Chapter III

Knowledge and Knowledge Based Economy

3.1: Introduction

We, the human species – *homo sapiens* - are ambitious- since we became the dominant species of the earth. Our journey started with our ability to adjust and utilize the natural surroundings – which we now call the resource – gift of nature. We ourselves are the most valuable resource of the nature – the knowledge creator and user.

Our physical strength while we were savage is exaggerated as our survival tool and progress. However, our knowledge – the ability to comprehend and utilize nature to our advantage has contributed immensely to our forward march. Physical power was necessary to protect but the sufficiency lied with identifying the danger – in identifying consumable material and possibility of attack from other species – physical strength is not so much necessary to avoid snake bite. Knowledge and efficient utilization of knowledge are jointly contributing in our progress. Our achievement is spectacular.

Our ambition is unbounded – monotonically increasing. Our optimistic attitude wants to overcome all sorts of difficulty. Source is our past achievements in various spheres. We have been successful to utilize the natural phenomenon of animal fertilization for reproduction of future man power. Greatest achievement seems to be overcoming the hurdle of gravitational force. Mass energy relation - transformation of mass into energy. Energy from wood and coal may be now regarded as primitive, even the utilization of potential difference of water flow into energy are superseded by nuclear energy. We have long been stepped into nuclear age. We want to develop commercial process to utilize sun ray. We are yet to imagine some other form of energy to substitute electricity or power.
We have diluted the physical distance of communication and spread of information, with the passage of time it is possible at increasing speed. Optimistic statement is without losing any time – time is marginalized.

Transforming knowledge into human use – technology is upheld. Creation of knowledge is not the end in itself. Technology helped us to widen our production frontier. That the pride of human civilization live and let live required for sustainability is a multidisciplinary sphere. Both Wealth creation and judicious distribution are equally important. While the contribution of scientific knowledge (Physical Science and Mathematics) is relatively more in wealth generation, contribution of social science is greater in the latter field. It is therefore worthy to comprehend the concept of knowledge with particular reference to economic growth and development. Defining knowledge economy is a difficult proposition like knowledge. However, understanding knowledge based economy is necessary. Primacy obviously lies with the latter one. In what follows, section I is brief on conceptualizing knowledge. Section II deliberates on knowledge based economy.

Section I

3.2: Knowledge: application focuses concepts

Conceptualizing knowledge is difficult for its complexity but application or utilization of knowledge is within our perception – like air or quality. We have realized the novelty of knowledge in the forward march of civilization.

In our personal life and in society, application of knowledge normally occurs without being conscious about its utilisation of acquired (simple knowledge) focuses the ability of human mind or society as the case may be, to comprehend and to derive optimal benefit. Translation of knowledge into action in our life is complex, nevertheless we are continuously practicing. However, interpersonal and transnational differences persist. Explanation is various – two most significant factors are efficiency and stock of knowledge. Knowledge is to be produced – the end product of our enquiries which may be directed or in other words gained by conscious disciplined endeavor. Human civilization has also been benefited by knowledge gained as by-product of some seemingly unrelated experiment investigation. Examples of indirect
invention are numerous – discovery of X-Ray Photography by German Physicist Wilhelm Rontgen in 1895 while experimenting with cathode rays is a classic example. Discovery of America is well known to us as well. I cannot resist my temptation “Great works are often born on a street corner …” - Albert Camus realized. Collection or gathering also influences stock of knowledge.

Without loss of any generality, it may be stated that, human mind - workplace of knowledge production - at the dawn concentrated more on survival and subsequently attention turned to wealth creation and devising means of wealth creation. As a matter of fact knowledge (due to social scientists) has also contributed by fashioning different stages of human bondage required for optimum wealth creation. Means of production is important but no less significant is mode of production at the aggregate level and organization and management at the grass root or micro level. Good governance is prescribed at all micro and macro level for optimal harvesting. We are convinced about the power or necessity of good governance to influence the environment for productivity and to bring about more harmony in the society. However, relatively more primacy is attached with productivity augmenting knowledge – technology. We can understand and appreciate the contribution of technology in the material progress of the world. However, ‘knowledge belongs to humanity and is the torch which illuminates the world’, Louis Pasteur.

3.3: Knowledge or application of knowledge

Means of production or techniques of production owes to scientific knowledge and innovation – none are end in themselves, they are in general supplementary and constitute the state of knowledge at any given period. Knowledge is dynamic and ever changing and expanding.

Discussion on knowledge is ancient – the cognitive science is the oldest discipline. The philosophical discourse on the concept of knowledge can be traced in all the significant civilization. Researchers are deeply engaged on discussing various facets of the knowledge. We may satisfy ourselves with “Gyanjogena sankhanang karmajogena youginam” Geeta - Creative mind is endowed with the trait and
responsibility of Knowledge expansion and the beauty of knowledge lies in its application

Both elongation or addition to knowledge and judicious and efficient utilization of knowledge are earnestly required for influencing our quality of life, happiness included. We get ample support from the dictionary meaning of the term – as noun (i) awareness and (ii) range of information. But hitherto it seems more appropriate meaning of the term lies in its use as an adjective (i) a theoretical or practical understanding of a subject and (ii) justified belief, certain understanding.

Interplay between social and physical science

Widening the stock of knowledge is a continuous process, it seems knowledge generation is a self-sustaining process and immensely contributes both at individual and social level. Domain of Social Science is to supervise application and utilization of knowledge for improving the quality of human face in best possible way. In the process social sciences generates knowledge. However, we overrule the misinterpretation - knowledge contribution of social sciences is at the root of humanity and development of civilization. Social Science Knowledge and Physical Science contributes in fashioning civilization they are mutually dependent and constitute the stock of knowledge at any region and at any time. Interplay between the two sets widens the horizon of knowledge in dynamic fashion, Dissemination of knowledge across the world as a continuous process is helping knowledge creation, on the other hand. Knowledge improves by sharing and paves the way of better and effective utilization. Historical evidences are enumerable,

Wealth generation: the arena of economics

It seems worthy to restrict ourselves to the outcome of scientific knowledge. Effect of knowledge is material well being has long been understood by our ancestor – Bidya Datati Binoyang, Binouyang dati Patratam, Patratat Dhnamapnoti Danath Dharma Tat Sukham - knowledge ultimately creates wealth.

Economic discipline inter alia concentrates on production of goods and services. Modern underpinning is that knowledge is the prime source of wealth creation and expansion. There is a strong tendency to consider knowledge as a
Chapter III: Knowledge and Knowledge Based Economy

commodity which is however the unique attribute of non-exhaustibility has and allows itself for repetitive use. Knowledge is considered renewable - the stock of knowledge is not depleted by use. Further recurring use of knowledge helps perfection and enhances efficiency in use. Indeed, the value of knowledge to an economy comes from sharing with others. However sharing in some circumstances may be restricted for competitive advantage - ensuring intellectual property rights is a global issue.

Section II

3.4: Knowledge Based Economy

In conceptualizing Knowledge Based Economy researchers have concentrated more on technology - application of knowledge for improving or influencing production frontier. Nevertheless as discussed in the previous section, Knowledge also contributes in changing economic order or socio economic and political economy for example ameliorating various types of asymmetry in the world –inter and intra regional inequality in the level of development.

Embryonic to contemporary

Economic order of the society has been undergoing continuous (mutative) changes. Primitive – prehistoric society- has been modeled in the literature as traditional. Traditional Economic society was simple – technology was unheard. Collection, gathering and hunting were the means of production and survival. Utilizations of knowledge and experience were sublime. Agriculture society from scattered nomadic societies was born from Knowledge of how to use seed to sow and harvest .Development of agriculture society was influenced by discovery of variation of land fertility and crop suitability of land and understanding of seasonality.

Utilizations of knowledge or invention in the material world are continuously been supplemented by social science in the growth and development of human societies. Civilization marched forward by inventing the power of exchanging necessities and information in the society. Bartering was the centrifugal element .Primitive Traditional economy or barter economy has not completely been abolished.
We experience mutative changes in many spheres; nevertheless we continue to brand it as traditional system.

Feudalism was born and successfully pushed forward production and productivity. Barter or Exchange system became mostly inoperative – money and market mechanism replaced exchange of goods and services in kind. We rarely understand that market system is our powerful social invention. Regime of traditional economy is however continued to operate in which agriculture was the main stay. Economists ignored the governance part which also underwent changes for efficient operation of market mechanism and early stage of economic expansion is univocally termed as agricultural economy. Feudalism prevailed for considerable part of Agriculture Economy in which land was the primary resource. Growth of market economy was facilitated by revolutionary changes in sociopolitical outlook on the one hand and scientific knowledge on the other hand, technology is relatively more emphasized in the literature. We therefore mostly observe Economic expansion discussed with reference to traditional agriculture economy and industrial economy. Take off Rostov is the classic example.

The systems have always been complex- superimposed mapping of sociopolitical and scientific knowledge is ignored. Knowledge development in every sphere is contributory to socio economic development and shaping the presently emerging Knowledge Based Economy. As discussed earlier scientific invention translated into technology has been at the centre and still dominating the underpinning of Knowledge Based Economy.

**In knowledge based economy utilization of knowledge and information are playing important role directly in** production and distribution. Market and consumption demand in consequence are undergoing changes. Discernible trend in ‘growth in high-technology investments, high-technology industries, more highly-skilled labour and associated productivity gains’ is regarded as the prime feature of knowledge economy.

It has just been elaborated that knowledge has since pre historic age been playing crucial role in economic life of human being. We are more conscious now. In what follows changes in production sphere and economic agents - important factor
Chapter III: Knowledge and Knowledge Based Economy

in economic growth, economists are now exploring ways to incorporate more directly knowledge and technology in their theories and models. “New growth theory” reflects the attempt to understand the role of knowledge and technology in driving productivity and economic growth. Spending on research and development, education and training and new managerial work structures are key to knowledge economy.

The next shift, from agricultural to industrial society, occurred in the eighteenth century when we learned how to use machines, particularly the internal combustion engine and the steam engine, to transform fossil fuels into controlled physical power. The ‘fuels' of industrial society are fossil: coal and oil. The industrial revolution was driven by knowledge about how to use the new fuels.

Both the agricultural revolution and the industrial revolution had one thing in common: the adoption of new fuels and new knowledge about how to use them. In both cases the standards of economic progress were associated with the increasing use of these specific ‘fuels’: land in the agricultural society, and fossil fuels in the industrial society. As societies prospered and human settlements expanded, land and fossil fuels have been extensively used in the pursuit of economic progress.

The current revolution is also driven by knowledge. As with the two previous revolutions, it involves new knowledge about how to use a new and different fuel: information technology. This fuel is fundamentally different because it is not physical, like land and fossil fuels. Therefore, economic progress no longer means using more physical resources. This revolution brings the hope of a society in which economic progress need not mean increasingly extensive use of the earth's resources.

The most dynamic sectors in the new society are of course those which benefit most from the use of information technology as an inexpensive and abundant fuel, exactly as the most dynamic sectors in the industrial society were those that benefited from the use of fossil fuels as an inexpensive and abundant input, and those in the agricultural society were the sectors using inexpensive and abundant land products. The new dynamic sectors are therefore those producing goods which use information technology to expand the ability of the human brain to save, process, retrieve and communicate information. Examples are computers and software, telecommunications and biotechnology, entertainment and financial markets, design
and animation, and all services based on human knowledge such as medical services and education. These are sectors where the main input to production is the ability to store, organize, process and communicate human knowledge. This is 'knowledge-intensive' sector.

The knowledge sectors will expand more quickly than the rest and therefore the resulting society will produce mostly goods which are knowledge-intensive, much as the agricultural society produced mostly agriculture related goods, and the industrial society produced mostly industry-related goods. This is why I call this new society the `knowledge society'. The logic for this term is the same as behind our use of the terms 'industrial society' and 'agricultural society'.

None of this means that we will cease to produce food or machines. Indeed, the industrial society did not cease to produce agricultural products. On the contrary, the industrial society used more land and produced more food than the agricultural society did. However, the proportions of economic production were altered in the industrial society: most produced goods involved industrial components. Similarly in the knowledge society we will still produce food and machines. It is all a matter of proportions. An increasing fraction of economic output will be 'knowledge-intensive', and will involve proportionately more use of knowledge than land or machines.

3.5: Knowledge Codification: Efficiency in Use

The ability to store, share, and analysis knowledge through networks and communities using the new ICT technologies allows firms to exploit the unique properties of knowledge to gain competitive advantage. Perhaps the most important property is that knowledge is the ultimate economic renewable - the stock of knowledge is not depleted by use. Indeed, the value of knowledge to an economy comes from sharing with others.

A distinction is often made between codified or rule based knowledge that can be written down and stored and tacit knowledge that is acquired on the job and resides with the individual as know-how and experience. Some argue that one of the key distinguishing features of the knowledge economy is deploying new technologies to allow the more systematic exploitation of tacit knowledge. The latter can of course
walk out of the door – and firms may make strenuous efforts to retain key workers or impose restrictive clauses in their employment contracts about future employment.

**Knowledge: economic underpinning**

In our above discussion it was implicit that knowledge has to be produced like other economic commodities. We may compare knowledge with improving quality of human capital, Utility of both are focused and similarly improvement of both involves spending, Knowledge is an end product of societal process utilizing resources thus expensive product in general.

Knowledge has fundamentally different characteristics from other commodities. Knowledge has the feature of a public good because knowledge leaks. It is a `public good' because, at the physical level, one can share it with others without losing it. Thus differs from other development augmenting goods / fuels- such as land and machines. They are `private goods' but the same is true with technology. Unlike physical goods information and technology – use values of knowledge is non-rival – not destroyed in consumption. Its value in consumption can be enjoyed again and again. Hence, social return on investment in its generation can be multiplied through its diffusion. One other important trait of knowledge is that it posses the property of positive inbreeding. More significant quality seems to be extended and wider application. Invention of processes and materials in space research has wider application in various other spheres.

Knowledge now a days is not a free good and not freely exchanged. Once knowledge is discovered and made public, there is essentially zero marginal cost to adding more users. Knowledge does not wear out and people can duplicate it practically without cost, it is a source of super value and super productivity. Knowledge alone can add value to an otherwise closed, zero-sum system of value. It can increase value without diminishing it somewhere else.

Ideas and innovations have extensive externalities, their benefits typically extending well beyond those who first put them forward; and it can be difficult to exclude other potential users of knowledge through intellectual property rights. What is more, there is an inherent ‘unknowability’ in knowledge: it is like an experience good, which consumers find hard to value unless they have used it.
We can readily understand the crucial implications in conceptualizing knowledge economy.

Knowledge puts humans rather than land or machines at the centre of economic progress. Knowledge is privately produced food and, at the purely physical level, it resides mostly in the human brain. The most interesting and innovative knowledge originates from human brains. Although much knowledge resides in physical and electronic media, such as books and CD-ROMs, the ability to create new knowledge and adapt or cross-fertilize across different areas resides in humans.

Capital and machines are crucial in the industrial society. But the main scarce factor of production is no longer capital. Knowledge and ideas are more important today and more scarce than capital. Who owns the capital is no longer the main issue. Ownership of ideas is becoming more critical. The ownership of ‘intellectual capital’ is key. This type of capital is different in a number of ways from standard capital, and markets which trade property rights on knowledge, or ‘intellectual capital’ behave quite differently from our classical markets.

**Knowledge influencing production frontier**

Traditional "production functions" focus on labour, capital, materials and energy; knowledge and technology are external influences on production. Now analytical approaches are being developed so that knowledge can be included more directly in production functions. Investments in knowledge can increase the productive capacity of the other factors of production as well as transform them into new products and processes. And since these knowledge investments are characterised by increasing (rather than decreasing) returns, they are the key to long-term economic growth.

It is not a new idea that knowledge plays an important role in the economy. Adam Smith referred to new layers of specialists who are men of speculation and who make important contributions to the production of economically useful knowledge. Friedrich List emphasised the infrastructure and institutions which contribute to the development of productive forces through the creation and distribution of knowledge. The Schumpeterian idea of innovation as a major force of economic dynamics has been followed up by modern Schumpeterian scholars such as Galbraith, Goodwin and
Hirschman. Economists such as Romer and Grossman have developed new growth theories to explain the forces which drive long-term economic growth.

According to the **neo-classical production function**, returns diminish as more capital is added to the economy, an effect which may be offset, however, by the flow of new technology. Although technological progress is considered an engine of growth, there is no definition or explanation of technological processes. In new growth theory, knowledge can raise the returns on investment, which can in turn contribute to the accumulation of knowledge. It does this by stimulating more efficient methods of production organisation as well as new and improved products and services. There is thus the possibility of sustained increases in investment which can lead to continuous rises in a country's growth rate. Knowledge can also spill over from one firm or industry to another, with new ideas used repeatedly at little extra cost. Such spillovers can ease the constraints placed on growth by scarcity of capital.

**Technological change** raises the relative marginal productivity of capital through education and training of the labour force, investments in research and development and the creation of new managerial structures and work organisation. Analytical work on long-term economic growth shows that in the 20th century the factor of production growing most rapidly has been human capital, but there are no signs that this has reduced the rate of return to investment in education and training (Abramowitz, 1989). Investments in knowledge and capabilities are characterised by increasing (rather than decreasing) returns. These findings argue for modification of neo-classical equilibrium models – which were designed to deal with the production, exchange and use of commodities – in order to analyse the production, exchange and use of knowledge.

### 3.6: Incorporating Knowledge in Production Function

Incorporating knowledge into standard economic production functions is not an easy task, as this factor defies some fundamental economic principles, such as that of scarcity. Knowledge and information tend to be abundant; what is scarce is the capacity to use them in meaningful ways. Nor is knowledge easily transformed into the object of standard economic transactions. To buy knowledge and information is difficult because by definition information about the characteristics of what is sold is
asymmetrically distributed between the seller and the buyer. Some kinds of knowledge can be easily reproduced and distributed at low cost to a broad set of users, which tends to undermine private ownership. Other kinds of knowledge cannot be transferred from one organisation to another or between individuals without establishing intricate linkages in terms of network and apprenticeship relationships or investing substantial resources in the codification and transformation into information.

**Knowledge codification**

Knowledge is a much broader concept than information, which is generally the “know-what” and “know-why” components of knowledge. These are also the types of knowledge which come closest to being market commodities or economic resources to be fitted into economic production functions. Other types of knowledge – particularly know-how and know-who – are more “tacit knowledge” and are more difficult to codify and measure (Lundvall and Johnson, 1994).

Increasingly the traditional factors of production – land, labor and capital – have become less important when compared with technology; the economists have termed this as the ‘expansion of the production frontier’. The source of technology is in science that is rooted in knowledge. It is easy to visualize that tomorrow’s industries will be knowledge industries. The emphasis will not be on physical or tangible assets, but on intangible knowledge assets. The value of intellectual capital of an industry will determine its rank and competitiveness. In such industries, there will be a major shift from people, who handled information and did routine and unthinking work, to those who will use knowledge at every stage. For knowledge workers, information and knowledge will be both the raw material of their labor as well as its product.

World’s major growth industries – such as microelectronics, biotechnology, designer-made materials, and telecommunications – are already brainpower industries. These knowledge industries stimulate other industries, in turn, to become knowledge based. Consider the oil industry. The issue of "bottom of the barrel" is driving the economics of these industries. New knowledge embedded in three-dimensional acoustical sounding, horizontal drilling and deep offshore drilling is turning oil business into a knowledge industry(economics of knowledge).
We may thus surmise that Knowledge Economy or Knowledge Based Economy is “… one in which the generation and exploitation of knowledge has come to play the predominant part in the creation of wealth. It is not simply about pushing back the frontiers of knowledge; it is also about the most effective use and exploitation of all types of knowledge in all manner of economic activity” (DTI Competitiveness White Paper 1998).

Thus the “the idea of the knowledge driven economy is not just a description of high tech industries. It describes a set of new sources of competitive advantage which can apply to all sectors, all companies and all regions, from agriculture and retailing to software and biotechnology (New measures for the New Economy, report by Charles Leadbeater, June 1999). The term “knowledge economy” may be used to describe this emerging economic structure.

It may be stated without further elaboration that ‘economic success is increasingly based on upon the effective utilisation of intangible assets such as knowledge, skills and innovative potential as the key resource for competitive advantage.” (ESRC, 2005). In the subsequent chapters investigation is made about the contribution of knowledge in different spheres of Indian economy.
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