Measuring a Society's Knowledge Base

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Abstract: The quest to measure knowledge effectively will in no doubt lead to better knowledge policies of governments around the world in both developing and developed countries. This paper endeavours to set a sound theoretical base for measuring knowledge and does this by demonstrating that existing tools used by economists for measuring knowledge are largely self contradictory, they contradict existing theory. Knowledge to be measured effectively we must give knowledge its own units like weight and length have their own units, only then can we say how much knowledge one needs to carry out a particular task.

Friedrich von Hayek, who did so much to advance the discipline of economists, observed in the Use of Knowledge in Society?(1945): , "The economic problem of society is thus not merely a problem of how to allocate "given" resources--if "given" is taken to mean given to a single mind which deliberately solves the problem set by these "data." It rather relates to how best to use the resources about which any member of society knows, for ends whose relative importance only these individuals know.] Or, to put it briefly, it is a problem of the utilization of knowledge which is not given to anyone in its totality". Thus the central concern of economics is with knowledge. Why is this the case? First, it is knowledge that gives everything value -- we cannot value what we do not know. It is knowledge that creates goods, services, and capital. All the money in the world will not help you if you do not understand what you are doing -- you will fail even to build a bridge with money that someone budgeted for that purpose if nobody knows how.

Modern economic theory has seemingly failed to deliver as much as it has promised because, I believe, of its grounding in capital, especially in the form of money. I am not criticizing monetarists, of whom Hayek is one of the finest; rather I am arguing that throwing money at economic problems cannot solve them. If the education system seems to be failing, then throw money at it, goes the popular refrain; if developing countries are failing to catch up with the rest of the world, throw money at them. This approach usually fails ?a reality that Hayek grasped over sixty years ago. Despite the billions of dollars that Africa has received, most of its nations have very little to show for the expenditure; when a commodity boom occurs, the same is true of much of Asia and Latin America.

The central problem of economics is knowledge. We must be able to measure knowledge, to quantify it as accurately as possible, if we are to understand it better. In the Fundamental Theory of Knowledge?(part II of my proposed book), I mention my eventual discovery of a simple method to quantify knowledge, which I elaborate in part III. Other economists and scientists have tried to measure a nation's knowledge assets but stumble over inherent contradictions within their premises. The core of their problem is that they base their theories on capital rather than on knowledge. As a creation of human knowledge, capital can hardly be more basic and central than knowledge.

Many people may argue that humans already measure knowledge, especially that of a nation. I argue that they are not actually doing what they think they are, and I seek to prove that their method is self-contradictory. I cite a prominent knowledge economist, Dr Yogesh Malhotra, and a paper he prepared for the United Nations: Measuring Knowledge Assets of a Nation: Knowledge Systems for Development?(2003). In its abstract, he observes, "first, to build the capacity of the Public sector for measuring and managing knowledge assets, we propose, develop, and define specific frameworks, methodologies, models and indicators with illustrative real world applications. Second, we make specific recommendations for necessary improvements needed in knowledge assets management and measurement models and indicators."

Why is this effort so essential to real-world practice? Malhotra writes, "prudent and effective policy directives depend upon pragmatic but theoretically and psychometrically valid measurement models for their success. Accordingly, we recommend that the future development of such models be based upon better understanding of human capital and social capital as well as their synthesis with existing intellectual capital frameworks and models." Malhotra concludes: "the findings and recommendations of this study will provide the cornerstone for measuring and managing national knowledge assets for United Nations Member States toward holistic socio-economic development, Prudent and effective policy directives depend upon pragmatic but theoretically and psychometrically valid measurement models for their success ". If the theoretical basis of such endeavours is wrong, then the conclusions will be wrong, and the applications inappropriate.

There are several models for measuring knowledge, but most, as Malhotra points out, fall short. Porter and Kaplan's balanced score card, however, seems to me merely incomplete, not self-contradictory. The others attempt to measure the value of knowledge and in doing so fly in the face of current economic theory. Take, for example, Andriessen and Tiessen's value explorer, which assesses the value, not the amount, of knowledge. The same flaw marks the simple and much-loved market to book value concept of Stewart (who also developed the theory of added economic value). The same holds for the methods that others have derived from it.

According to those methods, If the market value of a company is so much, say Y, and the book value is X, then knowledge (Z) presumably equals Y minus X, or Y - X = Z. What if Z is negative? Does that mean that a firm has no knowledge? That is the implication, which makes the premise incorrect . In real life, market values can change every day. The value of knowledge will more likely depend on how much a company pays the scientists, researchers, managers, and workers who generate the products. A firm's market value represents future expected earnings, as many economists have shown. Market value cannot represent two quite different things.

The value of knowledge will be equal to how much pay employees receive, and that depends on local, regional, and national markets. In a world of market segmentation, people and organizations sell goods and services for varying amounts in different markets. As a simple example, consider three students from Yale University taking an MBA. One student is American, another Canadian, and the third a Tswana from Botswana. Afterwards they all return to their respective countries and become analysts for investment banks. The American earns amount X, the Canadian ¾X, and the Tswana 3/7X. Does this mean that the American, who operates in the largest and highest-paying investment banking sector in the world, knows more than the Canadian in a not-quite-so-wealthy market and the Tswana, who lives in a nation with few stocks to analyse? Clearly such pay scales represent not amounts of knowledge, but merely its differential values in different countries and segmented markets.

Malhotra explains many models and offers his own, which defines concepts clearly but fails to show us how to determine the amount of knowledge a society possesses. His argument lacks a sound theoretical basis. I believe that a valid and effective theory must be internally consistent. When we measure something, we must put express it in units, and I term this unit for knowledge a knowl, just as grams measure weight and metres distance. To measure knowledge we must be able to put it into knowl, as in how many knowl a human possesses. More important, how many knowl does one need to carry out a specific task? If we have that figure, then we can talk of individuals requiring so many knowl to perform that job and hence determine an appropriate reward for its completion.

The interesting question arises of how I reached this conclusion. I started with marginal analysis. How can we apply such a method to explain the process of acquiring knowledge? I had to use time as the budget line, instead of units of currency i.e., how much time will it take to acquire so much knowledge?

Before I could do that, I had to uncover laws of knowledge, and I found the most important to be

1. Knowledge must be internally consistent.
2. The mind gathers knowledge.
3 Knowledge has a cause and generates an effect.
4 Knowledge creates a force.
5 Where people can pursue knowledge freely, that society attracts thinkers, who give that society access to more knowledge.
6 Knowledge is a real factor.
7 The limit of knowledge is everything.

My upcoming book deals thoroughly with these crucial laws.

In our discussion here, consistency is the central law: solid theories cannot contradict accepted theories, or else the latter are problematic. As well, knowledge has causes and produces effects. Some critics claim that there are random events, while I insist that laws of existence govern everything; what some people consider random appears so because we have not discovered the law that causes that action. One scholar's critique of my book manuscript discusses mutations in biology and their randomness. Let us look at the parasitic dodder plant; to survive, it attacks vegetables, destroying crops and the livelihoods of farmers. At first, scientists thought this action random -- the plant seemed to land anywhere, sometimes near vulnerable vegetables. However, experts at Pennsylvania State University have found out that the plant actually smells the vegetables and pursues them. What they thought random because they lacked knowledge proved, with scientific investigation, to be otherwise.

My pursuit of a way to measure knowledge began with my return to Economics 101, specifically marginal analysis. How could we use that technique in relation to knowledge? The answer turned out to be simple: by using time rather than money as the budget constraint. That substitution would obviously affect how much time one would allocate to seeking knowledge in an institution of higher learning. Satisfying myself that that method could quantify knowledge, I could then turn to a more general issue ?assessing the knowledge base of a nation. This essay is merely a look at how we can measure knowledge. The rest of my project I describe in my upcoming book.

I next had to reconsider what Hayek wrote in his groundbreaking paper of 1945: "this character of the fundamental problem has, I am afraid, been obscured rather than illuminated by many of the recent refinements of economic theory, particularly by many of the uses made of mathematics." Nobody in 1945 thought that it would be possible to measure knowledge. Thus Hayek must have felt that mathematics would distract people from the central place of knowledge. What I call capital-based theories measure monetary values, not knowledge; as we saw above, even recent attempts to assess knowledge have failed. With Hayek's concern in mind, let us continue.

In a society that follows the laws of knowledge, the knowledge base should grow over time. Figure 1 shows a simplistic linear graph of this trend; Figure 2, a somewhat more realistic picture, with a trend line that

actually consists of points. We can consider these points as a recurring point X -- at its most basic level a single law of existence, and at its ultimate, all the laws of existence. To create a foundation for measuring knowledge that agrees with existing theory and is internally consistent, we look at point X as only a single law of existence. After all, we want to figure out how many knowl a single law of existence contains. As we see by the end of the essay, room remains for future developments of the theory. If we can measure the amount of knowledge in one law, we can dream of assessing all the laws of existence.

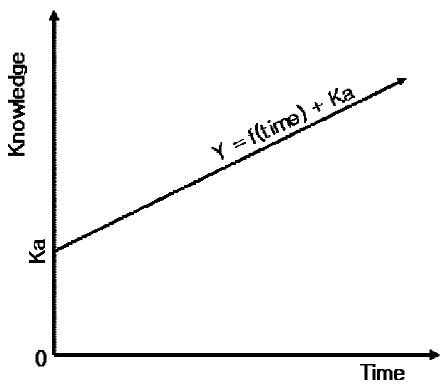

Fig 1

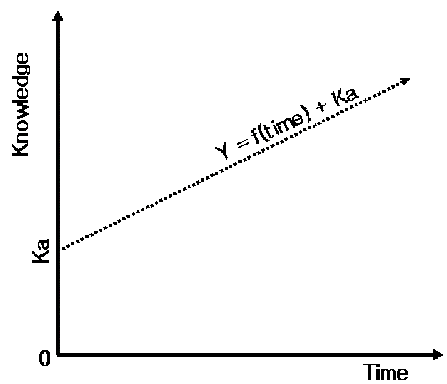

Fig 2

Before proceeding, we should look at the properties of point X, which will help with the first-ever meaningful measurement of knowledge. What are the properties of a single law of knowledge? The most important is independence: each law is independent of the others. It exists not because the others do, but because of itself, and it does not depend on the others for its existence. It is this independence that allows us to learn.

When we learn, it may seem to us as if all the laws interconnect, and they do, in the sense that they are all part of the whole. Yet they have to be independent of each other, or nothing would ever make sense. Take, for example, what we first learn in arithmetic: addition, subtraction, multiplication, and division. We start with addition because it is the easiest, and then we master subtraction and next multiplication. The laws governing addition are independent from those for subtraction, as they are from multiplication's laws. One does not need to know how to add to be able to multiply -- in fact, we could easily learn multiplication, then subtraction, and then addition. If every law of knowledge depended on another law, we would need to know everything before we could understand anything. We could in theory instruct children in quantum mechanics without first teaching them addition, but they might find the concept difficult to grasp. Being a point of knowledge, however, with a law governing it, quantum mechanics is independent from addition. Youngsters could very well grasp it, but prudence would lead us to start them with what is easy.

Another illustration may make the idea clearer. Stainless steel will be crucial when we try to calculate the value of use knowledge but is just as relevant for laws of knowledge. Stainless steel results from mixing iron with chrome, as I remember from science classes many years ago. Iron has its own governing laws, as does chrome, but when we mix the two the product is independent of them both. Stainless steel is another metal, neither chrome nor iron, and its properties are unique. One can understand them without knowing about those of iron or chrome. However, the person who first discovered stainless steel needed to investigate what would happen when mixing iron and chrome; being instructed and research are different activities.

Having established this fact of independence, I could relatively easily value one law of knowledge in terms of knowl. After all, that is the goal to measure a phenomenon in its own units, like metres for distance and kilograms for weight. All the laws of knowledge must have equal weighting in terms of knowl which law can be more important than the other, which law has so little importance that if taken out the universe would not be radically different . The dodo was an organism and thus had many laws go into it -- it had to breathe, obtain food, have a carbon-based skin like humans. These laws are all independent and had to have equal value. We can value each law at any arbitrary figure we choose ?we can say a law of knowledge is worth 13 knowl, or 1 knowl, or even 666 knowl, but it must remain consistent with existing theory.

In an earlier version of part II of my book, I stated that early human beings needed 1,000 knowl chose this figure out of the blue -- to survive. I never imagined that I would go as far as I have (thanks to encouragement from Dr Mullins and others including my editor), and now we must use this figure to estimate the value of a law of knowledge. An early human being needed just to eat, have shelter, protection, and clothing in other words, to know four laws. The choice of food, for instance, was personal, but food was necessary. If we divide 1,000 by four, we obtain 250; therefore a law is worth 250 knowl. Maybe early people needed to know more laws, but the figure of 250 knowl is arbitrary, like a metre or a kilogram, so it will work as the value of a single law of knowledge.

Now it becomes a simple matter to calculate how much knowledge a society possesses: count all the laws of knowledge and multiply their total by 250, which gives the answer in knowl. However, that is not all that the society has: it creates goods and services, and so it has much more knowledge than simply the sum of the laws of existence. The next task is to count how much knowledge derives from the goods that a society produces.

For every known point X, there are corresponding points U of use knowledge, or practical knowledge. Point X could have one point U, or several, or hidden U’s, which humanity does not yet know how to apply. Just as a simple point X can be one law of the universe, corresponding points U can represent one simple product or many complex ones. Today there are so many applications for radioactivity, yet discoverer Maria Skodowska (married name Curie) started with only medical ones. Figure 3 shows the relationship between Xs and Us.

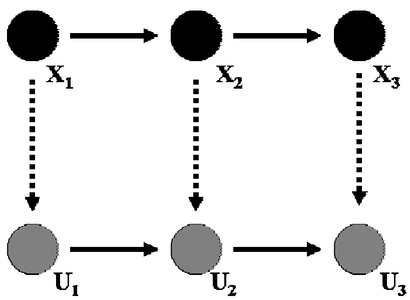

Fig 3

What is the value of a single point U one product -- at its most basic? Human beings make a product. We must not confuse knowledge with intelligence; some products take a great deal of thought? much more than others -- but they are still just products, a point U. To find the corresponding value of U's, we must first determine whether points U are independent of each other, like points X.

Many historians would say that the industrial revolution started with the invention of the steam engine, yet South Korea's industrial takeoff had nothing to do with that device. South Korea did not need that particular point U, but it is doing very well. Consider again stainless steel: human beings make it, but its properties differ from the iron and chrome that go into it, it is independent from them. According to the laws of existence, mixing iron and chrome produces stainless steel; as well, manipulating silicone in a certain way generates a silicone microchip -- a human creation. By the laws of existence, if we heat gasoline in a controlled manner we can create an internal combustion engine. If we then place that engine on a platform and attach wheels, we have a powered cart, or an automobile.

There is no product that defies the laws of existence, for that product would not exist. An ipod that we hold in our hands and listen to is nothing but a mixture of laws of existence that is in itself such a law. Although many laws of existence go into an ipod, it is worth only 250 knowl, just like a single law of existence.

A product represents a single law of existence; in terms of knowl, a spoon is worth as much as an ipod, a car as much as paper. A kilogram of sand weighs the same as a kilo of feathers or steel, but the steel is worth more. The ipod is worth more in monetary terms than a spoon, because it takes more intelligence or creativity to make [or design]; it takes more intelligence and creativity to build a satellite than an ipod. With mass production, how much longer does it take to produce a computer than a spoon? Not much considering to what goes into a computer and what goes into a spoon , for once we k now how to build a computer, we can do so quickly, just like we can a spoon, even though the spoon comes off a press. When metal spoons first appeared, they were a marvel available only to the gentry, the aristocracy, and royalty; now you can find them even in garbage dumps.

Economics is about demand and supply: what is the demand for knowledge, and what is its supply? When we manage knowledge, we look at demand and gauge policy towards that. Figure 4 applies Wassily Leontief's input output methodology. A society wants to have point U_1, U_2, or U_3 but does not possess X_1--

X_5 or U_1--U_3. To create U_1 it requires three laws of existence -- X_1, X_3, and X_5; for U_2, only X_2 and X_3; and for U_3, X_1--X_5. U_1 requires 750 knowl; U_2, 500 knowl; and U_3, 1,250 knowl. In the light of its available resources, the society must select an X_i. U_3 would probably be more lucrative than U_2. However, the leaders must factor in many considerations, including money and time.

	X_1	X_2	X_3	X_4	X_5
U_1	•		•		•
U_2		•	•		
U_3	•	•	•	•	•

Fig 4

I examine this situation in part II of my book. This paper deals only with the measuring of knowledge and presents just a sample from the volume, which covers far more topics, including how differently knowledge behaves in the short and the long runs (see Figures 5 and 6, respectively).

The short term has a limit: there are only so many products that we can take out of [meaning?] a point X; hence as a society moves towards X_2 the graph levels off, and at X_2 it takes off again (Figure 5). However, in the long term there are more laws to apply to obtain ever more products. Mixing iron and chrome, as we well know, produces stainless steel; however, with more knowledge of other metals, hundreds of different types of stainless steel can result -- titanium, nickel, and chrome all go into making today's super alloys (Figure 6). In the long term the number of products grows exponentially; if our lives are not becoming easier, we certainly can anticipate more and more comforts and conveniences.

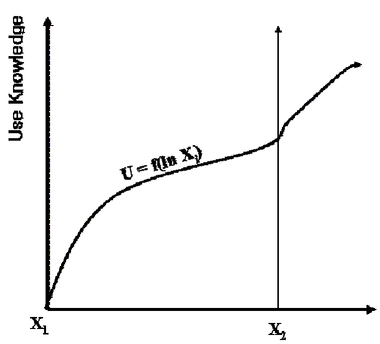

Fig 5

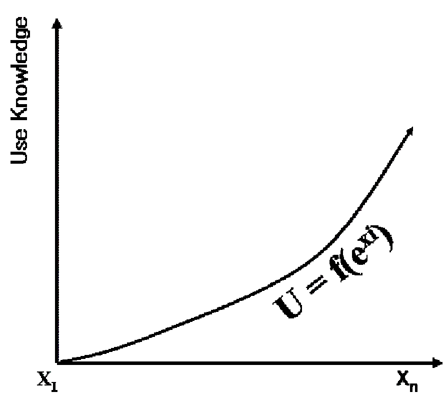

Fig 6

Like all theories, this one is not complete. A law of knowledge represents 250 knowl, and a product, 250 knowl. How much knowledge does it take to operate a machine or to work at an assembly line? These questions I find difficult to answer, but will be answered mankind moves into the future admitting what he can do and what he can not do. However one employs somebody so that in the end the result is a product, the final product is 250 knowl.

There are those who claim random events because you do not know does not make anything random, who would have thought in September 2006 the University of Pennsylvania will discover that some parasitic plants actually smell their prey what was before September 2006 thought to be random because people did not understand the laws of that plant completely.

Knowledge is the competitive advantage in economics, and whoever does not believe that may lead a society straight into the trap of being waiters and waitresses for tourists; it is as simple as that. This paper provides a theoretically sound methodology for managing knowledge.

The failure of the poorer countries in the world is their refusal to allow economic systems that allow knowledge to be the main function. As explained above all the aid in the world can not help if one does not know or understand what to do with it. The poverty reduction programs of the United Nations and other international organizations are of no use if knowledge is not recognized as the main resource.

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