TOWARD A THEORY OF INDUCED INSTITUTIONAL INNOVATION

by

Vernon W. Ruttan and Yujiro Hayami

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Center for Economic Research
Department of Economics
University of Minnesota
Minneapolis, Minnesota 55455

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by Vernon W. Ruttan and Yujiro Hayami*

In this paper we elaborate a theory of institutional innovation in which changes in the demand for institutional innovation are induced by changes in relative resource endowments and by technical change. We illustrate, from agricultural history, how changes in resource endowments and technical change have induced changes in private property rights and in the development of non-market institutions. We also consider the impact of advances in social science knowledge and of cultural endowments on the supply of institutional change. In a final section we present the elements of a model of institutional innovation that maps the relationships among resource endowments, cultural endowments, technology, and institutions.

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*Professor, Department of Economics and Department of Agricultural and Applied Economics, University of Minnesota, and Professor of Economics, Tokyo Metropolitan University, respectively. We are indebted to Margaret Andrews, Robert Bates, David Feeny, Elizabeth Hoffman, Robert Keohane, James Roumasset and Ford Runge for comments on an earlier draft of this paper.

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The interpretation of technical and institutional change as endogenous rather than exogenous to the economic system is a relatively new development in economic thought.

In work published in the early 1970's we extended the theory of induced technical change and tested it against the history of agricultural development in the United States and Japan [Hayami and Ruttan, 1971; Binswanger and Ruttan, 1978; Wade, 1981]. It is now generally accepted that the theory of induced technical change provides very substantial insight into the process of agricultural development for a wide range of developed and developing countries. And economic historians are increasingly drawing on the theory of induced technical change in attempting to interpret differential patterns of productivity growth among countries and over time [Cain and Paterson, 1981; Phillips, 1982].

The demonstration that technical change can be treated as largely endogenous to the development process does not imply that the progress of either agricultural or industrial technology can be left to an 'invisible

hand' that drives technology along an 'efficient' path determined by relative resource endowments. The capacity to advance knowledge in science and technology is itself a result of a product of institutional innovation--'the great invention of the 19th century was the invention of the method of invention' [Whitehead, 1925:96].

In the case of agriculture, for example, in both Japan and the United States, much of the technical change that has led to growth of output per hectare has been produced by public sector institutions. These institutions--state (or prefectoral) and federal (or national) agricultural experiment stations--obtain their resources in the political market place and allocate their resources through bureaucratic mechanisms. The success of the theory of induced technical change gives rise, therefore, to the need for a more careful consideration of the sources of institutional innovation and design.

In this paper we elaborate a theory of institutional innovation in which shifts in the demand for institutional innovation are induced by changes in relative resource endowments and by technical change. We also consider the impact of advances in social science knowledge and of cultural endowments on the supply of institutional change. After examining the forces that act to shift the demand and supply of institutional innovation we then present the elements of a more general model of institutional change. The perspective on the role of institutional innovation in the process of economic development presented in this paper is much more positive than the views that were held by the American institutional school or in the recent literature on social choice and collective action [Zingler, 1974; Seckler, 1975; Olson, 1982].

WHAT IS INSTITUTIONAL INNOVATION?

Institutions are the rules of a society or of organizations that

facilitate coordination among people by helping them form expectations which each person can reasonably hold in dealing with others. They reflect the conventions that have evolved in different societies regarding the behavior of individuals and groups relative to their own behavior and the behavior of others.[1] In the area of economic relations they have a crucial role in establishing expectations about the rights to use resources in economic activities and about the partitioning of the income streams resulting from economic activity--'institutions provide assurance respecting the actions of others, and give order and stability to expectations in the complex and uncertain world of economic relations.'[2]

In order to perform the essential role of forming reasonable expectations in dealings among people, institutions must be stable for an extended time period. But institutions, like technology, must also change if development is to occur. Anticipation of the latent gains to be realized by overcoming the disequilibria resulting from changes in factor endowments, product demand, and technical change represents powerful inducements to institutional innovation [North and Thomas, 1970; Schultz, 1975]. Institutions that have been efficient in generating growth in the past may, over time, come to direct their efforts primarily to protecting the vested interests of some of their members by maintaining the status quo and thus become obstacles to further economic development.[3] The growing disequilibria in resource allocation due to institutional constraints generated by economic growth create opportunities for political entrepreneurs or leaders to organize collective action to bring about institutional change.

Our perspective on the sources of demand for institutional change is similar to the traditional Marxian view.[4] Marx considered technological

change as the primary source of institutional change. Our view is somewhat more complex in that we consider that changes in factor endowments and product demand are equally important sources of institutional change. Nor is our definition of institutional change limited to the dramatic or revolutionary changes of the type anticipated by Marx. Rather, we share with Lance Davis and Douglass North the view that basic institutions such as property rights and markets are more typically altered through the cumulation of 'secondary' or incremental institutional changes such as modifications in contractual relations or shifts in the boundaries between market and non-market activities [Davis and North, 1971:9].

There is a supply dimension as well as a demand dimension in institutional change. Collective action leading to changes in the supply of institutional innovations involves struggles among various vested interest groups. Clearly, the process is much more complex than the clear-cut, two-class conflict between the property owners and the propertyless as assumed by Marx. In our view, the supply of institutional innovations is strongly influenced by the cost of achieving social consensus (or of suppressing opposition). How costly a form of institutional change is to be accepted in a society depends on the power structure among vested interest groups. It also depends critically on cultural tradition and ideology, such as nationalism, that make certain institutional arrangements more easily accepted than others.

Advances in knowledge in the social sciences (and in related professions such as law, administration, planning, and social service) can reduce the cost of institutional change in a somewhat similar manner as advances in the natural sciences reduce the cost of technical change. Education, both

general and technical, that facilitates a better understanding among people of their common interests can also reduce the cost of institutional innovation.

Our insistence that important advances in the understanding of the processes of institutional innovation and diffusion can be achieved by treating institutional change as endogenous to the economic system represents a clear departure from the tradition of modern analytical economics.[5] This does not mean that we abandon analytical economics. On the contrary, we try to expand the scope of modern analytical economics by treating institutional change as endogenous.

DEMAND FOR INSTITUTIONAL INNOVATION--PROPERTY RIGHTS AND MARKET INSTITUTIONS

In some cases the demand for institutional innovation can be satisfied by the development of new forms of property rights, more efficient market institutions, or even by evolutionary changes arising out of direct contracting by individuals at the level of the community or the firm. In other cases, where externalities are involved, substantial political resources may have to be brought to bear to organize non-market institutions in order to provide for the supply of public goods.

In this section we illustrate, from the agricultural history of a number of countries, how changes in factor endowments, technical change, and growth in product demand have induced change in property rights and contractual arrangements in order to promote more efficient resource allocation through the market.

The agricultural revolution that occurred in England between the 15th and the 19th centuries involved a substantial increase in the productivity of land and labor. It was accompanied by the enclosure of open fields and the replacement of small peasant cultivators, who held their land from manorial lords, by a system in which large farmers used hired labor

to farm the land they leased from the landlords. The First Enclosure Movement, in the 15th and 16th centuries, resulted in the conversion of open arable fields and commons to private pasture in areas suitable for grazing. It was induced by expansion in the export demand for wool. The Second Enclosure Movement in the 18th century involved conversion of communally managed arable land into privately operated units. It is now agreed that it was largely induced by the growing disequilibrium between the fixed institutional rent that landlords received under copyhold tenures (with lifetime contracts) and the higher economic rents expected from adoption of new technology which became more profitable as a consequence of higher grain prices and lower wages. When the land was enclosed there was a redistribution of income from farmers to landowners and the disequilibrium was reduced or eliminated.[6]

In 19th century Thailand, the opening-up of the nation for international trade and the reduction in shipping rates to Europe resulted in a sharp increase in the demand for rice. The land available for rice production, which had been abundant, became more scarce. Investment in land development for rice production became profitable. The response was a major transformation of property rights. Traditional rights in human property (corvee and slavery) were replaced by more precise private property rights in land (fee-simple titles) [Feeny, 1982].

In Japan, at the beginning of the feudal Tokugawa period (1603-1867), peasants' rights to cropland had been limited to the right to till the soil with the obligation to pay a feudal land tax in kind. As the population grew, commercialization progressed and irrigation and technology were developed to make intensive farming more profitable. Some peasants divided

their holdings into smaller units and leased them out to ex-servants or extended family members. Some accumulated land through mortgaging arrangements that made other peasants de facto tenants. As a result of the accumulation of illegal leasing and mortgaging practices, peasants' property rights in land approximated those of a fee-simple title by the end of the Tokugawa period. These rights were readily converted to the modern private-property system in the succeeding Meiji period [Hayami and Kikuchi, 1982:28].

Research conducted by Yujiro Hayami and Masao Kikuchi in the Philippines during the late 1970's has enabled us to examine a contemporary example of the interrelated effects of changes in resource endowments and technical change on the demand for institutional change in land tenure and labor relations [Kikuchi and Hayami, 1980; Hayami and Kikuchi, 1982]. The case is particularly interesting because the institutional innovations occurred as a result of private contracting among individuals. The study is unique in that it is based on a rigorous analysis of microeconomic data in a village over a period of about 20 years.

Changes in technology and resource endowments

Between 1956 and 1976, rice production per hectare in the study village rose dramatically, from 2.5 to 6.7 metric tons per hectare per year. This was due to two technical innovations. In 1958, the national irrigation system was extended to the village. This permitted double-cropping to replace single-cropping, thereby doubling the annual production per hectare of rice land. The second major technical change was the introduction in the late 1960's of the modern high-yielding varieties. The diffusion of modern varieties was accompanied by increased use of fertilizer and

pesticides and by the adoption of improved cultural practices such as straight-row planting and intensive weeding.

Population growth in the village was rapid. Between 1966 and 1976 the number of households rose from 66 to 109 and the population rose from 383 to 464, while cultivated area remained virtually constant. The number of landless laborer households increased from 20 to 54. In 1976, half of the households in the village had no land to cultivate, not even land for rent. The average farm size declined from 2.3 to 2.0 hectares.

The land is farmed primarily by tenants. In 1976, only 1.7 hectares of the 108 hectares of cropland in the village were owned by village residents. Traditionally, share tenancy was the most common form of tenure. In both 1956 and 1966, 70 percent of the land was farmed under share tenure arrangements. In 1963, a new agricultural land reform code was passed which was designed to break the political power of the traditional landed elite and to provide greater incentives to peasant producers of basic food crops.[7] A major feature of the new legislation was an arrangement that permitted tenants to initiate a shift from share tenure to leasehold, with rent under the leasehold set at 25 percent of the average yield for the previous three years. Implementation of the code between the mid-1960's and the mid-1970's resulted in a decline in the percentage of land farmed under share tenure to 30 percent.

Institutional innovation

The shift from share tenure to lease tenure was not, however, the only change in tenure relationships that occurred between 1966 and 1976. There was a sharp increase in the number of plots farmed under subtenancy arrangements. The number increased from one in 1956, to five in 1966,

and sixteen in 1976. Subtenancy is illegal under the land reform code. The subtenancy arrangements are usually made without the formal consent of the landowner. All cases of subtenancy were on land farmed under a leasehold arrangement. The most common subtenancy arrangement was fifty-fifty sharing of costs and output.

It was hypothesized that an incentive for the emergence of the subtenancy institution was that the rent paid to landlords under the leasehold arrangement was below the equilibrium rent--the level which would reflect both the higher yields of rice obtained with the new technology and the lower wage rates implied by the increase in population pressure against the land.

To test this hypothesis, market prices were used to compute the value of the unpaid factor inputs (family labor and capital) for different tenure arrangements during the 1976 wet season. The results indicate that the share-to-land was lowest and the operators' surplus was the highest for the land under leasehold tenancy. In contrast, the share-to-land was the highest and no surplus was left for the operator who cultivated the land under the subtenancy arrangement (Table 1). Indeed, the share-to-land when the land was farmed under subtenancy was very close to the sum of the share-to-land plus the operators' surplus under the other tenure arrangement.

The results are consistent with the hypothesis. A substantial portion of the economic rent was captured by the leasehold tenants in the form of operators' surplus. On the land farmed under a subtenancy arrangement, the rent was shared between the leaseholder and the landlord.

A second institutional change, induced by higher yields and the increase in population pressure, has been the emergence of a new pattern of employer-labor relationship between farm operators and landless workers. According to the traditional system called hunusan, laborers who participated in the

Table 1. Factor Shares of Rice Output per Hectare, 1976 Wet Season

	Number of Plots	Area (ha)	Rice Output	Factor shares[a] Current Inputs	Land-owner	Sub-tenancy	Total	Labor	Capital[b]	Operators' Surplus
			kg/ha							
Leasehold land	44	67.7	2,889	657	567	0	567	918	337	410
			(100.0)	(22.7)	(19.6)	(0)	(19.6)	(31.8)	(11.7)	(14.2)
Share tenancy land	30	29.7	2,749	697	698	0	698	850	288	216
			(100.0)	(25.3)	(25.4)	(0)	(25.4)	(30.9)	(10.5)	(7.9)
Sub-tenancy land	16	9.1	3,447	801	504	801[c]	1,305	1,008	346	-13
			(100.0)	(23.2)	(14.6)	(23.2)	(37.8)	(29.3)	(10.1)	(-0.4)

[a] Percentage shares are shown in parentheses.

[b] Sum of irrigation fee and paid and/or imputed rentals of carabao, tractor and other machines.

[c] Rents to sub-leasors in the case of pledged plots are imputed by applying the interest rate of 40 percent crop season (a mode in the interest rate distribution in the village).

Source: Yujiro Hayami and Masao Kikuchi, Asian Village Economy at the Crossroads: An Economic Approach to Institutional Change (Tokyo: University of Tokyo Press, 1981, and Minneapolis: University of Minnesota Press, 1982), pp. 111-13.

harvesting and threshing activity received a one-sixth share of the paddy (rough rice) harvest. By 1976, most of the farmers (83 percent) adopted a system called gamma, in which participation in the harvesting operation was limited to workers who had performed the weeding operation without receiving wages.

The emergence of the gamma system can be interpreted as an institutional innovation designed to reduce the wage rate for harvesting to a level equal to the marginal productivity of labor. In the 1950's, when the rice yield per hectare was low and labor was less abundant, the one-sixth share may have approximated an equilibrium wage level. With the higher yields and the more abundant supply of labor, the one-sixth share became larger than the marginal product of labor in the harvesting operation.[8]

To test the hypothesis that the gamma system was adopted rapidly primarily because it represented an institutional innovation that permitted farm operators to equate the harvesters' shares of output to the marginal productivity of labor, imputed wage costs were compared with the actual harvesters' shares (Table 2). The results indicate that a substantial gap existed between the imputed wage for the harvesters' labor alone and the actual harvesters' shares. This gap was eliminated if the imputed wages for harvesting and weeding labor were added.

Those results are consistent with the hypothesis that the changes in institutional arrangements governing the use of production factors were induced when disequilibria between the marginal returns and the marginal costs of factor inputs occurred as a result of changes in factor endowments and technical change. Institutional change, therefore, was directed toward the establishment of a new equilibrium in factor markets.

Table 2. Comparison Between the Imputed Value of Harvesters' Share and and Imputed Cost of Gamma Labor.

	Based on employers' data	Based on employees' data
No. of working days of Gamma labor (days/ha)[a]		
Weeding	20.9	18.3
Harvesting/threshing	33.6	33.6
Imputed cost of Gamma labor (P/ha)[b]		
Weeding	167.2	146.4
Harvesting/threshing	369.6	369.6
(1) Total	536.8	516.0
Actual share of harvesters:		
In kind (kg/ha)[c]	504.0	549.0
(2) Imputed value (P/ha)[d]	504.0	549.0
(2) - (1)	-32.8	33.0

[a] Includes labor of family members who worked as Gamma laborers.

[b] Imputation using market wage rates (daily wage = P8.0 for weeding, P11.0 for harvesting).

[c] One-sixth of output per hectare.

[d] Imputation using market prices (1 kg = P1).

Source: Yujiro Hayami and Masao Kikuchi, Asian Village Economy at the Crossroads: An Economic Approach to Institutional Change (Tokyo: University of Tokyo Press, 1981, and Minneapolis: University of Minnesota Press, 1982), p. 121.

Efficiency and equity implications

It is important to recognize that subtenancy and gamma contracts were the institutional innovations to facilitate more efficient resource allocations through voluntary agreements by assigning more complete private property rights. The land reform laws gave tenants strong protection of their tenancy rights with the result that a part of land property rights, which is the right to continue tilling the soil at a rent lower than the marginal product of land, was assigned to tenant operators. But the laws prohibited tenants from renting their land to someone else who might utilize it more efficiently, when they become elderly or found more profitable off-farm employment, for example. Subtenancy was developed to reduce such inefficiency due to the institutional rigidity in the land rental market based on the land reform programs. Likewise, the gamma system was developed to counteract the institutional rigidity in the labor market based on the traditional custom in the rural community in the form of a fixed harvester's share.

It might appear that these institutional innovations increased efficiency at the expense of equity. But, if the subtenancy system had not been developed, the route would have been closed for some of the landless laborers to become farm operators and use their entrepreneurial abilities more profitably. If the implicit wage rate for harvesting work had been raised in the absence of the gamma contract, it might have encouraged mechanization in threshing and thereby reduced employment and labor earnings. It must be recognized that the institutional innovations to develop more efficient market by assigning more complete private property rights do not necessarily impair equity, as is often argued by Marxist and populist critiques against private market institutions.

In the case reviewed here the induced innovation process leading toward the establishment of equilibrium in factor markets occurred very rapidly in spite of the fact that many of the transactions--between landlords, tenants, and laborers--were less than fully monetized. Informal contractual arrangements or agreements were utilized. The subleasing and the gamma labor contract evolved without the mobilization of substantial political activity or bureaucratic effort. Indeed, the subleasing arrangement evolved in spite of legal prohibition. Where substantial political and bureaucratic resources must be mobilized to bring about technical or institutional change, the changes occur much more slowly, as in the cases of the English enclosure movements and the Thai and Japanese property rights cases referred to at the beginning of this section.

THE DEMAND FOR INSTITUTIONAL INNOVATION--NON-MARKET INSTITUTIONS FOR THE SUPPLY OF PUBLIC GOODS

The examples of institutional change advanced in the previous section, such as the Enclosure in England and the evolution of private property rights in land in Japan and Thailand, have contributed to the development of a more efficient market system. Institutional changes of this type are profitable for society only if the costs involved in the assignment and protection of rights are smaller than the gains from better resource allocation. If those costs are very high, it may be necessary to design non-market institutions in order to achieve more efficient resource allocation.[9]

For example, in Japan, although the system of private property rights was developed on cropland during the pre-modern period, communal ownership at the village level permitted open access to large areas of wild and forest

land which were utilized for the collection of firewood, leaves, and wild grasses to fertilize rice fields. However, over time more detailed common property rules were stipulated for the use of communal land in order to prevent resource exhaustion.[10]

Detailed stipulations of the time and place of utilization of communal land as well as rules for mobilizing village labor to maintain communal property (such as applying fire to regenerate pasture) were often enforced with religious taboos and rituals. Those communal village institutions remained viable because it was much more costly to demarcate and partition wild and forest land than cropland among individuals and to enforce exclusive use. Any villager's use of communal land involves externality. For example, his collection of firewood reduces the availability of the firewood for other villagers. If property rights are not assigned, there may be only limited incentive for resource conservation. This is not a serious problem if the resource that is subject to open access is abundant relative to population. However, as population pressure begins to rise, a common understanding regarding appropriate use, reinforced by social sanctions, may act to limit excessive exploitation. But, as population growth continues to press against limited land resources and the market value of the resource product rises, it becomes necessary to impose more formal regulations regarding the access of individual villagers to communal land.

Group action to supply public goods, such as the maintenance of communal land, may work effectively if the size of group involved is small, as in the case of a village community. However, if a large number of people are involved in the use of a public good, as in the case of marine fisheries,

it is more difficult to regulate their resource use or to prevent free riders by means of voluntary agreements.[11] Action by a higher authority with coercive power, such as government, may be required to limit free riding.

The 'socialization' of agricultural research is common not only in socialist economies but also in market economies [Hayami and Yamada, 1975: 224-49]. This can be explained by the failure of the market in allocating resources efficiently for the supply of public goods for a large, unidentifiable clientele group. New information or knowledge resulting from research is typically endowed with the attributes of a public good characterized by nonrivalness or jointness in supply and utilization, and nonexcludability or external economies.[12] The first attribute implies that the good is equally available to all. The second implies that it is impossible for private producers to appropriate through market pricing the full social benefits arising directly from the production (and consumption) of the good--it is difficult to exclude from the utilization of the good those who do not pay for it. A socially optimal level of supply of such a good cannot be expected if its supply is left to private firms. However, present institutional arrangements are such that much information resulting from basic research is nonexcludable. This is the major reason why it has been necessary to establish nonprofit institutions to advance basic scientific knowledge.[13]

A unique aspect of agricultural research, particularly that directed to advancing biological technology, is that many of the products of research--even in the applied area--are characterized by nonexcludability. Protection by patent laws is either unavailable or inadequate. The nature

of agricultural production to be conducted would make it difficult to restrict information about new technology or practices. Furthermore, even the largest farms are relatively small units and would not be able to capture more than a small share of the gains from inventive activity. Private research activities in agriculture have been directed primarily toward developing mechanical technology for which patent protection is established.[14]

Another important attribute of the research production function is that it has a stochastic form. Research, by nature, is characterized by risk and uncertainty. Success in a research project is like hitting a 'successful oil well.' Any number of dry holes may be bored before the successful one is found. Richard Nelson has pointed out that this stochastic nature of the research production function, which is especially strong in the case of basic research, contributes to the failure of the market in attaining optimum resource allocation over time:

> 'The very large variance of the profit probability distribution from a basic research project will tend to cause a risk-avoiding firm, without the economic resources to spread the risk by running a number of basic-research projects at once, to value a basic-research project at significantly less than its expected profitability and hence, ... at less than its social value' [Nelson, 1959:304].

The public-good attributes of the agricultural research product together with the stochastic nature of the research production function make public support of agricultural research socially desirable. It does not necessarily follow, however, that agricultural research should be conducted in governmental institutions financed by tax revenue. The social benefit produced

by agricultural research can be measured as the sum of increases in consumers' and producers' surpluses due to the downward shift in the supply function of an agricultural product. If the benefit consists primarily of producers' surplus, agricultural research may be left to the cooperative activities of agricultural producers (i.e., to the activities of such institutions as agricultural commodity organizations and cooperatives). Research on a number of tropical export crops grown under plantation conditions such as sugar, bananas, and rubber is often organized in this manner.

However, most agricultural commodities are produced by a number of small producers. Under these conditions voluntary cooperation to support research would be very costly to organize. Furthermore, most agricultural commodities, except those intended for export, are characterized by low price elasticity of demand. As a result, a major share of the social benefit produced by research tends to be transmitted to consumers through lower market prices. In such a situation the cost of agricultural research should be borne by the general public.

If agricultural research were left entirely to the private sector the result would be serious bias in the allocation of research resources. Resources would flow primarily to those areas of mechanical technology that are adequately protected by patents and to those areas of biological technology where the results can be protected by trade secrets (such as the inbred lines used in the production of hybrid corn seed). Other areas, such as research on open pollinated seed varieties, biological control of insects and pathogens, and improvements in farming practices and management, would be neglected. The socialization of agricultural research or the predominance of public institutions in agricultural research, especially

in the biological sciences, can be considered a major institutional innovation designed to offset what would otherwise represent a serious distortion in the allocation of research resources.

THE SUPPLY OF INSTITUTIONAL INNOVATION

We have identified the disequilibria in economic relationships associated with economic growth, such as technical change leading to the generation of new income streams and changes in relative factor endowments, as important sources of demand for institutional change. But the sources of supply of institutional innovation are less well understood. The factors that reduce the cost of institutional innovation have not been widely studied by economists or by other social scientists.

In the Philippines village case discussed earlier, changes in tenure and labor market institutions were supplied, in response to the changes in demand generated by changing factor endowments and new income streams, through the individual and joint decisions of owner-cultivators, tenants and laborers. But even at this level it was necessary for gains to the innovators to be large enough to offset the risk of ignoring the land reform prohibitions against subleasing and the social costs involved in changing traditional harvest-sharing arrangements. While mobilization of substantial political resources was not required to introduce and extend the new land and labor market institutions, the distribution of political resources within the village did influence the initiation and diffusion of the institutional innovations.

The supply of major institutional innovations necessarily involves the mobilization of substantial political resources by political entrepreneurs and innovators. It is useful to think in terms of a supply schedule of institutional innovation that is determined by the marginal cost schedule

facing political entrepreneurs as they attempt to design new institutions and resolve the conflicts among various vested interest groups (or suppression of opposition when necessary). We hypothesize that institutional innovations will be supplied if the expected return from the innovation that accrues to the political entrepreneurs exceeds the marginal cost of mobilizing the resources necessary to introduce the innovation. To the extent that the private return to the political entrepreneurs is different from the social return, the institutional innovation will not be supplied at a socially optimum level.[15]

Thus, the supply of institutional innovation depends critically on the power structure or balance among vested interest groups in a society. If the power balance is such that the political entrepreneurs' efforts to introduce an institutional innovation with a high rate of social return are adequately rewarded by greater prestige and stronger political support, a socially desirable institutional innovation may occur. However, if the institutional innovation is expected to result in a loss to a dominant political block, the innovation may not be forthcoming even if it is expected to produce a large net gain to society as a whole. And socially undesirable institutional innovations may occur if the returns to the entrepreneur or the interest group exceed the gains to society [Tullock, 1967; Krueger, 1974; Tollison, 1982].

The failure of many developing countries to institutionalize the agricultural research capacity needed to take advantage of the large gains from relatively modest investments in technical change may be due, in part, to the divergence between social returns and the private returns to political entrepreneurs. In the mid-1920's, for example, agricultural development in

Argentina appeared to be proceeding along a path roughly comparable to that of the United States. Mechanization of crop production lagged slightly behind that in the United States. Grain yields per hectare averaged slightly higher than in the United States. In contrast to the United States, however, output and yields in Argentina remained relatively stagnant between the mid-1920's and the mid-1970's. It was not until the late 1970's that Argentina began to realize significant gains in agricultural productivity. Part of this lag in Argentine agricultural development was due to the disruption of export markets in the 1930's and 1940's. Students of Argentine development have pointed to the political dominance of the landed aristocracy, to the rising tensions between urban and rural interests, and to inappropriate domestic policies toward agriculture [de Janvry, 1973; Smith, 1969, 1974; Cavallo and Mundlak, 1982]. The Argentine case would seem to represent a case where the bias in the distribution of political and economic resources imposed exceptionally costly delays in the institutional innovations needed to take advantage of the relatively inexpensive sources of growth that technical change in agriculture could have made available.

Cultural endowments, including religion and ideology, exert a strong influence on the supply of institutional innovation. They make some forms of institutional change less costly to establish and impose severe costs on others. For example, the traditional moral obligation in the Japanese village community to cooperate in joint communal infrastructure maintenance has made it less costly to implement rural development programs than in societies where such traditions do not prevail. These activities had their origin in the feudal organization of rural communities in the pre-Meiji period. But practices such as maintenance of village and agricultural roads and of

irrigation and drainage ditches through joint activities in which all families contribute labor were still practiced in well over half of the hamlets in Japan as recently as 1970 [Ishikawa, 1981]. The traditional patterns of cooperation have represented an important cultural resource on which to erect modern forms of cooperative marketing and joint farming activities. Similar cultural resources are not available in South Asian villages where, for example, the cast structure inhibits cooperation and encourages specialization.

Likewise, the aspiration of new ideology may reduce the cost to political entrepreneurs of mobilizing collective action for institutional change. For example, the Jeffersonian concept of agrarian democracy provided ideological support for the series of land ordinances culminating in the Homestead Act of 1862, which established the legal framework designed to encourage an owner-operator system of agriculture in the American West [Cochrane, 1979: 41-47, 179-88]. Strong nationalist sentiment in Meiji Japan, reflected in slogans such as 'A Wealthy Nation and Strong Army' (Fukoku Kyohei), helped mobilize the resources needed for the establishment of vocational schools and agricultural and industrial experiment stations [Hayami, et al., 1981]. In China, communist ideology, reinforced by the lessons learned during the guerrila period in Yenan, inspired the mobilization of communal resources to build irrigation systems and other forms of social overhead capital [Schran, 1975]. Thus, ideology can be a critical resource for political entrepreneurs and an important factor affecting the supply of institutional innovations.

Advances in social sciences that improve knowledge relevant to the design of institutional innovations that are capable of generating new

income streams or that reduce the cost of conflict resolution act to shift the supply of institutional change to the right. Throughout history, improvements in institutional performance have occurred primarily through the slow accumulation of successful precedent or as by-products of expertise and experience. Institutional change was generated through the process of trial and error much in the same manner that technical change was generated prior to the invention of the research university, the agricultural experiment station, or the industrial research laboratory. With the institutionalization of research in the social sciences and related professions the process of institutional innovation has begun to proceed much more efficiently; it is becoming increasingly possible to substitute social science knowledge and analytical skill for the more expensive process of learning by trial and error.

The research that led to advances in our understanding of the production and consumption of rural households in less developed countries represents an important example of the contribution of advances in social science knowledge to the design of more efficient institutions [Schultz, 1964; Nerlove, 1974; Binswanger, Evenson, Florencio, and White, 1981]. In a number of countries this research has led to the abandonment of policies that viewed peasant households as unresponsive to economic incentives. And it has led to the design of policies and institutions to make more productive technologies available to peasant producers and to the design of more efficient price policies for factors and products.

Similarly, the diffusion of education designed to raise the intellectual level of the general public and to facilitate better understanding of the private and social costs of institutional change may reduce the cost to

political entrepreneurs of introducing socially desirable institutions and raise the cost of biasing institutional change in a manner that is costly to society.

TOWARD A MORE COMPLETE MODEL OF INDUCED INNOVATION

We illustrate, in Figure 1, the elements of a model that maps the general equilibrium relationships among resource endowments, cultural endowments, technologies and institutions.[16] The model goes beyond the conventional general equilibrium model in which resource endowments, technologies, institutions, and culture (conventionally designated as tastes) are given.[17] In the study of long-term social and economic change the relationships among the several variables must be treated as recursive. The formal microeconomic models that are employed to analyze the supply and demand for technical and institutional change can be thought of as 'nested' within the general equilibrium framework of Figure 1.

One advantage of the 'pattern model' outlined in Figure 1 is that it helps to identify areas of ignorance. Our capacity to model and test the relationships between resource endowments and technical change is relatively strong. Our capacity to model and test the relationships between cultural endowments and either technical or institutional change is relatively weak. A second advantage of the model is that it is useful in identifying the model components that enter into other attempts to account for secular economic and social change. Failure to analyze historical change in a general equilibrium context tends to result in a unidimensional perspective on the relationships bearing on technical and institutional change.

For example, historians working within the Marxist tradition often tend to view technical change as dominating both institutional and cultural change.

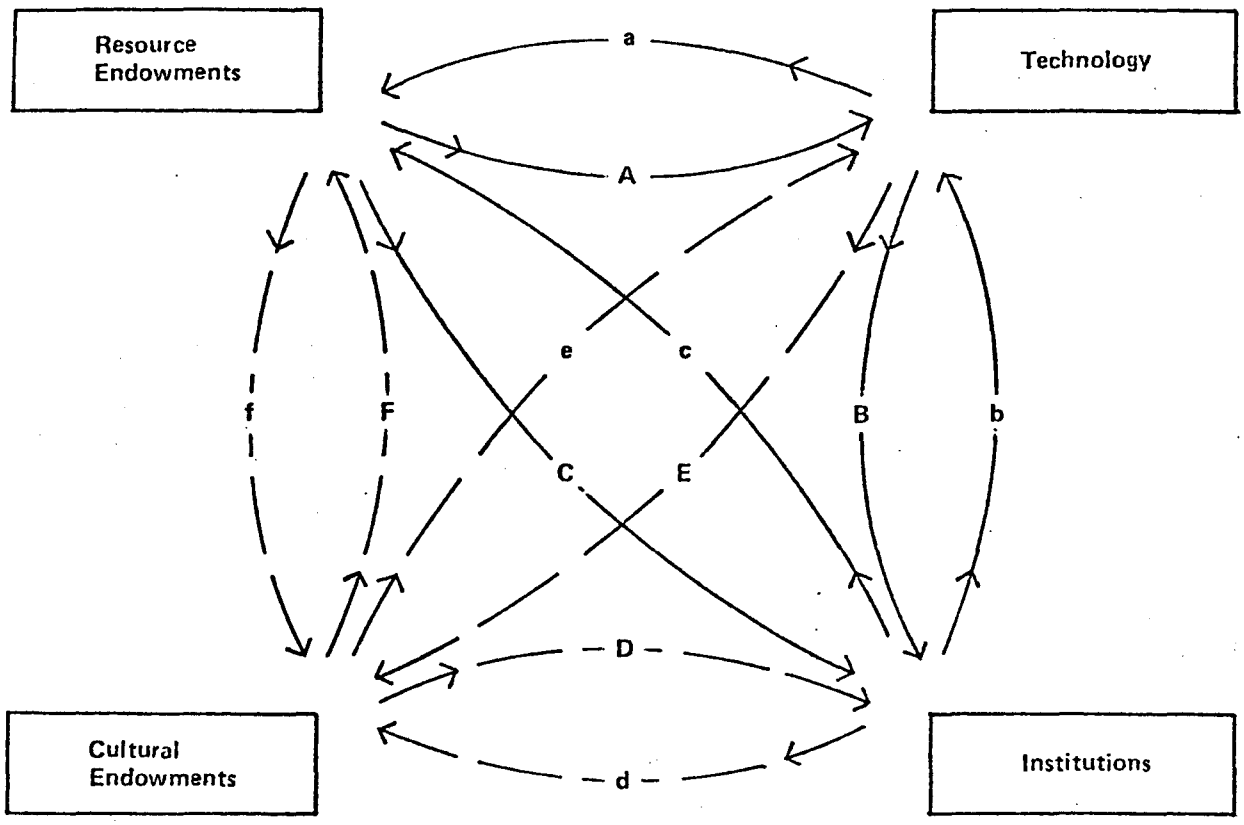

Figure 1. Interrelationships Between Changes in Resource Endowments, Cultural Endowments, Technology and Institutions.

In his book, Oriental Despotism, Karl Wittfogel views the irrigation technology used in wet rice cultivation in East Asia as determining political organization [Wittfogel, 1957]. In terms of Figure 1 his primary emphasis was on the impact of resource endowments on institutions (C) and (B).

A serious misunderstanding can be observed in contemporary neo-Marxian critiques of the 'green revolution'. These criticisms have focused attention almost entirely on the impact of technical change on labor and land tenure relations. Both the radical and populist critics have emphasized relation (B). But they have tended to ignore relationships (A) and (c).[18] This has led to repeated failure to identify effectively the separate effects of population growth and technical change on the growth and distribution of income. The analytical power of the more complete induced innovation model was illustrated in the work by Hayami and Kikuchi, discussed earlier in this paper, on the impact of both technical change and population growth on changes in land tenure and labor market relationships in the Philippines.

Armen Alchian and Harold Demsetz identify a primary function of property rights as guiding incentives to achieve greater internalization of externalities. They consider that the clear specification of property rights reduces transaction costs in the face of growing competition for the use of scarce resources as a result of population growth and/or growth in product demand [Demsetz, 1967; Alchian and Demsetz, 1973].

North and Thomas, building on the Alchian-Demsetz paradigm, attempted to explain the economic growth of Western Europe between 900 and 1700 primarily in terms of changes in property institutions.[19] During the 11th and 13th centuries the pressure of population against increasingly scarce land resources induced innovations in property rights that in turn created

profitable opportunities for the generation and adoption of labor-intensive technical changes in agriculture. The population decline in the 14th and 15th centuries was viewed as a primary factor leading to the demise of feudalism and the rise of the national state (line C). These institutional changes in turn opened up new possibilities for economies of scale in nonagricultural production and in trade (line b).

In a more recent work Mancur Olson has emphasized the proliferation of institutions as a source of economic decline.[20] He also regards broad-based encompassing organizations as having incentives to generate growth and redistribute incomes to their members with little excess burden. For example, a broadly based coalition that encompasses the majority of agricultural producers is more likely to exert political pressure for growth-oriented policies that will enable its members to obtain a larger share of a larger national product than a smaller organization that represents the interests of the producers of a single commodity. Small organizations representing narrow interest groups are more likely to pursue the interests of their members at the expense of the welfare of other producers and the general public. In contrast, an even more broadly based farmer-labor coalition would be more concerned with promoting economic growth than an organization representing a single sector. But large groups, in Olson's view, are inherently unstable because rational individuals will not incur the costs of contributing to the realization of the large group program--they have strong incentives to act as free riders. As a result, organizational 'space' in a stable society will be increasingly occupied by special interest 'distributional coalitions'. These distributional coalitions make political life more devisive. They slow down the adoption of new technologies (line b)

and limit the capacity to reallocate resources (line c). The effect is to slow down economic growth or in some cases initiate a period of economic decline.

What are the implications of the theory of institutional innovation outlined in this paper for the research agenda on the economics of institutional change? In our research on the direction and rate of technical change we were able to advance significantly our knowledge by treating technical change as endogenous--as induced primarily by changes in relative resource endowments and the growth of demand. We have also attempted to develop a theory of induced institutional innovation in which we treat institutional innovation as endogenous. There is now a significant body of evidence that suggests that substantial new insights on institutional innovation and diffusion can be obtained by treating institutional change as an economic response to changes in resource endowments and technical change.

We also insist on the potential significance of cultural endowments, including the factors that economists typically conceal under the rubric of tastes and that political scientists include under ideology. But our capacity to develop rigorous empirical tests capable of identifying the relative significance of the relationships between cultural endowments and the other elements of the model outlined in Figure 1 is quite unsatisfactory. Until our colleagues in the other social sciences provide us with more helpful analytical tools, we are forced to adhere to a strategy that focuses primarily on the interactions between resource endowments, technical change, and institutional change. The strategy suggested here does have the clear advantage of allowing us to explore how far a strategy based on the rather straightforward extension of standard microeconomic theory will take us in the analysis of both technical and institutional change.

NOTES

1. There is considerable disagreement regarding the meaning of the term institution. A distinction is often made between the concepts of institution and organization. We find the broad view which includes both concepts most useful for our purpose. This is consistent with the view expressed by both Commons [1950:24] and Knight [1952:51]. Our definition also encompasses the classification employed by Davis and North [1971:8-9]. We employ the more inclusive definition in order to be able to consider changes in the rules or conventions that govern behavior (a) within economic units such as families, firms and bureaucracies, (b) among economic units as in the cases of the rules that govern market relationships, and (c) between economic units and their environment, as in the case of the relationship between a firm and a regulatory agency.
2. See Runge [1981b:xv]. Formal analysis of the role of institutions in providing assurance of stability in economic relationships emerged from dissatisfaction with the implications of the assumption of strict dominance of individual strategy in modern welfare economics. See Sen [1967] and Runge [1981a]. In a less formal treatment, North argues, in a chapter on 'Ideology and the Free Rider Problem', that shared ideological and ethical perspectives provide assurance that is lacking in models built on the dominance of individual strategies [1981:45-58].
3. The role of special interest 'distributional coalitions' in slowing society's capacity to adopt new technology and reallocate resources in response to changing conditions is the central theme in Olson [1982:74].

4. 'At a certain stage of their development, the material forces of production in society come in conflict with the existing relations of production, or--what is but a legal expression for the same thing--with the property relations within which they had been at work before. From forms of development of the forces of production these relations turn into their fetters. Then comes the period of social revolution. With the change of the economic foundation the entire immense superstructure is more or less rapidly transformed' [Marx, 1913:11-12]. For a discussion of the role of technology in Marxian thought see Rosenberg [1982:34-54].

5. The orthodox view of a generation ago was expressed by Samuelson [1948:221-22], 'The auxiliary [institutional] constraints imposed upon the variables are not themselves the proper subject of welfare economics but must be taken as given.' Contrast this with the more recent statement by Schotter [1981:6], 'We view welfare economics as a study ... that ranks the system of rules which dictate social behavior.' There are now five fairly well defined 'political economy' traditions that have attempted to break out of the constraints imposed by traditional welfare economics and treat institutional change as endogenous. These include (a) the theory of property rights, (b) the theory of economic regulation, (c) the theory of interest group rent seeking, (d) the liberal-pluralist theories of government, and (e) the neo-Marxian theories of the state. In the property rights theories the government plays a relatively passive role; the economic theory of regulation focuses on the electoral process; the rent seeking and liberal-pluralist theories concentrate on both electoral and

bureaucratic choice processes; and the theory of the state attempts to incorporate electoral, legislative choice, and bureaucratic choice processes. For a review and criticism see Rausser, Lichtenberg, and Lattimore [1982].

6. There has been a continuing debate among students of English agricultural history about whether the higher rents that landowners received after enclosure was (a) because enclosed farming was more efficient than open field farming, or (b) because enclosures redistributed income from farmers to landowners. See Chambers and Mingay [1966], Dahlman [1980], and Allen [1982].

7. Although the passage and implementation of the Land Reform Code of 1963 was exogenous to the economy of the village, the land reform of the 1960's has been interpreted as the result of efforts by an emerging industrial elite to break simultaneously the political power of the more conservative land-owning elite and to provide incentives to peasant producers to respond to the rapid growth in demand for marketable surpluses of wage goods, primarily rice and maize, needed to sustain rapid urban industrial development. Thus, the Land Reform Code can be viewed as an institutional innovation designed to facilitate realization of the opportunities for economic growth that could be realized through rapid urban industrial development. See Ruttan [1969].

8. Real wages for agricultural labor declined significantly between the mid-1950's and the mid-1960's in the Philippines. See Khan [1977]. Thus, while we cannot be certain that the labor market was in equilibrium in the 1950's, it is clear that the degree of disequilibrium widened, as a result of both higher yields and lower wage rates, prior to the introduction and diffusion of the gamma system.

9. Harold Demsetz has pointed out that the relative costs of using market and political institutions is rarely given explicit consideration in the literature on market failure. An appropriate way of interpreting the 'public goods' vs. 'private goods' issue is to ask whether the costs of providing a market are too high relative to the cost of non-market alternatives. [1964]. A similar point is made by Leonid Hurwicz [1972].

10. For the distinction between open access and common property, see Ciriacy-Wantrup and Bishop [1975]. In the case of open access use rights have not been fully established. In the case of common property rules have been established that govern joint use. Common property is, therefore a form of land use that lies between the extremes of open access and fully exclusive private rights. The problem of resource exhaustion in open access properties was elaborated in Demsetz [1967] and Alchian and Demsetz [1973].

11. See Olson [1968]. Several students of institutional change have emphasized that coordinated or common expectations resulting from the assurance provided by traditional institutions or common assumptions about equity or ideology have permitted much larger groups to engage in either implicit or explicit voluntary cooperation than implied by Olson's model. See Runge [1981b:189-99] and North [1981:54]. North notes that 'the premium necessary to induce people to become free riders is positively correlated with the perceived legitimacy of the existing institution.'

12. For a characterization of the nonrivalness and nonexcludability attributes of public goods see Samuelson [1954; 1955; 1958] and Musgrave [1959].

13. Nonrivalness is an essential attribute of information. The use of information about a new farming practice (contour ploughing, for example) by a farmer is not hindered by the adoption of the same practice by other farmers. There is no capacity limit for its utilization. Nonexcludability, in contrast, is not a natural attribute of information but rather is determined by institutional arrangements. In fact, patent laws are an institutional arrangement that make a certain kind of information (called an 'invention') excludable, thereby creating profit incentives for private creative activities. Retention of trade secrets is another legally sanctioned method of retaining control over inventions or other forms of new technical knowledge. These arrangements are the ones designed to promote more efficient resource allocation through market arrangements as discussed in the previous section.

14. In a number of countries 'breeders' rights' and 'petty patent' legislation has induced rapid growth in private sector R&D related to agriculture. See Ruttan [1982] and Evenson and Evenson [1983].

15. See, for example, Frohlich, Oppenheimer, and Young [1971]. For a review and extension of concepts of political entrepreneurship see Guttman [1982].

16. Fusfeld [1980:33] uses the terms 'pattern' or 'Gestalt' model to describe a form of analysis that links the elements of a general pattern together by logical connections. The recursive multi-causal relationships of the pattern model imply that the model is always 'open'--'it can never include all of the relevant variables and relationships necessary for a full understanding of the phenomenon under investigation.'

17. In economics the concept of cultural endowments is usually subsumed under the concept of 'tastes' which are regarded as 'given'--that is, not subject to economic analysis. Our use of the term culture is consistent with the definition suggested by Leslie A. White, 'When things and events are considered in the context of their relation to the human organism, they constitute behavior; when they are considered . . . in their relationship to one another, they become culture' [White, 1974:1158]. We use the term cultural endowments to capture those dimensions of culture that have been transmitted from the past. Contemporary changes in resource endowments, technology, and institutions can be expected to result in changes in cultural endowments.

18. A major limitation of the Marxian model is the emphatic rejection of a causal link between demographic change and technical and institutional change [North, 1981:60, 61]. This blindness to the role of demographic factors, and to the impact of relative resource endowments, originated in the debates between Marx and Malthus. An attempt to correct this deficiency represents the major innovation of the 'cultural materialism' school of anthropology. See Harris [1979].

19. See North and Thomas [1970:1-17a; 1973]. For a critical perspective on the North-Thomas model see Field [1981]. Field is critical of the attempt by North and Thomas to treat institutional change as endogenous.

20. See Olson [1982]. For a review of the Olson work see North [1983:163-64].

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