

Science and Innovation Leadership for the 21st Century

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The Structures Supporting Technological Change

The evolution of intellectual arguments regarding the benefits, limitations, and characteristics of systems for organizing productivity activity can be understood in three parts. This paper begins with a discussion of the three systems for organizing productivity activity, followed by an introduction to institutions and their effect on the three systems. The paper concludes with an assessment of how the competitiveness of each system for organizing productivity activity is affected by exogenous change.

Section 1: Benefits of Organizing Productivity Activity and Systems for Doing So

The basic benefits and limitations of organizing productivity activity were first understood in the context of division of labor. In “The Wealth of Nations,” Adam Smith discusses how dividing labor — the process that leads individual workers to specialize in a limited set of tasks — enables individual workers to build proficiency, dexterity, and productivity in their specialty. Furthermore, Smith argues that division of labor and specialization reduces wasted time from task-switching and facilitates the invention of machines that enable one person to do the work of many. (Smith, 2009) In “Capitalism,” Karl Marx adds that division of labor enables economies of scale and cooperation between workers. (Marx, 2009) However, division of labor is limited across a number of key dimensions. Some tasks, such as the process of giving birth to a child, simply can’t be subdivided. Furthermore, a specialized worker also loses out if local market demand is unable to keep up with their rate of production. Workers who specialize in a very limited, repetitive set of tasks can lose interest in their work, hurting productivity. Overspecialization can also lead to uniformity and a below-optimal level of product variety. (Staats and Gino, 2011) Returning to the historical giants, Smith states that overspecialization creates workers who are “stupid and ignorant,” (Smith, 2009) and Marx argues that “the subdivision of labor is the assassination of a people.” (Marx,

2009) Setting this debate aside, it is necessary to consider which systems a society can employ to organize productivity activity and gain the benefits of specialization and the division of labor.

Markets are the first of the three methods for organizing productivity activity. Friedrich Hayek perhaps best presents the benefits of a market when he argues that the pricing mechanism of a competitive economic enables individual actors to make relatively rational decisions, circumventing the economic planning problem that centrally planned economies must contend with. Hayek contends that markets do a better job than centrally planned economies of responding to change in the face of information asymmetries. (Hayek, 2009) Frank Knight expands on Hayek's discussion of the implications of incomplete information by adding the concept of moral hazard to the literature. (Knight, 2009) Ronald Coase adds further complexity to Hayek's and Knight's models by answering the question of why productivity activity is conducted on the open market in some cases but aggregated into firms in other cases. (Coase, 2009)

Hierarchies are the second method for organizing economic activity. Broadly, there are two types of hierarchies: (1) firms, which are defined by employer-employee contracts, and (2) bureaucracies (e.g. government), which are defined by superior-subordinate relationships. Beginning with firms, Coase asked the following question: why do firms exist and what constrains their size? Coase's answer is that each interaction between economic actors incurs a transaction cost. Firms (as well as bureaucracies) are used to reduce transaction costs by aggregating economic activity into a single organization. However, production isn't carried out in a single enormous firm because the cost associated with absorbing some transactions into the firm eventually exceed the cost of conducting the transaction on the open market; a firm will stop growing when these margin costs become equal (Coase, 2009)

The other type of hierarchy, a bureaucracy, is defined by six characteristics in Max Weber's idealization of the system; the most important characteristic of a bureaucracy is exhaustive written rules that govern each individual's responsibilities within the organization. (Weber, 1958) While Weber saw the bureaucracy as the pinnacle of organization productivity, Michel Crozier discusses the far more inefficient reality of bureaucracy. Crozier pushes back against Weber's argument that society will inevitably move toward large-scale bureaucracies when he argues that members of a bureaucracy can use the organization's excessive rules to protect themselves from responsibility, leading to ambivalence,

inflexibility, and organizational stagnation. Crozier describes a “vicious circle” where bureaucratic rules deprives individuals of initiative and centralizes decision-making at the top of the hierarchy, further separating the people who make the rules from those who deeply understand the issues. Decision-making power concentrates both at the very top of the hierarchy and in the few tasks that the rules could not clearly define (e.g. someone who’s responsible for fixing problems). Crozier’s vicious circle presents a worst-case scenario that would grind most bureaucracies to a halt. (Crozier, 1964)

Networks are the third (and final) method for organizing productivity activity. Networks are built on reciprocal communication and exchange, and they can help participants achieve prices below market rates. Networks are flexible and can facilitate cooperation, collective action. They are ideal for rapid dissemination of information. Networks form in situations when there is existing trust between parties, mutual demand for speed, as well as when each party has extensive, specialized knowledge that’s usual to the other parties. However, networks can fail due if one of the parties is incompetent or exploits the relationship for nefarious purposes. (Powell, 1990)

Section 2: How Institutions Impact Systems for Organizing Productivity Activity

Institutions, or the rules of society that constrain human interaction, underlie the three methods of organizing economic activity. There are two types of institutions: formal and informal. Formal institutions are the written rules of society, while informal institutions are the codes of conduct and norms of behavior that govern social interaction. Organizations (i.e. bureaucracies, firms, and networks) are the teams that develop in response to the existing landscape of institutions. As organizations develop, they often begin to influence institutions to their advantage.

According to Douglass North, institutions, when considered in the context of path dependency and local minima, prevent convergence among nations to a single unified model of governance. Nations are set on a particular path of governance, and because of path dependency, they tend to resist deviation. As a result, inefficient institutions (e.g. laws) persist, nations reach local cost minima, and so, national differences in governance structures persist as well. (North, 1990) DiMaggio and Powell agree with North that market competition alone can not explain the convergence and divergence of economic systems. The

authors argue that similarities (i.e. isomorphism) in organizations can result from competition but also from institutions. Two firms with many employees from the same school might respond similarly, because people trained same way tend to arrive at similar conclusions. (DiMaggio and Powell, 1991)

Piore and Sabel extend this assessment of the importance of institutions to the structure of productivity activity by naming institutions as the determining factor in the balance of the second industrial divide. The second industrial divide is the ongoing transition from an economic system focused on traditional firms (hierarchies) conducting mass production to one focused instead on flexible specialization and networks. Piore and Sabel argue that the economy will eventually reach some equilibrium between these two sides of the divide, and the equilibrium will be determined by path dependent institutions. (Piore and Sabel, 1984) In conclusion, this section shows how institutions strongly influence the comparative balance between the benefits of the three types of systems that organize productivity activity.

Section 3: Systems for Organizing Production Respond to Changing Conditions

Finally the question remains of how the competitiveness of each system for organizing productivity activity decreases or increases when it faces exogenous change. Hayek speaks directly to this question for markets and hierarchies. Hayek argues that some form of economic planning is necessary and the more successful system (between central planning and market competition) will be the one that makes better use of available knowledge. The reality of constant, rapid change in the economy means that the more efficient system will be the one that's better suited to respond quickly to economic changes. According to Hayek, that model is market competition because a market economy can respond more quickly to rapid change in conditions than a centrally planned economy. (Hayek, 2009) Therefore, Hayek would likely argue that a market is a more appropriate model for organizing productivity activity than a hierarchy when considering each model's response to change.

Adding networks to the discussion, we can analyze the three systems for organizing economic activity along two dimensions: flexibility and the commitment of the system's members. Markets exhibit high flexibility and low commitment, hierarchies exhibit low flexibility and medium commitment, and

networks exhibit medium flexibility and high commitment. So if an exogenous change occurs that requires flexible decision-making, markets will likely perform best, then networks, and lastly hierarchies, which will struggle the most. However, if the exogenous change will be most easily weathered by systems for organizing productivity activity that exhibit a balance of high flexibility and commitment, then networks might become the most suitable option.

This paper reviews the literature on different systems for organizing productivity activity and assesses three categories of such systems: markets, hierarchies (e.g. firms and bureaucracies), and networks. Based on the characteristics of those three systems, markets and networks likely gain the greatest competitive advantage from technological change, depending on the institutional framework in any given location. While institutions likely constitute the determining factor as to which system for organizing economic activity is most competitive when faced with technological change, Piore and Sabel note that society can take agency in determining this balance. Societies can indirectly modify informal institutions through cultural change or directly modify formal institutions to shift the balance between which system for organizing productivity activity is seen as the most beneficial. (Piore and Sabel, 1984) From that perspective, the levers that shift the competitive balance between systems that organize economic activity are in our hands.

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