Short and long Term behavior of Knowledge

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Abstract: This paper explores the behaviour of knowledge in the short and long term. Knowledge behaves very different in the short term than in the long term. Once we can measure knowledge it is then possible to look at its behaviour, an impossibility if there where no theory formulated to measure knowledge. Once we can measure, humans can attempt to put knowledge in formulae that make sense. This paper is a follow up to the previous papers, written by the same author. These papers being "The Fundamental theory of Knowledge", "Point X and the Economics of Knowledge", and "Measuring a societies Knowledge Base". The paper is a consistent follow up from the basic theories of knowledge that where developed in those papers, keeping knowledge simply in the scientific realm, as any science should attempt, if economics is a science then its aim is truly to measure economic phenomenon, otherwise economics remains in the realm of art and philosophy where anything goes. Measuring means we can manage. Knowing the long and short term behaviour of knowledge means that societies will be better placed to manage knowledge. The short term though is much easier to manage than the long term, but then again this is a known fact take care of the pennies and the pounds will look after themselves, meaning take care of the small things and the big things will be easier to look after. This paper allows us to understand knowledge in a deeper way than before.

This paper looks at the short and long term properties of knowledge. Knowledge is the primary resource for a society to survive in the material realm, in the realm that we exist in. Goods and services exist because of the materials that mankind understands and utilizes for their benefit. Having demonstrated how knowledge can be measured and what type of knowledge can be measured it is now possible to analyse the behaviour of knowledge over time. The paper, "Measuring a Society's Knowledge Base", stated categorically that there are types of knowledge that would be very difficult to measure, variables like how to you measure how a task is undertaken, but the resultant task in the form of a good can be measured.

However this in economics is irrelevant, why should economics care about the value in knowls, the unit of measuring knowledge, of say, what one has personally experienced, or of undertaking a task, economics is interested in the producing and distribution of goods and services and the value of a good is known in terms of knowl, we also understand that no matter how much knowledge goes into creating a good, he resultant value in knowls is the same as a simple good that is useful to mankind. A simple good is a good that requires just one material, the material of course would be as a result of usually more than one law of existence. Take wood as an example, why use it to make boats, because it is strong and less dense than water, which already is two laws of existence.

In this paper as in all papers, one must try to simplify the problem, but it is in simplicity that one can understand the entire picture, that is why assumptions are built into economics, the paper must use assumptions to make our understanding easier by placing controls.

The paper shall look at the entire society, the behaviour of knowledge in the short and long term for the entire society. Why not look at the individual, the reason being that the individual exists and is functioning in the short term. The behaviour of knowledge for an individual could be said to approximate that of the short term in a society. Behaviour of knowledge for the individual was dealt with at an acceptable level in the paper, "The Fundamental Theory of Knowledge". Societies in normal circumstances outlast a single individual, one is usually born into a society and dies in that society, unless here are great upheavals.

The paper "Point X and the Economics of Knowledge", explained and introduced the theory of knowledge being a point on the knowledge plain. That point at its smallest contains a single law of existence, that single law can be any law, like iron melts at a certain temperature, birds of prey have talons, humans have a larger brain than other primates. At its largest, point X contains all the laws of existence. Each point X it was explained is independent from any other point X. One can teach a child the rules of complex algebra, however the child might not be mature enough so we start with addition in grade 1 or kindergarten, as one can teach subtraction before addition but it is more prudent we as mankind have discovered to teach addition before subtraction. Similarly the paper can start with discussing the long term properties of knowledge, but it would be more prudent to start with the short term properties of knowledge because that way it is easier to build into the long term without unduly complicating ourselves. Anyhow, let the cents take care of themselves, the short term, and the dollars will take care of themselves, the long term.

Short Term Properties of Knowledge

As economics is the about the production and distribution of resources we are primarily interested in point U that was also introduced in the paper "Point X and the Economics of Knowledge". Point U is at its most simplest a good, all goods are derived from the laws of existence. Therefore the dependent variable is U, which is a corresponding good derived from a law of existence X. For the purpose of this paper we have X ranging from $X_i \rightarrow X_n$. However taking X_i as identification, for example, this is iron, this is copper, it means having identified the material, the material has several laws that give its quality, many goods can be made out of iron because of its many properties. This many properties are described as $X_{i.n}$ where i is the identified material and n represents the many laws that go into that material to give it is qualities.

The growth of knowledge is non linear. We are assuming that nations exist through knowledge, and that in a competitive environment nations are actively seeking knowledge. This of course is not true, many societies around the world remain stagnant, static in terms of knowledge. One finds societies in the Congo, Kalahari, Amazon that have decided to remain as hunter gatherers and are therefore do not actively seek more knowledge except the knowledge they have existed on for millennia, that of hunting animals, these peoples in many instances are protected by law. These people are no in competition with other humans, they merely compete with nature to exist, and that is what they prefer.

However, economics is a competitive field, assuming a competitive environment, when a new material is discovered that material will be heavily analyzed in order to be exploited for the benefit of mankind. This will at first cause a steep rise in how the material can be used, however it will begin to taper of because it will become more and more difficult to extract use from that single material. This is demonstrated in figure 1.

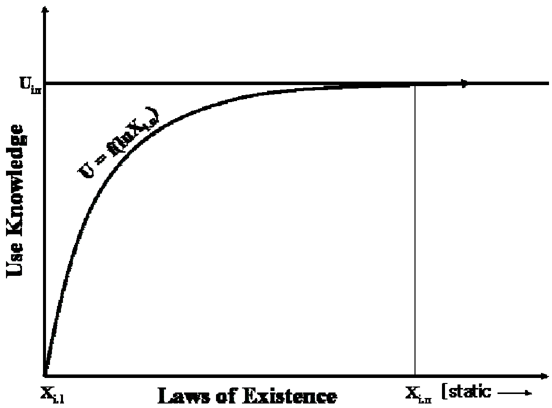

Figure 1

Figure 1 also demonstrates a very important phenomenon, from a single material there is so much use knowledge that can be derived for use knowledge. To say more correctly, from a single point X there is so much use that can be extracted from the laws of existence contained within that point X. This means that once so much use has been derived for use, the equation must breakdown, because it becomes meaningless. It is a point of singularity after $X_{i.n}$, this is because it cannot rise higher than $U_{i.n}$. In figure one this meaningless is described as static. If the equation did not break down the graph being a function of natural logarithmic extraction would continue to rise above the ‘real’ asymptote $U_{i.n}$, therefore the equation just breaks down. By being static it means that in terms of knowledge, time stands still.

It must be understood that at point $X_{i.1}$ knowledge exists, it is not a point of origin, there is no point $X_{i.0}$, hence the appearance of the graph seemingly starting from a point of origin. If the point $X_{i.0}$ did exist, then we would end up with a point of negative knowledge, and as explained in the paper, "The Fundamental theory of Knowledge", negative knowledge can never exist, be the knowledge represented by a point X or a point U. What real is the negative of a good, the good either exists or does not exist, hence figure 1 starts from $X_{i.1}$.

Figure 1 represents a frictionless society. By frictionless it is meant a society where there is no hindrance to the acquiring of knowledge, there is no such society. From the paper "Point X and the Economics of Knowledge", equation 4 was described as:

$Y = f(Y_{t-1}, X_1, X_2, X_3, X_4, X_5, X_6) + Ka$ where:

Y = knowledge level

Y_{t-1} = knowledge level of last time period

X_1 = Economic Freedom

X_2 = Conversion rate

X_3 = Academic Freedom

X_4 = Research, Private and government.

X_5 = Literacy rate.

X_6 = knowledge existing in other societies but not available in society

Ka = 1 000 knowls of knowledge needed to survive.

These variables determine how much knowledge a society will eventually have, they represent factors causing friction. Less economic freedom, the slower the growth of knowledge and the less the eventual amount of knowledge for example. In this paper we replace Y with U and X with V, we do not want to cause confusion, these after all are just variables. Therefore we end up with the function, $U = f(U_{t-1}, V_1, V_2, V_3, V_4, V_5, V_6) + Ka$. Therefore V_1 is economic freedom and henceforth.

Friction causes a society to gather less knowledge than it otherwise would. This is demonstrated in figure 2. Thanks to friction, the new function is demonstrated as $U = F[\ln(X_{i.n}), g(V_i)]$ where $g(V_i)$ represents the variables X_1 to X_6 as described above, variables economic freedom to knowledge existing in other societies but not available in society. Ka and Y_{t-1} are excluded. Note that it is very likely that the variables above will have correlation between each other.

It is important to understand that the function described above is for both point X and point U. Both need to be investigated, both are affected by politics, both are affected by research, both are affected by knowledge in the last time period, that is how goods are improved upon and that is how new laws of existence are brought about. In this case however we are dealing with increase in use knowledge, point U, therefore $g(V_i)$ in this case is not corresponding to any point X or laws of existence, hence it is on the right hand side of the equation and U is the single dependent variable.

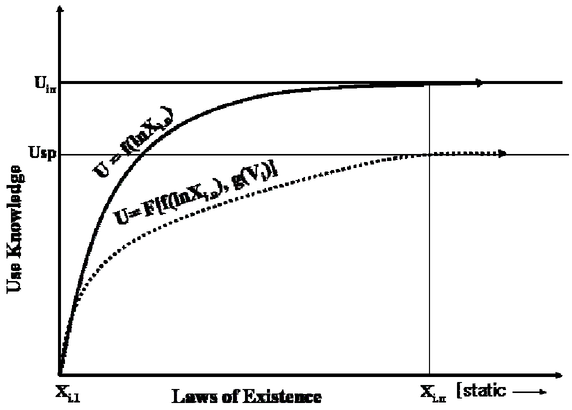

Figure 2

Figure 2 also demonstrates an important concept, the loss of time caused due to friction. In figure 2 the loss of time is represented by the difference between U_{in} and U_{sp}. Time taken as the distance covered in the knowledge plain means that the loss of knowledge is the loss of time. Take for example the Khoi Khoi in Botswana, they can be said to be at least many hundred years behind the ordinary Tswana person due to their preference to be hunter gatherers. The same concept applies in the time lost above.

Discussing friction, i.e. barriers to knowledge gathering, will a society with barriers even reach $X_{i.n}$. Obviously the friction levels, the barriers to knowledge gathering differ from society to society. Hence in figure 3 we have two societies B and C compared to the ideal society A. Society C has more friction than society B therefore it has a larger loss of time than society B.

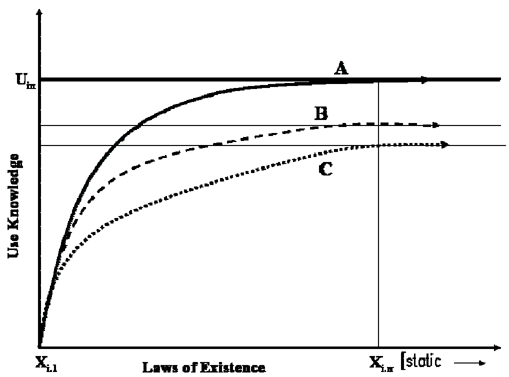

Figure 3

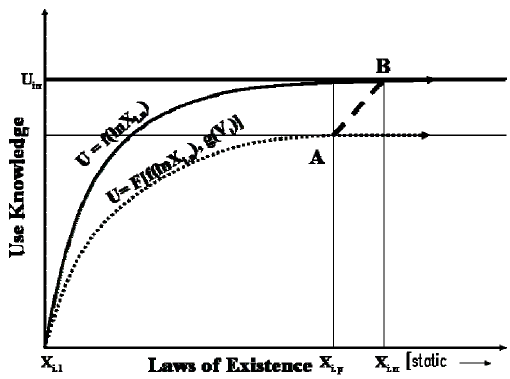

Figure 4

Figure 4 demonstrates an even more real situation than figure 2. Why, the reason being that friction by its nature causes a hindrance on knowledge gathering, all knowledge. It just does not cover the loss of gathering use knowledge but also the laws of existence themselves. Barriers to gathering knowledge will therefore also affect the ability to reach $X_{i.n}$ itself. This is illustrated in figure 4. Figure 4 illustrate what friction cause, the ideal equation is $U = f(\ln X_{i.n})$, however given friction the function $g(V_i)$ is included. The loss of time in a more realistic fashion is showed by the diagonal line AB. The diagonal line AB of course is longer than the line $U_{in}U_{sp}$ demonstrated in figure 2, meaning the time loss is even longer.

The barrier of $X_{i.n}$ is U_{in}. However this barrier can be crossed, it is crossed when a new law of existence is discovered, when a society moves from $X_{1.n}$ to $X_{2.n}$. The next major X point contains a whole new set of possibilities, to be simplistic, n possibilities. Remembering from developed theory in knowledge that the next preceding X point i.e. X_{i+1} contains the knowledge that is contained in X_i plus more information concerning point X_{i+1} itself. Thus once a society reaches point X_{i+1} the potential barrier moves from U_{in} to a point greater. This crossing of the limit of Xi.n is demonstrated in figures 5.1 and 5.2.

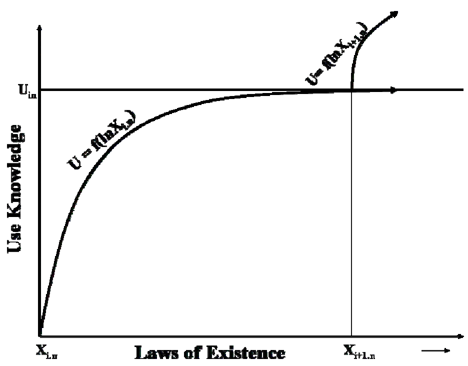

Figure 5.1

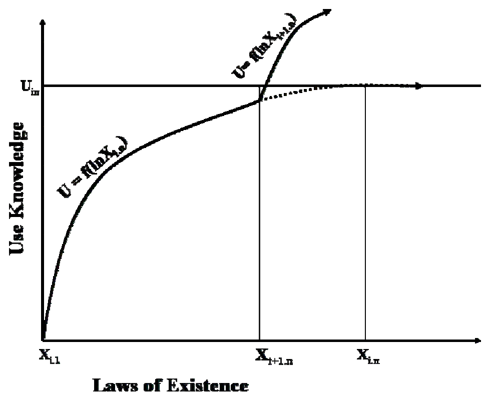

Figure 5.2

Figure 5.1 and 5.2 might seem similar but have fundamental differences. Figure 5.1 is very simple, much more an abstract than figure 5.2. Figure 5.1 assumes that a society exhausts a point X_i understands everything about it then a breakthrough is made and a society moves on to X_{i+1}, the next point of knowledge, this is demonstrated clearly by figure 5.1. Society however is not like that. It is very unlikely that a society will exhaust a certain point X_i before they move onto the next point X i.e. point X_{i+1}. The next point X might not be fully understood because by its nature for the human mind to grasp it they need another point X.

Take shipping for example, the manufacture of ocean going ships. The Ships where always made of wood for thousands of years. Yet the use of iron probably predated the ships of Europe and China that explored the oceans, or those used by the Polynesian races to cross the Pacific. Nobody ever thought why can we not build ships of iron, the reason was that a point X was missing, that of understanding volume, density and other mathematical and physical properties that would allow mankind to build ships of metal, that would replace the wooden ships in terms of size, strength and endurance. Iron could not be fully utilized because another point X was needed. Therefore figure 5.1 would be inaccurate in demonstrating what happens in the real world.

Figure 5.2 would be a more realistic depiction of what happens in the real world. Long before point X_i is exhausted, the society discovers X_{i+1}. X_i will be exhausted with an accumulation of knowledge maybe a long way off in the distance. We are still finding new uses of materials discovered hundreds of years ago because of our own increasing knowledge base. One should not be confused by the fact that in figure 5.2 X_{i+1} appears before $X_{i.n}$, this goes along with the above explanation that the next point X_i is more likely to appear before the current point X_i is exhausted. But then it should be remembered and understood that the next point X_i is greater than the previous point X_i and contains the previous point X_i, therefore in figure 5.2, point $X_{i.n}$ is contained in point $X_{i+1.n}$. Indeed it can never be known where the point X_i is exhausted, figure 5.2 itself is simplistic, point X_i could very well be exhausted at point X_{i+1} or point X_{i+300}, or even point X_{i+n}. It can never be known.

Figures 5.1 and 5.2 both miss the crucial question of friction, of barriers to knowledge. This is answered by figure 6, where the crossing of the barrier of a single point X is illustrated with the concept of barriers to knowledge gathering are introduced.

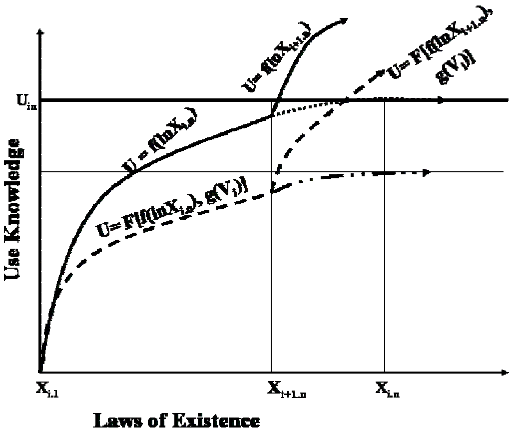

Figure 6

The dashed line in figure 6 is the line that demonstrates what happens in reality, there are barriers to knowledge. Up to point X_{i+n} the formula for knowledge with no barriers is $U = f(\ln X_{i.n})$. However once X_{i+1} is discovered the formula changes to $U = f(\ln X_{i+1.n})$, the function $U = f(\ln X_{i.n})$ becomes obsolete. In the short term once a new point X is discovered, a major point X, the last function becomes obsolete because the new point X contains the information that was contained in the previous point X.

However with the inclusion of barriers to knowledge, or more technically speaking the systems barriers, the function before $X_{i+1.n}$ changes to $U = F[f(\ln X_{i.n}), g(V_i)]$, as explained above in the explanation for the illustration represented by figure 2. Arriving at point $X_{i+1.n}$ the formula changes to $U = F[f(\ln X_{i+1,n}), g(V_i)]$, note that $g(V_i)$ remains as is because it represents not knowledge but human behaviour.

Why systems potential, the reason why it is proper to cal barriers to knowledge gathering systems potential is because it is the system that a society applies in its socio – economic policies that will determine the barriers to knowledge. If people are allowed to gather knowledge then the systems potential will be reduced. Hence for ages the desire for a more free economic and political system by countless philosophers including giants like Adam Smith, Ayn Rand and economists like Freidrich Hayek and Milton Friedman.

We are talking about use knowledge. Technology that was great 10 years ago in many instances in a competitive economic environment becomes redundant. In the computer industry according to Moore's law microchips double their power every two years, meaning technology in the computer industry becomes redundant very quickly. Therefore in reality we need to include obsolete knowledge, obsolete knowledge being use knowledge that is no longer relevant in the society. Figure 1 above demonstrated what happens in a society without any barriers, in reality there is obsolete knowledge, yes even in the short run, as demonstrated by the microchip industry, in a competitive industry, the better product wins. This obsolete knowledge is demonstrated by figure 7.

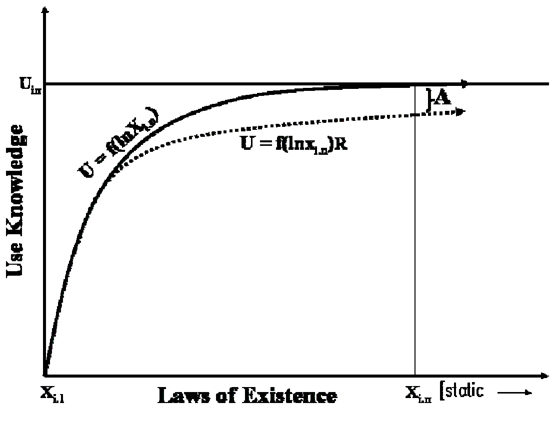

Figure 7

Figure 7 shows what happens when the concept of obsolete knowledge is introduced. The amount of obsolete knowledge is demonstrated by the distance A. In reality obsolete knowledge must be included for practical purposes. This will have the effect of reducing the amount of total use knowledge that can be extracted from a point X. The inclusion of obsolete knowledge has the effect of the need to revise the short term formula to:

$U = f(\ln X_{i.n})R$ where:

R = Replacement rate

$R = \sum r_i I_i$ where:

r = replacement rate of sector

I = sector.

The replacement rate really is a constant, Moore's law touched upon above can be considered a replacement rate, replacement rates are fairly constant, fairly because they do change over time. The higher the replacement rate the more dynamic the industry. There where times when the replacement rate was very low, before the industrial revolution there where few products, and those products hardly changed, the replacement rate was low, societies in terms of knowledge where not very dynamic.

Into The Long Run

Figures 5.1, 5.2 and 6 demonstrated to us an important concept, that after the introduction of the next X point a new function becomes relevant, as demonstrated in figure 5.1. Let us now merely concentrate on the issue of knowledge, let us not look at the issue of systems potential, the concept should be now fully understood.

Looking at figure 5.1 at the discovery of point $X_{i+1.n}$, the function changes to $U = f(\ln X_{i+1.n})$ as the previous function $U = f(\ln X_{i.n})$ becomes obsolete. Taking figure 5.1 and extending the next knowledge function $U = f(\ln X_{i+1.n})$ to its limit we get figure 8.

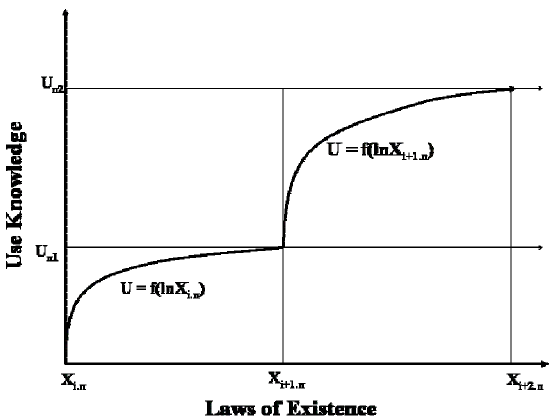

Figure 8

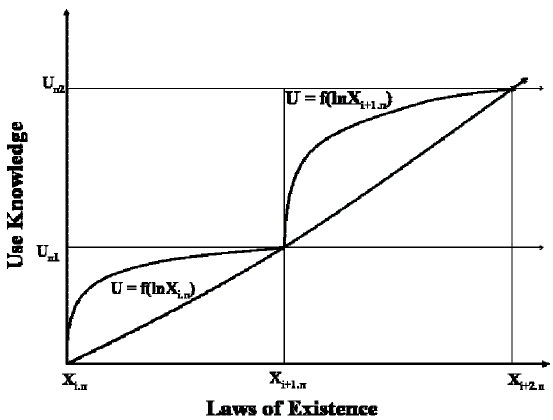

Figure 9

Figure 8 demonstrates where we end up when the formula $U = f(\ln X_{i+1.n})$ is taken to its end, it ends here for simplicities sake where $X_{i+2.n}$ starts. This of course is for simplicities sake, a point X is never usually exhausted until many other point X's are discovered that will complement the known point X, this was explained alongside the illustration for figure 5.2. However for simplicities sake the assumption that the function for the point X's ends when it is truly exhausted. This scenario is being created so that we can understand the long term behaviour of knowledge.

Looking at figure 8 point $X_{i.n}$ is exhausted at the level of knowledge U_{n1}. Point $X_{i+1.n}$ is exhausted at level of knowledge U_{n2}. Point X_{i+1} is a point that contains both the previous information contained in point $X_{i.n}$ and more, information specifically contained in point $X_{i+1.n}$ that is not contained in point $X_{i.n}$. This brings out an interesting property:
$(U_{n2} - U_{n1}) > (U_{n1} - X_{i.n})$.

We can connect the points where the points are maximized, where the functions end and we get figure 9.

We can take figure's 8 and 9 and extend them out and we get figure's 10 and 11 respectively.

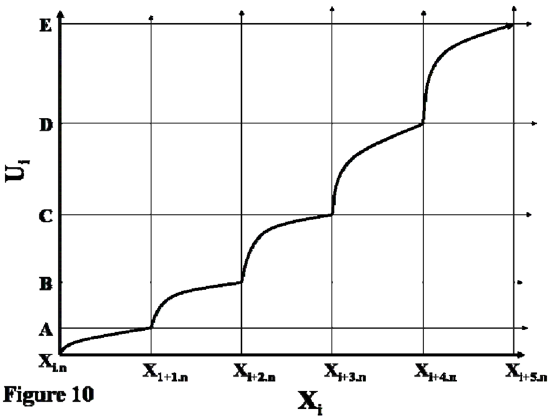

Figure 10

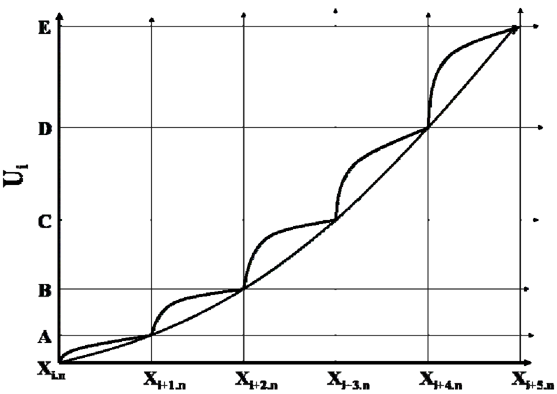

Figure 11

Figure 10 and 11 are the same except that figure 11 has a line joining all the points. In both figure 10 and 11 the following conditions apply,
$(E - D) > (D - C) > (C - B) > (B - A) > (A - X_{i.n})$

The above illustrations, figure 10 and 11 demonstrate to us the long term behaviour of knowledge. Now it can be appreciated why at first it was necessary for us to discuss the short term properties of knowledge, they would make our long term discussions of knowledge more simplistic. The long term properties of knowledge is that it increases at an ever faster rate. Whilst the short term increases of knowledge are limited, there is so much one/ a society can extract from a single point of knowledge, in the long term there are no real limits to knowledge as such, the limit theoretically is that a society knows everything.

Before moving on to long term knowledge it is important for us to understand key points of the short term properties of knowledge. This is just so that there is no misunderstanding. Figure 12 below shows the equation for U = f(lnX_i). Figure 13 is similar to figure 1 except it is made clearer in case one misunderstood the previous paragraphs above.

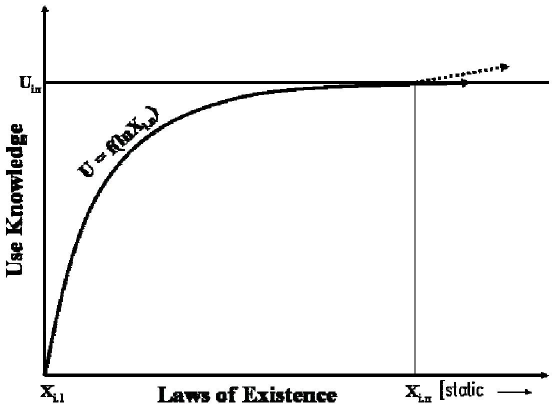

Figure 12

Note that at point $X_{i.n}$ in figure 12 the function U = f(lnX_i) would continue to grow above $U_{i.n}$ because logarithmic functions continue to grow at a slower and slower rate until infinity, the opposite of exponential functions that grow at a faster and faster rate. Hence there is a limit to the function U = f(X_i) and that limit has been defined as $U_{i.n}$, therefore in more formal mathematical notation we can say:

$$\lim_{X_i \to X_{i.n}} f(X_{i.n}) = U_{i.n}$$

After Xi.n the function U = f(lnXi) breaks down, it can not exist, point Xi.n point Ui.n are points of singularity because the function in the short term breaks down.

The Long Term Properties of Knowledge

The above explanation of deriving the long term properties of knowledge have been clearly explained, the explanation for figurers 8 – 11. The long term properties of knowledge are a combination of the short term properties. This gives the long term properties of knowledge a disadvantage, they can not be used to manage an economy as the short term properties, because the long term by its nature is very difficult to predict. One can not say in fifty years we desire this or that, but one can try and plan for next month or next year with some reasonable amount of certainty. However as mentioned above, look after the pennies, the short term, and the long term will look after itself. However there is an advantage at understanding the long term properties of knowledge, being affected by the short term, an economist or government/ society can understand the long term effects of the policies that they recommend, a society that exists solely for now is certainly one that might not survive the next generation. For if a society is failing in the short term, it will fail in the long term.

Figure 13 illustrates the long term properties of knowledge from a graphical point of view.

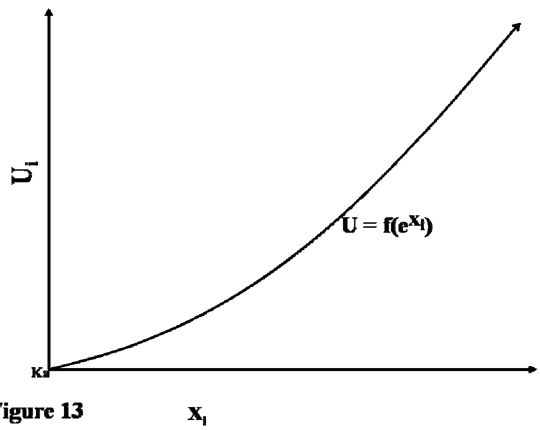

Figure 13

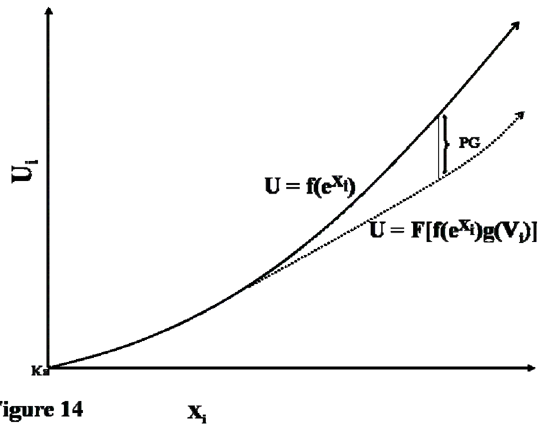

Figure 14

Figure 13 is the basic long term function of knowledge, the function of graph is described simply as $U = f(e^{X_i})$. Figure 13 is the basic function with no friction, what would occur if a society adhered fully with the laws of knowledge, there would be no friction, a totally rational society, such a society does not exist. There seems to be always political interference to protect one group or another, there seems to be always cultural barriers to gathering knowledge, class barriers to accepting knowledge, political barriers, knowledge is in many cases a very politicized commodity. It is because of these barriers that the real knowledge function will be as illustrated in figure 14.

The true function of knowledge is therefore:
$U = F[f(e^{X_i})g(V_i)]$.

As can be seen from figure 14 there is a gap between true knowledge that society has and the theoretical possibility if there was existed no systems barriers to knowledge. This gap has been termed the ‘potential gap’ abbreviated as pg in figure 14. PG represents what the society could gain if it became a more rational society. The longer a country remains in a constant path not fully adhering to the laws of knowledge, the larger the potential gap will be.

Looking at figure 14 it can be noticed that the illustration shows that the deviation from the theoretical knowledge and the real knowledge that the society possesses does not occur immediately over time. The reason is that at first knowledge is limited nobody feels threatened. However as the knowledge base grows, politics begins to take effect as society begins to understand that knowledge is power, and others want to control knowledge, purely for political reasons. Hence laws are created to control industries, guilds are created, only so and so can become an apprentice, this all was done in order to protect certain individuals and groups from competition.

Obviously a societies knowledge growth depends on how much they actually respect knowledge. The more a society respects knowledge the more it ill try to adhere to the laws of knowledge and thus in the long run will fare much better than a society that does not respect knowledge. This is demonstrated in figures 15 and 16.

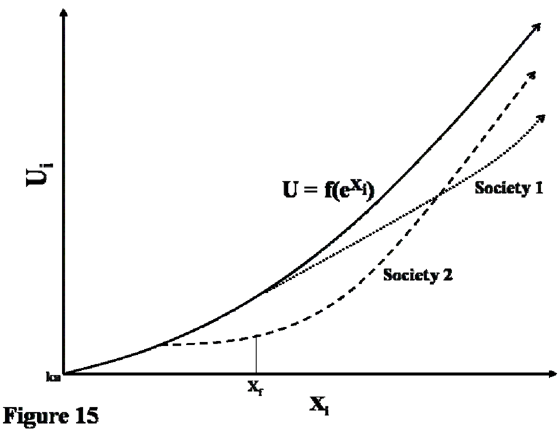

Figure 15

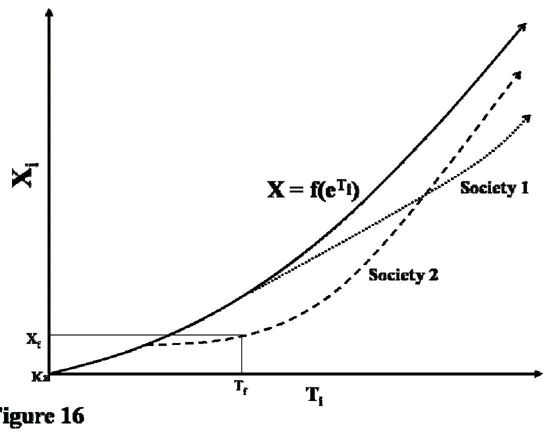

Figure 16

Figures 15 and 16 shows two different societies, these being society 1 and society 2. Looking at figure 15 one see that society 2 lags behind society 1 but then when society 2 arrives at point X_f they change their socio political outlook and begin to respect knowledge more. This leads them to a recovery and soon they take over society 1 as the leader in knowledge between the two societies.

Figure 16 is the same as figure 15 except that the dependent variable is not use knowledge but the laws of existence that use knowledge is derived from. The independent variable is time. At time T_f society 2 begins to respect the laws of knowledge and gives more credence to laws that adhere to the laws of knowledge. We know from figure 15 that at time T_f, the amount of knowledge that society 2 possesses in terms of laws of existence is X_f.

Assume that a society can fully adhere to the laws of knowledge and assume that it can be truly become 100% rational, the society will of course grow in terms of knowledge. Looking at figure 17 and 18, the society been described changes and fully adheres to the laws of knowledge, in figure 17, from point Xf it grows more rapidly than what would be expected naturally, in figure 18 this is point Tf. However it can not pass the natural boundary, which is a barrier, because the natural boundary represents in terms of use knowledge, the limit to the conversion rate of knowledge. Remembering that the conversion rate is how quickly laws of existence are turned into use products, products that we purchase in the market.

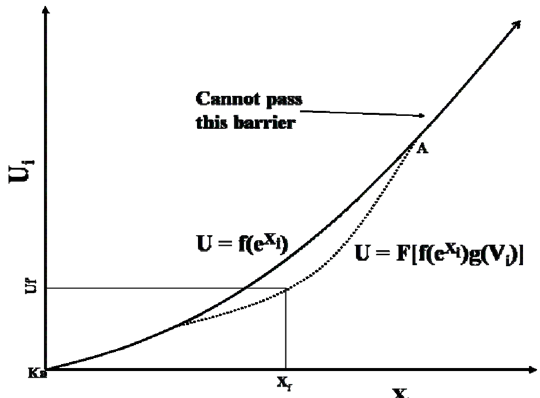

Figure 17

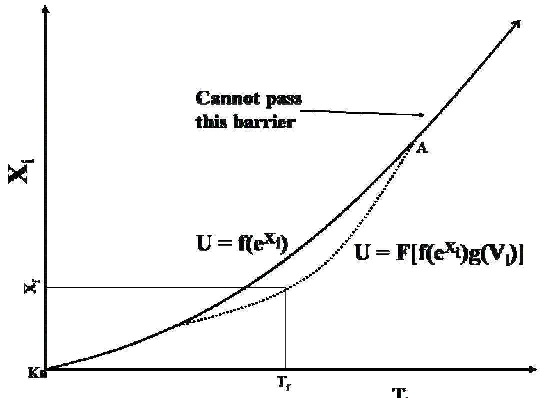

Figure 18

As can be seen from figures 17 and 18, at point A the society slows down to the natural pace, an impassable barrier, the fastest long term rate. At point A the function g(Vi) turns to 1, most neutral.

This paper has explained the short and long term properties of knowledge, hopefully understanding knowledge will help the world move forward, the entire world join in the game of making the world a better place, understanding the role of freedom of individuals, the smallest minority as well as adhering to the laws of knowledge.

These theories are new, but the world is driven like that, I have the confidence that a logical fault will not be found. If it is found, then I too shall learn.

Reference :

Khumalo, Bhekuzulu, (2007) .Point X and the Economics of Knowledge., http://mpra.ub.unimuenchen.de/3735/01/MPRA_paper_3735.pdf

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