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Path Dependence, Behavioral Rules, and the Role of Entrepreneurship in Economic Change: The Case of the Automobile Industry

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Abstract. This paper develops a complementary theory of path dependence based on rigidity resulting from the choice of management system within the firm. Rules-following behavior introduces rigidity which can lead to inefficient path dependence within a firm. Entrepreneurial alertness, in a crisis, can prevent lock-in from occurring since it leads people to alter perceptions and change behavior. An empirical look at the automobile industry explores the idea of rules-following behavior inducing path dependence development and the potential for change despite inefficient path dependent behavior.

Key Words: path dependence, entrepreneurship, automobile industry, case studies

JEL classification: L2.

Introduction

Discussions of path dependence in the economy have focused attention on the possibility that inefficient technologies will be adopted and persist due to increasing returns, self-reinforcing mechanisms, and externalities. Much of the focus has been on the possibility of market failure due to industry-wide adoption of an inferior standard. Less attention has been paid to the role of path dependence as it pertains to individual firms. Individual firms may find that the behavioral rules and routines that develop within the organization may be a source of rigidity once a set of rules and routines has been adopted. This paper addresses the question of whether the adoption of a set of rules within a firm causes it to exhibit path dependence. It looks at the degree of rigidity that is introduced into the firm by adopting a set of rules to organize production. It also looks at the ability of a firm, through internal entrepreneurship, to change or modify an existing set of rules.

Few industries have received the type of attention that the automobile industry has over the course of its long history. The wealth of empirical detail on the automobile industry provides an interesting avenue for exploring how a particular set of rules emerges, and once established remains in place. Rules tend to remain in place until market forces indicate that that particular rules framework has outlived its usefulness. The automobile industry developed two competing sets of rules and one set proved to be superior. This allows for an empirical analysis of the persistence of rules following behavior. It also provides empirical evidence that there is an impetus for change when a set of rules becomes clearly suboptimal.

The outline of the paper is as follows. The first section will outline the competing theories of the existence and persistence of path dependence. This is followed by a discussion of a complementary theory of path dependence in which the rigidity of a set of rules leads to inefficient levels of path dependence but not necessarily to lock-in. The paper continues with a brief discussion of the types of behavioral rules that emerged in the United States and Japanese automobile industries. It then looks at the causes and method of change that occurred in the United States automobile industry.

Theoretical Background and Debate

The discussions on path dependence are generally broken down into two competing theories.[1] First, that inefficient and persistent path dependence exists due to increasing returns, which result in lock-in. Second, that inefficient path dependence does not occur in the real world, because economic agents act in a highly rational fashion and respond quickly to profit opportunities. However, there is a third potential avenue to explore. Path dependence can occur not just as the result of increasing returns and technological factors but as a result of the rules following behavior. By relaxing the assumption that economic agents can conceive of and react to all possible contingencies, inefficient path dependence can exist and persist in the short run due to rules following behavior.[2] It will not necessarily result in lock-in. Entrepreneurial alertness will lead people to alter perceptions and change a clearly dysfunctional set of rules. If this occurs, the result will be rules following behavior for extended periods punctuated by changes in the set of rules when shocks occur. In other words, path dependence can result in real inefficiencies but they may be relatively short-lived due to entrepreneurial alertness.

Initial discussions of path dependence tended to focus on the role of technology as the driving force for the existence of path dependence and as a cause of market failure due to lock-in.[3] Increasing returns lead to a situation in which trivial effects are magnified and demonstrate persistence over time. When increasing returns are coupled with network externalities and large switching costs, an industry can become locked into a sub-optimal technology. Thus, the result of path dependence is market failure. This argument is then refined and tested empirically with conflicting results.

The discussion of the causes of path dependence and lock-in is broadened (Dietrich 1997, Rizzello 1997) beyond the narrow technological argument for path dependence to include potential path dependence arising as a result of organizational form and bounded rationality. In other words, bounded rationality means that human learning and cognition are subject to path dependence. This means that lock-in can result from bounded rationality. In addition, change in the system may not occur even though it can result in the bankruptcy of the firm.

A Complementary Approach: Rules as a Framework for Action

The discussion can be taken in a new direction by shifting the focus from the potential for industry wide lock-in due to path dependence to the issue of how path dependence may arise in individual firms. One result of this change in direction is that it shifts the focus away

from the debate over market failure. Instead, it couples insights from the path dependence literature with Austrian ideas of entrepreneurship in an attempt to better understand and assess the behavior of individual organizations rather than the market as a whole.

Building on insights of Arthur (1995), the concept of path dependence can be further developed by focusing on how human learning and cognition can be affected by path dependence. People develop patterns of behavior or methods of solving problems based on training, experience and exposure to certain types of situations. These response patterns can be referred to as habits. Once habits are developed, they tend to persist over time. In addition, once a habit is developed it is often followed without much, if any, thought. Similarly, organizations develop patterns of behavior generally referred to as routines (see Nelson & Winter). Organizations develop a pattern of response (a set of rules) to respond to problems as they arise. Once the set of rules is developed, it is reinforced by a variety of mechanisms including training and the incentive structure. In this way, a set of rules or problem solving techniques tends to exhibit persistence. Thus bounded rationality can induce rules following behavior which can lead to path dependence.

Why do Rules Develop Within Firms?

Individuals within a firm or organization develop patterns of response to problems that arise in the course of their activities. If a particular response seems to correct a problem or set of problems, it becomes a routine. Due to the limits of human capacity to anticipate every possible contingency, and devise a unique solution to every potential problem, it is rational to adopt a set of rules to organize production. This minimizes decision- making costs and provides guidance on how to go about producing goods and services. Thus, the limits of human cognitive abilities can make the adoption of a set of rules rational (see Heiner). Putting a set of rules in place opens the door to path dependence because of human inability to perceive all potential choices costlessly and to accurately gauge the responses of others. Setting up rules within an organization creates predictability that in turn fosters coordination.[4] Rather than trying to determine the optimal response to each situation they encounter, individuals will follow rules without thinking about them. Hence, individuals demonstrate a certain degree of unquestioning redundancy in their responses.

Regardless of how a set of rules is set in place, their effects can become magnified and self-reinforcing.[5] A set of rules becomes a mechanism for intraorganizational coordination and acts as an incentive structure to reward rules-following behavior.[6] As additional structures emerge that build on and create reliance on the set of rules, path dependent behavior may emerge.

The development of a set of rules involves putting some rigidity into the system, since behavior is constrained in certain ways to prevent opportunism and enhance productive abilities. The system of rules that develop will probably be partially the result of rational decision making on the part of individuals involved in founding or re-engineering the firm. It will also be partly the result of an evolutionary process in which rules are modified haphazardly, deliberately, or even discarded as changes occur. Once in place, rules tend to stay in place (no one thinks to radically alter them) with only minor, albeit potentially continuous, tinkering with the process.

Rules remain in place for at least two reasons. First, expectations are formed around them and this makes them costly to change (i.e., there are switching costs). Second, rules remain in place since people simply don't think about the rules. Thus rules-following behavior persists not just because it is expensive to change behavior, but because people may not know how to go about changing the system or even think about changing the system. Consequently, adopting a set of rules can create a path dependent process of learning and improving the existing set of rules rather than exploring options for the creation of a different system.

The Paradox of Rules

The value of following a set of rules is a result of its ability to provide focal points, incentives, and direction for economic actors within the firm.[7] In order to serve this purpose rules need to remain relatively constant over time. If rules are constantly changing or frequently disregarded, then they would not reduce uncertainty within the firm or act as a guide for behavior. Thus rules-following behavior is valuable precisely because of the rigidity it introduces into the system.

The strength of a set of rules is also its weakness in instances where the behavioral rules that develop are no longer optimal. Rules are only useful if they replace discretion, providing a framework for action. However, the downside is that rules-following behavior may provide a clearly suboptimal response to the problems of production. In this case, the rigidity of the system becomes a liability. A clearly inefficient set of rules means that there is not just a theoretically better course of action but a set of institutional arrangements whose superiority is recognized. The firm then faces a dilemma since the ingrained habits and patterns of behavioral responses it is following is forcing them to forgo recognized profit opportunities. Under these circumstances, either the framework guiding action must be changed despite the intrinsic resistance to change implied by the rules, or the firm becomes locked-in to a suboptimal organizational design.

The reasons why the set of rules is no longer functioning efficiently can be myriad. It can be a result of such things as calcification of rules, additions to the original rules that allow scope for opportunism, and problems with the original set of rules design. The failure of rules can also result from faulty problem solving techniques, and/or changes in external conditions that reduce the effectiveness of the rules. When standard problem solving techniques are no longer effective, the firm must either change its method of operation or face lower profits, and possibly bankruptcy.

Attempts within the firm to change an existing set of rules will entail both standard switching costs (in the form of retraining, reorganization of incentives, and coordination problems during the period of flux) and true uncertainty as people attempt to figure out the best way to modified the system. This added element of uncertainty exists because information is not only costly to obtain, but people may not know exactly how to go about obtaining it. Thus, inefficient path dependence can occur since the mechanisms for change involve both recognizable costs and true uncertainty about how to go about changing the process. Rather than a smooth switch from one set of rules to a superior one (albeit potentially with retraining costs etc.), the switching process itself is subject to uncertainty,

and unforeseen difficulties. This is complicated by the lack of a clear idea of how to improve the rules. Thus, human ignorance of possibilities means that inefficiencies will persist at least for relatively short periods of time while individuals attempt to figure out the best way to change the existing set of rules.

Despite the rigidity caused by the adoption of a set of rules, there is a potential for change. This implies that rules are not completely inflexible once set in place. Bounded rationality does not imply people all suffer from the same type of myopia. One mechanism for change within the organization is that differing individuals possess different sets of knowledge and differing perceptions of the world. The differences in individual perceptions provide a method of breaking out of inefficient path dependence. As a result of these differences, individuals will discern different strategic opportunities. A crisis can create a situation in which the scope for individual experimentation is broader than in times of less flux. The acknowledged problems with an existing set of rules implies rewards for stepping outside the rules and experimenting are potentially greater.

The tolerance of more experimentation during a crisis can encourage individuals to step outside the standard set of rules and procedures and consider how to improve the process. In this way, entrepreneurial alertness can be intensified during a crisis causing individuals to re-evaluate existing rules.[8] Managers and potentially other employees, step out of their traditional role of managing and acting according to existing rules. They explore why the rules are in place, how they got there, and whether they should remain. It is important to note that rules-following behavior does not preclude the existence of entrepreneurship. However, it does tend to provide bounds to experimentation.

The process of actively considering changes can lead to "Kirznerian moments" in which individuals seize upon ideas (sometimes pre-existing, readily available ideas) which lead to entrepreneurial innovation.[9] Entrepreneurship within a firm can be the direct result of a threat to the firm's profitability (or as a result of ideas on how to increase profitability). In addition, it may act as a mechanism that leads to the adoption of a superior set of rules. Thus, within the firm, entrepreneurship may act to prevent short-lived inefficiencies due to path dependence from developing into lock-in. This does not imply that change will occur instantaneously or smoothly but that change is likely to occur albeit with a lag. It is possible that not all firms within an industry will successfully use internal entrepreneurship as a mechanism for change, but lock-in on the level of one firm does not prevent other firms from successfully changing their set of rules.

An Empirical Example: The Automobile Industry

The theory outlined in the previous section has a number of empirical implications. The theory implies path dependence exists if the set of rules adopted by the company reflects the initial conditions. This is merely an extension of the standard implication of path dependence theory broadened to include path dependence as a result of rules following behavior. The theory also would lead one to expect, in the absence of lock-in, companies will change rules systems or the set of rules it follows, quickly as soon as they become aware of superior alternatives.[10] The theory identifies two potential causes for inefficient path dependence switching costs (which have been discussed by a number of authors) and human ignorance.

Rules-following behavior is the result of human limitations. It induces rigidity into the system and when inefficient, complicates the search for a better method of doing things. If inefficient path dependence is due solely to large switching costs, one would expect any major changes in organizational structure or rules to be preceded by a decline in switching costs or an increase in the benefits of switching. However, if inefficient path dependence is due to rules-following behavior and rules induced ignorance of alternatives, then one would expect any major change in the system to be preceded by an event that makes management and employees more alert to the potential benefits of some alternative set of rules.

The study of the automobile industry allows one to avoid one of the main empirical problems associated with documenting path dependence. Availability of data is not a problem in the auto industry since two competing set of rules emerged (albeit at different times), and one was generally perceived to be superior. In order to see if the evidence is consistent with the theory, a basic outline of the set of rules that developed will be presented.

The initial conditions faced by U.S. automobile manufacturers (and later by their Japanese counterparts) had a great deal of influence on the type of rules that developed within the industry. In the United States, a number of technical, social and idiosyncratic factors influenced the development of the basic set of rules that governed the industry until the 1970s.

Initial Conditions in the United States and the Development of Mass Production

There were a number of demand conditions that encouraged the growth of the automobile industry in the United States. In the early 1900s, the United States had an extensive, well-developed road system coupled with relatively low population density. This meant there was a need for some form of transportation to efficiently cover long distances with relatively sparse populations. In addition, despite the fact that population density was relatively low, there was a large population base in the country. Finally, average income levels in the United States were relatively high.[11] These factors created a high level of demand for cheap, low quality automobiles.

The supply side was characterized by low raw material costs (including real estate), a well developed machine tool industry (which developed the tools of mass production), and a shortage of labor, especially skilled labor (Flink:44). In addition, the new mass production techniques that Ford applied to automobile manufacturing dramatically changed the type of skills required to work in the industry. The highly skilled shop labor of the craft production process was replaced by a workforce that had routine, repetitive jobs.

Henry Ford was one of the first to recognize the potential mass market for automobiles. His search for improved methods of production led to the development of many of the basic elements of mass production including the moving assembly line (Chandler:11–13). This new type of production process required a new set of organizational rules. Ford set up an employee relations department that reorganized the wage structure and hiring/firing policies. In addition, this office also set up programs to teach employees English since more than half (estimates were of up to 60%) of the workers did not speak the language.[12] In 1914,

Ford raised wages to $5/day and shortened the workday to eight hours. These innovations dramatically lowered the worker turnover rates at Ford. Attempts to rescind these policies during the next economic downturn, coupled with the Roosevelt's New Deal democracy, set the stage for the unionization of the automobile industry (Chandler:180).

General Motors adopted most of Henry Ford's reorganization of the production process. Its main contribution to the development of the mass production system was twofold. First, Alfred Sloan reorganized the company into non-overlapping operating units. Second, a general office was set up to assure overall coordination of activities as well as strategic planning. This reorganization also allowed General Motors to produce a full product line from the Chevrolet (relatively inexpensive) to the Cadillac (expensive), which enabled the company to accommodate potential buyers across all income ranges. This system also allowed General Motors to take advantage of economies of scale by using some of the same parts across its product line. In essence, Sloan managed to resolve the conflict between the desire for product diversity and the cost advantages of product standardization (Sloan:61–91).

The last of the large U.S. automakers was formed by Walter Chrysler in 1925. He brought his technical and managerial expertise to Chrysler Corp, which quickly developed a reputation for engineering excellence. Beyond a focus on improved engineering, Chrysler organized his production and incentive system along the same lines as that of GM and Ford. Therefore, they all adopted the same basic set of rules that has come to characterize mass production.

Unionization: Standardization of Behavioral Rules

The United AutoWorkers Union (UAW) was set up in 1936 and began to organize unions within the industry. The result was an industry wide union. This meant that the set of rules governing much of the organization of the production process within all of the large automobile manufacturers was standardized. The system of labor relations in the U.S. automobile industry that lasted until the early 1980s was based on adherence to formal written procedures. For example, the agreement between the UAW and Ford for 1982 was composed of four volumes and was over a thousand pages in length (Katz:13).

A seniority-based system became the main criterion for determining layoffs and recalls in the industry. It also affected transfer and promotion policies. This meant that workers were no longer subject to arbitrary dismissal, but it also meant that merit and ability became increasingly unimportant in layoff and promotion decisions. The seniority system coupled with grievance procedural rules and binding arbitration put substantial constraints on managerial freedom to deploy labor and determine the type of workers the company retained and promoted. In addition, managers initially had the right to define job classifications but once defined, wages, worker allocation, and tasks to be performed became rigid (Piore:111–115). This system also meshed well with the popular Taylor scientific management theory. Taylor's theory held that strong supervisory authority along with clearly defined tasks for workers was an efficient organizational form (Piore:5–11).

Thus, the unionization of the industry did little to change the basic structure of the production process. Seniority, rather than competence, became the decisive factor that

determined who held onto a job during an economic downturn, and who did what jobs. This system resulted in a constantly growing list of work rules governing who was required to do what tasks (Womack, Jones, and Roos:43). This arrangement proved to be stable until outside competitive forces created pressure for change.

The Production System

The production system that developed out of the negotiations between the unions and management at Ford, GM, and Chrysler, remained relatively constant for a considerable period. It can be summarized as follows:

- Due to the fact that many workers in the early stages of the industry's development did not speak English (raising the cost of communication),[13] management came to view workers simply as interchangeable parts to be treated in much the same manner as machinery. In addition, the high cost of communicating with non-English speaking employees meant that their potential intellectual input into the process was ignored.
- Since workers received their pay based on seniority rather than competence, there was no incentive for management to provide training or workers to take part in it if it were offered.
- The adversarial nature of relations between workers and management made useful communication up and down the lines less likely to occur. Virtually all communication seemed to occur through official, legalistic channels.

This set of behavioral rules exhibited many of the key characteristics of a path dependent process in that relatively ephemeral factors (such as the language barrier faced by first generation workers) had a marked effect on the type of rules that emerged. Once the set of rules was put in place, it remained relatively constant for a period of over 30 years. Thus, a strong case can be made for the existence of path dependence resulting from the type of institutional framework adopted by the industry. A challenge to this set of rules in the form of an alternate set of rules developed in Japan around 35 years after the U.S. system was set in place.

Initial Conditions in Japan and the Development of Japanese Lean Production

The basic ideas behind the lean production system developed at Toyota are relatively simple and are not unique to the Japanese. In fact, W. Edward Deming,[14] among others, is credited with some of the basic notions on which the system is based. Despite the simplicity of the basic ideas of lean production, the trial and error process that linked these ideas together into a workable system required a considerable period of time (1948-late 1960s). The Japanese market differed from the United States market in a number of important ways. On the demand side, the automobile market was (particularly in the 1950s and 1960s) relatively small due to high population density, heavy investment in developing an extensive public transportation system, and relatively small numbers of people with high incomes. In

addition, there was considerable demand for product diversity (Cusumano:268–272). These facts meant it would be extremely difficult to cover costs following the standard policy of producing in the high volume batches. In addition, due to the relatively high income of auto buyers, the demand for quality was fairly high (Heffernan 1999).

On the supply side, the price of real estate in Japan was very high, which led to a much smaller average factory size in Japan. Consequently, Japanese factories tended to be small with little room for massive inventories and rework areas. In addition, raw materials were quite expensive in Japan. Another important point was that the Japanese labor force was homogeneous and spoke the same language, unlike the labor force employed by Ford, GM, and Chrysler in the early years.

The space constraint, coupled with the notion that high volume parts production led to a high defect rate, caused Toyota to experiment with a different type production system. Thus attempts were made to modify the technology to conform to the initial conditions in the Japanese market. Ohno developed what is frequently referred to as Just-In-Time production based on small batch sizes. In essence, a just-in-time production system produces the type of equipment and parts needed by workers assembling those parts, in the quantities required at the time they are needed. When this system is put in place effectively, it eliminates much of the intermediate and final goods inventories (Monden:50).

Unionization: Standardization of Behavioral Rules

The type of unions that developed in Japan differed substantially from the union structure found in the United States and Western Europe. Japanese unions were organized by company, not by industry or trade. In addition, these unions include both blue and white-collar workers. In part as a reward for forming a company union and dropping out of the national auto workers union, workers received lifetime employment contracts and a seniority/performance based wage system (Tolliday:171–174). These factors help explain why Toyota (and to a lesser extent other auto firms like Nissan) developed a system of flexible job routines, high worker productivity and low production costs.

The union negotiations resulted in a compensation system known as the job grade system. This system has a marked affect on workers' incentives to increase their skill level and ability to engage in problem solving activities. Remuneration for workers on the line is broken down into four main components. The first component (the 'basic rate') consists of entry wages (based on education level and experience) and yearly increments. The amount of yearly increments is determined based on job grade and individual assessments. The second element (the 'age rate') is a single rate for all individuals in a particular age category regardless of job grade and performance evaluations. It increases most for individuals early in their careers then increases at a decreasing rate as individuals age. (It actually declines for people in their fifties). The third component of the compensation package is based on 'job grade rates'. Job grade rates are determined based on a worker's demonstrated skill level. Finally, 'merit rates' that are based on a worker's job grade and individual performance appraisals.[15] (Aoki:56-59) Thus the set of behavioral rules and corresponding incentive structure governing the production process in Japan differed considerably from the one that developed in the United States.

The Production Process

Toyota tinkered with the standard mass production system that developed in the United States due to the fact that the demand and supply conditions in Japan were somewhat different than those in the United States. In essence, the system Toyota developed is based on four important production techniques.

- Production was organized in small batches with minimal inventory levels. This meant workers only produced as many parts as the next station needed at any point in time.
- A kanban system or inventory system was developed. Small tags (originally white paper) were attached to each batch of parts. These tags identify each component (or batch) and indirectly those who put the component together. Each tag is associated with a particular type and number of parts, so that it is fairly easy to keep track of how many of any given part are at any particular station. Small batch sizes mean that the number of defects is correspondingly small. Errors are reduced by eliminating buffers. This means assembly mistakes affect the next process immediately.

  Also tags act to assign responsibility for parts quality to certain individuals or groups. Thus the kanban system acts as a mechanism to make problems (including defects, overproduction, inefficient conveyance and/or equipment setup) in the production system highly conspicuous (Monden:34–36, "Adaptable Kanban..").
- Job categories are flexible. Workers were not assigned to do one particular task but a variety of tasks. This meant that workers had to be trained in a number of different jobs and received compensation based in part on the level of skill they demonstrated.
- Machinery was reorganized according to its step in the production process so workers would be able to operate more that one machine.

The more flexible set of behavioral rules that arose in the Japanese auto industry due to the differing worker characteristics and type of unions that developed allowed a slightly different production process to develop. Communication costs were considerable lower due to the common language. This meant higher returns to training workers and including their input in attempts to improve the productive process. The reorganization of the production process relied heavily on the input and expertise of the workforce. Workers were grouped into teams, who were given a set of assembly steps (or a piece of the line). They were then expected to work together to figure out the best method of accomplishing their set of tasks (Womack:56).

In this way, the large batch production process with extensive rework areas was modified. In its stead production was organized in small batch sizes with no stockpiling of parts. In addition, since there was no stockpiling, part quality became an issue. If parts were defective, it slowed down the work of those at the following station who could not work with defective parts, so they had to wait for replacements. This created a built in quality control check. The new production method based on a new set of behavioral rules tended to produce automobiles that were of relatively high quality.

Despite some differences (most notably a higher reliance on automation and computers to increase productivity and quality rather than a full-fledged kanban system), Nissan developed a production system that was much more similar to Toyota's than those found in the

U.S. and Europe. Nissan adopted many of the same basic production techniques as Toyota did, including small batch sizes, flexible job categories, a suggestion system and meetings to improve quality, a kanban system, and a just in time delivery system.

Finally, the last of the large Japanese auto manufacturers, Honda[16] developed a similar production system. Due to its late entry into the Japanese domestic market and resistance from MITI, it was also forced to produce in even smaller batch sizes than Toyota and Nissan, since it faced an even tighter automobile market. This meant that they relied even more heavily on the flexibility of their workforce to correct problems as they occurred and to improve the production process. Despite these differences, Honda developed a set of behavioral rules that was similar to those of Toyota (Shook:11–39).

Two Competing Sets of Rules

Two competing sets of behavioral rules emerged (albeit at different times) in the automobile industry as a result of differing initial conditions in the United States and Japan. Many of the ideas used to modify the standard mass production model were available for adoption by the United States shortly after World War II. Indeed, Deming had tried to interest American Automobile manufacturers in his ideas before finding a more receptive audience in Japan. Thus the information needed to modify the production process was available.

The superiority of the modified version of the mass production process referred to as lean production, became apparent during the 1970s when there was a marked shift in buyer preference toward Japanese cars.[17] In the United States, the decline in automobile market share caused a variety of responses. Chrysler lobbied for and obtained a government bailout. Ford drastically reorganized its set of organizational rules and its production process. General Motors did very little to change its production system or set of rules through the 1980s.

Given the fact that the United States automobile industry negotiated with a national union and production was organized in the same way across the industry, switching costs should be fairly similar throughout the industry. It appears that the benefits of switching increased as a result of changes in external conditions (i.e., Japanese competition). The main sources of switching costs seem to have been reorganizing and modifying machinery, and reorganizing supply schedules into smaller lots. If the problem was merely standard switching costs, once the added benefits of switching became apparent, General Motors, the firm with the biggest financial cushion, was in the best position to overcome lock-in that resulted solely from high switching costs. Instead, it was the last of the American firms to react.

A standard switching costs explanation does not provide an adequate explanation for the response of the American automobile industry to a superior method of production. Rules-following behavior was a separate source of rigidity. This meant General Motors could rely on its financial cushion to avoid change rather than embark upon an uncertain path to reform its production process. Instead of a reorganization at General Motors, the dramatic loss of market share and corresponding negative profits due to external competition from Japanese automakers induced Ford and Chrysler to make changes. Change occurred as a result of a threat to the firm's survival not merely due to changes in relative costs/benefits.

Chrysler was the first to wind up in trouble and resorted to a well-publicized government bailout. Chrysler did not immediately adopt the existing superior production techniques (using the government bailout to cover switching costs). Instead it downsized (it emerged from the bailout at about half its original size), and focused on the development of the minivan. These factors allowed Chrysler to survive. The severity of the crisis at Chrysler, did induced both management and workers to search for ways to modify their production process. The labor force was willing to make broad concessions in both wages and work organization. Workers were reorganized into teams and the production process itself wound up being modified to support the newly created teams (Levin:5–45). Chrysler embarked on a piecemeal modification of its existing set of rules rather than a complete switch to an obviously superior production technique. Rules following behavior created rigidity in the system that went beyond standard switching costs. Until the crisis occurred, Chrysler did not make itself aware of alternative production techniques. In addition, it did not wind up with the same organizational form as the Japanese or Ford.

Ford was also hard hit by declining market share. In 1980 alone, it lost over $1.5 billion, and was rated the lowest of the American automobile firms (Peterson:5–6). This crisis made corporate management aware that they needed to radically reorganize the existing production process, with its corresponding set of behavioral rules, or the company would go out of business. Despite switching costs and institutional impediments to change, Ford managed to re-engineer its set of rules. This shows that at least in Ford's case, the type of path dependence that occurred in the automobile industry was responsive to market conditions with a time lag.

The crisis at Ford caused it to engage in internal entrepreneurship as it sought to become more competitive. Managers were willing to experiment with radical changes in the traditional way of doing things. The result was a "Kirznerian moment." Managers at Ford picked up pre-existing ideas that they had not noticed before, and began to incorporate them into their business. Ford looked at the Japanese automobile firms, and then turned to Deming[18] for ideas on how to solve their problems. They began to take steps to include workers in the decision making process through employee involvement groups. These groups provided both technical information (including such things as knowing a machine's idiosyncrasies) and ideas (for example on improving the flow of materials through the plant) that were essential for the reorganizing of the production process (Katz:80–81). Lack of knowledge about existing potential alternatives resulted in a trial and error search for a new method of doing things, rather than merely switching smoothly from one method of production to another. Thus rules-following behavior induced rigidity into people's mindsets and behaviors which changed only once a crisis situation induced people to notice more efficient technologies that already existed. The changes in the set of rules at Ford include:

- A less adversarial relationship between workers and managers. Managers and workers worked together to save jobs and increase their compensation (Womack, Jones, and Roos:98–100).
- Changes in worker compensation packages in return for job and income security concessions on the part of management. This meant that compensation for production workers was tied in part to firm performance. This created an incentive for workers to try to

improve the production process by attempting to correct defects and tracing them back to their source.[19]

- There were shop floor changes in the way production was organized. Work procedures were modified to lower production costs and improve quality. Some changes in work procedures focused on increasing individual productivity by increasing individual effort (example: working more than one machine). Other changes concentrated on increasing the flexibility of the workforce.
- Union acceptance of a reorganized production system occurred at the local level. These changes were not mirrored in the national contracts signed by the UAW. On paper, workers have very narrow job assignments (the rigid job classification system is still in place) and no formal team structure. However, workers are ignoring the details of the contracts on a grand scale in order to cooperate and get the job done (see Katz).

Ford responded to crisis conditions in the 1980s with enhanced entrepreneurial alertness that resulted in an improved set of rules. The fact that Ford waited until it reached a crisis situation before changing its set of rules shows that inefficient path dependence occurred and persisted for a short period of time. The modification of the rules through internal entrepreneurial activity in the face of a crisis meant that lock-in to a clearly inferior set of rules can be avoided through entrepreneurship.

In contrast to Ford, the organizational form and incentive structure at General Motors remained basically the same structure copied from Henry Ford. (Womack, Jones, and Roos:42–44) Some experimentation occurred in the early 1980s but received little support from managers or workers. General Motors did not have the same sort of crisis situation that Ford and Chrysler encountered for a variety of reasons. General Motors had a marketing strategy of "a car for every purse and purpose." This meant that it was more diversified than Ford and Chrysler. When the Japanese automobiles began competing for market share, GM experienced competition only in small to mid-size cars rather than throughout its automobile line. In addition, GM's corporate structure and financial controls meant that it had greater internal efficiency than Ford and Chrysler when Japanese competition became a threat. General Motors' size and degree of vertical integration had allowed it to define competitive conditions on terms favorable to itself for a considerable period of time, and this advantage has eroded slowly. Its size and diversification allowed it to experiment with robotics and other production changes in only certain divisions rather than throughout the entire company (Flink:279). Despite these advantages GM, has lost heavily in terms of reduced market share (from 50% to 32.3%).

General Motors main innovations were the joint partnership with Toyota (NUMMI) and Saturn which applied the lessons learned from NUMMI. NUMMI was organized so Toyota handled product design, engineering, production, and day-to-day management of the plant; GM handled marketing and sales (Adler:100–108). Toyota reorganized the production system along the lines that had worked for them in Japan (Ingrassia:40–45). The attempts by General Motors to export the newly developed set of rules to the rest of its facilities is a mixed success. Saturn, organized along the same lines as NUMMI, has developed a reputation for high quality. However, many other GM facilities are plagued with problems resulting from resistance to change. GM shows signs of persistence in its rules-following

behavior despite clear indications that it is no longer the most efficient method of production. Changes have been made, but it is unclear how long it will take for GM to revise its set of rules.

American automobile manufacturers began to reevaluate their methods of production after losing substantial market share to Japanese firms that organized the production process in a somewhat different manner. The impetus for change in the U.S. was external competition. Thus the set of rules that was developed by the American automobile manufacturers, which may have been optimal when it developed, was no longer the most efficient set of rules on which to base production of automobiles. The ability to absorb switching costs and initiate change despite rules-following behavior indicate that while the adoption of rules can create path dependence, it does not necessarily result in a deterministic process. In the case of the automobile industry, rigidity in the rules slowed the pace of change to a readily available superior management technology, but did not prevent change from occurring.

Evaluation and Implications

The United States automobile industry exhibited path dependence as a result of rules-following behavior. It showed that rules adoption was sensitive to initial conditions, and the rules adopted persisted over time. A different set of initial conditions in the Japanese automobile market led to differing perceptions about how the production process should be organized. This led to the creation of a somewhat different organization of the production process and corresponding differences in the set of rules adopted. The superiority of the modified Japanese production process was demonstrated in the dramatic decline in the share of the U.S. market held by American firms, and in their profitability.

While American automobile firms exhibited path dependence in continuing to follow the existing set of rules when a clearly superior set of rules was available, they did not all get permanently locked-in to an inferior management technology. It is important to note that a crisis of sufficient proportions to call the firm's long term survival into question preceded attempts to modify the existing set of behavioral rules. It was not merely the expense associated with switching to a new set of rules that inhibited change. People did not even bother considering changing to a new set of rules until it became apparent that the firm's survival was contingent on it. Thus rules-following behavior induced rigidities which led to inefficiencies. These inefficiencies did not always result in lock-in, since crises created a situation in which there were rewards for internal entrepreneurship. Entrepreneurship can provide an impetus for change that prevents long term lock-in from occurring.

It worth noting that there is no evidence that the rules that emerged in the U.S. were inferior at the time they were chosen. The United States auto industry developed 40 years earlier than that of Japan, and under different conditions. It seems fairly clear judging from market share and profitability, that for at least 40 years, the set of rules that developed in the United States preformed quite well.

U.S. firms had little incentive to change their production system at the time the Japanese were experimenting with modifications since their position in the industry was secure. GM's biggest concern at this point in time was avoiding anti-trust legislation designed to break up the firm. In addition, there was no way to know in advance whether modification of the

system would result in an improved production method based on a different set of rules. However, it would have been more efficient for American automobile manufacturers to modify the set of rules prior to losing on average 30% of domestic market share.

Only when it became irrefutably obvious that the choice was between redesigning the set of rules and going out of business did Ford and Chrysler attempt to make changes. GM with its larger initial market share, has been even more sluggish in its response. Entrepreneurial alertness in the form of picking up on readily available existing ideas (those of Deming and the Japanese manufacturers, who were surprisingly open about discussing their innovative set of rules) played a key role in the transition. However, the delay resulted in a loss of market share and profitability which American automobile manufacturers have still not made up. The American automobile industry demonstrated inefficient path dependence that persisted over time even though the solution to the problem was available. Switching costs alone, cannot explain the delay. They were not much different when the transition occurred then they were a few years (and a fair bit of market share) earlier and the firms that switched were not the ones in the best financial position to do so. Rules-following behavior induced rigidities which can lead to path dependence. The type of path dependence that occurred in the American automobile industry was not deterministic, but did result in a time lag and real inefficiencies before the improved managerial technology was adopted.

Conclusions

Path dependence on the level of the individual firm can occur not only as a result of technological considerations but also as a result of the choice of institutional framework or set of rules adopted. The choice of a set of rules is sensitive to initial conditions, and once in place, can demonstrate considerable persistence over time. Rules develop to utilize existing knowledge and provide procedures for responding to situations that arise within the firm, due to the fact that individuals can not perceive all possible contingencies and act on them quickly and optimally. Routinization acts to limit the types of behaviors individuals within a firm are likely to contemplate. This aspect of rules means that there is a trade-off between lower decision making costs and innovative responses to new situations. Rigidity and rote responses to situations dull entrepreneurial alertness. This rigidity in the adoption of a set of rules can result in path dependence.

The existence of path dependence means that there will be not only standard switching costs, but costs associated with rules- following behavior associated with attempts to modify the production process. However, the existence of costs does not imply that a switch to an improved set of rules will not occur. The degree of path dependence exhibited by a firm or portion of an industry is limited by profitability considerations. If a crisis develops, people begin to look for new ways of doing things resulting in enhanced entrepreneurial alertness. There will be periods of rules-following behavior punctuated by crisis and change. This implies that there may well be short delays in the adoption of a more efficient set of rules, and that not all firms within the industry will succeed in changing their rules. Internal entrepreneurial alertness due to differing individual perceptions, can counterbalance the effects of rigid rules-following behavior, preventing lock-in from occurring. The role of entrepreneurship in facilitating change to a new set of rules needs further exploration, as

does the role of government in potentially causing lock-in to occur as a result of regulations and intervention into the marketplace.

Empirically, the American automobile industry provides a real world example in which path dependence existed and a demonstrably superior management technology was introduced. Despite the existence of switching costs and rules-following behavior, the loss of profits and market share encouraged change.

Entrepreneurial alertness provided a mechanism for change. In addition, entrepreneurship in the form of picking up readily accessible information and modifying it to suit the internal needs of the firm, acted to mitigate some of the costs associated with switching. Thus, the American automobile industry exhibited inefficient path dependence as a result of its rules-following behavior, which led to an inefficient delay in the adoption of an improved set of rules.

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Notes

1. Current usage of the term path dependence is somewhat haphazard. I will define path dependence as a process in which the consequences of small events and change circumstances, once they occur, can determine which particular path is followed. For a more complete discussion of this issue see Paul David (1997).
2. Bounded Rationality or instances of sub-optimal decision-making do not necessarily result in path dependence. It is only in the case where bounded rationality is coupled with rules following behavior that persistence is likely to occur.
3. See Farrell and Saloner (1985), Arthur (1991), Cowan and Gunby (1996), Liebowitz and Margolis (1990, 1995), Dietrich (1997) and Rizzello (1997) for a brief survey of the literature.
4. See Langlois pp. 171–189 in Kirzner (1986) for a longer discussion on this issue.
5. See Buchanan and Tullock (1962), Buchanan (1975, 1985), Hayek (1945, 1973), Rowley (1986), Gifford (1991), Heiner (1983) and Vanberg (1992) among others for a discussion of what types of rules are likely to emerge and why a rules system is likely to develop.
6. Nelson and Winter (1982) develop the idea that behavioral rules are developed to aid in the coordination of the production process. Routines give individuals guidance about how to perform their jobs and act as a store of organizational memory.
7. Nelson and Winter (1982) discuss this in greater detail.
8. See Kirzner (1973) for a more detailed description of entrepreneurship.
9. The phrase "Kirznerian moment" is borrowed from constitutional economics, where a various authors refer to "constitutional moments" where people see beyond their immediate interests and focus on the long term rules of the game. These moments occur where the existing rules are sub-optimal. Within the firm a similar process may occur.
10. A rules system can be defined as the set of organizational rules, incentive structures and routines that develop within an organization.
11. For example in 1914, U.S. per capita income was $334, Great Britain $234, France $185 and Germany $146. In addition, the U.S. had more equitable income distribution. Japan's per capita income in 1947 was only $199.
12. A 1914 survey of the workers' national origins broke the auto industry down as follows: 21% American born, 21% Polish, 16% Russian and the rest national groups which constituted less than 10% of the labor force.

13. Henry Ford consciously tried to simplify the production process so communication issues would not be a problem. In addition, in the early years, Ford did provide English classes after work for interested workers.
14. Deming is one of the main authors of the Total Quality Management (TQM) theory of management which is a set of principles and quantitative techniques designed to continuously improve an organization's products, procedures and performance.
15. The numbers given are approximate percentages which is why they do not total to 100% exactly.
16. Honda has a very interesting history—it did not enter automobile manufacturing until 1962 and faced a lot of interference and pressure from MITI which did not want another entry into the field.
17. Imported cars and trucks increased their share of the American market from 14.6% in 1970 to 25.2% in 1981.
18. Deming had tried to sell his ideas to American auto manufacturers around the time the Japanese showed interest in his ideas but to no avail.
19. Initially, Ford workers reaped no identifiable gain from this agreement since the company earned virtually no profits in 1982. However, the profit sharing agreement soon began to increase employee compensation. For example in 1987 individual Ford workers received an additional check for $2,100 in profit sharing and in 1988 they received around $3,700 (Ingrassia:138).

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