misassigning talented personnel to lower level positions. Then other firms, who might hire these persons, are incompletely informed. On the other side are the incentives that young managers have to pay for property rights in these signals, to in effect compensate the firm by working at lower pay, thus allowing managers to work at the more informative jobs and allow the results to be revealed to the market.

It is inevitable that all economic models of these complicated issues will be limited by the incompleteness of their domains. This assertion itself reflects the basic premise of this essay, that knowledge is remarkably disjoint in modern society and that the main economic problem is to find durable ways of somehow tying all this specialized knowledge together for the social good. The qualities of "openness," redundancy based on differences of informed opinion, and decentralized competition for control seem to be essential for achieving high and growing standards of living for extended periods of time. However, within these limits, some broad empirical observations suggest that there are many varieties of economic institutions, laws and social arrangements that produce comparable achievements. One only need observe the extraordinary varieties of forms of ownership and control in the successful market economies today to illustrate this point.

The fact is that we have many different types of division of labor between monitoring and control of business through open capital markets, investment and commercial banks, closely held corporations and myriad other financial institutions in different parts of the world. Germany, as one of the most successful economies in the world, has much more closely held control, much less mobility of control, but more financial monitoring by the private banks than do England or the U.S. But the U.S. looked much more like Germany does today prior to the 1920's. Similar comparisons between Taiwan and Japan strengthen the point. Another way of saying it is that there are different divisions of labor between the "wholesale and retail" functions of financial institutions and control in these economies. No doubt some of these differences are due to different financial regulations and to differences in culture. Apparently there are many durable mechanisms for achieving similar results. Competition for control, contractual incentives and open product market competition undoubtedly are substitutes in achieving acceptable results. We ought be less concerned about some of the details and more concerned with identifying the common elements institutional structures that produce the desirable outcomes.

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