

By taking technological regimes as the basis for sectoral innovation systems, Breschi and Malerba put much more of the burden of explanation on technological factors and much less on institutional factors than most writers adhering to the national system approach. This does not mean, however, that they deny the major role played by institutions in the development of all systems of innovation, including sectoral systems. In this chapter Breschi and Malerba demonstrate the usefulness of their approach by empirical discussions of five important sectoral systems of innovation. The results confirm that the specific history of industrial development of each country constitutes a background for the interactions between the institutional and technological factors, which shape the organization and evolution of innovative activities within a given industry.

Mark Elam's chapter is rather different from the others. It is basically an exercise in the history of economic thought about the character and role of the nation-state in economic development. Since there seems to be a general agreement on the existence of national characteristics and national differences in terms of innovation, it is important to have a clear view of how permanent and stable such national patterns may be. Elam shows that nations are not as fixed and stable as one might expect and he argues that once it is seen that nations, like technologies, are fluid and ambiguous the national systems of innovation approach will be in a better position to analyze globalization and international penetration of the national systems of innovation.

Taken as a whole the chapters in this section confirm the complementarity of territorially based and technically based systems of innovation. However, the proper balance between technology based and institutionally based explanations of innovation performance is far from obvious. We still lack a clear understanding of the very nature of (and the relations between) technological and institutional factors.

CHAPTER TWO

Institutions and Organizations in Systems of Innovation

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1. Introduction

During the latest few decades, economists have given increasing attention to the role of 'institutions' in the functioning and change of economic systems. 'Institutions' have also become increasingly important in innovation theory. From occupying a background position, they have been brought more and more into the analysis and have come to be viewed as a main character in the innovation process. The role of institutions is also emphasized in all versions of the system of innovation approach, as was shown in section 3.7. of the Introduction to this book. In addition, the role institutions play in the innovation process has become more qualified: from being looked upon as rigidities and obstacles to innovations to being seen as factors that can both retard and support innovation – depending, for example, on the degree of mismatch between technologies and institutions.

There are many problems associated with the role of institutions in the process of innovation, e.g., conceptual vagueness. What actually is this very important phenomenon called 'institution', and how does it, in its various forms, affect innovations? This is not at all clear in the literature and various scholars mean very different things when they use the term 'institution'.¹ In addition, its delimitations – for example, in relation to 'organizations' and to 'markets' – are not clear.

Let us initially illustrate the conceptual vagueness by the following quotation:

For several authors, an organization *is* an institution ... or an institutional arrangement ... , while for others its contractual nature is such that it is nothing but another form of market activity. ... Reciprocally, markets have been considered as specific organizational forms ... as well as institutions ... , and a market economy defined as 'one large organization'. (Menard 1990: 2)

Thus, organizations (like firms, universities, state agencies, etc.) and markets are often considered to be institutions, and the concept itself is often used in a very broad way to include routines, habits, taboos, formal law, common law, etc. In other words, almost everything – at least a very large part of economic behavior and many types of economic activities and processes – can be subsumed under the concept of institutions. No wonder institutions are important! But can we really use a concept that covers so much and tries to do so many things?

¹ In section 3.7. of the Introduction to this book it was shown that Carlsson and Stankiewicz (1995), Nelson and Rosenberg (1993), and Lundvall (1992b) mean quite different things when they use the term 'institution'.

We will devote most of this chapter to clarifying the concept of institution.² Generally speaking, our main purpose is to increase our understanding of the role of institutions in processes and systems of innovation. In discussing the concept of institution we will therefore relate especially to the phenomenon of innovation. We will try to identify and focus upon the subset of institutions that are important for innovation.

2. The concepts of innovation and innovation system

Technological innovations are here regarded as the introduction into the economy of new knowledge or new combinations of existing knowledge. This means that innovations are looked upon mainly as the result of interactive learning processes. Through interactions in the economy different pieces of knowledge become combined in new ways or new knowledge is created and, sometimes, this results in new processes or products. Such interaction does not only take place in connection with R&D but also in relation to normal and everyday economic activities such as procurement, production, and marketing. The interaction occurs within firms (between different individuals or departments), between firms and consumers, between different firms, or between firms and other organizations like public agencies.³

We also regard innovation as a cumulative process. It is now an empirically well-established fact that in many areas of technical change there is a strong cumulateness in the form of innovation avenues (Sahal, 1985) or technological trajectories (Dosi, 1982). Both these characteristics of learning processes – being interactive and cumulative – mean that the institutional set-up will affect innovation processes. As we shall see, institutions by their very nature affect interactions between people and the habits which partly constitute the cumulateness of learning processes.

This has relevance for the analysis of innovation systems. It has recently become increasingly common to study innovations within various kinds of ‘innovation systems’. In the available definitions of innovations systems, the concept of institution plays a dominant role.⁴ In other words, systems of innovation are normally defined in institutional terms. In all the definitions used, various economic, social, and political institutions influencing innovation are central elements rather than being assumed away. Examples of such institutions are universities, R&D laboratories, schools, patent systems, labor market organizations, banking systems, various government agencies, etc. There are also other kinds of institutions in the

² In section 4.1. of the Introduction to the book four general reasons for conceptual clarity were discussed.

³ This does not mean that individuals can never innovate all by themselves, i.e., without interaction, or that all new knowledge is the result of new combinations of already existing knowledge. Sometimes genuinely new and ‘uncombined’ knowledge may pop up. It means, however, that we consider interactive learning, which combines and recombines knowledge, to be a dominant source of innovation. To look at innovation as closely related to ordinary economic interactions also means that it is a ‘normal’ process which is integrated in the modern economy; it is to a large extent endogenous to the economic process and not a series of random events or manna from heaven.

⁴ See section 3.7. of the Introduction.

sense of norms, habits, practices, and routines that may be very important influences upon innovations and innovation systems, though this seems to be less emphasized in the literature. However, we do not know in any detail how important various kinds of institutions are for innovation. In fact, in order to answer this question it is necessary to develop a more precise concept of institutions.

3. The concepts of institution, organization, and market

It seems as if most innovation theorists think of institutions in accordance with the everyday meaning of the term, as rather concrete things that deal with the organization and utilization of research and development: for example, technical universities, industrial research institutes, R&D departments in large firms, consulting agencies, patent offices, technological service institutes, and other bridging organizations, etc.⁵ This way of using the concept of institution is not based in institutional theory – or any other theory. It builds upon generalizations from empirical observations to the effect that these things are crucial for processes of innovation. If these empirical generalizations are correct, the ‘institutions’ mentioned above should obviously be at the center in analyses of processes and systems of innovations.

Another group of scholars have dealt with institutions in a more theoretical manner, but they have rarely dealt with innovations. These ‘institutional economists’ usually adopt the ‘sociological’ meaning of institutions as the things that pattern behavior, e.g., routines, norms, shared expectations, morals, etc. – including certain ground rules for economic behavior often referred to as property rights.⁶ It is also common for economists (both institutionalists and more mainstream economists) to talk about the general categories of markets and firms as the basic economic institutions of capitalism.

In this chapter we will deal with institutions in both senses mentioned above: as concrete things and as things that pattern behavior. We will not try to marry the two – since we do not consider that fruitful! Instead, we will try to keep them apart in order to make it possible to study the relations between them. In section 3.1. we will address the more theoretically based variety of the concept, and in section 3.2. we will discuss the ‘concrete things’, which we prefer to label organizations. Firms will be included in the category of ‘organization’. The relations between institutions and markets will be discussed in section 3.3. Developing our own view in this process has required deducting ‘organizations’ and ‘markets’ from the wide concept. Thereby we have formulated another concept of institution which is less comprehensive, but still very wide in scope.

3.1. Some authors on the concept of institution

The thinking on institutions has come from a number of different theoretical angles. Ideally, the genesis of the concept should be analyzed as part of the development of

⁵ See Nelson and Rosenberg (1993: 5, 9–13). They make no mention of what we will below call institutions in the sense of ‘things that pattern behavior’. Patel and Pavitt (1994: 10, 12) mean something similar.

⁶ Durkheim referred to sociology as ‘the science of institutions’. Institutions, interpreted as established procedures and patterns of behavior, constitute a core concept in sociology.

various institutional schools. However, we will not try to carry out a detailed study here of the history of the concept of institution. Our ambition is much more limited. We will simply discuss the meaning given to the term by a few scholars who have made institutions a central concept in their analysis.

Neoclassical economics, with its rational economic man at the center of the scene and its lack of an evolutionary perspective, does not need more than a very simple concept of institutions. In neoclassical economics, the rules of the game – a common mainstream specification of institutions – can be described as utility and profit maximization guided by a set of parametric prices within a context of exogenously given populations, tastes, and technologies. This might be summarized by the term ‘competitive markets’. In this regard Schotter (1981) accurately estimates that: ‘Economics today, as seen in the works of Debreu (1959) and Arrow and Hahn (1971), is an institutionally limited science. The only social or economic institutions that exist are markets of the competitive type in which all agents act parametrically and in isolation. This lack of institutional detail must be considered a weakness of the theory’ (Schotter, 1981: 149). Of course it is possible to argue that competitive markets imply the existence of some basic institutions like private property rights and contract laws of some kind – otherwise exchange could not take place – but this does not add much institutional richness.

The simplistic character of economic behavior in neoclassical economics and its vision of the economy as an equilibrium system rather than a process in time have always irritated the institutionalist economists. Thorstein Veblen, who is often considered to be the founder of American institutionalism and who coined the term ‘neoclassical economics’, ridiculed its central concept of an institutionally unaffected *Homo economicus*.⁷ Veblen’s own understanding of economic behavior built on the concept of habits, or rather ‘habits of thought’, which he used to describe uncalculated, unreflective actions and behavior that were taken for granted. He defined institutions as ‘settled habits of thought common to the generality of man’ and suggested that ‘institutions are an outgrowth of habit’ (Veblen, 1919: 239, 241).⁸

An elegant definition of institutions in the American institutionalist tradition is provided by Walton Hamilton:

It connotes a way of thought or action of some prevalence and permanence, which is embedded in the habits of a group or the customs of a people. In ordinary speech it is another word for procedure, convention or arrangement; in the language of books it is the singular of which mores or the folkways are the plural. Institutions fix the confines of and impose forms upon the activities of human beings. The world of use and wont, to which imperfectly we accommodate our lives, is a tangled and unbroken web of institutions. (Hamilton, 1932)

⁷ See, for example, the oft-quoted passage, Veblen, 1898: 73–4.

⁸ It should be noted that in the American institutionalist tradition, beginning with Veblen, collective action is at least as important as individual action. John Commons emphasized that collective action was becoming increasingly important in economic processes and very much circumscribed the scope for genuinely individual action. In fact, he defined institutions as ‘collective action in control, liberation, and expansion of individual action’ (Commons, 1931).

The defeat of the American institutionalists by the neoclassical school nearly wiped institutions out of mainstream economics, and this situation was only to a very small extent changed by the Keynesian revolution in economic theory. Institutions were forgotten and theoretical insights were lost for a while.⁹ The last couple of decades, however, has seen a revival and a renewal of institutional economics. There are now new variants of institutional thought which put transaction costs at the center of the analysis. One branch of transaction cost economics is related to organizational theory (exemplified below by Oliver Williamson), and another takes its starting-point in economic history (exemplified by Douglass North). Both are strongly influenced by neoclassical economics. The stage is still dominated by agents trying to optimize, even if they are now less able to do so (because of bounded rationality), and who take transaction costs (and not only production costs) into account when doing their maximizing exercises – under more diversified and historically changing institutional restrictions.

The transaction costs economics developed by Williamson analyzes the relationships between transaction costs and organizational forms both at the levels of the firm and the market. The institutional set-up of the economy becomes important because it affects transaction costs and thereby the organization of firms and markets. Williamson does not offer a precise definition of institutions (he prefers to describe ‘institutional economics’ as ‘transaction cost economics’) but the title of one of his books captures his broad conception of the term rather accurately: *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting* (Williamson, 1985).¹⁰

In Douglass North’s historical perspective institutions develop as a means to reduce transaction costs. In the same way as Williamson, North considers the market to be ‘the most fundamental institution of modern Western economies’ (North, 1981: 33), but he also explicitly states that a theory of institutions must include a theory of property rights, a theory of the state, and a theory of ideology (North, 1981: 7). Otherwise historical processes would be impossible to understand. North offers several explicit definitions of the concept of institutions which differ slightly from one another:

Institutions are the rules of the game in society or, more formally, are the humanly devised constraints that shape human interaction. In consequence they structure incentives in human exchange, whether political, social or economic. Institutional change shapes the way societies evolve through time and hence is the key to understanding historical change. (North 1990: 3)¹¹

⁹ Of course, there were a few European institutionalists who resisted the neoclassical onslaught on institutions in economic theory. Gunnar Myrdal insisted on the importance of institutional and cultural factors and of cumulative causation in economic development. Karl Polanyi described and analyzed how market processes were embedded in institutions and showed the impossibility of pure markets.

¹⁰ Williamson’s understanding of institutions is clearly influenced by Ronald Coase who has summarized his institutional argument in a book the title of which is also a shorthand specification of what he means by institutions: *The Firm, the Market and the Law* (Coase, 1988).

¹¹ Obviously, when North talks about ‘the rules of the game in society’ he means something more comprehensive than what the neoclassicists referred to, as outlined in the beginning of this section.

Institutions are the humanly devised constraints that structure political, economic and social interaction. They consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights). (North, 1991: 97)

There is also now a new type of institutional theory, which analyzes the evolution of institutions with the help of game theory. In Schotter's theory institutions are organizers of information. Past experience is encapsulated in institutional rules and becomes a guide for forming expectations about the future. The more institutions encode expectations the more they reduce uncertainty and solve problems which arise from bounded rationality. This is analyzed in terms of repeated n -person uncooperative games in which the players develop confidence in each other, and norms are stabilized and passed over from one generation to another (Schotter, 1981: 11, 155).

Besides these developments in the so-called new institutional economics there is now also a revival of the more classical institutional economics both in the USA and in Europe. This development is to some extent converging with evolutionary economics in the sense that institutions are seen as forming selection environments and functioning as selection units in evolutionary processes.

We have here confined ourselves to summarizing some definitions and discussions of institutions presented by well-known institutionalists. The intention has been to show that, even if there are several varieties of the concept, institutionalists tend to use it to refer to important and general economic phenomena like basic behavioral patterns and ground rules. Let us, on this basis, present our own definition of institutions in the sense of patterned behavior: *Institutions are sets of common habits, routines, established practices, rules, or laws that regulate the relations and interactions between individuals and groups.* This definition catches the essence of the classical concept and relates to interactive learning, which is our link between institutions and innovations.

It is also a fairly open definition, which permits institutions either to play the basic, very important role of shaping people's cognitions, views, visions, and actions, or the much more limited role of being designed and malleable constraints on the decisions of rational agents (Coriat and Dosi, 1995).

3.2. *Institutions and organizations*

Our discussion of institutions so far has left important questions unanswered. For example, what are the relations between institutions and organizations and between institutions and markets? What are the relations between firms and organizations? These questions will be discussed in this and following sections.

In everyday language there is no clear distinction between institutions and organizations. Often they are used as synonyms. A police station, a trade union, and a nursery can be referred to both as organizations and institutions. The Commission and the Parliament are usually called the institutions of the European Union, etc. In the terminology of institutional economists the situation is generally not much better. As we saw in the introduction, some authors include organizations in the

concept of institution. Others suggest that a distinction between institutions and organizations is of critical importance.¹²

A crucial distinction in this study is made between institutions and organizations. . . . Conceptually, what must be clearly differentiated are the rules from the players. The purpose of the rules is to define the way the game is played. But the objective of the team within that set of rules is to win the game – by a combination of skills, strategy and co-ordination; by fair means and sometimes by foul means. . . . Organizations are created with purposive intent in consequence of the opportunity set resulting from the existing set of constraints (institutional ones as well as the traditional ones of economic theory) and in the course of attempts to accomplish their objectives are a major agent of institutional change. (North, 1990: 5)

Hence, organizations are, according to North, partly formed by the institutional framework and are, at the same time, vehicles for their change; the players follow the rules but they also influence them.¹³

The individuals or groups constituting an organization have a common purpose to achieve certain objectives. Organizations include, according to North, many kinds of entities: political bodies (e.g., political parties, city councils, regulatory bodies), economic bodies (e.g., firms, trade unions, family farms, cooperatives), social bodies (e.g., churches, clubs), and educational bodies (e.g., schools, universities, vocational training centers) (North, 1990: 5). In the context of innovation studies it is particularly important to note that firms, universities, and schools are considered to be organizations – since they are important engines of technical change.

This understanding of organization is much the same as what was called 'institutions as concrete things' at the beginning of section 3. They are not part of our concept of institution as defined at the end of section 3.1. Thus we adopt the distinction between institutions and organizations as well as include firms under the category of organizations. The reasons for this distinction are that institutions and organizations play different roles in the process of innovation and that we believe there are complicated but important relations between them. In order to be able to study this interaction we must conceptually distinguish between them.¹⁴ It is important to note that *organizations are formal structures with an explicit purpose and they are consciously created. They are players or actors.* In contrast, institutions may develop spontaneously and are often not characterized by a specific purpose.

Distinguishing between 'institutions' and 'organizations' as we have done in this section is actually the beginning of a taxonomy of the very wide concept of 'institution' referred to in the introduction. The two categories are still very comprehensive ones and there are strong reasons for continuing the taxonomic work by dividing the more narrow categories of 'institutions' and 'organizations' into finer ones. With regard to 'institutions', we will resume classification in sections 4 and 5, after a brief discussion of the relations between institutions and markets in section 3.3. 'Organizations' will be further discussed in sections 7 and 8.

¹² Hodgson argues that 'Perhaps a more appropriate distinction should be drawn between institutions which function primarily through authority and command, described as organizations, and those which do not, such as language and table manners' (Hodgson, 1993a: 10).

¹³ We will return to the issues of institutional change and the relations between institutions and organizations in sections 6 and 8.

¹⁴ These interactions will be addressed in section 8.

3.3. Institutions and markets

As we saw in section 3.1., both North and Williamson consider the market to be an important institution of modern capitalism. In neoclassical economics there is a tendency to conceptualize this most fundamental of institutions in an institutionally minimalist way: as transactions in an abstract marketplace in response to supply and demand, without specifications of the rules and procedures for these transactions. Exchange takes place without any specification of its institutional setting. Only prices and volumes matter. The market concept has more substance in the Austrian tradition where it is described, not as an equilibrium system, but as a process in which both needs and ways to meet them are discovered. Still, however, all communication is in terms of prices and quantities.

From an institutionalist point of view, definitions of markets as systems or processes of abstract transactions are not adequate. According to Coase, it really amounts to 'exchange without markets' (Coase, 1988: 3) which is a bit contradictory since the market is supposed to facilitate exchange. It would only be meaningful if you assume zero transaction costs:

Markets are institutions that exist to facilitate exchange, that is, they exist in order to reduce the cost of carrying out exchange transactions. In an economic theory which assumes that transaction costs are non-existent, markets have no function to perform, and it seems perfectly reasonable to develop the theory of exchange by an elaborate analysis of individuals exchanging nuts for apples on the edge of the forest or some similar fanciful example. This analysis certainly shows why there is a gain from trade, but it fails to deal with the factors which determine how much trade there is or what goods are traded. And when economists do speak of market structure it has nothing to do with the market as an institution but refers to things as the number of firms, product differentiation, and the like, the influence of the social institution which facilitate exchange being completely ignored. (Coase, 1988: 7-8)

In any economy 'out there' exchange will always be supported by a web of routines, rules, norms, and laws, i.e., by an institutional set-up. This support is so necessary for markets to be able to function that the concept of a pure, institution free market does not seem to make much sense. North (1981: 35) describes how even such a simple transaction as buying fourteen oranges for one dollar in the local public market depends on a complex structure of institutions. More complicated transactions require even more deeply embedded institutional arrangements.

Other authors have argued that institutions not only support market exchange but also protect markets from self-destruction. In a famous passage Polanyi describes how pure, institution free markets for money, labor, and land would, if they existed, tend to destroy society.

To allow the market mechanism to be the sole director of the fate of human beings and their natural environment, indeed, even of the amount and use of purchasing power, would result in the demolition of society. . . . Undoubtedly, labor, land, and money markets are essential to a market economy. But no society could stand the effect of such a system of crude fictions . . . unless its human and natural substance as well as its business organizations was protected against the ravages of this satanic mill. (Polanyi, 1957: 73)

If we think of markets as things which facilitate economic exchange and keep costs of exchange transactions manageable, it follows that markets without institutional support are not possible. Markets require rules for exchange: 'Exchange . . . involves

contractual agreement and the exchange of property rights, and the market consists in part of mechanisms to structure, organize and legitimate these activities. Markets, in short, are organized and institutionalized exchange' (Hodgson, 1988: 174). Voluntary transfers of property rights require rules, norms, and legal arrangements, and it is very difficult to imagine systematic exchange without institutions. Even Walras's process of 'tatonment' requires an institution, i.e., a rule for coming to a simultaneous decision about prices and quantities. The set of rules governing 'the auctioneer' is the institution needed to reach equilibrium.

We have seen that the concept of institutions is needed to understand how markets facilitate and organize exchange. This is important when analyzing allocation of scarce resources in a static context. If we want to understand innovation processes, an institutional specification of the market becomes even more necessary. In connection with innovation it becomes relevant to study the processes of communication and interaction in terms other than the prices and quantities that accompany market transactions. Pure markets, i.e., markets in which sellers and buyers only communicate with the help of prices and quantities, will not produce many innovations. Innovations require qualitative communication through which technical possibilities and user needs can be confronted and matched. Such communication and interaction can be organized in many ways but usually it is supported by different institutions. Markets are usually not 'pure' but are institutionally supported in different ways and the character of these institutional arrangements affects interactive learning and innovation. Again, we need to clarify the concept of institutions to understand how different types of markets affect innovations.

4. Taxonomies of institutions

In the introduction to this chapter we explained that in the literature a very large part of economic behavior and many types of economic actors, activities, and processes have been subsumed under the concept of institution. In section 3 we excluded organizations (including firms) from the concept and we discussed the relations between institutions and markets.

However, if we want to understand the role of institutions in innovation systems, we have to be more specific and concrete. Even our less comprehensive concept of institution is a very wide and heterogeneous one. Therefore it seems useful to continue the taxonomic exercise. In this section we will discuss various kinds, categories, or classes of institutions. The aim is to make it possible to identify different kinds of institutions that play specific roles in systems of innovation. This also seems to be a need perceived by other students of institutions. As Hodgson states, 'it is an important and as yet incomplete project to construct a more precise and reasonably comprehensive taxonomy of institutions' (Hodgson, 1993b: xiii).

If we start with our general definition of institution as a set of common habits, routines, established practices, rules, or laws that regulate the relations between individuals and groups, then it is of course possible to distinguish between many different kinds of institutions. There are institutions that are primarily affecting specific 'spheres' of society, as, for example, economic institutions and political institutions. Within the category of economic institutions, there are subsets that regulate specific types of markets, for example, labor market institutions, capital

market institutions, foreign trade institutions, etc. But we are not merely interested in institutions that regulate specific sectors of the economy. Essentially, we want to identify a subset of institutions that influence innovations and that may therefore be used to help define 'systems of innovation'. Before we get to that, however, it may be convenient to make some general distinctions, which apply to all spheres of society and all kinds of processes of change.

It is often useful to distinguish between institutions that are 'formal' (laws, e.g., patent laws, government regulations of bank conduct, formal instructions for officials of a technological service system, regulations and instructions for installation of electrical equipment, etc.) and institutions that are 'informal' (common law, customs, traditions, work norms, norms of cooperation, conventions, practices, etc.). This distinction is important because the balance between formal and informal institutions may differ between countries, between sectors within countries, and between small and large enterprises within sectors, etc. Formal institutions are more 'visible' than informal ones; formal institutions are codified and informal ones must be indirectly observed through the behavior of people and organizations. These differences must be taken into account when one, for example, describes and compares systems of innovation. In a country such as Denmark with almost no large firms, relatively low levels of R&D, and no conspicuous technology policy, the relative importance of informal institutions in the system of innovation might be much greater than in a country like Sweden with many large firms and a considerable amount of formal R&D activity.

It may also be fruitful to identify levels in the institutional set-up in the same meaning as there are levels in the legal system of a country, for example, constitutional laws, statutes, and ordinances. We may, for example, distinguish between 'basic' and 'supporting' institutions. Basic institutions are like constitutional rules or ground rules. They define basic rules in economic processes, for instance, property rights and rules for cooperation and conflict solving in the labor market and in firms. Supporting rules define and specify certain aspects of the basic rules, for example, restrictions on the use of private property in specific situations and rules for regulating overtime work in specific industries.

In addition to this, it may sometimes be useful to separate between 'hard' institutions which are perceived as binding and in some way policed, and 'soft' institutions which are perceived more as rules of thumb and suggestions than as commands that have to be obeyed. Whether an institution is soft or hard may depend on the context. Table manners may be very important and strictly respected in some social circles and on some official and ceremonious occasions, but in other circles and on everyday occasions largely ignored. Property rights may be closely policed in situations of scarcity but looked upon in more relaxed ways in situations of relative abundance, and so on.

Of course, both basic and supporting institutions can be formal as well as informal and hard as well as soft, and it is also possible to define more categories between formal and informal institutions. This leaves us with at least eight types of institutions that may be used in a description of an institutional set-up. As mentioned in the introduction to this volume, definitions and analytical distinctions are not right or wrong, but fruitful or not for certain purposes. Therefore the various distinctions discussed above have to be tried out – in formulation of conjectures and theories, in

scientific communication and in empirical work. That is the only way in which it can be judged whether the distinctions are useful or not. What we have presented here is just a beginning of the process.

5. The functions of institutions in relation to innovations

Institutions, by their very nature, regulate the relations between people and groups of people within as well as between and outside the organizations. This means that the pattern and the content of communication and interaction in the economy is affected by its institutional set-up. Since we regard innovations as mainly resulting from interactive learning processes, it follows that institutions affect innovations. In fact it is difficult to imagine innovations that are not to some extent formed by the institutional set-up. This perspective is not very common in institutionalist theory. A great deal of the literature assumes that institutions are the glue that keeps society together, but very little is written about the role that institutions play in processes of learning and innovation. It is not a common perspective in innovation theory either. At least, it is not common to link institutions in our sense to learning and innovation processes in a serious way. Something like this was acknowledged by Douglass North in his Nobel prize lecture in 1993 in which he discussed some relations between cognition, learning, and institutions: 'While there is a substantial literature on the origins and development of science, very little of it deals with the links between institutional structure, belief systems, and the incentives and disincentives to acquire pure knowledge' (North, 1994).

Connections between institutions and innovation are ubiquitous and exist at many levels. They exist at the level of the firm where institutions affect the relations between R&D, production, and marketing – relations which strongly influence innovation. They also exist at the level of the market, i.e., the relations between firms and between firms and households. Feedback mechanisms for consumer reactions on new products, durable and selective user–producer relationships, and network relationships are essential to many types of innovation processes. Relations between government agencies and private firms and stable forms of technology policies are examples at a third level in which institutions influence innovations. The pattern and content of communication and interaction in relation to innovation activities are thus shaped by the institutional set-up of the economy. But this is a general statement. If we want to be more precise about the channels of influence between the institutional set-up and processes of innovation, it might be fruitful to take the point of departure in various specific functions of institutions.

In the following sections we will discuss three basic functions of institutions:

- to reduce uncertainty by providing information;
- to manage conflicts and cooperation;
- to provide incentives.

These are general functions of institutions, but in the discussion we will try to point to their specific role in relation to innovations. Having discussed these functions of institutions, we will address two specific aspects. These concern institutions that channel resources to innovation activities (section 5.4.) and the fact that institutions might serve as obstacles as well as supports to innovation (section 5.5.).

5.1. *Institutions provide information and reduce uncertainty*

The most basic, and at the same time general, function of institutions is probably to reduce uncertainty about the behavior of other people by providing information or by reducing the amount of information needed. In this way institutions act as signposts; perhaps they even make it easier to be rational in that they reduce the informational and computational burden of *Homo economicus*.

Institutions are needed to cope with the high levels of uncertainty that apply to innovation activities. Technological service systems reduce uncertainty about technical solutions. Patent laws and other intellectual property rights reduce uncertainty about appropriation possibilities, and so on. Long gestation periods for innovations increase uncertainty and emphasize the importance of innovation financing institutions for resolving this uncertainty. Norms for repayment periods in relation to investment projects affect the time perspective and the management of risk and uncertainty in innovation. There are also norms that concern the operation of banks and other financial organizations on fast earnings through financial investments and speculation and on long-term industrial development projects. Punter capitalism (as in Britain and the USA) has a different norm set, including less patient capital, than industrial capitalism (as in Japan and Germany). Other norms have to do with the balance between behavior building upon opportunism and lack of mutual trust or upon honesty and trust (Lundvall, 1992a: 61).

Many more examples can be mentioned. However, genuine uncertainty is an unavoidable component of innovation activities – most innovation projects are terminated even before market testing, and among those that reach the market most do not survive the test. Therefore rules, practices, stable relationships between parties, etc., are needed to provide information. The uncertainty reducing function of institutions applies to standard economic activities like production and sales, but is even more important in relation to innovation activities. Indeed, in view of all the uncertainties and long lead times involved in innovation, it is not unreasonable to believe that without such institutional support innovations would be rare and the resources allocated to them would be insignificant.

5.2. *Institutions manage conflicts and cooperation*

On a more specific level, it is also common to say that institutions control and regulate conflicts and cooperation between individuals and groups. This is of course a basic function: without institutions for conflict regulation, the survival of society would be at constant risk and cooperation and economic change would be very difficult. Conflict has the potential to be a very serious problem in connection to innovation activities. Within firms, for example, the channels of communication and the established patterns of cooperation between the departments of R&D, production, and marketing, which are usually considered to affect innovation processes, may easily be disturbed by conflicts and mutual mistrust. The R&D personnel may tend to be more long-term oriented and less focused on cost reduction and productivity than the people in the production department. In the marketing department they may be more oriented towards consumer wants and less towards the manufacturability of products than the personnel of the production department. How serious such latent conflicts turn out to be depends partly on norms and

established practices of cooperation, job security, work place democracy, and other institutional factors.

Other kinds of conflict may be provoked by innovation processes. When new products and processes are introduced, old ones often have to give way; high rates of innovation may be accompanied by fast restructuring of firms and reshuffling of power, prestige, and income. The same kind of phenomena can be observed on higher levels of aggregation. New firms are born and old ones go bankrupt. Whole sectors of production stagnate while others grow. Such restructuring of the economy is part and parcel of high rates of innovation, and it burdens people with costs of change. Skills and competencies become obsolete, relative incomes and job options decline, etc. These costs are often unevenly distributed and may provoke resistance and conflicts. Social security arrangements, education and retraining rights, labor market arrangements, and other institutions shape the character and seriousness of such conflicts and resistance to change. An institutional set-up that effectively redistributes the costs of change and compensates the victims also supports fast rates of innovation.

5.3. *Institutions provide incentives*

A third function of institutions is to provide incentives, i.e., to specify and implement the sticks and carrots of economic life. There may be different incentives to engage in learning and to participate in innovation processes. Some are of the pecuniary kind. Salary and wage schemes, income taxes, tax allowances, and inheritance rules affect innovative efforts. Property rights to knowledge and ideas (laws and rules concerning patents, copyrights, trade marks, etc.) are also important as incentives, since they permit appropriation of temporary technological rents, and affect the diffusion of knowledge. They provide a temporary monopolization of knowledge. And there are also pecuniary sticks. Profits are competed away and firms risk going bankrupt if they are not innovative enough. It has been argued (Rosenberg and Birdzell, 1986) that one of the main reasons for the dynamic inefficiency of the former Soviet Union was the lack of a proper institution for closing down firms and bringing failed technical projects to an end. New resources were too often thrown after wasted resources.

The motives and incentives of the entrepreneur may also be affected by many non-pecuniary aspects of the institutional set-up. And there are negative incentives or sticks to take into account too. What happens to persons who fail in innovation processes? Who bears the financial risk? Are there costs in the form of losses of status and prestige? And so on. These negative incentives may be important, though perhaps not as much as they were in the past. At least it is probably safe to assume that the practice of burning people who spread 'false' knowledge about the laws of nature, such as the early evolutionists Giordano Bruno (1548–1600) and Lucilio Vanini (1585–1619), is a custom detrimental to learning and innovation.

Since individual entrepreneurship has become less important and collective entrepreneurship more important than in earlier periods, there may be a need to adapt the incentives structure and reduce the importance of individual incentives. There may be an increasing conflict between individual incentives, which may restrict trust and sharing of information and knowledge on the one hand, and

interactive learning and innovation, which needs trust and sharing on the other. The incentives for communication and cooperation between departments within firms, between firms in industrial networks, and between firms and government agencies are important aspects of the incentives for collective entrepreneurship. These incentives may be formed just as much by norms of cooperation, practices for acquiring intellectual prestige, access to publication, status norms, etc., as by more traditional individual pecuniary incentives. It is clear that many aspects of the institutional set-up affect the system of incentives for learning and innovation.

5.4. *Institutions channel resources to innovation activities*

In sections 5.1. to 5.3. we argued that some general functions of institutions affect the mechanisms of innovation. However, the performance of an innovation system is not only affected by how innovations are done but also by the amount of resources that are allocated to innovation activities. It is well known that some countries apply more resources toward R&D than others and that some firms have a larger share of new products in their turnover than others. Other aspects of the resources applied to innovation activities are less well documented. The amount of resources that are used on day-to-day innovations in small firms or in networking between firms or in education in connection with the diffusion of innovations, etc., is anybody's guess. These activities are not identified and documented as innovation related in the bookkeeping systems of firms. The costs of innovation are often hidden under quite different entries.

How does the allocation of resources to innovation activities come about? To some extent, of course, it is a result of deliberate decisions by management in firms and by politicians in the form of government support to specific programs of technology development. But resources may also be allocated more or less by chance, for example, as a result of lack of information and managerial control.¹⁵ However, some resources are allocated by institutions or at least affected by institutions. R&D may be supported by formal institutions like tax rules and government subsidies. In addition, governments and industry organizations make long-term commitments in terms of agreement to finance technological service systems, and so on. Governments are also committed through informal norms and traditions to allocate resources to universities, research institutes, libraries, and other organizations involved in learning and innovation.

A substantial part of the allocation of resources to innovation is informal. In many industries there are norms and routines that make it almost imperative to establish and run R&D departments. For certain kinds of small and medium-sized firms, management gurus and consulting firms influence habits of thought so that increased resources are invested into research and development cooperation and innovation networks. A vast body of ideology and soft theorizing about the information society,

¹⁵ Inability to identify and add up the costs of innovation in firms may be a precondition to carrying out the activities. On information received from Uno Lamm, Technical Director of ASEA/ABB, Erik Dahmén has suggested that if the costs of developing the technology of very high voltage electricity transmission over long distances had been known to the managers responsible they would have stopped the project at an early stage. It turned out to be commercially very successful (private communication).

the knowledge society, the necessity of perpetual ongoing change, re-education and flexibility, and the importance of being in the forefront of the technological development tend to support resource flows into innovation related activities at all levels of society. Clearly, institutions are important in affecting the amount of resources devoted to innovation. Institutions are also important in helping to channel resources to specific areas and in rechannelling them from ailing activities to new ones with promise – or failing to do so. The institutions that regulate how firms go bankrupt and determine how to distribute the social costs of moving resources on the firm and the sectoral levels from one type of activity to another are important in this connection.

5.5. *Institutions as obstacles to innovation*

We have emphasized that innovation activities are so uncertain and conflict ridden that they need strong institutional support in order to become an important activity to which more than marginal resources are allocated. This is not the traditional perspective on the relations between institutions and innovations. It is more common to regard institutions as entities that introduce stability, even rigidity, into the economy, and act as innovation brakes rather than accelerators. Institutional change is often supposed to be slow and lag behind technical change. This may cause mismatch problems, which prevent the full realization of the productivity potentials of technical innovations, which forestall the reallocation of resources and efforts from mature to emerging technologies, and which generally favor established technological trajectories to new ones. The term 'institutional sclerosis' has been used by the OECD to characterize this phenomenon (e.g., OECD, 1979).

It is true that there are limits to how fast institutions can change (except for shorter periods of institutional turbulence) and still be the things that are responsible for stable patterns of behavior. Continuously changing institutions are, after all, contradictions in terms (Johnson, 1988), while institutional rigidity is in the long run a threat to technical change. However, it is important to move beyond these limited perspectives, and recognize that institutions may have both supporting and retarding effects on innovation. The balance between them, however, may be very different between countries and may change drastically over time. The concept of techno-economic paradigms has been developed by Freeman and Perez (1988) to illustrate how increasing tensions between radical technical change and the institutional set-up may lead to periods of economic stagnation until new institutions and institutional restructuring establish a new match between institutions and technologies to support renewed growth. This illustrates that a specific institutional set-up can neither permanently support nor retard innovation. It depends on the historical situation which includes the specific technologies in question. The economy's ability to generate growth depends on its ability to generate technical change, and, at the same time, on its ability to adapt and renew its institutions to support growth and innovation.

6. **Institutional set-ups and institutional change**

Our taxonomic discussion of institutions suggests that the institutional set-up of an economy consists of many different kinds of institutions which more or less hang

together and are related to one another. They form a complex system, which taken as a whole fulfills some functions in relation to both the cohesion and change of the economy. We may also, even if the borderlines may not be very sharp, define a subset of institutions that have sufficient effects on innovation processes to be included in what we might call the 'institutional set-up of the system of innovation'.

So far we have concentrated on how the institutional set-up influences innovation processes. There is of course a large degree of stability in the institutional set-up which makes this direction of causality natural. One reason for this stability is the enormous complexity of a modern economy's institutional set-up. Such a complex order normally only changes incrementally. There is also much more resistance to institutional (and organizational) change than to technical change. Institutions are about relations between people, while technologies are often disguised as more neutral relations between people and things. Furthermore, society invests much more physical and human capital in technical change than in institutional change, and the experts on institutions and institutional change – lawyers, administrators, etc. – tend to value stability and permanence, which of course is quite different from the ideals natural scientists and engineers tend to hold.

But the institutional set-up does change over time. Completely rigid institutions would, of course, make long-run economic development impossible. Our taxonomy of institutions should include at least two aspects of the relationship between institutions and innovations. First, there are different modes or ways of institutional change, and second, there are different forces behind institutional change.

The 'classical' force behind institutional change is technological change. Famous social scientists like Marx and Veblen have discussed how radical technical change and technological revolutions have, again and again, broken through the institutional barriers, provoked institutional change, and generated new institutions. This is also a central observation in Freeman and Perez's (1988) theory of technological-economic paradigms. But in more stable times too, institutional adaptations tend to accompany incremental technical change. In addition to technical innovation, other forces behind institutional and organizational innovation may concern conflicts revolving around political and social relations and income and power distribution. Political, social, and economic conflicts between labor and capital have been important factors behind many changes in the structure of property rights.

When it comes to the ways in which institutions change, it may be useful to separate 'incremental' from 'radical' institutional changes and 'changes in technological paradigms' as a parallel to Chris Freeman's (1992: 132–3) taxonomy of technical innovations. It may also be illuminating to distinguish between institutions that are 'designed and consciously created' by economic or political agents on one hand and institutions that are 'self-grown' on the other. The self-grown institutions have evolved, so to speak, behind the backs of decision-makers – by human action but not by human design, as it was formulated by Menger.

Although the borderlines between designed and evolved institutions are fuzzy, it may be useful to make distinctions within both categories. Institutions may be designed by private decision-makers as, for example, when groups of firms enter into networking arrangements or banks design new types of risk dispersing options. They may also be designed by government policy-makers: a set of rules for procurement

policies may be developed, instructions for public technological service systems may be designed, etc. Institutions may also be borrowed or imported from abroad by both private and government policy-makers. We may talk about 'institutional imitation' when institutions are transferred more or less as they are and about 'institutional adaptation' when changes are made in order to improve upon the borrowed institutions or make them fit into the existing institutional set-up.

The undesigned evolution of institutions is more difficult to categorize. It may be possible to identify more or less random institutional changes and different selection mechanisms in relation to these. Maybe we can use the term 'institutional drift' when existing institutions – through incremental changes – take on new functions (as for example when copyrights increasingly become applied to computer software). However, the emergence of institutions is often a long-term process, which includes both minor and radical changes and in which elements of design enter at different points of time and in which existing institutions condition new ones.¹⁶

These crude taxonomic distinctions may be used to shed some light on the processes of institutional change. The match between basic and supporting institutions is important here. Incremental institutional change, which is necessary if the system of innovation is to support continuing technical change, may be easier if the institutional set-up is coherent in this respect. For example, property rights need to be well defined and supported by rules for introducing incremental change and resolving conflicts that may develop during the change process. In the same way, the distinction between 'soft' and 'hard' institutions may be useful for understanding institutional change. In many cases soft institutions are more easily adaptable and open to incremental changes than hard institutions, and on average hard institutions may be more durable than soft ones. The distinction between formal and informal institutions is also important in this connection. Formal institutions are changed by design (policy or strategy) while informal institutions are more likely to develop spontaneously. But formal institutions cannot be designed without taking the evolution of informal institutions into account. An understanding of how the institutional set-up as a whole changes and of the possibilities to design and implement changes in it depends on how formal and informal institutions complement each other.

The distinction between institutions and organizations is also important for understanding institutional (and organizational) change. If the organizations are the players and the institutions the rules, then how are the rules changed? The rules may, of course, gradually evolve behind the backs of the players as the play goes on, but they may also be deliberately changed by the players themselves or as a consequence of the interaction between players. In some cases organizations may apply to superior organizations with rule-making power; for example, firms may apply to employer organizations, industry associations, or the state. In other cases the initiative may come directly from the rulemaker. In any case, interactions between organizations and institutions – between players and rules – influence the process of institutional change, and this is why we make this distinction and do not subsume one entity to the other.

¹⁶ A famous analysis of the development of market institutions is by Hicks (1969).

Observe that when we talk about institutional change we mean both the emergence of new institutions and the decline and disappearance of old ones. Furthermore, when we say that institutions fulfill some necessary functions in the existence and survival of society, as we do in section 5, this is not the same as saying that it is impossible to find institutions without functions, i.e., empty or purely ceremonial institutions. Institutions may persist even after they have ceased to fulfill any function or to serve anyone's interest, perhaps because, for example, there may be more costs than benefits associated with changing them or because of simple inertia. Of course this may only be a temporary situation; empty institutions may be reminiscences, which will either fade away or take on new functions (Polanyi, 1957).

7. Organizations and innovations

In our discussion of institutions, we have dealt with taxonomy, the functions of institutions in relation to innovation, and institutional change. We will not, however, pursue a similar discussion of organizations here. This is certainly not because of the topic's lack of relevance, but because of the need to limit the scope and length of this particular chapter.¹⁷ In this section we will therefore only briefly touch upon the role of organizations for innovation. In section 8 we will discuss a few aspects of the relations between organizations and institutions.

No one questions the importance of organizations for innovation. Organizations, including firms, are the main vehicles for technological change in that they carry through innovations. For example, most formal research and development activities are carried out in organizations such as (technical) universities, research institutes, and R&D departments of firms, with the processes of diffusion of product and process innovations occurring mainly through firms.

Without attempting to create a taxonomy of innovation-relevant organizations, we would like to distinguish between private and public organizations. Private organizations include industry associations and scientific and professional societies (Nelson, 1991: 19). But the most important components among the private innovation relevant organizations are, of course, the firms. Although the primary objective of capitalist firms is not innovation, innovation is often an important precondition for making a profit and therefore a large portion of the innovation processes in a capitalist market economy takes place within firms. This means that in addition to 'production',¹⁸ firms must be able to have a good overall innovation performance, i.e., they must be consistently able to innovate over long periods. This means that innovating firms must have certain competencies, such as the capacity to:

- carry out a routinized search for new knowledge;
- change the search routines when necessary;
- utilize the search results;
- absorb new knowledge created elsewhere (in other firms, etc.);
- stimulate the emergence of 'unexpected' new knowledge;
- utilize unexpected new knowledge.

¹⁷ Another reason is that we know far more about the role of organizations in innovation than about the role of institutions – thanks to previous research.

¹⁸ Compare the neoclassical conceptualization of firms as 'production functions'.

Of course this leads to difficult organizational questions and dilemmas, which, however, will not be addressed here.

The public organizations of importance for innovation include those that formulate and implement technology policy, regulatory agencies, organizations for higher education and research, technology support entities (training programs, industry specific research organizations, extension services), standard-setting organizations, and patent offices. The activities of innovation-oriented organizations vary substantially and it might be fruitful to distinguish between organizations for knowledge production (for example, universities), knowledge distribution (for example, science parks), and knowledge regulation (for example, standard setting committees and patent offices, which are responsible for creating elements of the institutional framework for private organizations).

The importance and role of different organizations differ substantially between systems of innovation. For example, universities are very important for research in the USA and Western Europe. In Japan, however, most research is done in firms and private research institutes. In a system of innovation, organizational change means altering the structure of the organizational matrix, but it may also involve changing the character of existing organizations. The emergence of the multidivisional form of firm organization might be an example of the latter kind of organizational change.¹⁹ Any description of the anatomy and change of systems of innovation should include the character, structure, and change of the organizational matrix, and therefore it is as important to develop an organizational taxonomy as an institutional one.

8. The relations between institutions and organizations

We have, in this chapter, argued that it is useful to make an explicit conceptual distinction between institutions and organizations. One reason for this is that the relations between institutions and organizations are important for innovation and for the structure and performance of systems of innovation. We will now conclude this chapter with a brief discussion of these relations.

Organizations are strongly influenced, colored, and shaped by institutions. Organizations can be said to be 'embedded' in an institutional environment or set of rules. This includes the legal system, various norms, standards, etc., which influence all organizations of a certain kind, (e.g., all firms in a country). For example, we mentioned in section 5.1. that there are laws, rules, and norms which affect the operation of banks and other financing organizations. These influence the repayment periods for loans – which in turn may have a strong impact on the incentives, risks, and uncertainty related to innovation. Similar 'rules of the game' also influence the operation of both private firms and public organizations.

But institutions are also 'embedded' in organizations, which may be seen as concrete hosts for specific institutions. Certain established practices, for example, in bookkeeping or concerning the relations between workers and managers, are only relevant in the operation of firms. A lot of institutions develop in organizations and are only used in or in connection with organizations.

¹⁹ Organizational change in this sense has previously been dealt with in Edquist (1992).

There is thus a complicated two-way relationship of mutual embeddedness between institutions and firms, and one reason for focusing on this relationship is that it influences both the performance and change of systems of innovation. For example, since the connection between organizations and institutions differs substantially between various countries this leads to important differences in the operation and performance of the various national systems of innovation.

Another type of relation between organizations and firms is that some organizations are directly responsible for creating institutions. There are, for example, 'dedicated' standard-setting organizations which formulate or determine technical standards, which, in our sense of the term, are institutions. These standard-setting organizations may be public, but there are also voluntary, private standard-setting bodies. There are also organizations that formulate innovation policies and other organizations that implement those policies. If such policies are repeated over time they may evolve into stable patterns which become taken for granted and thus take on an institution-like character. The task of such organizations is, to a large extent, a matter of creating institutions.

The character and strength of the interactions between organizations and institutions is an important research issue. The dynamics of technological innovation in systems of innovation might be better understood if studied in relation to institutions and organizations and the interaction between them. In this chapter we have tried to contribute to the development of a conceptual framework which might be useful for such research. Because of the underdeveloped state of the art with regard to research in this field, we expect that case studies of the relations between institutions and organizations and their role for innovation would be an appropriate approach for the time being.

9. Concluding remarks

As we saw in section 2, the concept of institution – used in a very comprehensive sense – plays a key role in all definitions of innovation systems (i.e., systems of innovation are always defined in institutional terms). But the concept of institution is not very clear. In many cases what is meant is what we have called 'organizations' that influence innovation (e.g., Nelson and Rosenberg, 1993; Patel and Pavitt, 1994). Others, however, primarily refer to institutions (and not organizations) when they use the term institutional set-up (e.g., Lundvall, 1992b).

If a definition of an innovation system is to be capable of embracing all important determinants of innovation processes, both institutions and organizations should obviously be included in that definition. The relations between organizations and institutions are also crucial for the functioning and change of systems of innovation. Furthermore, we believe that specifications of different kinds of institutions and organizations as well as different kinds of institutional and organizational change are important in an analysis of the performance, structure, and change of systems of innovation.

However, our arguments have been of a theoretical and common-sense character. It would be an important research task to show that this is also empirically true. In such work it may be necessary to be more specific than we have been with regard to which kinds of specific institutions influence innovation and in what ways. Not much

empirical knowledge exists on this. Are institutions, in the sense of 'things that pattern behavior', really that important for innovation? What do we know and what would we want to know about this?

Empirical work is also called for in the study of organizations, although the lack of knowledge here is not as severe as in the case of institutions. Furthermore, in relation to institutional change, better conceptual tools than those we have at the moment are needed. We have suggested that a distinction between designed and self-grown institutions is important in this context, and that concepts like incremental and radical institutional innovations, institutional imitation, adaptation, and drift might be useful. But since the proof of the pudding continues to be in the eating this also needs verification through empirical work.

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