

The HO Theory of International Trade and the Concept of Capital Goods

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Introduction

Often, we find that a proper estimation of the value of a theory requires that we shift attention away from matters of internal logical consistency, and even away from the basic axioms upon which the theory is premised. Sometimes, we need to consider if the very concepts to which the theory refers are actually legitimate concepts in the first place. In my recent studies of economics, I have encountered certain theoretical problems that I have been impelled to consider in this way. The essay which I wrote a few weeks ago on the “Falling Rate of Profit” problem is an example.

As a part of my effort to better understand the workings of the international economy, I came upon a theory called the “Heckscher-Ohlin theory”, or “HO Theory”, or “HO model”. After thinking about the model, as described in various locations, I realized that the problem with the theory was of the type just described-- the very concepts being referenced as the elements of the theory were not actually legitimate concepts. That is, the basic concepts utilized in the theory were not clearly defined and comprehensible.

The treatment below of the HO-theory per se will be found to be, primarily, a point of departure for a philosophical examination of some of the basic concepts of economic theory. What is written below is intended to be read in the spirit of a Platonic dialogue, particularly part two- *The Question of “Capital Goods”*.

The HO Model

Before proceeding, let us briefly summarize the essential content of the HO model.

The HO model states that an accurate prediction can be made respecting the kinds of goods that a country will import and export. The model states that this prediction can be made by identifying the ratio of the abundance of the different “factors of production” (such as capital and labor) within a national economy, and, then, comparing this ratio with the “factor of production” ratios of other countries.

For example, the model states that if one country has a high capital-to-labor ratio compared to the capital-to-labor ratio in other countries, then that country will tend to export more goods

which require relatively greater amounts of capital-goods for their production, while it will tend to import more goods which require relatively greater amounts of labor for their production. Conversely, countries with relatively low capital-to-labor ratios will tend to export goods which require relatively greater amounts of labor for their production, while they will tend to import more goods which require relatively greater amounts of capital goods for their production.

The reasoning behind this is as follows: The cost to a society to produce a good depends upon the cost of the things required as inputs for the production of that good (“factors of production”). According to the law of supply and demand, the more abundant a thing is, the cheaper it is; and, conversely, the more scarce a thing is, the more expensive it is. Therefore, factors of production which are relatively abundant will be cheaper, and factors of production which are relatively scarce will be more expensive. Therefore, all other things being equal, countries which have a relative abundance of a certain factor of production will be able to produce things requiring that factor as an input at less of a cost than could a country with a relative scarcity of that factor of production. Therefore, as countries tend to export goods in which they have a comparative productive advantage, a country will tend to export the good the production of which is cheaper due to the abundance of the factor of production necessary to that good’s production within that country.

In short: All other things being equal, the relative abundance of the factors of production within a country will determine the goods which that country imports and exports. Or: All other things being equal, a country will export mainly those goods the production of which requires relatively greater amounts of the factor of production in which the country is abundant, and import mainly those goods the production of which requires relatively greater amounts of the factor of production of which that county suffers scarcity.

Initial Examination

Before proceeding to an investigation of the basic concepts which the theory references, let us proceed to consider whether or not the theory makes sense even if we ignore the question as to whether or not those basic concepts are legitimate in the first place.

Provisionally, we might consider capital goods as those goods which humans produce for the purpose of being used to produce other goods which humans desire- goods which are sometimes called “consumer goods”. While we can readily identify certain instances in which some goods fall into both categories, the general distinction is useful as a starting point.

Let us start by imagining two equal societies. That is, two large groups of people identical in every respect; equal physiological characteristics, equal levels of culture and

scientific/technological advancement, and so on. Further, imagine that these two groups inhabit two identical islands; that is, they exist in identical environmental conditions. Further, imagine that these two groups have the same exact goods available to them. Assume that both groups adhere to identical economic policies and ideologies. Again, assume that the two societies are equal in every respect. Clearly, the economic conditions prevailing in the two groups would be equal.

Imagine that some of the goods produced by these societies were capital goods. The effectiveness of the capital goods of the two societies would be equal because the effectiveness of capital goods is dependant upon the level of scientific and technological advancement of the society which produces them, and we already assumed the level of such advancement between these two societies as equal.

Continuing with our thought experiment, what if we decided to take away some of the capital goods from one of these societies? Clearly, at that moment, the society which had some of its capital goods taken away would have less capital goods than the other (otherwise identical) society which did not have capital goods taken from it. The only difference between the two societies at that moment would be the amount of capital goods in each society.

Now, according to HO-theory, a society which is identical to another in all respects except the relative abundance of capital goods, will tend to export more “labor intensive” goods while importing more “capital intensive” goods than the other. Thus, according to HO-theory, the society described above (which had its capital goods taken away) would begin to export more labor intensive goods and import more capital intensive goods than it had done before.

But, this is an absurd conclusion- at least to say that this change in trade pattern would persist for any significant amount of time. Why? Because the capital goods which a society has are produced by that society itself (or purchased from abroad) for the purpose of maximizing the consumer goods available to it. A society will produce the most effective capital goods to this purpose possible (given the level of technological and scientific advancement of the society). Thus, in the our example of the society which had capital goods taken away from it, that society would simply produce (or procure in some other way) more of those capital goods in order to reestablish the maximum consumer goods production made possible by that society’s level of science and technology. Once that society had again possessed all of the capital goods which had been taken away from it, the economic conditions would again be equal to the other society, and, thus, no reason would exist as to why the trade patterns of the two societies would differ in any way.

True, the trade patterns of the society might be altered in the interim period before the former level of capital goods of that society had been restored. And, it is true that the alteration in the trade pattern would reflect the altered comparative advantage of the society resulting from the temporary alteration in the available capital necessary to the production of certain goods. But, as mentioned, this would not persist past the point that the society once again restored its capital good stocks.

Let us look at another example. Imagine, again, our two identical societies from the above example. Imagine that these societies produce a certain good, say A, with both labor and capital. Imagine, then, that one society is given a large amount of the specific capital goods needed to produce A. At that point, the only difference between the societies would be the amount of these specific capital goods which they possessed. At that point, the relative abundance of these capital goods in the society which received them would make the production of A less costly than the production of A would be in the other society. Thus, as HO-theory would predict, a comparative advantage in the production of A would be established for the society which received these extra goods, and that society would increase their exports of A. But, this would only be temporary, for these extra capital goods would, eventually, be entirely consumed, the cost of production of A would return to the original level, and the society would return to the former level of production of A which it had prior to receiving the extra capital goods.

Therefore, we might say that the HO-theory would only be even plausibly useful under conditions in which a society were undergoing a readjustment back to “normal” levels of capital goods utilization and production. We might also say that the theory seems possibly useful under conditions in which irrationality prevailed, and a society which had the capability of producing more capital goods to increase total productivity did not do so. That is, it seems that the HO-theory *could* be useful if we assume that societies are irrational, in the specific sense that they do not utilize their scientific and technological knowhow to produce the capital goods which maximize their total productivity. But, this is not the case, for, even then, in the case of two equal societies, we would need to conclude that they were not equal in the strict sense, given that one society would understand the need to maintain a certain amount of capital goods, while the other society did not. We might say that, given the assumption of equal levels of science and technology between two such societies, the difference which would account for such a discrepancy in economic practice would be a cultural factor which inhibited economic performance. In this case, the societies would not, strictly speaking, be equal in everything other than the amounts of capital goods in their possession- in which case, the HO-theory would not apply, since, the HO-theory claims that, all other things being strictly equal, the differences in the amounts of capital goods possessed by a society will determine trade patterns.

We seem obliged to judge the HO-theory as useless except for, perhaps, brief periods of time in which societies restore the amounts of capital goods in their possession to “normal” levels. After normal levels of capital had been restored, we would, then, resort to the traditional method of considering the two factors determining comparative advantage in the production of goods -scientific/technological progress (or, “knowhow”), and environmental conditions- to account for and predict the patterns of trade which one society might have in an intersociety trading context.

In short, the HO-theory, which states that two societies, equal in every respect save relative abundances of capital goods, would exhibit different trade patterns as a result of this single difference, is not of significant use, since any two societies which were equal in every respect save relative abundances of capital goods would quickly become equal in that respect as well. The amount of capital goods possessed by a society changes based on the needs of the society and the capability of that society to actuate those changes.

This inadequacy of HO-theory considered, let us continue to examine other aspects of the theory which are of conceptual interest.

Whence the Correspondence Between Capital Goods and Productivity?

Imagine, again, two equal societies. Imagine there is one good, say A, which these societies produce which requires capital goods and labor for its production (at a certain level of man-hour productivity). Imagine, then, that one of the two societies discovers how to produce more A *with only labor* than the amount of A which they had formerly been able to produce with both labor and capital goods. Imagine, further, that the total man-hour labor productivity in the production of A by the society which had made this discovery exceeded the total man-hour labor productivity associated with the former mode of production of A when the labor required to produce the capital goods involved in that production was accounted for. That is, imagine that, after the discovery, the total labor needed to produce A were less than the sum of the labor formerly required to produce A and the labor required to produce the capital goods formerly needed for the production of A. In such a case, this society would reduce the amount of capital goods which it utilizes while increasing its productivity in the production of A, and, thus, its comparative advantage, in the production of A. Thus, exports of A would increase, while the capital goods associated with its production would decrease.

While this example does not serve to contradict the HO-theory (since, the two societies would no longer be equal in every respect save the amount of capital goods in their possession-- they would also differing in “knowhow”), it serves to illustrate that the comparative advantage of a society in the production of a single good ultimately traces back to the amount of labor which is required for the production of that good when all of the labor required for the capital goods used

in that production is taken into account. It also serves to reveal that the assumption that the addition of more capital goods necessarily results in greater productivity is not *necessarily* true. But, wait a second- how would we know whether there were “*more*” capital goods in one instance than in another?

Measuring Capital Goods

Let us look at a few circumstances:

- 1.) The productivity of production of good A is increased while all use of capital goods in that production is eliminated. (The example above)
- 2.) The productivity of production of A decreased while all the use of capital goods in that production is eliminated.
- 3.) The productivity of production of A is increased while the exact same kinds and quantities of capital goods used in production remains unchanged. This would be a case in which workers simply discovered ways in which the capital goods at their disposal could be used in a more productive way.
- 4.) The productivity of production of A is decreased while the exact same kinds and quantities of capital goods used in production remains unchanged. This would be a case in which workers somehow lost knowledge of the ways in which the capital goods at their disposal could be used at a certain level of productivity.
- 5.) The productivity of the production of A is increased by the addition of more of the same capital goods currently used in production.
- 6.) The productivity of the production of A is decreased by the addition of more of the same capital goods currently used in production.
- 7.) The productivity of the production of A is increased by the replacement of the capital goods currently used by new kinds capital goods.
- 8.) The productivity of the production of A is decreased by the replacement of the capital goods currently used by new kinds capital goods.
- 9.) The productivity of the production of A is remains unchanged by the addition of more of the same goods currently used in production.
- 10.) The productivity of the production of A remains unchanged by the replacement of the capital goods currently used by new kinds capital goods.

In 1, we cannot say that capital goods increased.

In 2, it seems we should say that the capital goods decreased.

In 3, it seems that we cannot say that capital goods increased, although, it seems that, in this circumstance, the capital goods employed in the production of a would become *more valuable* by the discovery of the superior mode of use of them.

In 4, it seems that we cannot say that the capital goods decreased, although, it seems that, in this circumstance, the capital goods employed in the production of A would become *less valuable*.

In 5, it seems that we must say that the amount of capital goods increased.

In 6, it seems that we must say that the amount of capital goods increased.

In 7, it seems that we must say that the capital goods increased.

In 8, it seems that we must say that the capital goods decreased.

In 9, we are inclined to say there was no increase in capital goods.

In 10, we are inclined to say there was no increase in capital goods.

Considering all these hypothetical circumstances, we are impelled to conclude that the only meaningful measure of “capital goods” of which we could speak would be the *effective capacity* of those goods to increase the productivity of the labor required to produce some other thing, (like a desired good perhaps).

With this new interpretation of what we would mean by the “amount” of capital goods, we would conclude that:

In 1, we cannot say that capital goods increased.

In 2, the amount of capital goods decreased

In 3, the amount of capital goods increased

In 4, the amount of capital goods decreased

In 5, the amount of capital goods increased.

In 6, the amount of capital goods decreased.

In 7, the amount of capital goods increased.

In 8, the amount of capital goods decreased.

In 9, the amount of capital goods remained unchanged

In 10, the amount of capital goods remained unchanged

Instances 3 and 4 are particularly striking, since they show how it is that the “amount” of capital goods available actually depends upon the state of knowledge of the persons to whom those goods would be available. This seems to be a radical idea- the objective amounts of a particular thing are changed by the state of knowledge of the persons considering them. That would, indeed, be a radical idea, but, perhaps it is only a reminder that “capital goods” are subjective objects. That is, they only exist to the extent that they are understood to be capital goods- or, goods capable of being used to increase the productivity of labor. Replace all of the workers in a modern factory with a bunch of cavemen, and the capital goods which formerly existed there would no longer be capital goods at all. Even if those cavemen were to strongly desire whatever that factory, and the goods in it, might have been designed to produce, they would have no idea about how to use those objects as capital goods in the production of that desirable thing.

It seems that we must consider capital goods, and the “amount” of capital goods, only in relation to the things which the use of those goods is intended to produce. For instance, who has “more” capital goods- a clothier with a sewing machine, or a blacksmith with an sledgehammer? As the clothier would have no use of the sledgehammer in the production of clothes, a clothier (adhering to our notion of the “amount” of capital goods) would be inclined to judge that his capital goods had not been increased by his receipt of the sledgehammer. While, on the other hand, a blacksmith would reckon that his capital goods had greatly increased upon receipt of a sledgehammer, especially if he had been trying to carry on his work without one prior to that receipt! Conversely, the receipt of a sewing machine by a clothier will be viewed as an increase in capital goods, while the receipt of a sewing machine by a blacksmith would not be viewed as an increase in capital goods.

If we were to ask the blacksmith how he might measure the amount by which his capital goods had been increased, he (adhering to our notions of measurement indicated above) might respond by estimating the amount of finished product which he were able to produce with the sledgehammer as compared to the amount of finished product which he had been able to produce before his use of the sledgehammer. Similarly, a clothier might measure the increase in his capital goods attended by the receipt of the sewing machine by the increase in the capacity to produce clothes.

This seems like a reasonable and straightforward way of measuring the amount of capital which the addition of a certain good represents. But, what are we to say of the introduction of a good which were to enable a person to not only produce more of the same things which they already were producing before, but, also, new things which they could not possibly produce before-- at any level of labor? To illustrate the problem more clearly: imagine that a new capital good were to be given to a blacksmith which enabled him to produce certain metal devices which were otherwise impossible for him to produce with any amount of labor before his receipt of that new good. How would this blacksmith “measure” the amount by which his capital increased? He could not do it in the way we discussed above, for there would be not a quantitative increase in the production of a single good, but a qualitative change in the kinds of goods which he could produce.

Even if we ignore the glaring problem of qualitative transformations in the power of labor, there are yet further difficulties. The addition of a certain good can lead to a quantitative increase in the labor productivity of production of a certain article. By our earlier reckoning, the increase in the labor productivity would represent the measure of the capacity to produce created by the introduction of that good, which, in turn, would be the only meaningful measure for the change in the “amount” of capital goods. However, this increase in the labor productivity attending the

introduction of a single new good into a productive process is not always the same- it can be different given the different arrays of goods already possessed and utilized in production by the producer. As a simple example, if a blacksmith were to already have all the hammers he needed, his receipt of a new sledgehammer would not lead to any increase in his production capacity. The same situation applies for productive processes of greater complexity. The elimination of one capital good, A, from a productive process might result in the reduction of productivity, X, by %10. This would incline us to conclude that the “amount” of capital that good A represented would be about %10 of productivity, or .1X¹. However, before eliminating A, we might eliminate another good, B, which would also result in a reduction of capacity by %10. It might be the case that, after eliminating B first, the subsequent elimination of A would result in a further %20 decrease in productivity. This would lead us to conclude that the *combined* capital amount of A and B were greater than the individual capital “amounts” of A and B as “measured” from identical initial conditions.

This suggests that it is more meaningful to measure not the amount of capital which a single good represents, but, rather, the amount of capital which an *array* of goods represents in their collective potential contribution to a productive process.

Clearly, the question of what are capital goods, and how capital goods are to be measured, is not simple. Let us proceed to examine the question of capital goods a little further.

The Question of “Capital Goods”

What are capital goods?

According to the Oxford Dictionary of Economics, the definition of “Capital Goods” is “*Goods intended for use in production of other goods or services, rather than for final consumption.*”

Let us examine this definition to see if it can assist us in identifying how we might measure capital goods.

Examining the Element of the Definition “Goods”

First, how are we to define “goods”? Let us adopt the following simple definition: Man-made things. That is, existing things which, without the action of mankind, would not exist.

¹ Or, technically, %11.11 of the initial productivity if we take the final productivity level achieved by the introduction of A to the capital stock to be X.

But what is a “thing”? The question as to what constitutes a “thing” has plagued philosophers for milenia. However, we can simply adopt the definition of “thing” used in our definition of “goods” as: “Material objects, or causally connected collections of material objects, distinguished by their functional capabilities.” Therefore, a car is a thing, or a good, itself since it is has functional capabilities which the individual parts of the car do not have. No single part of the car has the functional capability of the totality of the parts of the car when they are causally connected so as to create the capacity to act as a means of automated transportation for humans. Therefore, the totality of the parts of the car, when they are causally connected so as to establish this functionality, is the thing-- that is the car-- that is the good.

The distinction of “things” on the basis of functional capacity -on the basis of differences in the capacity to elicit specific distinguishable changes in nature- seems to be a useful basis for defining “things” generally. But, it is necessary to digress.

*Examining the Element of the Definition “Goods **intended** for use in production”*

We first notice that, implied in this definition, a capital good is not an objective phenomena. For, according to this definition, a capital good is a good which is “*intended* for use in production...”. As we know, different persons will often have different intentions. One person might wish to use a good for something other than producing other goods, while another person might wish to use the same good for producing other goods. In such a situation, the fact that two persons had different intentions respecting the same good would necessitate that the good be defined both as a capital good, and not a capital good-- at least according to this definition. When we consider how this contradiction in the classification of a good can arise from the disagreement of just two persons, we can only imagine how much more difficult it would be to establish a consensus respecting the classification of goods when we consider that there are billions of persons in the world, all of whom might disagree as to the best way to use a particular good. Given this, how could we ever expect to identify what goods were capital goods or not? The introduction of subjectivity into the definition creates impossibilities in identifying those objective phenomena which correspond to the definition.

Perhaps we should limit the number of persons whose intention we are to consider when deciding whether a good is to be classified as a capital good or not. This may enable us to proceed with this definition without further problems. It seems reasonable to respond to the above indicated problem by limiting the meaning of the definition to indicate that only the intention of *those who own the good* is the basis for classification of the good. That is, a good is a capital good if the owner of that good intends that that good is to be used in the production of other goods. But, what about cases in which the ownership is legally divided among multiple

persons? No problem, for we can simply say that the majority intention defines the good in that case. We seem to have found a solution to this problem in classifying goods as capital goods.

However, what if we were to find that a particular good was used in the production of other goods even though the owner of that good did not intend for that good to be used in the production of other goods? Could we, in such an instance, convince ourselves that a good being used in the production of other goods would not be a capital good simply because the owner of the good did not intend for the good to be used in that way? Imagine the following situation: A retired man buys a new truck which he intends to use simply for his leisure, and not for any production at all. Let's say that this man goes on vacation and leaves his truck at home. Let us say that this man has a son who builds houses, and that, one day, the work truck which the son normally used broke down. Let's say that the son then borrowed his father's truck for a few days to use in his work making houses while the his truck was in the shop getting repaired. Let's say that the son and the father had such a good relationship that the son felt no need to ask his father for permission to use the truck in this way. In this case, the truck would be being used for the production of other goods (houses) even though the owner of the truck had no intention of putting it to that use. Here, we would be hard pressed to say that the truck was not a capital good, at least for the time it was being used in the production of houses.

It seems, then, that even our qualified definition is inadequate, for it leaves out goods which are used in the production of other goods, but which are not intended by the owners of those goods for that purpose.

What if we were to try to define capital goods as: *Goods intended, by the persons using them, for use in production of other goods or services, rather than for final consumption.*

This definition seems to solve the problem posed by the last definition illustrated by the hypothetical case of the worker-son using his father's truck. For, as we can see, according to this definition, the truck would be a capital good, since the person using the truck (the son) intended to use the truck to produce other goods.

But, what if a person were to use a good without the intention of producing any good at all, and, yet, by their use of the good, were to produce another good? We might conceive of instances in which persons who were particularly fascinated by the operation of machines were to ask, while on a tour of some kind of factory, if they could set one of the machines into operation to view the intricacies of its motion. In this case, though the person controlling the machine would have no intention to produce another good, the effect of their use of the machine would be to produce another good, namely, whatever good the operation of that machine was designed to produce. For an example which would require less strain of our ability to imagine circumstances

corresponding to the last example, take the case of a highly complex production process. It is not inconceivable, given the high complexity of production processes, and the multitude of actions required to produce certain products, that some persons employed in a complex production network use goods (like machines) to produce other goods, without even knowing or consciously intending to so produce those final goods by that use. We might imagine such an employee saying: “I don’t know what the final product which my action helps to bring about, I just do the things which get me paid!”

Identification of instances in which goods are used to produce others goods, without the conscious intention to so produce on the part of the person using those goods, reveals, again, our again modified definition to be inadequate. For, that definition would leave out some goods which were used in the production of other goods.

Examining the Element of the Definition “...in production of other goods or services, rather than for final consumption”

Let us examine another part of the definition which warrants attention: “...in production of other goods or services, *rather than for final consumption.*”

What is “final consumption”? How is the “final consumption” of a good to be distinguished from other kinds of consumption? Are we to take “final consumption” to be the complete using up of a good such that it no longer exists for the same use as before? If so, we must admit that goods can be used up in various ways. Sometimes goods can be used up in a way which contributes to the bringing into existence of another good. Sometimes goods can be used up in a way which does not contribute to the bringing into existence of another good. Perhaps, then, we should take “final consumption” to mean: *the using up of a good which does not contribute to the bringing into existence of another good.* Eliminating the subjective factor from the Oxford definition, and substituting this meaning of “final consumption”, we have the following definition of “Capital Goods”:

Goods which are used in a way which contributes to the production of other goods or services, rather than used in a way which does not contribute to the production of other goods or services.

Before proceeding, it seems necessary to get rid of the “services” part of the definition. For, a service could be any activity whatsoever, not necessarily one which is requisite to the production of any good. Many absurd examples of goods corresponding to the above definition could be found by virtue of the fact that those goods were used in a way which contributed to ridiculous kinds of “services”. Let us, therefore, adopt, for now, the following improved definition:

Goods which are used in a way which contributes to the production of other goods, rather than used in a way which does not contribute to the production of other goods.

It will be noticed that this definition includes all of the goods which are used in a way which contributes to the production of services which are themselves part of the causal process leading to the production of new goods. Therefore, this definition includes goods used in the production of services which are causally connected to the production of other goods, while leaving out goods used in the production of services which have no causal connection to the production of other goods.

Problems of "Tense"

However, this definition presents us with new difficulties.

How are we to determine whether or not the use of a good contributes to the production of other goods? Some instances are very clear. For example, the use of machines in a productive factory clearly exemplify a use of goods which contributes to the production of other goods; while the use of goods for the perpetration of a missile strike which destroys a car exemplifies the use of goods which definitely contributed not to the production of new goods, but to the destruction of existing goods.

-- A Brief Interlude

But, it will here be noticed that, according to our definition of "good", we might say that the destruction of a single good could actually create other goods by liberating the parts of the destroyed good from participation in the establishment of the functionality which defined the good that was destroyed as a good. For example, if had not a wall, but had bricks, we might build a wall of bricks such that we, then, would no longer have bricks but would have a wall. Then, if wished to have bricks again, we would need to destroy the wall to have our bricks. Similarly, if had not a car, but had parts, we might build a car of the parts such that we, then would no longer have parts but would have a car. Then if we wished to have parts again, we would need to destroy the car to have our parts.

Thus, someone might destroy a car so that the good defined by the functionality of producing automated human transportation (the car) was destroyed, while some of the parts of what had been the car were still in good condition and capable of being used as parts.

It seems we should say that the use of a part in the establishment of a more complex good destroys the existence of that part, since that part's existence is "absorbed" into the "greater good" (pun intended), while, the existence of the part is reestablished upon destruction of the

“greater good”, so long as the part is still of equal functional capability as before it was so absorbed.

But, in addition to these subtleties, we have the question: If all actions must represent destruction of some type, but, also, perhaps, creation, how do we measure the amount of total “benefit” resulting from the action? This is, essentially, the same question being addressed here-- namely, how do we measure “capital”.

Returning --

But, what about instances in which the use of goods does not immediately contribute to the production of other goods? The consumption of food is an example. A person might use up (eat) food, and, afterwards, go out to perform work in the production of new goods (perhaps new agricultural products even) on the basis of the energy which the food provided that person. Alternatively, a person might eat food and not perform any productive work with the energy which the food provided, but, rather, allow the energy to be stored in the fat cells of that person's body. It seems, then, that, according to our new definition, the food consumed by the person who used the food energy to work to produce new goods, falls under our new definition of capital goods. On the other hand, it seems that the food consumed by the person who simply stores the food energy in their fat tissue does not fall under this new definition of capital goods.

But, things are not so simple. For the energy stored in the fat of the person could be utilized in the process of work by that person in the production of goods at some future time. Should that occur, we would need to consider the foods consumed earlier (the energy from which was stored in fat) as capital goods, given that the consumption of those foods proved to causally contribute to the production of other goods. Thus, we could not dispute the retort of “I am merely engaging in asset transformation to better prepare for future productive work!” from a fellow whom we were to criticize for doing nothing but getting fat from his gluttony and laziness.

A similar example is that of the growing child. A person will consume many goods from birth until adulthood. During this time, the person produces essentially nothing (except dirty diapers). However, once the person reaches adulthood, they can begin to work to the effect of producing goods. Thus, all of the goods consumed by that individual from birth until adulthood, the consumption of which contributed to the establishment of that individual's capability to perform the productive (goods producing) work in adulthood, must then be considered as capital goods (by our new definition). On the other hand, if a person were to suffer an unfortunate accident before reaching the time at which they could engage in productive work, those same goods consumed in childhood could not be considered capital goods by our definition, since they would have contributed nothing to the production of other goods.

Thus, we see that goods can be consumed in a way which enables them to be qualified as capital goods at a point some time after their consumption, (because of how their consumption created a potential for future production). Further, this is even the case for goods which were used to effect the destruction of other goods. For, sometimes, the destruction of goods is needed to make way for the production of other (hopefully new and better) goods. In controlled demolitions of large buildings, for example, there is a use of goods to destroy other goods. But, in the final analysis, such destruction is seen to have contributed to the production of other new and better goods. Thus, the goods used to bring about that destruction must be classified as capital goods, as the use of them causally contributed to the production of new goods. As another example, machines might be used to rip up the asphalt which makes up a road, but, by such destruction, the way is made for a new and better road to be laid, and, therefore, we would need to consider those machines to be capital goods as well.

It seems, then, that we can not possibly measure the amount of capital goods in existence at one time, for, many of the goods the use of which might have no contributive causal relation to the production of other goods at one moment, may prove, at some future time, to *have been used* to causally contribute to the production of other goods.

Overcoming Problems of “Tense”

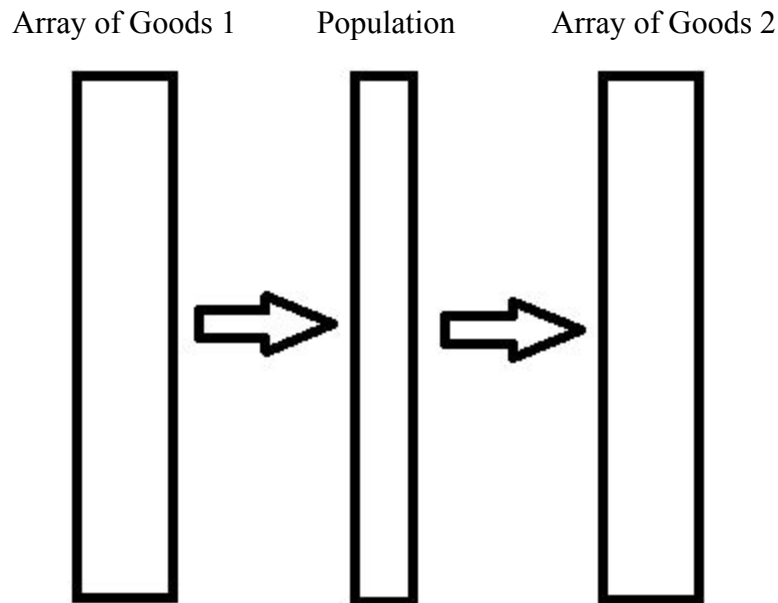
Let us restate our current working definition of “Capital Goods”: *Goods which are used in a way which contributes to the production of other goods, rather than used in a way which does not contribute to the production of other goods.*

We will now try to overcome the problems of *tense* arising out of the above definition-- that is, the inability to use the definition to determine whether to categorize certain existing goods as “capital goods” due to the uncertainties as to whether the potentialities for future goods production made possible by the use of those goods will be actualized in future goods production. Again: because the effect of the use of a good might not itself causally contribute to the production of another good until some future action is taken to bring that effect into causal connection to the production of another good, there are some goods which we are unable to say are capital goods or not at any one moment.

In order to overcome these problems, we can idealize the way in which we think about the process of consumption and production as occurring only in discrete intervals of time. This will enable us to overcome problems of categorization arising out of uncertainties respecting ultimate causal contribution of the use of goods indicated above. While this is an idealization, and, thus, a departure from reality, the use of the idealization may enable us to arrive at certain useful results

which can be subsequently modified by divesting them of the assumptions of the idealization, therefore, allowing a more direct application to reality.

For this purpose, let us make use of the idealized model of social reproduction represented by the bar diagram:



At a certain point in time, a society has a certain array of goods available to it for consumption. As these goods are consumed, new goods must be produced if the society is to maintain the quality and quantity of goods available to it. We can idealize this process of consumption and production as occurring in discrete intervals of time. That is, we can imagine that all of the goods available to a society are consumed over a certain definite time interval, while the production of all the goods produced by that society is completed only at the end of that time interval. This is represented in the above figure.

Let us consider every single good existing in a society. Of all these goods, which are capital goods? Making reference to the above figure, we might say that only the goods in “Array of Goods 1” (AG1) would be considered capital goods, since AG1 was the array of goods associated with the production of AG2. However, we cannot assume that the use of every single good in AG1 by a society over an interval of time causally contributed to the production of AG2. Out of all of the goods in AG1, only some of them will correspond to our working definition of capital goods, for it is likely that the use of only some of them would have causally contributed to the production of AG2. We call the array of goods within AG1 which correspond to our definition of capital goods to be AG1*.

We will notice the following possibilities respecting the relation of AG1* to AG2:

- 1.) AG2 could contain all of the goods in AG1*, plus some other goods not in AG1*.
- 2.) AG2 could contain only all of the goods in AG1*.
- 3.) AG2 could contain only some of the goods in AG1*, plus some other goods.
- 4.) AG2 could contain only some of the goods in AG1* and no other goods.
- 5.) AG2 could contain non of the goods in AG1*, plus some other goods.
- 6.) AG2 could contain no goods at all (zero production).

Option 6 is a peculiar situation in which no production occurs out of the consumption of goods by society. In such a case, there would be no capital goods in AG1.

All of the above listed scenarios (besides option 6), there would be goods within AG1 corresponding to the definition of capital goods (the array of which we would call AG1*). Accordingly, we can reformulate our above definition of capital goods in a way consistent with the idealized model of production and consumption, which we have adopted for the purpose of eliminating the problems of “tense” described above, as follows: *Capital goods are those goods, included in the first array of goods (AG1), the consumption of which by society over a certain time interval causally contributes to the production of the second array of goods (AG2).* I will note, reminding the reader of an earlier section, that it is necessary to speak of an “array” of goods the consumption of which results in the production of another identical array, since, in a complex economic system, it is only the *coordinated consumption* (or, coordinated use) of many different goods which results in the total productive effect, not the use of individual goods in isolation.

But, before contenting ourselves with this definition, let us see if we can identify certain situations in which the use of this definition would violate our sensibilities in such a way that we would be prompted to modify our working definition once more.

Productivity

We consider the question of *productivity* of use of AG1. AG1 might be used by a society in a way corresponding to option 1. On the other hand, that same society might use an identical AG1 in a way corresponding to option 4. Clearly, the productivity of use of AG1 by the society would be greater in the former case than it would be in the latter case. It might be said that the AG1* in the former case would be different than the AG1* in the latter case. This could be so, and, if it were, we would not be able to make a comparison of the relative productivity of use of the same array of goods by each society, since different arrays of goods would have been used. But, let us make the reasonable assumption that two identical societies could use identical arrays of capital

goods AG1* to produce different arrays of goods AG2. That is, let us assume that the productivity of use of an array of goods by a society is variable.

Let us entertain some extreme examples to illustrate the problems with which we are confronted at this stage in our inquiry.

Assume two identical societies consume an identical arrays of goods (AG1*) in a way such that the consumption of each good in the array causally contributes to the production of a new array of goods AG2. Imagine that one society manages to produce an AG2 which is equal to AG1*. Imagine that the other society is so inefficient in their use of AG1*, that the AG2 which they produce is comprised of only a single teacup.

According to our definition, the arrays of capital goods consumed in the two societies would be equal in this situation. But this violates our sensibilities. How can we say that one batch of goods is just as much to be considered capital goods as another batch of goods, when the consumption of the first only resulted in the production of a single good, while the consumption of the latter resulted in the production of a large array of a variety of goods? We are almost inclined to say that the first batch of goods should be considered “capital goods” *less* than the second batch of goods.

Is there a way in which we might be able to modify the definition so as to ensure that we are establishing some kind of standard of productive use of goods before they can be classified as “capital goods”? Let us adopt this modified definition to see if we obtain the desired result.

Capital goods are those goods the consumption of which by society over a certain time interval causally contributes to the production of an equal or greater array of goods.

This seems to be an innovation. Only those goods in the array the consumption of which results in an equal or greater array can be considered capital goods.

It will be noticed, briefly, that this definition seems to implicitly address the requirements of a society for existence within the universe. How? Because, if, by our definition, we include in the category of “capital goods” all of the goods the use of which causally contributed to the production of an array of identical goods over time, we necessarily include those goods which sustain human existence in the universe, since, without human existence, no goods would be produced. That is, since human existence must be maintained in order for any goods to be produced, all goods the consumption of which causally contributes to the sustenance of those humans which produce goods included in the subsequent goods-array must also be said to be

capital goods. In other words, all goods consumed in the sustenance of the existence of capital goods producers are themselves capital goods.

But, what about instances in which the consumption of an array of goods causally contributes to an array of goods which is quantitatively larger and/or qualitatively different?

The question might be raised, also, how it is that we know that the goods produced by the consumption of these capital goods are as *useful* to society at the point in time at which their production has been completed as they were during the time of their consumption? For example, if a society were to consume AG1* and produce an AG2 which were identical to AG1*, how could we know that the subsequent consumption of AG2, with the same amount of labor and mode of use, would again result in the production of an identical array of goods? Environmental conditions, for instance, could change, reducing the ability of society to use the same goods to produce another batch of identical goods with the same amount of labor. This question applies equally well to cases in which the use of AG1* results in the production of an AG2 which is equal to, or larger than, or qualitatively different from, AG1*. Further, what if a society were to produce an AG2 which had less goods in it, but which was, actually, more useful than the AG1* the consumption of which produced it?

If we assume that all other factors are constant (such as environmental conditions, technological and scientific advancement, labor force population, total labor expended over the time interval, and so on) the above definition might satisfy us. For, then, the usefulness, or, productive potential, of the goods produced by the consumption of the capital goods is assured.

However, those factors are never constant. Therefore, we should try to find a definition which does not rely on the assumption that all those factors are fixed in order to be of any help to our efforts to establish a certain standard of productive use for those things which are to be considered as capital goods.

Let us try to provide a definition which does not assume the fixing of these important productive factors, and which also addresses the issue of the possibility that greater usefulness might be provided by an AG2 which were to have less goods in it than AG1*.

Capital goods are those goods the consumption of which by society over a certain time interval causally contributes to the production of an array of goods of equal or greater aggregate usefulness.

This definition seems to work since it guarantees that only those goods included in AG1 the consumption of which contributes to the production of another array of goods which is just as

useful as -or more useful than- AG1*. But, we are now confronted with the task of defining “usefulness”, or, aggregate usefulness.

“Aggregate Usefulness”

How do we define “aggregate usefulness”? Let us make a first attempt.

We begin with the case of a society which, in the consumption of AG1 reproduces an array of goods AG2. Out of those goods in AG1 consumed, only some of them would have been used in a way which causally contributed to the production of AG2; we refer to this group of goods as AG1*.

How do we account for the introduction of a new good, or multiple new goods, into this process of social reproduction?

We start by assuming that the production of AG2 out of the consumption of AG1* requires a certain quantity of labor expended over the interval of time with which we are working. Assuming all other factors, like environmental conditions, the length of the time interval etc., remain constant, we have the following: If the quantity of labor involved in the consumption of (AG1* + some new good (NG)) which results in the production of (AG2 + NG) is less than the amount of labor involved in the consumption of AG1* which results in the production of AG2, then, the introduction of NG would represent an increase in aggregate usefulness of the totality of capital goods. For, less labor would be required to produce the same product.

What about the case in which a good in AG1* were to be replaced with a new good? How might we determine if aggregate usefulness had been increased?

In the case that one good in AG1* were to be replaced by a single new good (NG), then, if the quantity of labor involved in the consumption of (AG1* - replaced good (RG) + NG) which resulted in the production of (AG2* - RG + NG) were less than the quantity of labor involved in the consumption of AG1* which resulted in the production of AG2*, then, aggregate usefulness would have been increased. Less labor would have been required to produce the same product. We can imagine a situation corresponding to this as that in which a single product of higher technology replaces a lower technology product.

This all seems to make sense. But, what if we were to replace more than one good in AG1*? Let us take an extreme example: What if *every* good in AG1* were to be replaced by one single good? What if we replaced every single good available to the complex modern economy with a single shovel, for instance? In this case, we would be replacing goods in AG1* with a new good.

It may actually be the case that the man lucky enough to get the single new shovel would be able to reproduce the single shovel in the time interval of production, meaning that the total labor expended to reproduce the new array of goods (or, in other words, a single shovel) would be far less than the amount of labor required of society to reproduce the vast and variegated array of goods corresponding to a modern economy. It seems that we would need to admit that, in this case, aggregate usefulness would be increased, at least according to the meaning of aggregate usefulness suggested by the above examples intended to illustrate what is meant by “aggregate usefulness”.

But, of course, if this were to actually occur- if every single good available in a modern economy, like the USA today, for example, were to disappear and be replaced by a single shovel, then there would be mass death of the persons living in that society, for the goods the consumption of which would be needed to sustain a large population would no longer exist.

From this we see that, if we pivot the definition of capital goods, and the aggregate usefulness of arrays of capital goods, solely around the issue of the reproduction of goods and the labor required for that reproduction, we open up the possibility of absurd consequences respecting the reproduction of the human beings in a society. When we look back at what we said earlier respecting the way in which an earlier adopted definition implicitly addressed the requirements of human existence in the universe, we notice that the definition only did so for those who were considered capital goods producers. Thus, by changing the array of capital goods to one involving less producers, the less persons there are whose existence is assured by the assumption of constant capital goods reproduction. For instance, if we measured the usefulness of one array of goods as compared to another solely on the basis of which array of goods required less labor to reproduce by society, we would say that the array of goods available to caveman society would be more useful than the array of goods available to the USA today, since the caveman array would require less labor to reproduce. Of course, if all of the goods in the USA were to be replaced by a batch of caveman goods, there would be mass death. Indeed, the most useful array of goods, by this idea of usefulness, would seem to be not very useful at all.

How might we attribute a meaning to the word “usefulness” which addresses the needs of human existence to a more complete extent?

Let us, then define “usefulness” as it is used here, to refer to two things: 1.) The usefulness of the goods aggregate to the sustenance of the human species at constant or greater levels of population and/or average lifespan; and 2.) The usefulness of the goods aggregate to the production of another goods aggregate with a given amount of labor.

We can conveniently refer to the average lifespan in conjunction with the total population of a society by a single value which is the product of those two values-- those two values which seem suitable to indicating the degree to which human existence is being promoted by a society- we call it the "Existence Metric" or EM. By taking the product of average lifespan and the total population within a given society inhabiting a fixed area of land, we produce a value which is a convenient shorthand way to indicate the general degree to which that society is promoting human existence, without indicating the exact proportion between that society's average lifespan and total population.

With the two factors of EM, and total labor required for the reproduction of the goods array, it seems that we can compare the usefulness of two arrays of goods in the following ways:

If a new array of goods AGN replaces AG1, AGN is more useful if the EM of the society sustainable through the reproduction of AGN is equal to that sustainable through the reproduction of AG1 while the amount of labor required to reproduce AGN is less than that required to reproduce AG1.

If a new array of goods AGN replaces AG1, AGN is more useful if the EM of the society sustainable through the reproduction of AGN is greater to that sustainable through the reproduction of AG1 while the amount of labor required to reproduce AGN is equal to that required to reproduce AG1.

But, what about cases in which neither the EM value potential, nor the required-labor of reproduction, of two arrays of goods are equal, to enable us to make this comparison? The above example of all of the goods in a modern economy compared to a single shovel is an example of such a case.

Perhaps we can address the question of relative usefulness in such situations in the following ways:

If the labor required to reproduce AGN is less than that required to reproduce AG1, and the EM sustainable through the reproduction of AGN at that amount of labor is less than the EM sustainable through the reproduction of AG1, then, AGN is more useful if the level of labor involved in the reproduction of AGN could be increased to equal that required for the production of AG1 such that the EM sustainable in that reproduction of AGN would be higher than the EM sustainable through the reproduction of AG1 at that amount of labor.

The same method of determination could be used to identify the more useful array of goods in the case that the labor required to reproduce AGN is greater than AG1, while the EM sustainable

through that reproduction were also higher. That is, if the labor required to reproduce AGN was higher than that of AG1, while the EM sustainable through that reproduction were higher than that sustainable through the reproduction of AG1, then, AG1 would be more useful if the amount of labor involved in the reproduction of AG1 could be increased to equal the amount required to reproduce AGN while the EM sustainable through the reproduction of AG1 at that increased level of labor were higher.

Returning to our hypothetical case of the replacement of an advanced society's AG1* by a single shovel, the total labor required to reproduce the shovel may be well below that required to reproduce AG1*, and the EM of the society attained through the reproduction of the shovel would be far below the EM of the society attained through the reproduction of AG1*. We then ask, could the amount of labor involved in the reproduction of the shovel alone be in any way increased such that the EM of the society engaged in that reproduction could ever attain the EM of the society reproducing AG1*? The answer would be no. Therefore, the lonesome shovel is of lower aggregate usefulness than the AG1* of an advanced economy.

Before taking up the question as to how we are to compare the usefulness of different arrays of capital goods the EM and reproduction-labor values of which have no overlap, let us see how we might proceed based upon what we have discussed up to this point..

To restate our definition with the notion of "usefulness" made more clear, we have:

Capital goods are those goods the consumption of which by society over a certain time interval causally contributes to the production of an array of goods (AG2) which is equally useful or more useful.

Elimination of Useless Goods from the Defined Category

The kinds of unpalatable results arising out of definitions of capital goods which do not address, in some way, the question of the usefulness of goods are avoided by this definition. For example, if we take the definition of capital goods as those goods which are used to produce other goods, we would need to categorize all goods which were used to make anything called a "good" as capital goods- no matter how useless that "good" might be. We would need to categorize, for example, the human feces contained in the piece of modern "art" named "Artist's Shit"² as a capital good, since, apparently, there are actually some unfortunate persons who consider that

²That's right, there is a piece of "modern art" called "Artist's Shit" which is nothing but a can of human feces. One can recently sold for 275,000 Euros, or about 319,000 dollars. See https://en.wikipedia.org/wiki/Artist%27s_Shit

disgusting item to be not only a “good”, but *art*-- art worth \$319,000 according to the latest purchase price. This extreme example is enough to illustrate the nature of the problem.

But, how does our above definition eliminate this problem? Because we defined capital goods as *those goods the consumption of which by society over a certain time interval causally contributes to the production of an array of goods (AG2) which is equally useful or more useful*, we necessarily eliminate from the defined category of capital goods those things the consumption of which does not causally contribute to the production of an array of goods of equal or greater usefulness. A can of a lunatic’s feces seems not to be something which could be integrated into the total process of production in a way which were to either reduce total reproduction-labor or augment the EM of society. Thus, the feces used in making that “modern art” is not included in our defined category of capital goods, whereas, that feces is included in Oxford’s definition of capital goods (as well as some of our earlier ones).

In response to this, it might be said that anything could be put to some useful purpose; anything could be used in some way which contributed to social-material reproduction. This is an assumption however. There is such a thing as opportunity cost. The very attempt to put a relatively useless thing to some sort of useful purpose might cost a society more than the benefit derived from the putting of the thing to use-- even assuming that any benefit would be derived at all. By our concept of usefulness, the consumption of a relatively useless good during the process of economic reproduction would either lower the EM attainable by that society with a given amount of labor, increase the amount of labor needed for the reproduction of the goods array available to society, or both.

Based on these considerations, it seems that the definition of “capital goods” at which we have arrived under the assumption of the idealized model of social reproduction is quite adequate. We will restate the definition here:

Capital goods are those goods the consumption of which by society over a certain time interval causally contributes to the production of an array of goods (AG2) which is equally useful or more useful.

Impossibility of Knowing Which Goods Correspond to the Definition

Now, we return to our original task of measuring the amount of capital good which exist in a society- how is this to be done? There are more problems here.

Take the following example:

What if a man were to desire a certain good, like a shiny new bicycle which he saw in the display window at his local bicycle store. If the man had no means of producing the bicycle himself, and no money with which to buy the bicycle, he would need to either find a way to make the bicycle himself, to steal the bicycle, or to procure the money requisite to its purchase. Let us imagine that our hypothetical bicycle lover decided to procure money enough to purchase the bicycle. For this purpose, he finds employment in the production of goods. After working enough hours producing these goods to earn enough money to buy the bicycle, he quits his job and buys the bicycle. Here we have a situation in which one good, the bicycle, causally contributed to the production of other goods-- seemingly before it was even used. For, if the bicycle did not exist, the man would have had no desire to purchase it, and would, therefore, have had no desire to work for pay in the production of other goods. It seems that the bicycle somehow contributed to the production of the goods which the man contributed to producing at the job he took.

We might note that we defined capital goods as those goods which are *used* in a way which leads to the production of other goods, and that, in this case, the bicycle is not used by the person who desires it. This sounds true. Yet, we would need to more clearly define the word "use". For instance, do we "use" a painting when we look at it? It would seem, in fact, that the primary "use" of a painting is simply the looking at of it. Therefore, if the looking at of a painting can be considered "use" why not the looking at of a bicycle? Thus, if a bicycle is used by looking at it, and that use creates a desire to have it, then that use would need to be considered as causally contributive to everything which that desire would lead the person to subsequently do-- including working to make goods for pay. Therefore, it seems that the bicycle must be considered as a capital good by our definition, even though, initially, we never would have thought it to be so.

This illustrates one of the problems of identifying those things which correspond to our definition. For, the causal influence of one thing upon another may be difficult to discern due to being so remote from, or indirect to the cause. Causal influences may be exerted in ways which are unexpected. When we consider the seemingly infinite number of ways in which efficient causal influences might play into the bringing about of a particular effect, we tend to alternate between thinking that the attempt to identify all of the things which causally contribute to an occurrence is hopeless, and thinking that perhaps there is nothing at all in the world which could not, upon sufficient examination, be said to not causally contribute to every occurrence in some way.

Further, it seems that our definition precludes our ability to ever identify all of the goods in a society which might correspond to that definition for another reason.

We defined capital goods as those in the array of goods the consumption of which *causally contributes* to the production of goods. But, it is in the nature of things that the we mortals never

attain unto a complete knowledge of things. Therefore, no one can attain unto a complete knowledge of the causal relations adhering in the universe. Therefore, no one could ever identify *all* of those human activities (and the goods consumed in those activities) which causally contributed to the kind of production referenced in our definition. It would not only be impossible in practice, but impossible in principle.

For instance, someone might define all of the air molecules in an arbitrary volume of space at some arbitrary point in time as being of interest. In principle, every molecule corresponding to that definition could be identified by persons with sufficient observational capabilities; while, in practice, the task might be impossible. As another example, we might define every every body in our galaxy of mass greater than 1Kg as of interest. In principle, it would be possible for us to count every such body, but, in practice, it would be impossible. However, in the case in which we define capital goods in the way we have, it would not be possible, in principle, for anyone to ever determine what goods in the society corresponded to that definition of capital goods, for that would necessitate a complete knowledge of all of the causal principles operative within the universe-- how else would we identify all the goods the use of which causally contributed to production of the type referenced in the definition?

After all this effort at identifying the most adequate definition of capital goods, we have only come to find that it is impossible, in principle, to ever identify all of the goods which correspond to that definition.

Perhaps, we can settle for a modified definition: "*Capital goods are those goods the consumption of which by society over a certain time interval is known to causally contribute to the production of an array of goods (AG2) which is equally useful or more useful.*" Although, we feel a little uneasy about leaving out those goods the consumption of which does indeed causally contribute to the production of useful goods even if it is not understood that they do, this definition seems at least to provides us with the ability, in principle, to identify at least some of the goods in a society which correspond to our preferred definition.

However, we must notice another problem. How are we to be sure that the notions of causality which we have at any moment are valid?

The modified definition we have adopted above tacitly assumes that a person can attain unto true knowledge of *some* of the causal relations adhering in the universe, even if it is not *all* of the causal relations. However, as the history of the development of science has shown us, the hypotheses respecting the causal principles of nature seem to be *always* subject to supplantation by different hypotheses which are found to be more fruitful in the adherence of society to them. That is, we seem obliged to admit that no hypotheses, including hypotheses respecting causal

relations, are ever immune to supplantation by new and better hypotheses. Therefore, how can we say that a person ever has an actual knowledge of causal relations, when their ideas of causal relations is always subject to supplantation of a type which impels a retroactive judgement of their old ideas of causal relations as being *incorrect*?

Therefore, even if we assume, as our definition does, that the basis of all occurrences in the universe (including the production of goods) is the interplay of operative causes, we are obliged to concede that mankind never attains unto a true understanding of these causes, and that, therefore, adherence to the last definition proposed would necessitate that no goods could ever be categorized as “capital goods”!

We might avoid this difficulty with the following modified definition: “*Capital goods are those goods the consumption of which by society over a certain time interval is hypothesized to causally contribute to the production of an array of goods (AG2) which is equally useful or more useful.*”

However, since various persons have various hypotheses of causal relations, this definition of capital goods would correspond to different sets of goods for different persons.

Perhaps we could modify this definition as: “*Capital goods are those goods the consumption of which by society over a certain time interval is hypothesized, by the person using them, to causally contribute to the production of an array of goods (AG2) which is equally useful or more useful*”

This definition would eliminate the problem of the definition corresponding to different sets of goods for different persons, since every good-user’s hypothesis about causality is incorporated into it.

But, the adoption of this definition creates another problem. What if there were a society of strict empiricists who did not entertain hypotheses about the causal relations of processes in nature? Our definition of “capital goods” would correspond to no goods at all in such a society- that is, by our definition, that society would have no “capital goods”!

In light of this, perhaps we should adopt a slightly different approach to the question. Let us adopt the one of our previous definitions: *Capital goods are those goods the consumption of which by society over a certain time interval causally contributes to the production of an array of goods (AG2) which is equally useful or more useful.*

Despite the fact that we cannot, for reasons indicated above, know what goods correspond to this definition, we can still *guess* what goods correspond to this definition. Though we cannot attempt to measure the amount of goods corresponding to this definition, we can attempt to measure the amount of goods which we guess to correspond to this definition. Though we are guessing, it is not unwarranted to assume that some of our guessing is correct. For example, the consistent correlation of certain activities with certain specific changes in nature provides a strong suggestion that those activities causally contribute to those changes in nature. Therefore, consistent correlation of certain activities with the production of goods strongly suggests that those activities are causally contributive to the production of those goods, which, in turn, strongly suggests that the goods used in those activities correspond to our definition of capital goods.

Though we do not like to measure a set of goods which we only guess to correspond to our definition of capital goods, it seems to be the best we can do.

Potential Capital Goods

A question might be raised at this point in the investigation as follows: “What about the goods in a society which *could have* been used by the society in a useful way, but which were not used in a useful way? Is it not an error to leave out such goods from what we consider to be a society’s stock of capital goods?”

The definition we have adopted simply includes all goods utilized in the way indicated by the definition. It does not include goods which *could have been* utilized in that way. But, the question of goods which *could have been* used as capital goods is still worthy of consideration. It seems that, in order to do so, we need to clarify what we mean by “*could have*”.

For the sake of argument, let us assume that every person in a hypothetical society were to be motivated solely by the desire to engage in the most economically useful behavior possible.

Then, it follows that such a society would achieve the maximum EM value through the cycle of consumption *which the collective knowledge of the persons in the society enabled them to attain*, and, that the consumption by that society of AG1 would result in the production of the most useful new array of goods (AG2) *which the collective knowledge of those persons enabled them to attain*.³

³ Although, this brings up another question that might be raised: It seems possible that the persons in a society might sacrifice a certain amount of the EM which they might attain for themselves over a certain cycle of consumption in order to ensure that the array of goods resulting from their consumption (AG2) would be of greater EM potential than the AG2 which would have been produced had that society operated in such a way as to achieve a higher EM

However, we can imagine that those same persons, in the same society, with the same environmental conditions, and the same AG1 available for consumption *could have attained a higher EM* through their economic reproduction as a result of better *knowledge* of the productive potentialities of the goods available to them. We can easily imagine that some of the goods in AG1 which had not been utilized in the former case as capital goods, would be used in this case as capital goods. Thus, we can see how it is possible that there could be goods in a society which *could have* been used as capital goods but were not.

We can extend this thought experiment to the case of a society in which each person had *infinite knowledge*. Only such a society (granted that its inhabitants were motivated in the way as stated above) would behave in such a way that we could guarantee that *all* of the goods in that society's AG1 which *could be used* as capital goods *would* be used as capital goods. On the other end of the spectrum, a society in which the inhabitants had no knowledge at all would utilize none of the goods in AG1 as capital goods- for they would not know how to do so, and they would perish.

Measuring Capital Goods

Now that we have defined capital goods, how are we to measure the “amount” of capital goods within a society, or a country?

The usual means by which the “amount” of goods is measured in economics is by considering the market prices of those goods. From this, we might imagine that we could quantify the amount of capital good in a society by adding up all of the prices of each good which falls in the definition of capital good. It has been pointed out, however, that in the HO model, the profitability of capital goods are determined by their scarcity. The more scarce are the capital goods, the greater is the profitability of their employment. However, it is supposed to be the case that the price of a good is determined by the profitability of that good. Therefore, a logical contradiction is created: If capital is scarce, then it is profitable, then it is high in price, then it is abundant. That is, if capital is scarce, capital is abundant. Apparently, problems such as this have created great disputes amongst academic layers, one such dispute being dubbed the “Cambridge Capital Controversies”.

Also, since the market price of things does not necessarily reflect their usefulness, this would be an inadequate measure.

value over that same cycle of consumption. Which is better for a society to do? Sacrifice EM in the present for EM in the future, or sacrifice EM in the future for EM in the present? How might the proper balance, or harmony, be found?

Someone might ask: “Why not simply enumerate all of the goods corresponding to the definition and use the number arrived at as the basis for comparing the amounts of capital goods in society?” This would not be satisfactory, because there might be one array of goods which has numerically less goods than another array of goods and yet which is more useful than the array with more goods in it. This same problem can be said of any measure of capital goods which is specific to the goods themselves, such as the total mass of the goods, total spatial volume, and so on.

It seems that the only approach to establishing a satisfactory measure of capital goods is one which attempts to pivot the measure of the capital goods around the effect which the capital goods brought about, namely, the production of another array of goods of equal or greater usefulness.

The preceding section *“Aggregate Usefulness”* brought forth a particular problem which must be incorporated into our considerations here. We cannot attribute to one array of goods a greater usefulness than another because usefulness is measured in two ways, by the amount of labor required for reproduction of the array, and the EM sustainable by the society through that reproduction. We can measure the productivity of the labor in achieving a certain level of EM by the use of a certain goods array. However, there may be higher productivity values for lower total EM of a society. But, it seems like it would be more desirable for a society to attain higher EM, even if the ratio of the labor involved in the attainment of that EM to that EM value were higher.

Perhaps, then, it would be better to resort only to the EM value as the measure of usefulness. This would imply that an array of goods were more useful than another as long as its consumption could sustain a higher EM than that other array over the interval of its reproduction. This would solve our problem. The measure of the amount of change in capital attended by a change in the goods array, would be the amount by which the maximum EM value attainable by that society through the reproduction of the new array of goods changed. However, we hesitate to leave out the consideration of total labor required. For, what if there were an instance in which one array of goods had a maximum sustainable EM which was only very slightly higher than another array of goods, while requiring very much greater labor in its reproduction? It seems that the array requiring much less labor at the sacrifice of only a small amount of EM would be preferable.

Perhaps we could take the ratio of the maximum EM attainable through the reproduction of an array of goods to the labor required for that production. Whatever array has the highest ratio would be the superior stock of capital. But, this would not work. For there may be goods arrays

which have very low EM values yet which have high ratios of this type. Clearly, such a goods array would be considered an inferior capital stock to one which had a much higher maximum EM potential and a slightly lower EM to labor ratio.

We will notice another complication: Different societies have different environmental conditions. These different environmental conditions determine the maximum EM value which a society might attain given any particular array of goods and a level of scientific/technological knowledge. Therefore, we cannot compare the “amounts” of capital between two societies which have non-equal environmental condition. That is, since we can only speak of measures of “capital” which are relative to a certain environmental condition, we cannot compare measures of capital stocks which are measured relative to different environmental conditions. This causes us to notice that the same problem applies to a single society. For, the environmental conditions of a single society are always changing. Therefore, we cannot compare the amount of capital of a single society at one point in time, to the amount of capital in that same society at a different point in time.

Thus, it seem that a definition of “capital” which renders that defined by the definition susceptible to measurement has eluded us, and we are left exhausted and bewildered.