Capital and Interest

Lucas M. Engelhardt

8/13/2010

1 Introduction

One central question in factor pricing theory is where interest rates come from. All of economics is derived, ultimately, from the undeniable fact that humans act. This short introduction will lay out how the action axiom implies interest, and just how pervasive interest is in the economy.

2 Human Action and Time Preference

Humans act. It is an undeniable fact, and the foundation from which so-called "Austrian" economists have been working since at least the time of Ludwig von Mises. So, how does the reality of human action relate to interest? Here, there is a phenomenon which is inherent in every action: time preference. Any time a person acts they implicitly show that they prefer sooner to later. Such is the standard argument. One can easily point out problems with the standard argument. After all, with almost every action there is a time before that action. If sooner is preferred to later, by logical necessity, why is it that action did not take place even sooner? In fact, procrastination seems to imply that later is often preferred to sooner for some actions. These objections fade away, however, once we recall the key assumption underlying nearly all economic thought experiments. Sooner is preferred to later *ceteris paribus*. All other things equal, sooner is preferred to later. However, this still does not seem to cut it. After all, even ceteris paribus, I would rather never do any work than do work now. To avoid such criticisms we must add an additional condition (and this condition will help rule out other ridiculous objections). Restating again: for any specific quantity of any specific good, sooner is preferred to later, ceteris paribus. The reason for this is obvious. Consider the choice: I can either have a dollar now, or I can have the same dollar later, and I know that none of the external conditions will have changed between now and then. I will choose the dollar now. Why? Because one possible use of a dollar now is to put it in my sock drawer until later. So, every possible use for a dollar later is present in that current dollar. Therefore, the current dollar must be at least as valuable as the future dollar. In fact, it will likely be more valuable, as the current dollar has uses that the future dollar does not have. For example, with a current dollar I can buy a

candy bar now. As long as there is at least one use for a current dollar that is preferred to the highest valued use of a future dollar, the current dollar will certainly be preferred. Now, once we allow for uncertainty to enter the picture, the preference for the present increases. After all, the future is more uncertain than the present. For example, my likelihood of death is necessarily increasing as I look further into the future. By necessity, the likelihood that I will die before I can use a dollar today is less than the likelihood that I will die before I can use a dollar tomorrow. This probability of death (however small) provides an additional reason to prefer present possession of goods to future possession.

Another objection that may be made is that my logic only applies to goods that are effectively infinitely durable. That is, a dollar does not decay fast enough to prevent a present dollar from being perfectly transformed into a future dollar. However, some goods are not so easily transformed. A glass of milk, after all, will spoil. So, the uses of a future fresh glass of milk are not subsumed by the uses of a present glass of milk, since one is not transformable into the other. This is a valid criticism of using the time preference theory too broadly. Fortunately, it is an objection that is easily avoidable. To understand the phenomenon of interest, it is best to think in money terms, and any good money is sufficiently durable that we need not concern ourselves with the possibility of spoilage.

Thus far, I have established that time preference arises from the fact that humans act. At the very least, action to acquire a good today rather than the same quantity of the same good later implies some preference for the present over the future. This holds certainly for money. Now, we are sufficiently equipped to apply this phenomenon to interest.

3 Time Preference and Interest

If current money is easily transformable into future money, then, if one is to acquire a certain amount of present money, one must offer a larger quantity of future money in exchange. As someone with time preference, I will not accept $1 tomorrow in exchange for $1 today. (Naturally, I'm abstracting from other goods that can be included in this exchange like "good feelings" and "senses of friendship".) If I wanted $1 tomorrow, I could simply hold my $1 until then, and avoid the risk that you would not pay me back and, more importantly, have command over my $1 in case I decided to use it before tomorrow. So, if you want $1 from me today, you have to offer me more than $1 tomorrow. This difference is what we call interest, and it will exist simply by virtue of the durability of money, and the fact that present money, by virtue of its durability, has more uses than an equivalent quantity of future money.

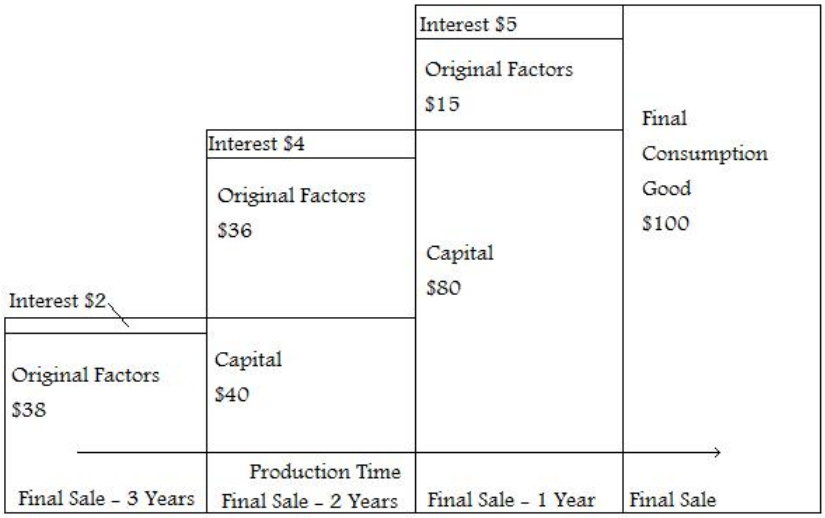
However, this is insufficient to show that interest will actually arise as a real phenomenon. In order for interest to arise, there must be an actual exchange of present money for future money (and vice versa) taking place. For that to occur, it cannot be the case that everyone has the same rate of time preference. After all, if I value $1.03 tomorrow more than $1 today, and $1.02 tomorrow less than $1 today, and you have the same values, then we can never come to an

agreeable interest rate. I will offer to loan you $1 today, but want at least $1.03 tomorrow in exchange. But, like me, you would rather have that $1.03 tomorrow than $1 today. So, no exchange will occur and the phenomenon of interest will not arise. For interest to arise, there must be differences in our rates of time preference. For example, I must value $1.03 tomorrow more than $1 today, while you prefer $1 today to $1.03 tomorrow. Then, there is the possibility of us trading. A sensible result is that those who have relatively low rates of time preference (that is, that require comparatively less future money in return for lending present money) will be "saver/lenders" while those with relatively high rates of time preference will be borrowers. However, this phenomenon of interest has a wider application than just in credit markets. It is applicable any time that there is a tradeoff between present and future money, including during the process of production.

4 Interest, the Production Process, and Capital

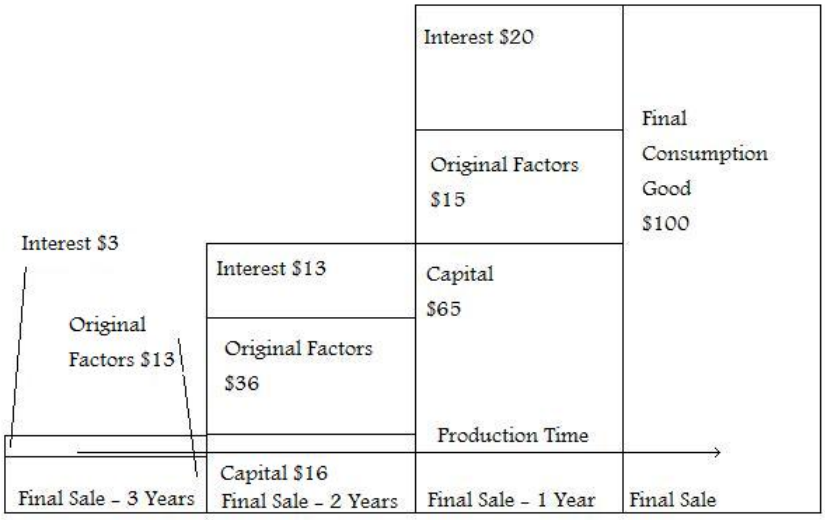
Interest appears in the production process once we recognize that every production process requires time. First, present money is required to obtain the factors of production. Then, they are combined through a production process to create a product which is sold only in the future. Suppose that an entrepreneur has a product in mind that they think can be produced in one year, and which will sell for $100 at that time. How much would they be willing to put into the factors of production today? Naturally, it depends on the entrepreneur's rate of time preference. Suppose that the entrepreneur values $100 in one year just more than $95 today, but less than $96 today. In that case, the entrepreneur is willing to pay up to a total of $95 today for the factors of production. This is equivalent, from the entrepreneur's perspective, to lending $95 on the credit market, expecting to be repaid $100 in one year. Because both are possible uses of saved funds, the internal rate of interest in the production process must be equal to the rate of interest on credit markets. This follows from a simple no-arbitrage condition. If the rate of return is larger on the credit market than in the production process, then entrepreneurs will not bid for factors, which would tend to drive factor prices down. Savings would all flow into credit markets, increasing the supply of credit and driving interest rates down in that market. The result is that the two "time markets" must have the same rate of return on the margin. Consider the opposite case: the rate of return is larger in the production process than on the credit market. In that case, it is possible to earn an infinite rate of return simply by borrowing funds and then investing them in the production process. But, as entrepreneurs move to take advantage of that opportunity, an increased demand for funds on the credit market will drive that interest rate up. Also, increased demand for factors would drive factor prices up, decreasing the rate of return in the production process. This process continues until the two rates of return are equal. So, the rate of internal interest in the production process and the rate of interest on the credit market must be equal on the margin.

The logic goes a step further when we think about the nature of the production process, and the factors that are used in production. The factors may be divided into two types: "original" factors and "produced" factors. The original factors of production do not require any production process to be brought into existence. For example, labor and natural resource exist naturally. Produced factors of production are precisely what the name implies: factors of production that are themselves the result of a productive process. This is what is typically called "capital", and it includes everything from machinery to steel to goods half-way finished, and even inventory waiting to be delivered and sold. So, revisiting the previous example: the entrepreneur expects to make \$100 by selling the product when it is finished in one year, but must pay \$95 for the factors of production. This \$95 is divided as follows: \$15 for original factors (labor and natural resources), and \$80 for capital. But, this capital was also produced. So, there must have been a previous production process, and that entrepreneur (assuming, for simplicity, that their expectations were correct) expected to get \$80 at the conclusion of the production process. If they required the same rate of return as the first entrepreneur (and, from a no-arbitrage condition, they will), then the second entrepreneur would pay no more than \$76 for the factors of production for his production process. Suppose that of the \$76, \$36 is for original factors, and \$40 for capital. The capital from this stage must also have been produced. That entrepreneur would be willing to pay up to \$38 for the factors of production. Suppose, just to bring an end to this example, that all \$38 were used for original factors. One can easily convert this into a figure like this:

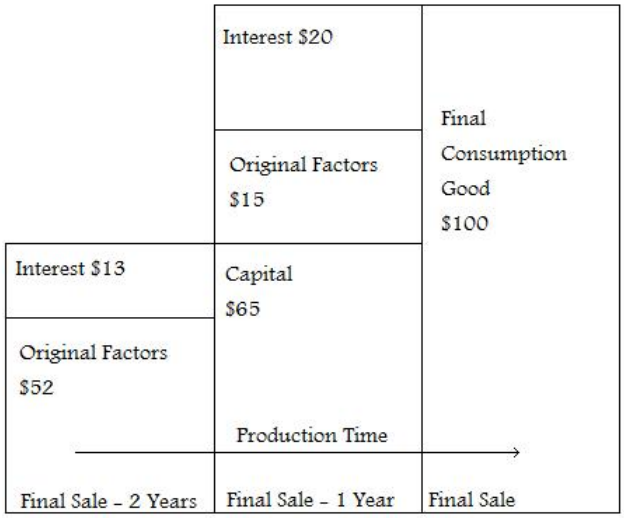


Now one can consider the impact of interest on the production structure. In the previous example, the interest required was roughly 5%. Consider a case

where the interest rate is mush higher. Say, 20%. In that case, the figure would have to be redrawn as:



Here, for simplicity, I assumed that the cost of original factors did not change in the late stages of production. But, if that is true, then the increased portion of interest must diminish the quantity paid for capital. This causes significant problems at the earliest stage of production, as rather than $38 to purchase original factors, the first stage only has $13. It is certainly true that the previous technology will not be viable under this new interest rate. In fact, we would expect the production structure to change to eliminate this stage of production, as it cannot be carried out. Consider a different production technology. In the Final Sale - 2 stage, no capital is required, but $52 of original factors are needed. In that case, the Final Sale - 3 stage can be eliminated, resulting in a production structure like this:

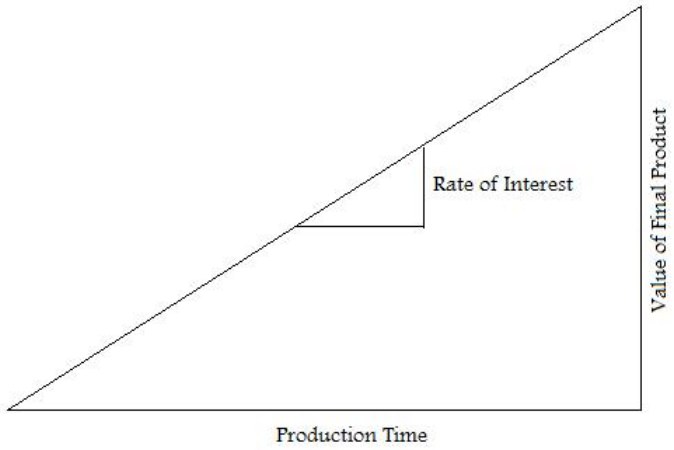


The earliest stage of production has been eliminated. So, we have shown that there is a tendency for high interest rates to decrease the time for production. The opposite follows: low interest rates tend to increase the time of production. Now, a natural question arises: Why would an economy choose a longer period of production at all? In fact, choosing a longer period of production when a shorter one is available (as is the case in this example) seems to violate the principle of time preference. After all, in the longer structure, the consumer must wait 3 years to get the product, while now the consume must wait only 2 years to get the same product.

Here, the answer is obvious: our example is unrealistic. I assumed that one could achieve the same result with a long production process and a short one. However, this is very rarely true in the real world. In the real world, we voluntarily undertake long production processes because they are more productive than shorter production processes. That is, they give a result that is better. Consider a simple case of Robinson Crusoe on an island. He has 8 hours a day to spend catching fish. If he spends all 8 hours fishing, he can catch 1 fish per hour: 8 per day. However, if he fishes for 6 hours and spends 2 making a net, he can make a net in 5 days. Then, fishing with the net, he can catch 2 fish per hour (but the fishing net requires 1 hour of maintenance per day to keep it usable). So, Robinson can opt for the shorter production process whereby he produces 8 fish a day, or he can opt for the longer production process which, eventually, will yield 14 fish per day (7 hours fishing + 1 for mainenance). All it takes is 5 days of only catching 6 fish rather than 8. This illustrates the role of time preference as well. When Robinson begins to make the net he has decided to give up 2 fish on that day (and the next four) in exchange for an additional 6 fish in 5 days (and every day following). If Robinson is very impatient, then he will not make the net. (The reason for this impatience might be that Robinson

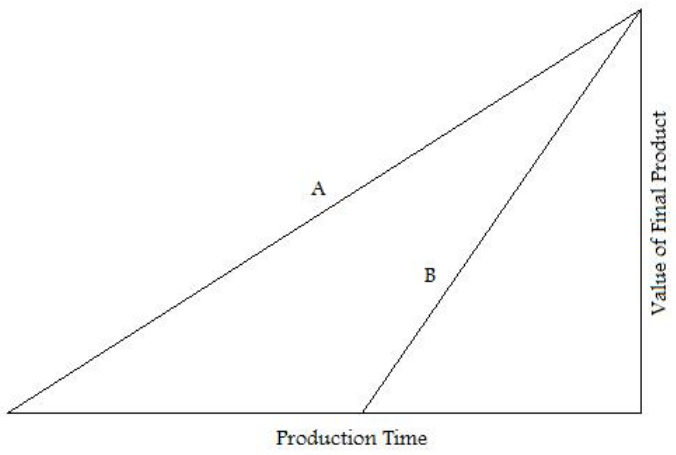
needs 8 fish per day in order to survive.) But, if he is patient, he will make the net. One thing is certain: If the net would only provide the same amount of fish per day as not using it, then Robinson would not bother making the net. Making the net would be pure waste. So, the end result is that Robinson will invest his labor time in making the net if and only if (1) the net will increase production when it is complete and (2) Robinson is sufficiently patient to value the increase in future production more than the current production that could be obtained by not producing the net.

The same principle applies to the larger economy. If we can achieve the same result through a short or long production process, we will obviously choose the shorter process. Using a longer process would waste resources and lead to unnecessary waiting. So, if we use longer processes it must be that these longer processes are more productive. To further illustrate this point, it may be advantageous to introduce Hayekian triangles. Friedrich Hayek, starting with the concept that underlies the figures above, simplified them into the following diagram.



Hayek simplified the figure to focus on the impact of the interest rate on the time structure of production. The interest rate in this figure is approximated by the slope of the triangle's hypotenuse. So, if the interest rate is high, then the time of production will be relatively short. If the interest rate is low, it will be relatively long. The point made here is that a relatively long production process will only be chosen if it is relatively more productive. That is, if the value of the final good is higher in the long production process.

To put it graphically, the decision we face is not a decision between Production Process A and B:



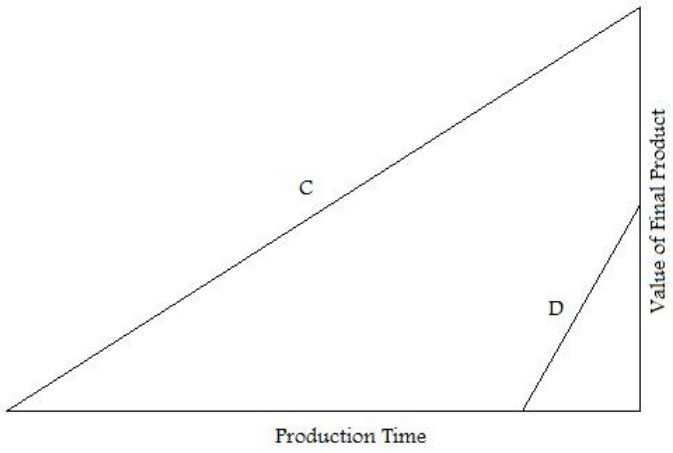
The decision we actually face in the real world is between Production Process C and D on the following page.

That is, we face the choice between "less sooner" and "more later", and it is clear that the choice we make depends on (1) how much less and more? - that is, how much more productive is the longer process?, and (2) how much do I value the present over the future? - that is, what is my time preference?

5 The "Intratemporal" Structure of Production

All that has been spoken of to this point is the structure of capital across time. I have shown that, as interest rates rise, production processes will be shorter, and as a result capital will be allocated away from the "early stages" and toward the late stages. If interest rates fall, the opposite procedure would occur. (Naturally, this process is not without pain in either direction - capital is somewhat specific, and as such it may not convert "fluidly" from one part of the production process to another. After all, a coal pick - which is early in the production process - is not easily convertible into a steel stamping machine - which is late in the process.) However, I have not spoken of capital within a particular point in time. Here, I will limit myself to one major point: capital is heterogeneous. That is, it is not all the same.

When we look at "consumption" in the real world we are faced with a simple reality. It is not all the same. A hamburger is very different from a brussel sprout. In fact, $1 worth of hamburger is very different from $1 worth of brussel sprouts, even though, in the aggregate GDP numbers they are considered



"equal". Thinking one step beyond this, the different types of consumer goods require different types of capital, and some of that capital is "specific". That is, some capital is only good for a limited number of specific purposes. To use Braden Robinson's favorite illustration: you can't go to Burger King and order a BMW. It's not for a lack of capital. Burger King has a lot of capital in the form of the building, deep fryers, heating lamps, and so on. The problem is that the type of capital is all wrong. You can have all the sewing machines in the world, and you still won't be able to produce a microchip (unless, by some chance, you are MacGyver... but that show ended in 1992). The fact is pretty blatantly obvious, but much of macroeconomic theorizing ignores it. Why? Because macroeconomics deals with aggregate values, and therefore apples and oranges must get added together. The difficulty arises when we try to explain macroeconomic phenomena (like business cycles) that may be the result of compositional changes within an aggregate. By the assumed aggregation, we have ruled out such an explanation. An additional, and more dangerous, difficulty arises when we start making policy prescriptions based on highly-aggregated theory. It is far too easy to conclude from highly aggregated reasoning that, in order for an economy to grow, what is needed is "more capital investment". But, it does not then follow that the government can simply invest in additional capital to "grow the economy". Rather, if capital is specific (and it is to at least some degree), then capital must be of the right type if it is to lead to real, lasting, sustainable economic growth. The government building bridges to nowhere, lead baseball factories, or pyramids will not "stimulate the economy" - at least not in the sense of actually making people better off. Such "investments" will be a pure waste of resources as they will divert real factors of production - land, labor, and capital - into projects that do little to fulfill

society's preferences. The only test of whether an investment project is actually the best use of resources is profit. If it is the most profitable project that can be undertaken with the given resources, then it is the best use of those resources. How do we know? Because consumers are willing to pay more for it than for any other possible use of the resources. But, if profit is the only true method of evaluating the ability of a project to satisfy consumer desires to the greatest degree possible and businessmen are naturally profit-seeking, then there is little room for the government to stimulate the economy through capital investment, as all the "good projects" will already be undertaken by the private sector.