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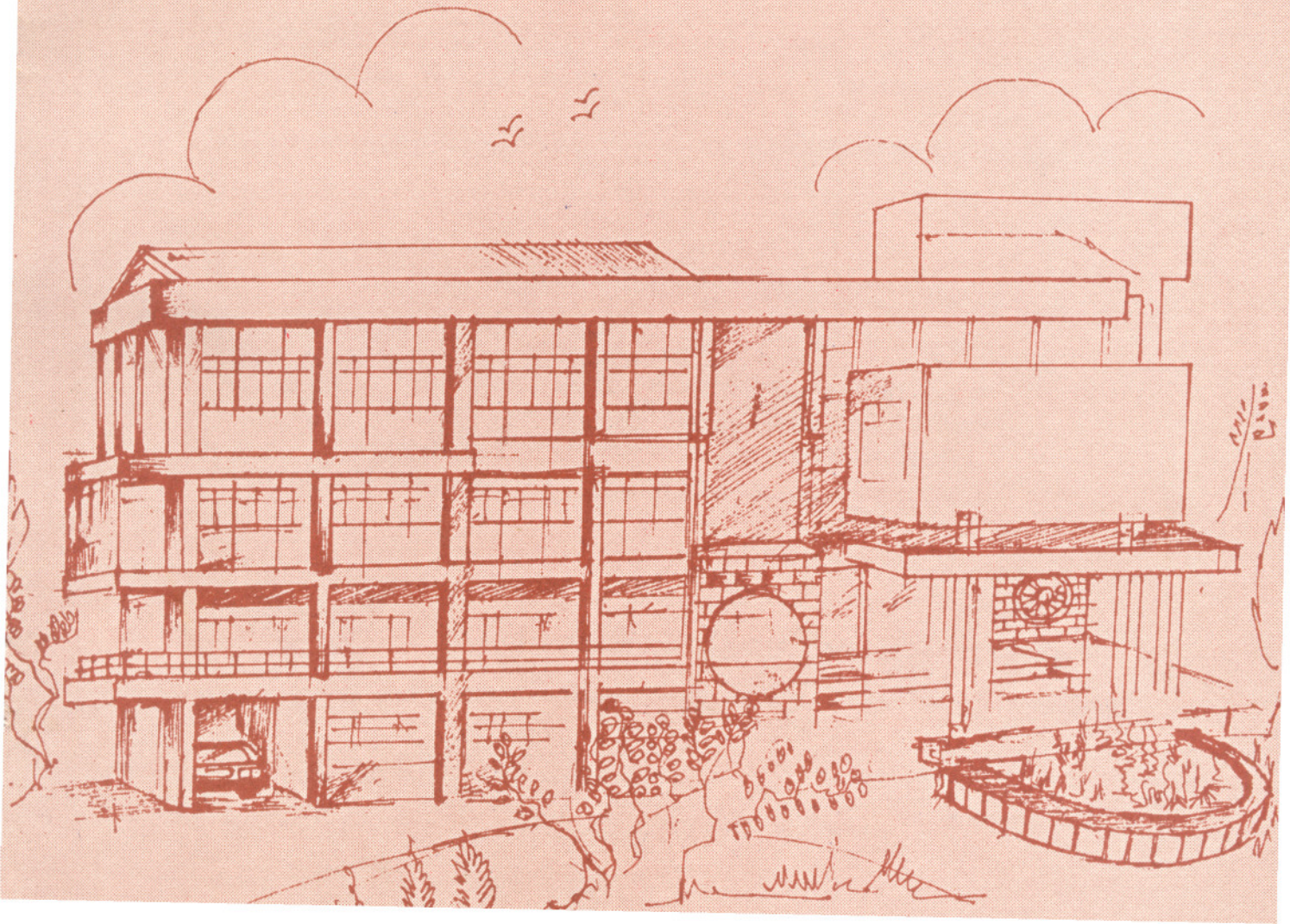
No. 71

Working Paper Series

Capability-Achievement Link: Role of Knowledge and Institutions



TWP71

Capability-Achievement Link: Role of Knowledge and Institutions

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TAPMI WORKING PAPER SERIES NO. 2006/ 02

The objective of TAPMI working paper series is to help Faculty members of TAPMI to test out their research ideas/findings at the pre-publication stage.

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January 2006

Capability-Achievement Link: Role of Knowledge and Institutions

Abstract

According to Amartya Sen, a person's capability leads to achievement. He defines capability as a process that involves first having opportunities themselves and next, having the freedoms to make use of these opportunities.

This relationship between capability and achievement is complex. To actualize capability-achievement link it is important for the person to have some endowment of knowledge, for instance knowledge to properly valuate achievement or knowledge to identify the characteristics of commodities and so on. In other words, capability-achievement link involves knowledge on the part of the individual.

Knowledge, the way we define it, is an evolving behavioral process (for instance knowledge coming from enactment). We first illustrate the role of knowledge and knowledge activity through two simple equations.

The individual's behavioral process is highly influenced by institutions. Institutional role may be of dual nature; as a source of knowledge or as the intermediary that facilitates exchange. Using a simple diagram we model how institutions function as an intervening variable in capability-achievement link.

Our paper links welfare economics with evolutionary economics and shows the role of knowledge and institutions in development.

Key words: Capability, Knowledge, Institutions

Capability-Achievement Link: Role of Knowledge and Institutions

I Background

Taking a cue from Amartya Sen (1987) we start our discussion on achievement in relation to commodities. Commodities per se have no value except in that they have certain characteristics. These characteristics of a commodity do not tell us how the person who possesses the commodity would be able to use these characteristics. To account for the ability to use, Sen introduces the idea of "functionings". Functionings is "what the person succeeds in doing with the commodities and characteristics at his or her command." (pp. 6). This functioning is nothing but the achievement of the person.

Taking an example (from Sen himself) of a person who is cycling, functioning is the act of cycling, which is posterior to possessing the bike and prior to having the utility which may well be obtaining happiness out of cycling. In other words, functioning "sits" between possession and attainment of utility.

Sen presents the above argument in symbolic terms where achievement is a function of personal utilization of the characteristics available. The characteristics themselves constitute the commodity.

$b_i = f_i\ (\ c(x_i))$ where …1

(i) = person $_i$
b_i = achieved function
c(.) = Function converting a commodity vector into a vector of characteristics
f_i (.) = a personal utilization function of person i
x_i = vector of commodities possessed by person i.

The vector b_i represents the person i's achieved functioning like being well nourished, being well clothed, being mobile, taking part in the life of the community etc.

The utilization function 'f_i (.)' results in happiness 'u_i' to person i

$$u_i = h_i\ (f_i\ (\ c(x_i)))$$ ... 2

h_i (.) = happiness function of person i related to functioning achieved by i.

u_i = Happiness of person i .

h_i (.) is a scalar that represents just how happy the person is with the functioning vector b_i; it is silent on how much value the person ascribes to that happiness. To incorporate the value aspect, Sen goes on to define the value function as follows:

For person i, valuation function is v_i(.). The value of vector of functioning b_i is given by

$$v_i = v_i (f_i (c(x_i)))) \quad \ldots 3$$

v_i (.) = valuation of function of person i.

The utilization function f_i (.) is the subset of the set F_i.

F_i = the set of utilization functions f_i , any one of which person $_i$ can in fact choose

The feasibility of utilization functions (f_i(.)) is shaped by the search process by the person for whom it may or may not be feasible to get what he or she intends to get. The set P_i (x_i) represents the feasible functioning vector for the person.

$$P_i (x_i) = [b_i \mid b_i = f_i (c(x_i)), \text{ for some } f_i (.) \in F_i] \quad \ldots 4$$

P_i (x_i) = Set of vector of feasible functionings

f_i (.) $\in F_i$ implies that f_i (.) is the subset of F_i.

For the person, feasibility consideration is applicable to the commodity vectors too. x_i belongs to a set of commodities 'Xi'. The new set incorporates feasible functioning vectors and feasible commodity vectors. New set, $Q_i(X_i)$, may be expressed as:

$$Q_i (X_i) = [bi \mid b_i = f_i (c(x_i)), \text{ for some } f_i (.) \in F_i \text{ and for some } x \in X_i] \quad \ldots 5$$

Q_i (X_i) = Capability set

Capability set according to Sen (1987) "represents the freedom that a person has in terms of the choice of functionings, given his personal features F_i (conversion of characteristics into functioning s) and his command over commodities X_i ("entitlements")" (p.9).

Given the valuation function in equation 3 above, we can say that the value of well being the person can achieve is

$$V_i = [v_i \mid v_i = v_i (b_i), \text{ for some } b_i \text{ in } Q_i] \quad \ldots 6$$

V_i = Set of v_i (.)
v_i (.) = valuation function

The highest value of one's own well-being may not be only motive for choice. Say, for example, one's commitment to family or society may demand sacrifice of maximum value of v_i in favor of inferior ones.

It is important to note that Equations 4, 5 and 6 have certain important implications. The quantifier "some" in these equations point towards the search done by non-omniscient persons who have no ability to do an "infinite" search. This line of thinking is close to the bounded rationality school. Quite evidently, Sen has broken away from traditional rationality assumptions.

That the bounded rationality perspective gets reflected in Sen's treatment of wellbeing is clear from another angle. The above equations do not presuppose optimization. Rather, it appears that Sen seems to imply satisficing which he affirms by saying that "It must not be taken for granted that the highest value of v_i in V_i will necessarily be chosen (when such a maximum exists), since maximizing one's own wellbeing may not be the only motive for choice." (p.9)

While Sen prefers the Capability route to understand wellbeing, he also points out alternatives such as through Utility and Opulence.

Utility can be interpreted in terms of three ideas all of which have had major impact on economic theory. These are desire fulfillment, satisfaction and rational choice. These respectively represent willingness to pay, pleasure from consumption, and choice as a binary relation. According to the other alternative approach, viz., Opulence approach, well-being is valued in terms of the personal endowment of commodities, independent of the person using them. The commodity bundle under the opulence approach is evaluated in terms of the costs incurred on purchase of the commodities.

Sen notes that his capability approach is superior to Utility and Opulence approaches because these two suffer from two major defects, viz., physical condition neglect and valuation neglect. Physical condition neglect implies the utility approach's inability to incorporate physical condition of human being in the valuation of his well-being. This may be explained with an example. The metric of happiness may be high for a person suffering from paralysis or blood cancer if he is accustomed to reality. Valuation

neglect, on the other hand, refers to the situation when a person's own valuation of life is subject to considerations of circumstances. For example, an unemployed housewife may report high level of wellbeing despite her subjugated roles in traditional social arrangements.

The contrast between Capability approach and traditional approaches (Utility and Opulence) can be illustrated by Sen's contrasting description of the link between value and desire. He says that according to the Capability approach a person would say, "I value X and so I desire it' while for the Utilitarian approaches the corresponding statement would be "I desire X and so I value it".

II Capability-Achievement Link - Role of Knowledge

The relationship between capability and achievement is complex. The question now is "how does the search become feasible for the person?" This happens because of the knowledge a person possesses or has access to. This knowledge includes skills to identify the characteristics of commodities, properly valuate achievement and so on. In other words, capability-achievement link involves knowledge on the part of the person.

In this section we discuss how knowledge is viewed in the economic literature. Broadly there are three approaches; knowledge as a growth driver, knowledge as a commodity, and knowledge as a process. While we give an overview of all the three approaches, we will explore how the third paradigm can be juxtaposed with Sen's view of capability-achievement link. The result is incorporation of knowledge as a process into the capability model. To make the argument clear we have also introduced a system of equations.

Knowledge as Growth Driver

Significance of knowledge, as one of the sources of growth, has been recognized by generations of economists from Classical School to the Endogenous Growth theorists. Economists' exploration of sources of economic growth was influenced by metaphors such as ideas, stock of information, state of art etc. Smith while specifying division of labor as a growth factor paid due respect to knowledge. He suggested that the success of division labor would depend upon the process of knowledge-embedding in artifacts. According to him knowledge embedded instrument is essential for sharpening dexterity, and thus would propel growth (Smith, 1776).

For Schumpeter it was innovation that provided the explanation for economic development. He said that new combinations of existing means of production, representing knowledge, would cause 'spontaneous and discontinuous' change (Schumpeter, 1912). Unlike neo-classicists, neither Adam Smith nor Schumpeter felt pressure to be bound by "heroic assumptions or equilibrium constraints". They were less bound by paradigmatic boundaries and were primarily interested in identifying growth factors.

Later economists too were concerned about growth. Noted among them was Solow. Solow Residual (Solow, 1956) and subsequent Total Factor Productivity (TFP) formulations have concurred with the possibility of knowledge being a major source of growth. Solow Residual accounts for growth unaccounted by capital and labor. Empirical research on sources of growth, especially TFP estimates, corroborates the significance of Solow Residual being an important explanation for growth. Following this came the endogenous growth theorists who went even further by treating knowledge as a factor of production (Romer 1990, Kremer 1993, Jones 1995).

Knowledge as Commodity

Another important perspective on knowledge treats it as a commodity. One early proponent of this tradition was Marshall (1890) for whom knowledge was a non-material good. Much later we have economists for whom knowledge is a commodity (Arrow, 1962, Romer, 1990). Arrow perceived stock of information satisfying the properties of public good as knowledge. Arrow assumes that an increase in capital necessarily leads to proportionate increase in knowledge through learning by doing. Endogenous growth theorist like Romer defies the assumption of knowledge being a public good. He postulates knowledge as a non-rival, partially excludable good; and growth is the outcome of the accumulation of a partially excludable, non-rival input. Romer (1990) cites that, "the design is non rival but the ability to add is not. The difference arises because the ability to add is inherently tied to a physical object (a human body) whereas the design is not" (p 74). The stated advantage of Romer's approach is that it enhances the scope of theorizing knowledge spillover and the ensuing economic growth.

Knowledge as Process

One major criticism against knowledge as commodity or "factor of production" came from Boulding for whom knowledge must be regarded not just another factor of production but "… must itself be regarded as a structure, a very complex and frequently quite loose pattern" (Boulding, 1955 cited in Langlois 2001, p 79). This logical progression in treating knowledge as a process is reflected in recent writings too such as that of Weitzman (1998) and Cowan et al (2000).

Weitzman (1998) conceives production of knowledge as the function of productive ideas. He takes the cue from biology and sees growth of knowledge as a recombinant process. Just as new forms of biological beings come about by genetic processes, regroupings new forms of knowledge also come about by processes similar to those in biology.

The process orientation is again displayed by Cowen et al (2000) who developed the distinction between codified and tacit knowledge, ideas that came about from Polanyi (1967). Codified knowledge is knowledge that can be converted into symbols for easy transmission, replication and storage (Langlois, 2001). Tacit Knowledge stands for the aspects of human intelligence that cannot be replicated by any algorithm (Nelson and Winter, 1982).

Tacit and Codified Knowledge

Cowen et al (2000), while not convinced that knowledge is a public good, elaborated on how knowledge evolves wherein new tacit (or for that matter new codified) knowledge gets generated and exiting tacit knowledge gets codified. Cowen et al further pointed out how this dynamic process of knowledge generation both at the "tacit" and "codified" levels is influenced by market mechanisms and incentives.

First let us elaborate on codified knowledge. Codification process involves two aspects: Creation of a model for language and creation of messages. Creation of model is essentially about the theory of language which gets expressed through grammar. Model for language or grammar provides the structure for acquiring knowledge. Linguist Noam Chomsky (1965 p. 25) states, "It is useful to consider the abstract problem of constructing an "acquisition model" for language, that is, a theory of language learning or grammar construction." Having formed the model for language or

grammar construction, the next step is creation of messages which completes the codification process.

At both these stages there is need for a lexicon or codebook. The lexicon is nothing but a source for checking out standardized semantic and syntactic rules or codes. The lexicon, while aiding message and information generation, also gets enriched as more communication happens. In other words, the codebook at any time is a repository of codified knowledge.

While the codebook represents codified knowledge, the skill to interpret, understand and communicate it is tacit knowledge. This skill is nothing but capability as Nelson and Winter (1982) point out, "By a skill we mean capability for a smooth sequence of coordinated behavior that is ordinarily effective relative to its objectives, given the context in which it normally occurs." (p. 73)

Different types of skills may have different characteristics in common as shown by Nelson and Winter (1982). Performing a skill, as shown by Nelson and Winter, has similarities to the execution of a computer program. For instance, it has a beginning and an end. The program execution is also coordinated. Similarly, manifestation of tacit knowledge involves not simply the written code but the "internal" cognitive processes involving complex neural networks.

Articulation

Generation of tacit knowledge requires the codebook to be articulated so that knowledge is in usable form to be recognized and worked upon by cognition. In other words, articulation involves sending message from the codebook to the performer with, ideally, minimum noise. Incentives and circumstances influence articulation of knowledge, and this reduces tacitness. Nelson and Winter (1982) cite an example of how "it has been established in occasional emergency situations that it is not impossible to convey by radioed verbal commands enough information on how to fly a small plane so that a person who lacks a pilot's skills can bring the plane in for a landing" (p 78).

However, the articulation is impacted by three major factors (Nelson and winter 1982). They are a) rate of information transfer through symbolic communication, b) causal depth of knowledge and c) coherence aspect. Language or code the performer has in memory may not be transferred at a feasible rate to performance. For example, a

person's knowledge of probability and arithmetic may not be available to himself or herself for solving a puzzle. In other words, communication or coordination of knowledge within the solver himself or herself may not be fast enough to successfully solve the puzzle within a particular time span. This kind of problem of articulation may occur in screening tests for a job or business school admission.

Causal depth of knowledge too influences articulation of knowledge. This refers to the underlying knowledge of causal variables and their relationships which allows certain degree of explanation and prediction. Of course, Polanyi (1967) had pointed how a swimmer need not necessarily understand the principle of buoyancy for survival purposes. On the surface, this may appear contrary to what Nelson and Winter are suggesting. But on closer examination we find that for Polanyi it was a question of survival, and for Nelson and Winter it is about performance. In other words, for performance it is required that the performer possesses causal depth.

The last factor which influences articulation is coherence. Degree of coherence refers to the match between symbol-based communication and the way the human brain processes the incoming communication. Perhaps the best way to further understand coherence is by seeking the view of Nelson and Winter on sources of incoherence. "Efforts to articulate "complete" knowledge of something by exhaustive attention to details and thorough discussion of preconditions succeed only in producing an incoherent message. This difficulty is probably rooted to a substantial extent in the related facts of the linear character of language-based communication, the serial character of the "central processor" of the human brain, and the relatively limited capacity of human short-term memory" (p: 81).

While articulation is of the codebook is made difficult by the three factors we just described, there are short-run solutions to overcome the problem. These solutions are provided by technology and institutions. An example of the former coming to rescue would be the case of gears (a product of technological development) available to the driver to control speed. By the knowledge of what gear should be applied (appropriate to the speed), the driver is able to readily access the technological artifact. A driver through experience is able to drive comfortably without any conscious cognitive processing. What we see is routinized response to situations based on rules. So we see technology imposing rules that reduce co-ordination efforts. Such rules that reduce

coordination efforts also arise from institutions. In Section IV we will be addressing the role of institutions in knowledge activity.

Codification

Having discussed the role of articulated knowledge for performance, we would like to introduce the related idea of codified knowledge and its relationship to the idea of articulation. Following Cowan et al (2000) we illustrate the relationship between the two through Table 1. First, knowledge can be classified as articulated or unarticulated, the former requiring codification. In fact all articulated knowledge is codified. Such knowledge is represented by "A" in the Table. Examples of such knowledge is textbooks, source codes etc. One of the features of A-type knowledge is that when semantic difficulties arise codebook is accessible for reference to reduce noise. In fact, it is the access to codebook that makes codified knowledge articulated.

Table: 1 Relationship between Articulated and Codified Knowledge

	Codified	***Uncodifiable***		
Articulated	Codified and Articulated (A)	Does not exist (B)		
Unarticulated	Displaced codebook (C)	No disagreements. Culturally evolved (D)	Procedural authority, governed by rules (E)	No Procedural authority, governed by the Guru (F)

Type "B" knowledge does not exist since there can be no articulation without codification. The next type of knowledge, represented by "C" in the Table, is codified but not articulated. This is because the codebook, described earlier in this paper, is displaced. Displacement here implies non-access to existent codebook. Cowan et al (2000) reflect on displaced codebook, "'A displaced codebook' implies that a codified body of common knowledge is present, but not manifestly so. Technical terms figure in descriptive discussion but go undefined because their meaning is evident to all concerned; fundamental relationships among variables also are not reiterated in conversation and messages exchanged among members of the group, or epistemic community…. This often infuriates outsiders who complain vociferously about excessive jargon in the writings and speeches of physicists, economists and psychologists." (p. 232).

There are many interesting upshots to considering certain types of knowledge as belonging to "C" category. For instance, purpose of most examination would fall into probing the candidates' memory of the codebook. If examinations are meant for checking out suitability for action in the real world, such examinations become questionable. Considering, as Cowan et al point out, that displaced codebook causes semantic confusion it is ironic that traditional examinations reduce themselves to simulated codebook concealment…. a devise that artificially creates avoidable confusion!

Unarticulated and uncodifiable or tacit knowledge can be broken down to three categories; D, E and F. The first of these, D category consists of uncodifiable knowledge that is culturally rooted in the collective memory of the group and manifests in social mores and conventions. These cultural codes are used by the members of the community without any disputes over meanings of particular conventions. Significant part of indigenous knowledge seems belong to this category. One of possible reason for agreement is fear of exile if one disagrees.

In the case of E and F, members of the community disagree over conventions. Agreement could, in such cases arise from: (i) procedural authority and (ii) reference to Gurus. Procedural authority is like random selection being used for solving disagreements. Say, for example, suppose a group of people (six men) is trapped in a deserted island far off the coast. A fishing boat happens to spot these people. The boat can accommodate one person. There is disagreement among the group members about the choice of those who would go overboard. Finally, they arrive at a solution. They decide to cast a lot and choose the lucky person. Type F knowledge is that kind of knowledge that is agreed upon through the unquestioned acceptance of what the Guru tells.

A related issue is the instability in semantics or frequent change in the meaning of words. Unstable language often limits the scope of codification. When there is instability in semantics, vocabulary is open for interpretation. Different languages are used for interpreting the meaning of words. For example the word, "dynamics" can be interpreted in different ways by natural language, calculus or statistics.

Different interpretations of vocabulary by alternative languages create difficulty in communication between knowledge generators and users. On this issue Cowan et al

have the following comments, “Models and languages are fluid and the community of agents conversant with the models and is itself changing. The fluidity of language implies that there exists a certain amount of uncertainty about what the message actually mean, because there is uncertainty, and perhaps change, with regard to the vocabulary in which they are written. Even when scientific papers express new discoveries, or re-examine old results in some “natural” language, much jargon specific to the subject matter remains ‘terms of art’ are employed whose meanings are lost on outsiders, and in formal modeling, definitions of variables specific to the model may remain in flux as the model itself is modified and reconciled with observational data. In an important sense, the progress of research involves – and requires- the stabilization of meanings, which is part of the social process through which the stabilization of beliefs about the reliability of knowledge comes about.” (p. 247). This situation is not a rarity in social sciences. For example, concepts like quality of life, inequality etc., undergo revisions and get interpreted differently by alternative schools. In this game for semantic dominance a few dominant schools would finally emerge.

Knowledge-Capability Link

In this section we incorporate knowledge into Sen’s capability set which we discussed in Section I. Suppose person i is learning swimming. He or she is being trained by a coach who explains and demonstrates to the trainee how ability to be buoyant helps swimming. The trainee follows the instructions keenly thereby improving the skill day by day. The coach is, of course, aware of the principle of buoyancy and other relevant knowledge useful in training. These principles may be sourced from textbooks or instruction manuals. The literature on these principles represents the codified knowledge. Performance of the trainee not only depends on the quality of training imparted by the trainer, but also his or her innate ability to swim.

The innate ability or skill is tacit in the person. Achieved functioning, which we defined in Section I, is now the function of

a) $c(x_i)$ which is the function converting a commodity vector into a vector of characteristics and

b) the knowledge available to i. This knowledge consists of k_i (knowledge from source to i. ie. tacit knowledge) and k_j (Knowledge k_j from source j that is external to the person which may be in tacit or codified form)

Given this, Equation 1 from Section I will now become

$$b_i = f_i (c(x_i), c_1(k_i, k_j)) \quad \ldots 7$$

where $c_{1\,(.)}$ = the function converting a knowledge space into a vector of characteristics of knowledge. It may indeed be plausible to talk in terms of knowledge vector considering recent developments in scientometry!

Following the equation 7, equations 2, 3 and 4 now will become 8, 9 and 10 respectively.

$$u_i = h_i (f_i (c(x_i), c_1(k_i, k_j))) \quad \ldots 8$$

$$v_i = v_i (f_i (c(x_i), c_1(k_i, k_j))) \quad \ldots 9$$

$$P_i (x_i) = [b_i \mid b_i = f_i (c(x_i), c_1(k_i, k_j)), \text{ for some } f_i (.) \in F_i] \quad \ldots 10$$

Please refer to Section I for explanation of symbols used.

All the accessible knowledge need not be the part of capability set because of factors like feasibility consideration, myopia etc.

Equation 5, which gives Capability set, can now be written as:

$$Q_i (X_i) = [b_i \mid b_i = f_i (c(x_i), c_1(k_i, k_j)), \text{ for some } f_i (.) \in F_{i,}, \text{ for some } x_i \in X_i, \text{ for some } k_i \in K_i \text{ and for some } k_j \in K_j] \quad \ldots 11$$

It may be stated that some goods, some knowledge, their characteristics and relevant functionings constitute capability set of a person. Given same endowment of goods other than knowledge, an increase in knowledge that is relevant to the functioning enhances the capability set of a person. So, knowledge may have direct impact on the well-being of a person.

III Knowledge Activity

Knowledge, the way we define it, is an evolving behavioral process. Knowledge activity involves a variety of human actions and may take the form of production, exchange, enactment, diffusion and so on. All these forms of activity involve participation of persons and institutions.

Let us consider production of knowledge. If h_p and k represent the vector of performance of skills and codified knowledge respectively, K_p (or knowledge produced) may be said to be

$$K_p = [\ (h_p, k) /\ h_p(k_c, k_r, H) \rightarrow h_p \text{ and } k(k_c, k_r, H) \rightarrow k;\ h_p \in H \text{ and } k \in K] \qquad \ldots 12$$

where

K_p = Knowledge Produced

h_p = Performance of skill by human

k = Codified knowledge produced

k_c = Existing codified knowledge

k_r = Knowledge from other repositories of knowledge

k(.) = Mapping function for codified knowledge

h_p(.)= Mapping function for performance skill

H = Labor

K = Stock of knowledge

$\rightarrow$ Mapping $\in$ = subset of

The above equation suggests that Knowledge produced is a set consisting of human performance and codified knowledge. Both these are a function of

a) Existing codified knowledge,
b) Knowledge from other repositories (such as persons, artifacts, institutions, conventions, collective memory etc.). In other words, this involves some form of outsourcing tacit knowledge embedded in outside sources
c) Labor, which is tacit knowledge, of the persons in the activity

Our formulation of knowledge produced has many implications. First, creation of new knowledge requires a certain extent of action along with presence of some existing tacit knowledge (embedded in the performer, artifacts or associated institutions) and availability of codified knowledge. As action is completed, new tacit and new codified knowledge would emerge. Vis-à-vis knowledge two things would happen at the end of action:

a) Tacit knowledge would get embedded in the performer (or may even within the actifacts and institutions), part of which may be available to posterity for further usage.
b) Codified knowledge would emerge if the action is accompanied by documentation for posterity.

Let us illustrate the above knowledge activity through an example. Say, an economist investigating the determinants of capital formation conjectures up a set of causal relationships. For this, he reads literature or 'k_c' (books and journal articles). The scholar also builds up semantic clarity having first found some ambiguities in the present literature. This is done through his or her labor or 'H' which is involved in the process of conceptualization and criticism. The scholar discusses the observations generated with the peer group and obtains some useful comments. These constitute 'k_r'. Finally, the scholar publishes a paper on this issue which is nothing but 'k'. He or she further attends an important conference and presents the paper, the endeavor involved in which could be said to be 'h_p'.

Acquisition and Diffusion

Once knowledge is produced, the next important question is its acquisition by others. Those who first acquire it would be readers. They acquire knowledge and diffuse it to listeners, who themselves may be enthused to read by the pioneering spirit of the early readers. It is quite likely that there is inter-personal variation in acquiring knowledge. Let us say that the knowledge, now contained in an article, carries an certain extent of vocabulary, symbols and symbolic relationships etc. Tracing back to our earlier example of capital formation, let us say that some readers are not be able to distinguish capital and capital formation or understand econometric terms such as structural stability. Some may even be confused between rate of change and compounded annual growth rate.

As opposed to this, it is also likely that some readers are very knowledgeable and they forward critical comments to the author on the article. They may even write another article challenging the present one. Some of the readers, call them quacks, understand partially and may even wrongly interpret some of the findings. Quacks communicate 'their understanding' to people who are not aware of the article or have no access to the article. Even though a published article is a public good, due to the difference in linguistic abilities (here in this example, language of macro economics), not every one

has equal 'access' to the knowledge content of the article. This is a case of unequal diffusion of knowledge on account of interpersonal variation in tacit knowledge.

Let us think of a highly stylized repository of codified knowledge to which hundred persons enjoy free access. This is shown in Table 2. Of the hundred, let us assume that ten know verbatim the content of the repository. In modeling language we could say that these ten have complete knowledge of the content and can communicate it at near-zero noise. In the Table this group is represented by A. Say, another sixty have partial knowledge of language. Their incomplete knowledge causes ambiguity about the semantics and often results in signaling wrong messages to others. Let us call this group B. Let us also hypothesize that group C, consisting of thirty persons, is even worse. They have even less knowledge about what the article content when compared to Group B. Now let us take it that B and C do not seem to want to improve their understanding. Neither do they admit their inadequacy.

Table 2: Diffusion of Knowledge

Readers		**Listeners' Threshold Level of Comprehension**				
Readers' Group	**Number of Readers**	**Verbatim of A's message**	**Verbatim of B's Message**	**Verbatim of C's Message**	**Ignorance**	**Listeners Total**
A	10	15 (A_1)	5 (A_2)	0 (A_3)	0 (A_4)	20
B	60	0 (B_1)	60 (B_2)	30 (B_3)	10 (B_4)	100
C	30	0 (C_1)	0 (C_2)	10 (C_3)	30 (C_4)	40
Total	100	15	65	40	40	160

The way we have classified readers and listeners here does not mean that there ought to be a hierarchy in terms of knowledge creation and comprehension. We are not suggesting that groups A, B and C are based on existing "reputation" of university to which these individuals are affiliated to, or for that matter, the individuals themselves. We are only pointing out that there would be differences in accuracy of how knowledge resources are interpreted and communicated. In fact such a resource as knowledge is highly sensitive to noise or, in other words, to being under or over interpreted to the detriment of epistemic inventory. The noise we are talking about would be more individual-generated (through hubris etc.) rather than circumstance-generated. Here the sense in which we mean capability to grasp knowledge is a more on account of the person's consciousness (Aumann, 2005) than anything else.

Now let us assume that A gets twenty listeners. Out of this, fifteen (call A_1) learn the content fully and five (A_2) have only partial understanding. But, A_2 can potentially learn B's message entirely. Next, Group B gets hundred listeners, out of which none of them are capable of fully understanding A. Sixty (call them B_2) understand B's message entirely. Since to start with B's learning was partial, B_2 also would have partial learning.

Only thirty of B's listeners are capable of fully understanding C. This group could be labeled as B_3. And finally ten of B's listeners completely ignore message from B, designated as B_4. As far as group C is concerned, it has 40 listeners. Of these, ten happen to fully learn from C's knowledge (call them C_3). The remaining thirty ignore C's message (call them C_4).

The hypothetical data highlights inter-group or inter-personal variation in the knowledge acquisition-diffusion-acquisition cycle. Inequality in the process across individuals is caused by factors such as language proficiency and even beyond that, consciousness. While consciousness is a difficult area of scientific inquiry, existing understanding of value comes to rescue. We explain variations in acquisition and diffusion of knowledge across the readers and listeners through the idea of valuation.

The data on reading preference seem to be explained by persons' valuation of knowledge. Some people read because of the exchange value of any piece of knowledge. Similarly other values also enter into the choice. On some occasions, all four values or multiple values (that includes, besides exchange value, use, option and existence values) enter into the choice process. Whichever type of value the readers considers, let us assume that he or she also classifies the knowledge obtained as high, medium and low. This may be illustrated with an example shown in Table 3.

Table: 3 Value-Characteristics Set

Characteristics of knowledge	**Value (high)**				**Value (Medium)**				**Value (Low)**			
	E	U	O	X	E	U	O	X	E	U	O	X
C_1	a	b	c	d	e	f	g	h	i	j	k	l
C_2	m	n	o	p	q	r	s	t	u	v	w	x

E = Exchange Value

U = Use Value

O = Option Value

X = Existence value

a….l = Characteristics-value combination for Reusability

m…x = Characteristics-value combination for Abstractness
C_1 and C_2 are characteristics such as reusability, abstractness etc.

Suppose the readers recognize as valuable two characteristics of knowledge; namely C_1 and C_2. Next they choose any of the characteristics-value combination or set of combinations. The choice of sets '{a.b,c,d}' and '{m,n,o,p}' indicate that high value is accorded to knowledge. In situations like high valuation, readers read the whole book/article. This group of readers, it is assumed, is well versed with the language of the book; and reading is not difficult.

Knowledge of language does not imply reading the entire work. Some people who are proficient in language may be interested in a particular set, say '{a,b,c,d}', may skip '{m,n,o,p}'. An important reason for this preference is because the set is compatible with their area of interest. There are some readers, who belong to the group of 'quack' (groups B and C; see Table 2), who choose sets like: {a}, {m} etc. They send wrong signals to the listeners. Indeed they may be maximizing the exchange value at a social cost. They are capable of creating semantic confusion because they don't admit their incompetence in language and listeners cannot crosscheck the message. Let us assume that groups A, B and C certify competence of their listeners. A, B and C certificates signal that all listeners belonging to each of these categories possess equal competence; it also signals that persons belonging to any of these groups have identical competence levels. If labor market trusts certified competency as the sole signal of capability, it may result in information asymmetry and the market failure. As a result, less competent individuals may crowd out more competent ones. To minimize the uncertainty, labor market accesses other signals too along with the certificate. The institutional background of individuals, for example, is often recognized as a signal of capability.

It may be noted that institutions are the sources of certification. We may impute the characteristics of institutions to groups A, B and C. This follows North's (1990) view that institutions are humanly devised constraints which are of formal (for instance procedures) and informal nature (culture, style etc.). The net result is that labor market would associate A with competence and B and C with incompetence. Listeners from B and C are identified as less knowledgeable, and labor market may not even consider them as legitimate entrants to the labor market. Some of the listeners affiliated to B

and C institutions may be as good as some A in terms of their potential for the pursuit of knowledge activity. However, in the screening process, such individuals from B and C would be excluded. Such exclusions (and inclusions) which are not in the interest of knowledge activity are a matter that institutions should be aware of. In the next section we will explore the idea that this kind of institutional order can result in lock-ins and adaptive inefficiency, and that it may evoke changes that can cause either conflict or cooperation.

IV Role of Institutions

The individual's behavioral process is highly influenced by institutions. Institutional role may be of dual nature; as a source of knowledge or as an intermediary that facilitates exchange. Using a simple diagram we model how institutions function as an intervening variable in capability-achievement link.

Before we come to the specific model, a brief discussion on institutions and institutional change and its impact on knowledge are in order. Institution is akin to a game. Rules structure the interaction between teams in a game. Same rules and different teams produce different outcomes. Skill and knowledge vary across teams. Skill and knowledge form the knowledge endowment, differences in which account for variation in outcomes. Teams with equal or unequal knowledge endowment participate in games. Similar process of institutional configuration exists in several exchanges. One such case is academic research. (Of course, such institutional formation would apply to knowledge-based firms also). In the case of academic research, universities, journals and individuals participate in the knowledge activity. Repeated personalized exchanges, predominance of informal constraints, mix of tacit and codified knowledge and imperfect enforcement characterize such exchanges.

We can conceive of this knowledge activity as a game that is different from other games such as soccer. In the former there would be significant presence of cooperation between teams while the latter would be characterized entirely by conflict (of course, within a set of given rules). Even within the realm of knowledge activity there would be differences which could only be explained by differences in tacit knowledge. Characteristics of cooperation or conflict between scholars belonging to Harvard University and MIT would be different from those universities that are less well-known. Codified knowledge that guides formal constraints may be the same between

the two sets of universities and more or less the same formal rules may moderate both the interactions. However, both interactions are likely to produce significantly dissimilar results. Tacit knowledge embodied in the individuals, institutions and artifacts associated with the two sets may constitute an important source of differences in results.

If tacit knowledge accounts for differences in results, it is indeed important to sustain performance by providing incentives for the right knowledge and learning activities. Knowledge and institutions interact with each other to create a system of mutual causality.

Consideration of knowledge as one of the sources of the institutional performance renders the traditional efficiency concepts narrow. Allocative efficiency is a traditional concept, mainly catering to the neo-classical models. Adaptive behavior regulates institutional performance, and adaptive efficiency is a more realistic construct than the allocative efficiency in the said context. North (1990 p 80) gives a clear distinction of allocative and adaptive efficiencies: "In allocative efficiency, the standard neoclassical Pareto conditions obtain. Adaptive efficiency, on the other hand, is concerned with the kinds of rules that shape the way an economy evolves through time. It is also concerned with the willingness of a society to acquire knowledge and learning, to induce innovation, to undertake risk and creative activity of all sorts, as well as to resolve problems and bottlenecks of the society through time."

Incentives for trials, experiments and innovation, development of tacit knowledge, and decentralized decision-making characterize the adaptive-efficient institutions. Allocative efficiency is a consequence-based decision rule, and the allocative process is not a part of it. At the same time, adaptive efficiency incorporates both the process and the consequence. Computation of adaptive efficiency requires more information than what allocative efficiency requires. Not all allocatively efficient institutions are adaptively efficient. Some of them may be and some may not be.

Institutions involved in similar activity may perform dissimilarly. Some institutions perform poorly, and some experience continuous progress. Interestingly, poor performance may sustain long. This generates an important question. "Why does poor performance survive for long?" Insights from theories on competing technologies provide a pointer. An example would be the prevalence of QWERTY, the keyboard

design, over competing and superior designs (David, 1985). Arthur (1989) explores reasons for persistence of inferior technologies over superior ones. According to him, four factors contribute to the persistence of inferior technologies over superior ones. They are (a) Large fixed cost (b) Learning effects (c) Coordination effects and (d) Adaptive expectations. Large fixed costs cause inverse relationship between average cost and output, creating less incentive for change. Similarly Learning effect also creates undesirable tenacity for maintaining the status quo. The third factor that inhibits change, coordination effect, refers to increasing returns to cooperation. And finally adaptive expectations, or expectations of persons based on the belief that past trends will continue to shape future more than anything else, inhibits change.

Institutions undergo change. Individual, who responds to incentives embodied in institutional framework, is the agent of change (North, 1990). Changes in relative prices and ideologies form the source of change. Before discussing institutional change, we need to understand stability better. Two factors account for stability: (a) expensive rule alteration (b) persistence of informal constraints (e.g. routines). Stability does not imply efficiency. North reflects (1990 p 83-84): "It is important to stress once more, however, that this set of stability features in no way guarantees that institutions relied upon are efficient, although stability may be a necessary condition for complex human interaction, it is certainly not a sufficient condition for efficiency."

Changes in relative prices can alter stability. Changes in relative prices, as North points out, include the following: changes in the ratio of factor prices, changes in the cost of information, and changes in technology. Changes in relative prices induce institutional change. However, changes in relative prices do not offer satisfactory explanation for change processes associated with social-moral issues (e.g. role of women in society). On the other hand, ideology better explains institutional change in social-moral issues than does changes in relative prices. It is easy to see that ideology-guided decisions (say, based on patriotism) often do not recognize cost-benefit considerations. In such a situation bargaining power of individuals or groups will have little role in decision making.

Timing of institutional change is another important issue. The concept of institutional equilibrium seems to provide informational clues to temporal magnitude of institutional change. Institutional equilibrium refers to unchanged institutional configuration, and

no individual or group may be interested in restructuring existing configuration. North defines institutional equilibrium (1990 p 86): “Institutional equilibrium would be a situation where given the bargaining strength of the players and the set of contractual bargains that made up total economic exchange, none of the players would find it advantageous to devote resources into restructuring the agreements.” Institutional changes are not necessarily continuous. Discontinuous change is also a possibility, and it refers to a radical change in the formal rules. Sources of discontinuous change consist of wars, revolutions, conquest and natural disasters.

Institutional change affects the well-being of persons who participate in the knowledge activity. Some institutions subscribe to a particular language (say ‘M’). The increasing return and enhancing network size go in favor of the subscribed knowledge (David, 1985; Arthur, 1989). In other words, network externality is an important source of increasing returns. Enhancement of the user network causes increasing returns to the subscribing institutions. High investment in M by its patrons prevents the emergence of alternatives that are superior survives for a longer period than it should have. Survival of inferior knowledge here is referred to as ‘lock-in’. It is difficult for the innovative-alternative knowledge to emerge itself. Subscription to M affects the institution’s future choice set. The sustaining prevalence of M leads to the rejection of future alternatives, and this forms a case of path dependence. Individuals who subscribe to an alternative language, or N, experience, what we term as, capability loss. The prevalent knowledge and patronizing institutions block the transformation of capability set into well-being.

The concept of the capability-loss needs more elaboration. Different functionings form capability set. Figure 1 presents capability set of two persons P (who uses language M) and Q (who uses language N). In this simple model, we assume that there is no one with skills in both the languages. Functioning 1 and Functioning 2 represent outputs which uses either M or N as the media. Functioning 1 and Functioning 2 could, for instance, be anything like verbal flair or analytical expression.

Now just for a moment, assume that curve A is the capability set of P and Q during period t_0 using M and N respectively for activating the functionings. In this stylized example we assume that both P and Q are identical in terms of functioning combinations. Curve A represents capability set for both P and Q during t_o. The

concave curve implies increasing opportunity cost incurred for extra unit of functioning 2 at the cost of functioning 1 and visa versa.

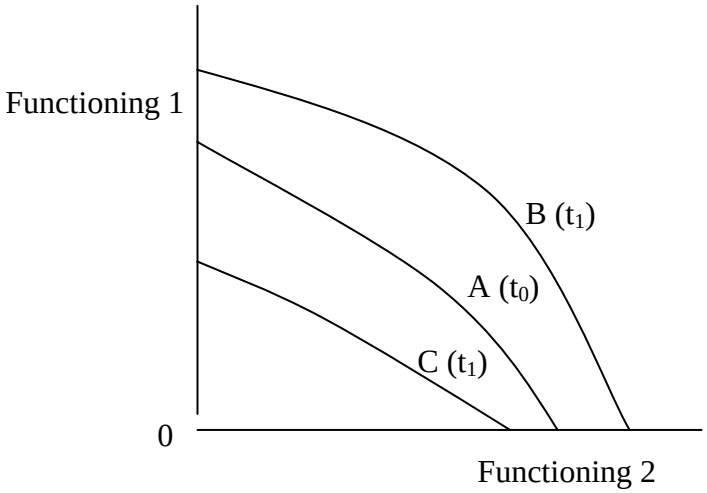

Figure 1: Prevalence of particular knowledge and Capability Loss

Let us assume that both the languages have more or less the same size of user network. Further we assume that P and Q belong to institutions I and J respectively. M has I as its patron and N finds its patron in J.

I foresees increasing returns from the investment on the expansion of M user network. Therefore, over a period of time, I provides incentives to knowledge producers to use M for achieving their functionings. Fear of obsolescence and possibility of increasing returns prompt knowledge producers to adopt M. Users of M would therefore experience enhancement of their capability set mainly due to network externalities. Curve B represents the capability enhancement accruing to P during t_1. Either Q is ignorant of institutional change or refuses to subscribe to I. Meanwhile the network registers significant increase in the size of users for M. By period t_1, N looses a large number of users to M. Consequently, I enjoys more bargaining power than J.

Assuming M's prevalence is the function of I's bargaining power and network externality, M poses entry barriers to emerging superior languages. With the erosion in user base of language N, Q's capability set too erodes. Curve C shows loss of Q's capability in period t_1. In our model, there will be two population sets whose members resemble P and Q.

Institutional equilibrium level would prevail during t_1. Over this period, sets B and C representing capability sets of P and Q see no further scope for improvement in their

well-being and the situation would sustain long. They prefer to retain respective capability sets (i.e. B and C respectively) for a while. Bargaining power of I overshadows J's bid to alter the prevailing equilibrium, and this results in sustenance of the equilibrium. Interaction between I and J is not a one-shot encounter, but a sequential or simultaneous process. This process may be path dependent whereby the winner continues to win and loser continues to lose. The process may also be cyclical, whereby both experience winning and losing. Or they may cooperate and move in tandem. Prevalence of path dependence requires I to raise entry barriers for preventing others' entry. Making alternatives incompatible with N is an important step to lock in. Even superior alternatives would succumb to the 'incompatibility' trap.

Over a period of time, I may express resistance to changes and would prefer the sustainability of lock-in or, alternatively, it may accept changes. This is represented by Y axis in Table 4. In the event of acceptance of change equilibrium will be disturbed. The other factor (or more accurately construct) that influences change would be J's reaction to lock-in, cooperation between I and J, discontinuities like revolution and unforeseen exogenous factors. Following North (1990) we call this construct Institutional Change.

Interaction between I's future choice and Institutional Change produce a variety of outcomes that are shown in Table 4. Institution's resistance to change and the dormant forces of institutional change form quadrant 1. This quadrant has the following characteristics: prevalence of lock in, eclipse of N by M, institutional monopoly, capability loss and adaptive inefficiency. The leading institution uses codes and sanctions to oust the competing ones. Violation of the code by a person who belongs to I invites the sanctions or even exile. The history of civilizations provides cases similar to quadrant 1.

Quadrant 2 presents the scenario of competing institutions revolting against the dominant I. The revolting institutions/individuals often challenge the authenticity of formal rules of dominant institutions. The post-revolution equilibrium need not necessarily be welfare enhancing. It may increase losses or gains or even be indeterminate.

In a similar vein, institutional oligopoly (shown in Quadrant 3) need not necessarily lead to welfare loss; it may be welfare enhancing if dominant institution becomes more

flexible to changes. The flexibility from leader's side may not be due to the active forces of institutional change, but may be due to realization of more enlightened self-interest. In the said scenario, I enhances compatibility between M and N. As a result, J gains more capability. Quadrant 3 represents a case of welfare enhancing institutional oligopoly and it is closer to adaptive efficiency e.g. endeavor to conserve indigenous

Table 4: Institutional Change

Dominant Institution's (I) future choice		Institutional Change	
		J is dormant	J is active
	Resistance	*Quadrant 1*	*Quadrant 2*
		Prevalence of Lock in, Eclipse of N Institutional Monopoly, Capability Loss, Adaptive Inefficiency	Revolution, Uncertainty
	Flexibility	*Quadrant 3*	*Quadrant 4*
		Institutional Oligopoly, Capability enhancement, Dilution of lock in, Step to Adaptive efficiency	Cooperation, Capability Enhancement, No lock in, Adaptive Efficiency

knowledge. Preference for change is influenced by factors like increasing bargaining power of competing institutions, mutual advantage from cooperation, exogenous changes which enhance competitors' capabilities, threat of obsolescence that looms over the leading institution etc. Quadrant 4 is entirely efficient in the adaptive sense. Here institutions cooperate and enhance individual capability. This quadrant fulfills various welfare criteria, and may be judged as the ideal institutional arrangement for social well-being. Prevalence of institutional/regional/individual inequality is an important welfare issue, especially in the context of knowledge activity. The institutional arrangements, presented in Table 4, provide the reasoning for future research that looks into the welfare implications of institutional role in knowledge activity. While our model is based on 'two language-two user groups-two institutions' setting with no overlapping language skills among the persons, our exploration would apply to more complex situations also. For this reason, quadrant 4 in Table 4 could

accommodate more complex situation like more than two languages with poly linguistic persons.

V Concluding Remarks

Although a vast literature exists on capability and knowledge they have essentially evolved in isolation. This paper is an attempt to combine the two ideas. An important rationale for such an attempt is to bring the perspective that knowledge is indeed a major source of capability. Recent literature on economics of knowledge, especially Cowen et al (2000), treat knowledge as a process instead of merely seeing it as a commodity. We took cues from this stream of literature to show how knowledge activity functions. Also we looked at behavioral aspects of acquisition and diffusion of knowledge. Our discussion of knowledge activity clearly showed the nature of role that institutions play in knowledge activity; we posit that institution is an important intervening variable in the knowledge-capability link.

Taking cues from North (1990) we view institutions as humanly devised formal and informal constraints. This perspective helped us to explore institutions' role in variations in performance. We argued that performance in knowledge activity is sensitive to institutional equilibrium and institutional changes. By using a simple model we showed how institutions provide incentives and gain dominance over competitors in knowledge activity and sustain it over a period of time. We also showed impact of such equilibrium on capability; because of this institutional equilibrium some persons lose capability and some gain. This situation would clearly be adaptively inefficient, although it may be allocatively efficient. Further we explored sources of institutional change and their impact on institutional equilibrium in the long run. We finally explained future path with the help of four likely scenarios.

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