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Making sense of institutions as a factor shaping economic performance

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Abstract

There has recently been a resurgence of interest in how institutions affect economic performance. A review of this literature reveals that the concept of an "institution" means different things to different scholars, both within economics and across the social sciences. We discuss what factors unify the different definitions of institutions, and develop a concept of institutions useful for the analysis of economic performance, and economic growth in particular. Specifically, we develop the notion of institutions as standard "social technologies". Economic growth results from the co-evolution of physical and social technologies. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

There clearly is a renaissance of interest in institutions as a factor shaping economic performance. The particular focus of this essay will be on the role of institutions and institutional change in economic growth, a topic that lately has attracted a lot of discussion (see e.g. Matthews, 1986; North, 1990; Greif, 1998). However, the issues, and for the most part the range of relevant writings, are those that are central to consideration of the role of institutions in economic life more generally.

The surge of new interest by economists in how institutions affect economic performance can be regarded as a return to old ground. Institutions of course were a central concern of

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Adam Smith and his great classical followers. However, given the recent history of the field, the renewed interest in institutions on the part of many economists can be recognized as a growing conviction that satisfactory understanding of economic performance requires going beyond the lean logic of at least stripped down neoclassical theory.

However, our perusal of the new (and old) literature on institutions in economics and social science more broadly has convinced us that there is a difficult road ahead before institutions can be weaved into a coherent theory of the determinants of economic performance. The term apparently means significantly different things to different authors. The notion of institutions itself is not yet a coherent concept, at least not across the various users of the term.

On the other hand, we think we have came to understand some of the reasons behind this diversity. And that understanding, we believe, helps to clear the way to developing a concept of institutions that can be integrated into a coherent theory of economic activity.

We proceed as follows. First, in Section 2, we "box the compass", discussing various strands of institutional analysis. Then, in Sections 3 and 4, we develop a concept of institutions that, we think, may be useful for analysis of economic performance, and economic growth in particular. In Section 5, we provide some examples of the theory at work. In Section 6, we pull strands together.

2. Writings on institutions and economic activity: boxing the compass

2.1. Motivations behind the new writings

There have been several wide ranging and thoughtful reviews of institutional ideas in economics. We have benefited in particular from those by Hodgson (1988, 1994, 1998), Eggertsson (1990), Rutherford (1994), and Langlois (1986, 1989, 1997). In addition, Hall and Taylor (1994) recently have surveyed the varied meanings of institutions in political science, and Powell and DiMaggio (1991) have compared the concepts of institutions in economics with those in sociology. These reviews obviate any need for us to provide an extensive review of our own. By and large below, we follow along the lines they have charted, although our stress will be different in various places.

All of these reviewers identify the new institutional writings in economics with attempts by economists to enrich, or to get away from, the austere assumptions about human behavior contained in at least the standard versions of neoclassical theory. Those writers that might be called "neoclassical institutionalists" (this is the group on which Eggertsson focuses) are sympathetic with the dual presumptions about human and organizational behavior contained in neoclassical theory: that human actors understand reasonably well the contexts in which they are operating, and choose actions that in fact are appropriate, given their objectives, and the opportunities and constraints they face. Their concern is that the theory, in its simple version, does not adequately recognize certain very important variables that define the structure for human action.

But there also is another group of institutionalists who take what for most modern neoclassical economists is a more radical theoretical stance, arguing that the belief systems and preferences taken as given by that theory, with the former at least presumed to match the actual reality, need to be explained not assumed. More generally, this branch of the stream

of institutional analysis posits that human rationality needs to be understood as a social and cultural phenomenon. Among the above cited authors, Hodgson is particularly interested in this line of theorizing.

We note a similar divide in political science between what Hall and Taylor (1994) call "rational choice" institutionalism and what they call "historical" institutionalism. On the other hand, in sociology, the dominant position clearly is that beliefs and values are socially constructed, at least to some degree. We will propose later that there, therefore, is a natural affinity between the more unorthodox strand of institutional theorizing in economics and institutional theorizing in sociology.

We want to flag right away, since the fact is highly relevant to our current inquiry, that the authors of a number of the works now included under the collection called "the new institutional economics" did not originally call what they were analyzing an "institution". This is so, for example, of the early writings on property rights. The term "institutions" generally is invoked by those using it to denote a broad concept under which are included a number of specific instances. But if, as we suggested above, the term is used by various authors to denote what they think is missing from neoclassical theory, given the diversity of authors it would be strange if all the things called institutions were of the same ilk. We believe they are not.

To tip our hand somewhat, the basic question we will be asking is not "What is the right general definition of institutions?", because we do not think there is a general answer to that question. Somewhat different particular definitions (generalizations) may be useful for different kinds of analysis. Our quest here is for a concept of institutions that is useful for analysis of factors molding economic performance, and long run economic growth in particular.

2.2. Strands of institutional analysis

All of the above reviews recognize the writings concerned with property rights (Demsetz, 1967; Alchian and Demsetz, 1973), and more broadly the general law and economics program that developed in the 1960s, and 1970s (see Goldberg, 1976) as one of the major strands of the new institutional analysis in economics. Much of this body of analysis focuses on formal law (e.g. Posner, 1981, 1992), but some of it identifies norms of behavior that are enforced through social sanction as contrasted with the force of government. Some of the writing even reflects upon norms enforced largely by an individual's sense of what is right and wrong (see for example, Sugden, 1989 and Axelrod, 1997).

Many of the writers in this camp, and several of the broad surveyors of institutional writing in economics, propose that all of these elements define the "rules of the game." The rules of the game are proposed to be important for two reasons. First, well understood rules establish baseline conditions for human interaction, and give a certain predictability to what other parties will do in a particular context, that permits individual decision making, and multi-party negotiation, to proceed with some degree of certainty, the actions of different individuals to be coordinated, and efficient transactional agreements achieved. (This is, in effect, the Coase theorem.) Second, rules can serve to discourage or rule out actions that, if widely practiced, would be economically costly, and encourage actions which, if widely taken, can be productive for all.

Most of the articles of this genre cite Coase (1960) article on "The Problem of Social Cost" as providing the intellectual starting place for their work. And like Coase, the writings here mostly focus explicitly or implicitly on transactions among different economic parties, and transaction costs.

Coase (1937) earlier article on "The Nature of the Firm" clearly is the source of another broad strand of economic institutional analysis. The body of writing on firm organization and governance now is vast, and is concerned with a variety of topics, from what determines the boundaries of firms, to what explains the ownership pattern of a firm (that is who works for whom), to internal problems of agency and their management, to corporate culture (Kreps, 1990). Some of the writers here, Williamson (1975, 1985) in particular, have been strongly influenced by the writings of business historians like Chandler (1962, 1977). However, most of the writing of this genre is focused on the present situation and not with how it has evolved.

The natural generalizing language here would seem to be that of "governing structures", which is not quite the same as "the rules of the game". On the other hand, Williamson in particular, stresses that governance here refers to transactions, which he proposes as the basic unit of economic activity. This establishes a certain affinity between the "rules of the game" conception of institutions, and the "governing structures" view.

While Williamson's focal governing structures relate to firms, that concept of what institutions are would seem quite compatible with the designation of other kinds of governing structures as institutions. Thus, many economists have written about prevailing "labor market institutions" in a way that suggests they have in mind the governing structures, perhaps including but transcending "the rules of the game", that define how labor markets work and the structure of employer–employee relations. Economists have written in the same vein about "financial institutions". Some have called the Bank of England an institution, and the American Federal Reserve System.

Still another strand of the new institutional writing in economics, and the center of the new institutional analyses in political science (Hall and Taylor, 1994), is concerned with the structures that induce and govern collective decision making. The prisoner's dilemma problem, and the potential tragedy of the Commons, have attracted a lot of attention. Here, the orienting question often is "Can humans devise a system of rules, or a governing structure, so as to deal with problems of this sort which would exist in certain contexts absent some kind of institution to prevent them?". Thus, Ostrom (1991) has been concerned with how institutional structures get formed that deal with, or prevent, over and careless use of common resources.

Axelrod (1997) on the forces generating and sustaining cooperation is another good example. In his analysis of how a large group enforces cooperative behavior on the part of it's members he places stress on the norms supporting cooperation, and on the norm of punishing those who violate the cooperative norm.

As the Ostrom work on protecting the Commons, and Axelrod's on cooperative behavior in large groups indicates the new institutional writings by political scientists, as that by economists, aim to identify and analyze the influence of forces and structures that, in the eyes of the analyst, are ignored or underestimated by earlier analyses. Thus, Elster (1989a, b) has proposed that to explain certain kinds of human action and interaction, it almost surely is necessary to recognize the role of internalized norms, even though these are difficult to square with rational actor theory of the conventional sort, a position also taken by Ostrom,

1998, and Axelrod, 1997. Other political scientists stick with rather austere assumptions about informed human rationality, but bring in various constraints and structures to explain behavior that simpler analyses cannot. An important example is the work of scholars like Shepsle and Weingast (1982) to explain why majority voting tends to lead to more predicable and stable outcomes than earlier analyses, influenced by Arrow's impossibility theorem, had deemed likely. The explanation is posed in terms of procedural rules of voting.

But to return to analysis of governing structures in economics, Williamson proposes that his focus on transactions links his modern institutional analysis with that of the older American institutionalists, in particular, the perspective of Commons (1934). Indeed, it would appear that the desire to make such a connection across the generations is a good part of Williamson's motivation for calling his analysis, which at that time was largely concerned with the modern capitalist firm, "institutional".

However, as Rutherford, Hodgson, and Langlois document in detail, there were a variety of different earlier traditions of institutional analysis in economics, not just one. The American institutional economics tradition includes not just Commons, who did focus on transactions, but also Thorstein Veblen, who defined institutions in terms of widely common and predictable patterns of behavior in a society, including generally shared "habits of thought" as well as of action (see e.g. Veblen, 1899). In his review, Langlois focuses attention on the long-standing German and Austrian tradition of institutional analysis, which seems closer to Veblen than to Commons, but contains special elements of its own.

Langlois is especially interested in the development by Friedrich Hayek of a body of thought that has spawned a group of present generation economists who say they are institutionalists in the "Austrian" tradition. For Hayek and the modern Austrians, institutions are defined as widespread and widely recognized practices in a society that commonly are deemed appropriate in the circumstances (see e.g. Hayek, 1967, 1973).

As Langlois has noted in several places (Langlois, 1995, 1997), the notion that institutions define rules for behavior can mean either that rules set constraints, or that behavior itself follows a set of rules (see also Crawford and Ostrom, 1995; Jepperson, 1991; Scott, 1991). While most of the neoclassical institutionalists have the former in mind, even within these ranks there are some who lean towards the latter, being inclined to define institutions in terms of prevailing Nash equilibrium behavior (see e.g. Schotter, 1981). For Hayek and Veblen, the notion of institutions clearly carries the latter connotation. The position is that behavior itself follows a regular pattern, that needs to be explained on the basis of additional, or deeper, or other, arguments than simply informed rationality.

Hodgson, in particular, highlights the imbedding of economic activity and behavior in the broader cultural context that is central in Veblen (and also in Hayek). That theory of behavior certainly is a far distance from that of the group of modern neoclassical economic institutionalists, treated by Eggertsson in his 1990 volume, for whom institutions are seen as influencing human behavior that is basically "cold turkey" rational. Recently, Eggertsson (1999) himself has moved a significant distance from his earlier articulation, and has focused on the role of culture in influencing human behavior. Given the way the disciplines have developed in the time since Veblen wrote, these views today ring much better in sociology than in economics.

The lines between what some analysts calls "institutions", and what might be called "culture" are very blurry in modern institutional analysis in sociology. Thus, Powell and

DiMaggio (1991) argue, as would many sociologists, that the patterns of organization and behavior one sees in firms generally are those deemed "appropriate" within the relevant business culture. For the most part, firms do not engage in any wide ranging scan of alternatives, but rather simply do the standard thing. Scott (1991) includes symbol systems under his concept of institutions. And in anthropological analysis, institutions tend to be seen as an aspect of culture, or at least something that is determined by culture. Douglas (1986) has written a book with the title "How Institutions Think".

There clearly is an important difference between Veblen, Hayek, and the modern Austrians on the one hand, and many of the modern neoclassical institutionalists on the other, that all of our reviewers have noted. The former do not believe that the strong rationality assumptions of neoclassical theory provide the right explanation for the relatively effective human behavior that one apparently observes in contexts where there is considerable common experience. (Hodgson clearly associates himself with this point of view, if not with all of the "fellow travelers".) For the Austrians, institutions define, mold, and support "rational behavior" in such contexts. Individual persons and economic units do not "think out" good practice for themselves, but rather do well by doing what is conventional in the context.

There is a related contrast between, on the one hand, the old American institutionalists in the school of Commons and many of the new neoclassical institutionalists, and on the other hand, institutionalists of the Austrian tradition, regarding how they see institutions as arising and changing. Hayek saw institutions largely as the unplanned consequences of human action, with the actual structures which developed, and their effects, not well predicted by the individuals who influenced their development (see Powell and DiMaggio, 1991 for a general discussion). While Commons (1924, 1934) does recognize that customs, norms, and rules can arise spontaneously, his writings emphasize the role of conscious collective governmental action, i.e. through the legislatures and the courts, in working out conflicts between such institutions and deciding which should become law or supported by policy, and thus, made more precise and durable.

The difference between a theory that posits that institutions involve conscious coordinated planning, and a theory that posits they are the result of a largely uncoordinated evolutionary process, does not map immediately into a difference about whether prevailing institutions are "efficient" or not. Much of the early "neoclassical" institutional writing following Demsetz on property rights, and the law and economics tradition in general, presumed that the law was efficient, and that changes in the law reflected changes in the "rules" that are socially optimal. Similarly, much of the writing on business organization assumes that organizational forms are chosen rationally and are optimal, given the context. (see also Ruttan and Hayami, 1984). But on the other hand, Hayek, who was an evolutionist on the first count, saw prevailing institutions as largely efficient.

Recently, there has been a noticeable breaking away from this position. The intellectual movement of Douglass North from an early position that institutions evolved in a way that assured they always were close to efficient (e.g. Davis and North, 1971; North, 1981), to his present belief that societies that possess relatively efficient institutions are very lucky (e.g. North, 1990), may well reflect a general trend in theorizing about these matters. Earlier we noted that Eggertsson has made a similar shift in point of view.

The position that institutions need not be, and often are not, efficient, opens the door to seeing prevailing institutions as a hindrance and a trap, and to explaining cross country

differences in economic performance as being caused by differences in institutions. North (1990) takes this road, in a way that is reminiscent of Adam Smith's arguments over 200 years ago.

Economists and other social scientists have been asking the kinds of questions for which "institutions" often is the name given to the answers for a long time. The use in institutional analysis of the terms, concepts, and modes of analysis of modern game theory is something of a Johnny-come-lately. However, recently formal game theory, or at least the language of formal game theory, clearly has played a prominent role in various parts of the new institutional analysis, in political science and in sociology, as well as in economics. Thus, while earlier institutionalist often defined institutions in terms of widely accepted and enforced rules, the specific language "rules of the game" clearly is drawn from formal game theory.

Shubik (1975) was among the earliest of the formal game theorists to associate "institutions" with the often complex "rules of the game". Later, of course, that became common. A number of game theorists (e.g. those writing in the mechanism design literature) have proposed that the rules of the game themselves can be a matter of choice, and thus, institutions are consciously chosen rules of the game, a point of view consistent with some of the authors discussed earlier. On the other hand, Schotter (1986) has proposed that the rules of the game can emerge spontaneously, rather than by design, an argument along the lines of the Austrian tradition.

In recent years, the notion of multiple equilibria has become prominent in the game theoretic literature on institutions. Again, Schotter (1981) was among the first game theorists to develop the concept of institutions as "the way the game is played" (in the presence of multiple equilibria) as opposed to simply the "rules of the game". Specifically, in this strand of the game theoretic literature, institutions are "ways of playing the game" which sustain cooperation or solve coordination problems in a repeated game context (see also Sugden, 1989).

The literature on repeated games with multiple equilibrium paths of play, each often supported by a specific set of beliefs and expectations, is consistent with the notion of "path dependence" which has become increasingly popular in the broader literature on the evolution of institutions. And this conception has pulled a number of institutional theorists who earlier had conceptualized institutions somewhat differently, to stress the expectational aspects involved.

Formal game theory obviously is a highly stripped down and stylized model of reality. It is interesting, therefore, that the concepts of institutions that come out of analyses using formal game theory reveal the same varied bestiary as do the collection of concepts associated with less formal analyses. Some authors identify institutions with the rules of the game, or with the governing structures controlling the players, others with the way the game is played, others with systems of beliefs and expectations. What about the proposition that institutions should be defined to include "all of the above"?

We believe there is a real inclination to do just that. However, it also is clear that many writers working in the field are arguing that this is something to be avoided. North (1990), in his recent analysis of institutions and economic growth, takes pains to state that, under his conception, institutions define the environment within which organizations can grow up and within which they operate, but that organizations are not institutions. And a variety of particular organizational forms are compatible with a given broad institutional regime.

Granovetter (1985) has taken a similar stance, proposing that social scientists not "over institutionalize" human behavior, but rather admit that there can be a variety of behavior patterns (that need to be explained on other grounds) compatible with a given set of institutions. North's interests recently have turned to the role of ideology, and ideas, in influencing human behavior, but he has tried hard to keep his institutions concept separable from his concept of ideology.

On the other hand, for Williamson standard organizational forms are among the most important of an economy's institutions. Institutional economists from Veblen to Hayek to Schotter have defined institutions in terms of standard and expected patterns of behavior. And Veblen includes under his concept of institutions "habits of thought common to the generality of men".

2.3. What is common and what is different across the concepts?

Despite the obvious diversity, there are certain common perceptions, or themes, that run at least through significant subsets of what we have described above. These seem to promise that broad but coherent conceptualization of institutions is possible.

In particular, virtually all the analysts who call themselves institutionalists, or who are called that by surveyors of the field, have their attention focused on human interaction, in contexts where the interests of one party, and the efficacy of the actions of that party, are strongly influenced by what other parties do. Many focus on the uncertainty, indeed the chaos, that would exist in such contexts absent reliable expectations regarding what others will do. Virtually all writers recognize, and highlight, that in such situations customary behavior patterns often emerge, and that these patterns can be of varying efficacy.

The focal contexts differ from writer to writer. In some cases, the focus is on transactions between economic units; the property rights literature is a good example. Other analyses focus on authority and control within economic units, as in the principal-agent literature. A number are focused on the problem of achieving agreement and coordination in contexts where there is a collective interest in channeling and controlling self-interested behavior, and achieving a pattern of action that is in the collective interest. Political processes, more broadly, are widely regarded as being strongly institutionalized. However, there would seem no particular difficulty in recognizing these different action contexts and generalizing across them. Indeed, the survey writers cited earlier take all aboard.

While the standard behavior patterns that often emerge in these contexts are of central interest to most of the authors we have surveyed, our survey also reveals that different authors use the term "institutions", as they relate to these patterns, in different ways. Some use the term to refer to the standardized behavior patterns per se. Others use the term to refer to factors and forces that constrain or support these patterns of customary behavior, like norms and belief systems, or the rules of the game, or governing structures. Further, within the latter camp some authors define institutions in terms of factors associated with particular behavior patterns, like the M-form. Others tend to define institutions in terms of the broader social and cultural context within which particular rules and organizational forms take shape. While there is a semantic and causal chain linking various definitions of institutions, the different definitions clearly refer to different kinds of things.

Given this diversity of uses, one might ask whether the term "institutions" is needed at all. We think that regardless of how one might answer that question, we are stuck with the term. While it might be better if we could expunge it from our vocabulary, that does not seem to be in the cards.

However, there is something of a problem when these different conceptions of institutions are lumped together. To call the smooth customary low transaction cost way customers and suppliers interact on a certain product market, the particular body of law and the organizational structures that support that interaction pattern, and the broad belief systems and political processes in the society that enabled those particular structures to develop all "institutions", is a recipe that makes coherent analysis very difficult.

More generally, we believe it is a mistake to try to make the term "institutions" cover too much conceptual ground. At the least, the term ought to refer to a set of things at the same causal level. Also, we believe a useful concept of institutions can be developed for analysis aimed at particular phenomena only in the context of a broader theory bearing on those phenomena which naturally invokes, as it were, a relatively coherent concept of institutions. In any case, this is how we proceed in our attempt to "make sense of institutions" as a factor in economic growth.

3. Building institutions into economic growth theory

3.1. The challenge

To a first approximation, a theory of economic growth is a dynamic theory of production. More specifically, it is a theory about the factors that drive changes over time in output per worker and living standards, and those which lie behind cross economy differences in these variables. Scholars studying economic growth are in considerable agreement regarding the "immediate" or "proximate" factors behind the cumulatively vast increases in worker productivity, and standards of living, that many economies have achieved over the last two centuries. Here, almost all economists would list as key elements technological advance, investments in physical capital, and the growth of human capital. When pressed many economists would recognize, as well, factors relating to the efficiency with which firms operate, and the effectiveness of the processes that allocate and reallocate resources. These same proximate factors generally are invoked when the analytic focus is on cross economy differences.

Economists also are in broad agreement that "institutions" are an important factor molding and involved in economic growth. But there is far less coherence across the analyses. There would seem to be widely shared agreement on two matters. One is that one ought to bring in institutions to deepen the analysis and try to explain some of the variables treated as proximate factors behind growth. Thus, this strand of growth theorizing tends to involve reflections on the institutions supporting technological advance, physical capital formation, education, and the efficiency of the economy and the resource allocation process.

The second broadly shared conception, and one that we will use as the basis for our subsequent analysis, is that institutions influence, or define, the ways in which economic actors get things done, in contexts involving human interaction. They do this by making certain kinds of transactions, or interactions more generally, attractive or easy, and others

difficult or costly. Thus, while very parsimoniously modeled, markets, and the prices generated by markets, are part of the growth theory espoused by virtually all economists. So, too firms. Security of property and clarity and enforceability of contracts enter many accounts of the factors that support economic growth. Many economists recognize the importance of mechanisms for collective action. Economists tend to call of these things, or the things that shape them, "institutions".

Beyond this, consensus breaks down. Indeed, as we suggested above, there is not much agreement among economists working in this arena even regarding exactly how to define institutions.

3.2. A proposal

We think there is a straight forward way to bring institutions into a theory of production, and hence into a theory of economic growth. In particular, we propose to elaborate on the concept of an "economic activity" (a key building block of at least one sophisticated version of production theory) so as to recognize the multi-party interaction involved in the operation of most productive economic activities — interaction which sometimes goes on inside economic units, and sometimes between them. In the activity analysis formulation, an activity is associated with a vector of inputs and outputs, but also implicitly with a process. An important advantage of the activity formulation, from our point of view, is that it invites natural discussion of "how the activity is done". While that notion generally is presumed to involve a description of the "physical" technology involved, here we propose also to include a characterization of the "social" technologies. The notion of "social technologies" (if by another name) that in some ways are similar to "physical technologies", but which involve patterned human interaction rather than physical engineering, also has been put forth by North and Wallis (1994), Boserup (1996), and Day and Walter (1987).

Our suggestion is to associate the term "institutions" with "social technologies" that have come to be regarded by the relevant social group as standard in the context. We will unpack the social technologies concept in the following section. Here, it is sufficient to regard it generally in terms of how knowledgeable people act and interact where the effective coordination of interaction is key to accomplishment. Under our proposed language, not all social technologies are institutions, but rather only those that have become a standard and expected thing to do, given the objectives and the setting.

Thus, our institutions concept corresponds to Veblen's "widespread habits of action", and to Schotter's "the way the game is played". Widely used social technologies need to have a certain flexibility, an open fine structure as it were, so as to be applicable in a range of specific contexts and to meet a variety of specific needs. They define a structure for behavior, but not a ridged lock step. Thus, our concept of institutions as social technologies is consonant with the notion that institutions are "the rules of the game" when these are regarded as defining relatively closely, but with discretionary room, what people do when they play the game.

This conception of institutions is tied to is standardized patterns of behavior per se, rather than to broad factors behind the scenes that constrain and shape that behavior, although these of course are basic to any explanation of prevailing institutions. We think a major advantage of this formulation is that the standard social technologies that the analyst sees as central to

economic performance immediately become the focal objects of description and analysis. This seems a promising way of framing an empirical as well as a theoretical research program. Another advantage of the formulation is that it is open regarding exactly the factors or structures that support prevailing standard social technologies. It is not biased towards seeing these factors as "the rules of the game" (interpreted as broad constraints) or "governing structures" (embodied in particular organizational forms) or "cultural beliefs and norms". Different physical technologies have different physical (as well as institutional) requirements for their implementation. Some require specialized machinery, some specialized materials. Similarly, different social technologies are institutionalized in different ways.

Earlier, we highlighted the problems of coherence that emerge when both a pattern of action and the factors that support that pattern are called institutions. However, in some cases, it may be convenient to refer to a particular standardized social technology by using the name of the particular background factor or structure associated with it. Thus, to call Chandler's M-form, an institution is a convenient way of referring to the social technology of corporate management associated with it. Similarly, to say that in pharmaceuticals strong intellectual property rights is an institution is a convenient way to refer to the proclivity of companies in that industry to take out patents. From our perspective, this is a legitimate use of the term, so long as the supporting structure and the pattern of behavior are closely linked, and the substance of the institution is seen as the social technology. Thus, from this point of view, in some cases, the very name of an institution will indicate an important factor or structure supporting the social technologies being described or analyzed. Similarly, some physical technologies are named in terms of the equipment used to implement them, e.g. the "open hearth" method for making steel.

We proposed above that particular social technologies become institutionalized through different mechanisms and are sustained through different structures. However, once they become institutionalized, they become attractive ways to get things done. Indeed, we would argue that this is largely why they become and remain the standard way to do something. We can couch our proposal in the language of transaction costs. Institutionalized social technologies define low transaction cost ways of doing things that involve human interaction. Note that, under this conception, on the one hand, institutions are constraints. They in effect define the particular ways things must be done if they are to be done parsimoniously. But on the other hand, effective institutions, like effective physical technologies, define productive pathways for doing things. Absent of an effective institutionalized social technology for doing something, it may be very costly to do that thing, or doing it may be impossible. We develop these notions in the following section.

In addition to being embodied in and molded by particular organizational and governance structures, standardized social technologies are formed, and held in place, in the context of the broad system of norms, beliefs, and rules of the game, that prevail in a society. We propose that our social technologies concept is a useful generalization of North's notion of the variety of particular kinds of institutional arrangements that are allowed by the institutional environment. The language we are using here associates the term institutions with the specific behavioral (and organizational) structures, and uses the term institutional environment for the more general molding forces. However, we would have no difficulty if the reader wants to call our standardized social technologies institutionalized behavior, and use the term institutions for the broader background structures.

Our point is that, while the differences are a matter of degree not kind, it is important not to confound the different meanings. In what follows our focus is on standardized social technologies, with the institutional environment allowing and shaping these in the background.

4. Routines, and physical and social technologies

We believe that the language of routines, as developed in Nelson and Winter (1982), is a useful vehicle for characterizing social technologies, and we begin our analysis with a general discussion of the "routines" concept.

A routine involves a collection of procedures which, taken together, result in a predictable and specifiable outcome. Complex routines, of the sort associated with the production of goods and services, almost always can be analytically broken down into a collection of subroutines. Thus, the routine for making a cake involves subroutines like pour, mix, and bake. These operations generally will require particular inputs, like flour and sugar, and a stove. In turn, virtually all complex routines are nested and linked with other routines that must be effected to make them possible, or to enable them to yield value. Thus, a cake-making routine presupposes that the necessary ingredients and equipment are at hand, and the provision of these at some prior date required their own "shopping" routines. And before these artifacts could get to the store, they had to be designed and produced, activities involving their own complex structure of routines.

As the example suggests, the productive operation of any particular routine generally is keyed to and made effective by the embodiment of the operation of other routines in materials and equipment (see Langlois, 1999 for an elaboration on the theme that routines often are embodied in machines). The cook "turns on" the stove and sets its temperature gauge to 350°. The stove then carries out its routine.

We noted above that our concept of a routine admits, indeed highlights, that choices are made in the course of performing a routine. On the other hand, the term connotes that the flow of action in the activity proceeds more or less automatically. Routines do not eliminate choice, but they do sharply channel it. Choices need to be made about what broad routine to invoke in the first place, and a whole series of choices need to be made along the way in operation of the routine. However, under the theory put forth here, given a particular objective and the context for its pursuit, these choices are highly focused and, to a considerable extent, are made routinely, i.e. without much conscious thinking.

Thus, to return to our cake making example, a given cake recipe — a routine for making a cake — generally allows the mixing to be done with a hand or electric mixer. Margarine may generally be substituted for butter. An individual cook may use a little bit less of this, and add some of that, without breaking very far from the recipe. Making a chocolate cake involves basically the same recipe as making a vanilla cake, except for a few inputs and steps. Thus, there is room within a routine for variation, perhaps motivated by particular tastes, or the kind of cake the cook deems appropriate under the circumstances (it is a birthday cake and the birthday child likes vanilla), or the skill and experience of the cook, or input availabilities (there is margarine but not butter in the refrigerator), perhaps by input

prices (butter is very costly these days). Many cake makers have their own particular secrets that they regard as contributing to superior products.

However, one important aspect of many productive routines we want to highlight here is that, while the particular operation of a routine by a competent individual or organization generally involves certain idiosyncratic elements, at its core almost always are elements that are broadly similar to what other competent parties would do in the same context. By and large the ingredients and the equipment used by reasonably skilled cooks are basically the same as those used by other skilled cake makers. And the broad outline of the steps generally can be recognized by someone skilled in the art as being roughly those described in "The Joy of Cooking", or some comparable reference.

As the example suggests, the latter aspect of a routine, the part that is broadly familiar to all those skilled in the art, tends to be associated with a title or name, and with written or otherwise codified descriptions and explanations of how it is done. It may also be associated with a positive theory purporting to explain why the routine works, and a normative argument about why it is appropriate in the context. The ability to name what one is doing, explain the procedure in a reasonably articulate way, and to provide reasons for it, is a principal difference between skilled human behavior, and skilled behavior of non-human animals. This general characteristic of widely used routines is, we will argue, particularly important for social technologies.

We do not play down that, almost always, a nontrivial part of what is involved in performing routines may not be explainable in a way that completely permits someone who is not already familiar with the practice to "do it" without a lot of learning by doing. Michael Polanyi's point about the tacitness of much of human knowledge is highly relevant. Further, while some routines (as the use of rDNA techniques in doing genetic research) are backed by a sophisticated scientific understanding, in many cases the "explanation" for why something works may be more folklore than science (consider the rationales for certain steps in a cake recipe). In some cases, the normative argument for using it in a certain context may be nothing more than the proposition that it is the most effective way to do something; in other cases, the reasons for use of the routine may include preservation or furtherance of important interests or values. In fact, routines differ enormously in the degree to which they are articulated, the extent to which they are understood in a scientific sense, and in the strength and nature of the values at stake.

However, in any case, a key characteristic of most routines that are used extensively in an economy is that, in their broad outlines at least, they are widely known and employed by those skilled in the art. And this is not just happenstance, or the result of separate individual learning experiences that lead to the same learned actions. The standard elements of widely used routines are standard because they are culturally shared.

Particular individual and organizational actors need to have mastery over these culturally shared aspects, in order to operate effectively, for several reasons. First, great cake recipes, or effective ways of organizing bakeries, or for producing steel or semiconductors, tend to be the result of the cumulative contributions of many parties, often operating over many generations. This is a central reason why they are as effective as they are.

A second reason why individual persons and organizations wanting to operate effectively in a particular arena need to tap into the public aspects of the relevant routines is that, as we noted, particular routines tend to be part of systems of routines. The inputs needed

for them tend to be available, routinely. If help is needed, it generally is easy to get help from someone who already knows a lot of what is needed, and to explain the particulars in common language, etc.

As a special aspect of the above, but a central one for this discussion, for activities requiring effective interaction among different parties, mutual knowledge about and use of the standard appropriate meshed routines may be essential for coordination the be achieved. This observation leads us naturally into our discussion of social technologies.

4.1. Physical and social technologies as constraints and as productive pathways

We now would like to propose that the program built into a routine, generally involves two different aspects: a recipe that is anonymous regarding any division of labor, and a division of labor plus a mode of coordination. We propose that the former is what scholars often have in mind when they think of "technology" in the conventional sense; we will call this aspect of a routine the "physical" technology involved. And we will call the latter aspect, that which involves the coordination of human action, the "social" technology involved.

From one point of view, prevailing physical and social technology limit choices regarding how to do things. By "limit" here, we mean a soft set of constraints, not a hard one. Earlier we noted that different practitioners will use physical or hard technologies, like cake recipes, in different ways. Different contexts will induce different variants. However, to use a physical technology completely different from what professionals in the field are familiar with and have developed cumulatively over the years involves not taking advantage of that social learning. Available inputs — machinery and materials — generally are tailored for use in prevailing routines, and to try to do something significantly different may require hand crafting the inputs, perhaps at considerable cost and risk of failure.

On the other hand, as Schumpeter (1934) argued years ago, breaking from prevailing routines is exactly what innovation is all about. Continuing economic progress is impossible without it. But innovation is risky for exactly the reasons just put forth.

We propose that the situation is similar regarding the aspects of a routine that involve division of labor and coordination mechanisms. Individual organizations operating a particular routine inevitably will differ in how labor is divided and work coordinated, both within the particular organization in question, and across the borders of the organization, just as they will differ in the details of the physical technology employed. These differences may reflect variations in opportunities and contexts. As circumstances change, a particular organization may modify its ways of doing things in ways that are responsive to those changes. However, there are a lot of advantages in abiding by at least the broad outlines of prevailing and generally accepted "modes of organizing work" and "appropriate practice", and not taking a route that is deemed strange or inappropriate to those who have to be involved. In a sense, standardized social technologies themselves can take on the character of norms a la some of the game theoretical literature surveyed above.

On the other hand, generally accepted social technologies, institutions, may be highly inefficient compared with other ways of organizing transactions, should these be effectively implemented. In particular, prevailing institutions may not work well with new physical technologies, or to cope with new conditions of demand and scarcity. But institutional innovation, like innovation in physical technologies, is risky.

There is widespread recognition that powerful "physical technologies" generally are involved centrally in productive routines. Under neoclassical theory, at least there has been less explicit and systematic reflection on the roles of effective "social technologies" in productive activity, although as we have noted this is what much of the new discussion of institutions seems to be mostly about. This is our focus here.

It is apparent that "knowing" prevailing social technologies, and what they allow and deny, and how to operate within them, is just as important as "knowing" available physical technologies in determining the available range of "choice" facing a particular actor. Thus, in the cake making example, in this society at least sugar and flour tend to be available at one kind of store, which may or may not also sell mixing devices, but almost never stoves. Stoves are available at a different kind of store. What different kinds of stores provide, and how one gets to obtain merchandise from them, define a good part of the institutional context for cake making. To be an effective cake maker, one needs to know not only the recipes but also how to get the right ingredients.

That knowledge, and the prevailing social technology in this context, of course involves much more than who sells what, but also matters of law and law enforcement, and customary practice. To take merchandise from a store without paying for it is a crime. Cash is legal tender for purchase, but the custom may be for particular kinds of stores also to accept personal checks, or credit cards. Thus, knowledge of "background factors" and of social technologies employed by others affect the choice of social technologies available for shopping. Indeed, an important reason for relying on standardized social technologies is that actors can draw on cumulative public knowledge useful for the operation of these routines.

In these examples, prevailing institutions have been defined in terms of generally employed ways to get things done where the doing involves coordinating the actions of independent individuals or organizations. In stripped down neoclassical economics, these mechanisms are often subsumed under the concept of "markets". The discussion above aims to unpack the market concept and make it something that can be modeled as a set of processes or routines. A well worked out routines model of a market would incorporate how prices are set, and how prices affect the details of what is done by actors buying and selling in that market. But it would involve a considerable amount of other "institutional" detail as well.

The fact that some social technologies are standardized — that is, they are institutions — also constrains effective routines within organizations. Thus, in any era in any country (or at least within particular sub-cultures) there are some widely held notions about how a bakery should be run which, if violated, might make it difficult to get regulatory clearance, or bank credit, and notions about appropriate job classifications and payment that, if violated, could cause labor trouble. Again, this is a case of the institutionalized social technologies themselves taking on the character of norms.

Broad organizational forms can be thought of as institutions, to the extent that they define or induce particular social technologies which are thought of as the appropriate ways to organize economic activity. Thus, Ford's organization of mass production provided a model followed by many companies engaged in producing assembled products which was for many years considered the norm. Presently, Toyota style "lean production" now is the vogue. In both cases, at least the broad outlines of the organizational format became

well-known, if not always easy to make work in practice. In both cases, a broad "theory" about why the mode was efficient came to be widely articulated and accepted. That is, these forms were "institutions", or generally available "social technologies".

While our focus here is on "economic" institutions, or more generally institutions that mold economic performance, not political ones per se, it is clear that political institutions play an important role in economic performance. The way management and labor negotiate, or fight, about wages and work rules, is a good example. These procedures tend to be highly patterned, that is institutionalized, if with a significant stochastic element. In turn, these patterns of interaction are molded by a body of formal law, which in turn is the result of how a nation's political institutions grind out legal resolutions to the demands of competing interests. Does the labor union have to vote on a contact negotiated by it's representatives and management? Will a passionate minority accept the decision of a majority? In many cases, prevailing social technologies need to be understood as reflecting a kind of truce between different interests. Names, and shared understandings, clearly are vital aspects of social technologies. So too, in many cases, are rationales for what is done.

As the examples indicate, generally employed social technologies — institutions — differ in the extent to which they are supported by norms and values. Some, like the institutions of collective bargaining, may be powerfully supported by interests that argue that prevailing practice is right and proper, and to deviate would break a moral bargain. Others, like whether a grocery store sells hardware, may carry very little moral load.

"Institutions", both those that define what in a simpler conception would be called markets, and those that mold intra-organizational activity, can be very complex and intertwined. Thus, consider what is involved in the design and development of modern aircraft. One observes that these activities tend to proceed in quite similar ways, regardless of the company where they are undertaken. The nature of the division of labor and the modes of coordination that have in the past proved effective are widely known in the trade. In turn, that division of labor is molded, and constrained, by the nature of prevailing scientific and engineering disciplines. Engineering schools reflect and enforce this division. While there is overlap, electrical engineers are trained in one set of subjects and aeronautical engineers in another.

Because of this, firms know "the kind of engineer to hire" when they need someone to do a particular kind of job, and they know how to locate that new employee within the prevailing framework of work. The nature of the job market is molded as well by such "institutions" as the meetings of professional societies, which serve as a meeting ground for employers looking for people and engineers looking for jobs, and also by broadly accepted rules regarding when it is and when it is not legitimate to jump from one employer to another, the mechanisms by which salaries are bargained out, and the like.

We are not arguing, of course, that all companies organize to design planes in exactly the same way, or that every person with a degree in electrical engineering knows the same thing, or that all engineering schools divide the turf the same way. There clearly are non-trivial differences, across societies, between firms in a given society, and even among projects within a firm. And there is change, often significant change, over time. But at a given time within a particular society there tends to be certain reasonably well established practices in these arenas. Major deviation from them is, at the least, cause for notice and surprise, and likely will lead to inadequate outcomes. That is, the design of aircraft, the structure of

technical professions, the division of fields in engineering schools, and the structure of the job market for engineers, all are institutionalized.

As we noted, social technologies become institutionalized through a variety of different mechanisms. But given that they are institutions define and provide low transaction cost ways of doing things that require coordinated interaction with other parties. This is not to say that one cannot organize the division of labor and inter-party coordination through means that are not institutionalized. But the transaction costs of so doing may be much higher. An "institution" is like a paved road across a swamp. To say that the location of the prevailing road is a "constraint" on getting across is, basically, to miss the point. Without a road getting across would be impossible, or at least much harder. Developing an institutionalized way of doing something may be the only way to achieve a low transaction cost way of doing it.

5. Institutions in a theory of economic growth

The question of how institutions fit into a theory of economic growth of course depends not only on what one means by institutions, but also on the other aspects of that theory. While in Section 3, we stressed the common elements of the theory of economic growth employed by most knowledgeable scholars of the subject, we also noted that there were some differences. We believe that the concept of institutions as widely used or customary social technologies fits well with most variants. However, not surprisingly, the formulation we have given fits extremely well, like a glove on a hand, our particular view. Below, we articulate that view, first at a quite general level, and then as a way of interpreting two important historical episodes.

5.1. Technological advance as the driving force

Earlier we noted the widespread agreement among scholars of economic growth regarding the key "proximate" sources, in particular the advance of physical technologies, and rising amounts of physical and human capital per worker. These days any theory of economic growth that does not assign to technological advance a major share of the credit for growth would be regarded as odd, by most scholars of the field. However, our own views on this matter are more extreme than most.

At least for countries operating at the technological frontier, we would argue that, without the creation of new technology, very little productivity growth from existing levels can be achieved simply by increases in physical and human capital per worker. For economists who find the standard production function concept useful in their thinking, our argument is that the relevant elasticities of substitution are very small, if the production function concept is defined in terms of given technology.

Put more positively, our argument is that the economic growth we have experienced needs to be understood as the result of the progressive introduction of new technologies which were associated with increasingly higher levels of worker productivity, and the ability to produce new or improved goods and services. As a broad trend, they also were progressively capital using. (the varied reasons for the capital using nature of technological change has been developed elsewhere: in particular, see Nelson, 1998). Rising human capital intensity

also has been a handmaiden to that process, being associated both with the changing inputs that have generated technological advance, and with the changing skill requirements of new technologies.

Within this formulation new "institutions", new customary social technologies, come into the picture as changes in the modes of human interaction that are called for as circumstances change, and in particular, as new technologies are brought into economic use. Just as the implementation of new physical technologies may require new machinery and new material inputs, as well as new institutions, the institutionalization of these new social technologies may require new law, new organizational forms, new sets of expectations.

New social technologies and their support structures emerge largely because they are needed and useful. They also may be sticky, and have a life of their own. We noted earlier that there is a long tradition in economics of ascribing to prevailing institutions the failure of certain economies to adopt available productive technologies. North (1990) among others recently has rearticulated the "institutional obstructions" theory of economic backwardness. And Freeman and Perez (1988) have proposed that the changing of national locus of industrial leadership that has occurred several times over the last two centuries has been the consequence of the ability of some nations, but not others, to put in place institutions suited to the new technologies. In so arguing, they are of course echoing a theme made long ago by Veblen (1899, 1915).

The conception and language of "routines" is well-suited to this theory of growth. As noted, the notion of operating with a particular routine connotes that, while there may be a range of input mixes and output characteristics compatible with a basic "recipe", that range is quite constrained. Thus, so long as old routines continue to be used, there is only limited room for increasing worker productivity by increasing inputs per worker. Significant productivity increase requires the introduction of new routines, which in general will involve new recipes or physical technologies. And, in turn, these new physical technologies often will require new social technologies if they are to be employed productively.

We believe that the concept of institutions as standardized social technologies, the routines language for describing them, and the theory we have sketched of how institutions and institutional change are bound up with the advance of physical technologies in the process of economic growth, becomes more powerful, the closer the analysis gets to describing actual social technologies in action. Thus, we turn now to two important particular developments in the history of experienced modern economic growth: the rise of mass production industry in the United States in the late 19th century, and the rise of the first science based industry — synthetic dyestuffs — in Germany at about the same time. Given space constraints, our discussion must be very sketchy, but we hope we provide enough detail so that one can see our proposed conceptualization in action.

5.2. The rise of mass production

During the last parts of the 19th century and the first half of the 20th, manufacturing industry, particularly in the United States, experienced rapid productivity growth, associated with the bringing into operation of a number of new physical technologies that together set the stage for mass production. The new railroad technologies and the development of the telegraph enabled firms producing transportable goods to reach distant markets much more

quickly and reliably than before, thus, opening the potential for large scale production and marketing. The advance of machine tool technology, and improvements in metals, allowed the design and development of machinery that was very productive at high sustained rates of production.

The bringing into place of these new technologies was accompanied by growing scale of plants and firms, rising capital intensity of production, and the development of professional management, often with education beyond the secondary level. However, these latter increases in "physical and human capital per worker", and in the scale of output, should not be considered as independent sources of growth, in the sense of growth accounting; they were productive only because they were needed by the new technologies.

At the same time, it would be a conceptual mistake to try to calculate how much productivity increase the new technologies would have allowed, had physical and human capital per worker, and the scale of output, remained constant. The new production routines involved new physical technologies which incorporated higher levels of physical and human capital per worker than the older routines they replaced. To operate the new routines efficiently required much larger scales of output than previously.

And they also involved new "social technologies". Chandler's great studies are largely about the new modes of organizing business that were required to take advantage of the new opportunities for "scale and scope". The scale of the new firms exceeded that which owner–managers plus their relatives and close friends could deal with, either in terms of governance or finance. The growing importance of hired professional management, and the diminished willingness of the original family owners to provide all the financial capital, called for the development of new financial institutions and associated markets. The need for professional managers also pulled business schools into being. More generally, the new industrial organization profoundly reshaped shared beliefs of how the economy worked, and came to define the concept of modern capitalism.

The development of mass production proceeded especially rapidly in the United States, in part at least because of the large size of the American market, but also because the associated new institutions grew up rapidly in the new world. In general, Europe lagged, on the other hand, the rise of new institutions to support science based industry occurred first in Europe.

5.3. Synthetic dyestuffs

We turn now to consider another example; the rise of the first science based industry, in Germany, that occurred over roughly the same time period as did the rise of mass production in the US.

Our formulation of this second case will be somewhat more elaborate, and also somewhat more stylized. We propose to present a nearly formal account of the rise of the organic chemical products industry toward the end of the 19th century, and of the ascendancy of German firms over their British rivals. The basic story has been told by several scholars, but the account we draw most from here is that contained in the thesis by Murmann (1998). Murmann's account is presented in standard language. The account we present here is "semi-formal" in the sense that it makes explicit use of the concept of routines, and the physical and social technologies involved in routines.

Several new packages of routines play the key roles in our story. The first is a new physical technology for creating new dyestuffs, with university based chemists as the key inputs, which came into existence in the late 1860's and early 1870's as a result of improved scientific understanding of the structure of organic compounds. However, this development would not have had the economic impact that it did without the invention and adoption of a new set of routines for organizing chemists to work in a coordinated way for their employer: this new "social technology" is the modern industrial research laboratory. A third element in our story is another social technology, the system of training young chemists in the relevant physical technology, that is in the understandings and research methods of organic chemistry. The social technology was university based, and funded by national governments.

In the story, there are two types of firms. The "old" type does not possess an industrial research laboratory, achieves new dyestuffs slowly through processes that involve only small levels of investment. The "new" type of firm invests in industrial research laboratories and does R&D, and as a result achieves new dyestuffs at a much faster rate than do old firms.

Firms also have routines that link them to national chemical products industry associations. These associations lobby for support of university training. National political processes and government funding agencies are also part of our story, but they will be treated implicitly.

There are two key markets in the model, one for chemists who work in industry and the other for the dyestuffs that firms produce. Chemists and firms each have a national identity. German chemists (we will assume that they are all trained in German universities) require a significantly higher salary to work in a British firm than in a German one, and vice-versa. (For present purposes, it is sufficient to think of this as reflecting transportation costs.) This means that, other things being equal, it advantages national firms if their national universities are training as many chemists as they want to hire.

There are also national markets for dyestuffs. The British market is larger than the German market throughout the period under analysis. Other things equal, British firms have an advantage selling in the British market, and vice versa. However, the advantage of national firms can be offset if a foreign firm is offering a richer menu of dyestuffs. Under our specification, if a foreign firm does more R&D than a national firm, it can take away the latter's market, at least partially.

There are several key dynamic processes, and factors affecting them, in our story. To a first approximation, the profits of a firm, gross of its R&D spending, are an increasing function of the number of dyestuffs that it offers, and the volume of its sales. This first approximation, however, needs to be modified by two factors. One is that the profits of a firm that does R&D depend on whether the chemists it hires are national or not. The other is that, for a given level of the other variables, British firms earn somewhat more reflecting their access to a larger domestic market.

R&D is funded out of profits, but not all firms invest in it. "New" firms have adopted the industrial research lab routines, and invest a fraction of profits in R&D, while "old" firms do not. Initially, all firms are sufficiently profitable to invest in a small scale R&D laboratory, but only some do so. If the profits of a "new" style firm grow, they spend more on R&D.

Given the availability of the new physical technology, it is profitable to invest in a R&D laboratory and, given competition from the "new style" firms, those that do not do R&D lose money. This is so both in Germany and in the UK. In both countries, a certain fraction

of firms start to invest an R&D laboratory and do R&D once the new physical technology arrives. These profitable firms expand, and the unprofitable ones contract. As firms that do R&D expand, their demand for trained chemists go up too. National firms hire nationally trained chemists first, and then (at higher cost) foreign trained chemists.

The supply of chemists provided to universities is a function of the funding that those universities receive from government. For a variety of reasons the supply of German chemists is initially much greater than the supply of British chemists. This initial cost advantage to German firms that do R&D is sufficient to compensate for the disadvantage regarding the location of the product market. And over time, the political strength of the national industry association, and the amount of money they can induce the government to provide national universities, is proportional to the size of that part of the national industry that undertakes organized research. (Of course, this is an important feedback mechanism that makes adopting the social technology progressively more attractive, and is among the forces fueling the "diffusion" of R&D laboratories within countries.)

Start the dynamics just before the advent of the new scientific understanding that creates a new technique for creating new dyestuffs. There are more (and bigger) British firms than German firms in this initial condition, reflecting their closeness to the large part of the market. No firm has an industrial research laboratory. The supply of chemists being trained at German universities is more than sufficient to meet the limited demands of German firms, and British firms, for chemists.

Now, along comes the new scientific technique. Some British firms and some German firms start doing industrial R&D on a small scale. They do well, and grow. The demand for university trained chemists grows. Since most of the existing supply of chemists, and the augmentations to that supply, are German trained, German firms are able to hire them at a lower price than are British firms. The German firms who invest in R&D do well, on average, relative to both British firms and to their German competitors who have not invested in R&D. They grow, and as they do their R&D grows. The effectiveness of German industry lobbying for government support of training of chemists increases as the German industry grows. Scientists become cheaper, and the adoption of an industrial research lab more profitable. The reader can run out the rest of the scenario.

6. A brief summing up

We believe that the conception of institutions as widely employed social technologies is coherent, broad enough to be useful in analysis of economic growth, and well tailored to fit with other aspects of the understandings about economic growth shared by empirical scholars of the subject.

Given space constraints, we cannot discuss in any detail our evolving theory of how institutions change. We have proposed that institutional change is to a considerable extent induced by other changes in the ways that economic activities proceed. Other writers on institutions have stressed changes in prices and in the pattern of demand and scarcity more generally. We have focused on changes in the physical technologies used, or which are available and deemed promising if social technologies could be adjusted to exploit them effectively. But in turn, prevailing social technologies strongly influence the way that physical

technologies evolve. Thus, it probably is useful to think of physical and social technologies as co-evolving.

The use of the term "evolves" seems appropriate. This is not to deny that the processes by which institutions evolve involve thinking, planning, purposive actions, on the part of individuals, organizations, collective bodies. However, if these two cases, and others with which we are familiar, be a guide, the process of institutional change involves lots of trial, failure, try again, learn from mistakes. And it is very much a cultural evolutionary process.

The cases, we used as examples, were of coevolutionary developments in economies at the technological frontier that the coevolutionary perspective also is useful for analysis of the development process of countries far away from the frontier. From this point of view, the key development problem is to reform institutions — operative social technologies — so as to encourage and support the adoption of superior physical technologies that are in use elsewhere, and to facilitate climbing the technology ladder (see Nelson and Pack, 1999).

We have not taken a hard stance regarding the basic theory of human behavior that fits with our conception of the role of institutions. Our own view involves a strong belief in the importance of shared culture in molding what people think is appropriate to do, but at the same time a belief that in many cases at least individual and group learning processes winnow out grossly inferior or self destructive practices, and when new challenges or opportunities arise, there can be major changes in institutions which allow significant economic progress. We are impressed on the one hand by the hold of the broad aspects of culture on what people do, but on the other hand by how rapidly particular cultural doctrine can change when there are strong pressures for change and clear signals regarding better things to be doing. We would propose that, where one does see very rapid adaptive institutional change, the institutions involved do not carry a heavy normative load.

However, the reader does not need to pick up this package, nor our particular use of language regarding institutions. We think the standardized social technologies concept can stand in its own right as a useful way of thinking about institutions as a factor shaping economic performance.

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