Unanticipated Intertemporal Change in Theories of Interest

by

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Mario Rizzo

Dedicated to the memories of

Sir John Hicks

and

Friedrich Hayek.

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Preface

This book is a collection of three separate essays that I wrote while on the Austrian fellowship at New York University. My interest in this area started when I had to prepare a paper for the NYU Austrian Colloquium. Initially I wanted to work on the Austrian business cycle theory, but I soon found that my dissatisfaction with the Austrian approach to interest was such that I had to divert my attention to pure capital and interest theory. I presented my (lengthy) paper, "Interest in the Austrian Tradition," to the Colloquium. Much of the work in this book is merely an elaboration of that original paper.

Although they were written as stand-alone essays, the essays should be read in order, as the later ones build upon the earlier. (However, the reader who is able and willing to read the mathematical appendix should probably do so immediately after the first essay.) A central theme running throughout the papers is that economists have traditionally paid insufficient attention to the problems of change, and in particular *unanticipated* change, in their theories of interest.

The first essay introduces the impressive work on capital and interest theory by Eugen von Böhm-Bawerk. In it I explain Böhm-Bawerk's views and his celebrated critique of what he called the naïve productivity theories of interest. As I read

Böhm-Bawerk's work for the first time, I slowly began to suspect the negative verdict given him by the profession. I hope that my (qualified) defense of his work will cause subsequent historians of economic thought to reevaluate his pioneering contributions.

The second essay is a critique of the Austrian "pure time preference theory" of interest. I claim that the Austrians focus too narrowly on one aspect of Böhm-Bawerk's work, and have caused needless confusion in their writings. I further argue that, ironically, the pure time preference theory is deficient on precisely those criteria of economic theory that are quintessentially Austrian, such as heterogeneity of goods, uncertainty of the future, and dynamic processes through time.

In the third essay I widen my focus. I claim that a fundamental problem with Böhm-Bawerk's theory was his aggregation of goods according to their date of availability. This component of his work led to the modern "real" approach to interest theory, which explains the premium on money loans as the outward expression of the underlying intertemporal exchange of real commodities. Drawing on the insights of the so-called "radical subjectivists," I offer a completely different explanation of interest rates, viewing them as purely monetary phenomena reflecting the uncertainty of the future.

Finally, in a mathematical appendix I formalize Böhm-Bawerk's arguments against the naïve productivity theories. Using general equilibrium models, I show that the standard one-good mainstream growth models completely overlook Böhm-Bawerk's insights in this area.

This book is intended to address a gap in economics. Somewhere between common sense and calibrated models, there is a loose collection of principles that help us judge the merits of any particular economic theory. I have dedicated the book to John Hicks and Friedrich Hayek, for they were excellent role models for the purpose I had chosen. In particular, their work was a constant reminder that even metatheoretical musing can be rigorous, and indeed must be.

RPM

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INTRODUCTION

In the late nineteenth century, Eugen von Böhm-Bawerk's magisterial work (1959 [1889]) on capital and interest provided the foundation upon which virtually all modern theories are built. In his first volume, *History and Critique of Interest Theories*, Böhm-Bawerk classified and (in his mind) refuted all previous explanations. Böhm-Bawerk thought a proper theory of interest must explain the apparent *undervaluation* of future goods. For example, if a machine is expected to yield annual rents of $1,000 for ten years, why does it sell now for *less* than $10,000? To answer this question was to provide a theory of interest, for only with such an undervaluation would it be possible for a capitalist to invest in machines (for example) and reap a flow of returns (over time) greater than his initial investment.

The naïve productivity theory

With the task of the interest theorist so formulated,[1] Böhm-Bawerk found the existing doctrines of his time to be inadequate. In particular, Böhm-Bawerk criticized what he termed the "naïve productivity theory" of interest. The naïve productivity theory[2] explained the net return earned by an investor, by reference to the *productivity* of the capital goods in which he invests. For example, a farmer might purchase a tractor for $8,000, even though it will last ten years and increase his profits by $1,000 for each of those years. The twenty-five percent[3] return on the investment would be due (according to the naïve productivity theory) to the fact that tractors are productive; more can be produced with a tractor than without one.

Böhm-Bawerk considered this reasoning to be completely fallacious, for it conflated *physical* productivity with *value* productivity. Yes, the physical productivity of the tractor explains why more crops can be harvested with it than without. But the tractor's physical productivity does not (by itself) explain why the *value* placed on the tractor (i.e. its price of $8,000) should be *lower* than the value placed on its future products (i.e. the marginal revenue of $10,000). The net rate of

[1] The specific problem was to explain, "Whence and why does the capitalist receive this endless and effortless flow of wealth?" (I, p. 1, italics removed).
[2] Actually, the "second variant" of naïve productivity theories, in Böhm-Bawerk's classification; see below.
[3] In fact the return would be more than twenty-five percent, because of compounding. The rest of the analysis disregards this complication, and assumes the farmer will have $10,000 when the tractor is discarded.

interest (twenty-five percent in our example) does not correspond to the value of a capital good's services, but rather to the *ratio* of its value to the value of its services.

Böhm-Bawerk's agio theory

After criticizing his predecessors, Böhm-Bawerk offered his own explanation ("agio theory") in his second volume, *Positive Theory of Capital*. The "nub and kernel" of his theory was the insight that, "Present goods are, as a rule, worth more than future goods of equal quality and quantity" (II, p. 259). Böhm-Bawerk argued that the market's objective undervaluation of physically identical objects in the future was due to individuals' subjective undervaluations of these temporally distant goods.

To return to our earlier example: The price of a tractor represents an opportunity cost in *present* goods and services, and will only yield its returns in the future (over the course of a decade). If individuals subjectively value present goods and services more than future ones, then it naturally follows that the price of a tractor ($8,000 in our example) will be lower than the total revenues ($10,000) it is expected to generate. As such, an investment in tractors will yield a net financial return over time, and it is this appreciation in market value—as future income

becomes transformed into more highly valued *present* income—that is the source of "originary interest."[4] All forms of interest, including contract interest on consumption loans, are manifestations of originary interest, and reflect a difference in intertemporal utilities (and a corresponding difference in intertemporal market prices).

Although elementary from a modern perspective, Böhm-Bawerk's explanation was the first to systematically apply the new insights of the marginal (and subjective) revolution (e.g. Menger 1994 [1871]) to the problem of interest. However, as Fetter pointed out, Böhm-Bawerk hadn't really *explained* interest; he had just formulated the problem in a more satisfactory manner. Yes, positive interest rates could be viewed as equivalent to a subjective premium placed on present goods, but *why* should such a premium exist at all?

Böhm-Bawerk's three causes

To explain the existence of such a premium on present versus future goods, Böhm-Bawerk offered three main reasons. First, in general people expect to grow wealthier over time, and thus on that account (due to diminishing *intra*temporal

[4] "Originary interest" is the term Böhm-Bawerk used to denote the surplus proceeds earned (over time) by investment in capital goods (I, p. 6). Originary interest is to be contrasted with the more conventional "contract or loan interest" (ibid.). Böhm-Bawerk believed that the terms of contract loans were subordinate to the conditions established in the capital goods markets, i.e. he believed that the rate on contract loans adjusted itself to the market rate of originary interest.

marginal utility or what may be called a preference for "consumption smoothing" over time) value the marginal present good more highly than the marginal future good.[5] Second, for various psychological reasons, in general people tend to systematically *discount* future satisfactions, and so even though a present and future good may offer the same instantaneous utility at the moment of consumption, the presently available good is valued more highly. And third, Böhm-Bawerk claimed that as a technological fact, more "roundabout" production processes were more *physically* productive, and so present goods (because they can be employed in processes that are more roundabout) possess a higher value (since it is always better to have more output than less). (II, pp. 265-273)

Critics of the third cause

Many economists have criticized Böhm-Bawerk's positive theory of interest,[6] in particular his "third cause" (i.e. the alleged superior productivity of roundabout processes). John Maynard Keynes thought the third ground was an arbitrary distinction, and pointed out that a "smelly" process would command a greater reward too (Keynes 1965 [1936], p. 215).

[5] More generally, changes in the conditions of supply and demand will cause a preference for present goods, so long as the goods can be stored. Goods on hand can always be saved for a later use that yields the highest marginal utility, whereas future goods cannot be consumed in the present (if present consumption happens to yield the highest marginal utility).

[6] Economists have also pointed out tremendous (and in my opinion, fatal) difficulties with Böhm-Bawerk's theory of capital, in particular his concept of the "average period of production." But these criticisms, and Böhm-Bawerk's replies, fall outside the scope of this essay.

Frank Fetter (1977) leveled a much more damning charge, when he claimed that Böhm-Bawerk's third ground was susceptible to the critique of productivity explanations that Böhm-Bawerk himself had given in his first volume! Subsequent economists in the so-called Austrian school, most notably Ludwig von Mises (1966 [1949]) and Murray Rothbard (in Fetter 1977), have expanded on Fetter's claim that Böhm-Bawerk's writings on interest were internally contradictory.

The father of modern neoclassical interest theory, Irving Fisher, attacked Böhm-Bawerk's third ground as superfluous; even if true, Fisher claimed, such a technological fact would influence the premium on present goods entirely through Böhm-Bawerk's first ground (i.e. the differences in wealth over time).

A (qualified) defense of the third cause

In this paper, I claim that the above criticisms of Böhm-Bawerk are unjustified. That is, I will show that (contrary to Keynes) Böhm-Bawerk's emphasis on roundabout processes is quite useful in understanding the nature of capitalist production. I will then argue that (contrary to Fetter and the Austrians) Böhm-Bawerk's emphasis on the higher productivity of roundabout processes, is not itself susceptible to his critique of the naïve productivity theories of interest. Finally, I will show that (contrary to Fisher) Böhm-Bawerk's third ground represents a truly

independent cause of interest, though this independence is really only manifest in dynamic settings.

Notwithstanding these arguments, my defense is only qualified; that is, I do not *endorse* the Böhm-Bawerkian theory of interest. Indeed, I have written elsewhere (Murphy 2003c) that Böhm-Bawerk's concentration on purely "real" factors (to the exclusion of money) is flawed. However, if one agrees—as at least Fetter and Fisher do, but I do not—with Böhm-Bawerk that positive interest rates represent a premium placed on present versus future goods, then Böhm-Bawerk's three grounds to explain this premium are quite natural.

BÖHM-BAWERK'S CRITIQUE OF (NAÏVE) PRODUCTIVITY THEORIES

In order to demonstrate that Böhm-Bawerk's own approach was not susceptible to his critique of (naïve) productivity theories of interest, let us review his arguments against them. Böhm-Bawerk first reiterates the phenomenon to be explained by the interest theorist:

> The sum of the means of production (labor, capital, and services of land) employed in making a product has, as a rule, a lower exchange value than is possessed by that which is subsequently their finished product…
>
> Now experience shows that the particular quota of the total product which falls to the share of capital, that is to say, the gross yield of capital, is

> normally of greater value than the capital expended in its acquisition. Therefore, an excess of value, a "surplus value," arises which remains in the hands of the owner of the capital, and constitutes his originary interest.
>
> The theorist, then, who professes to explain interest must explain the emergence of surplus value. The problem, more exactly stated, can therefore be contained in the question, "Why is the gross return to capital regularly of greater value than the portions of capital, which are consumed in acquiring that return?" Or the question can be worded, *"Why is there a constant difference in value between the capital expended and its return?"* The *productivity theories* propose to *explain,* and say they do *explain,* this difference in value as a result of the *productive power of capital*. (I, p. 77, italics original)

Now, in order to determine whether "the productive power of capital" can explain the value surplus of originary interest, the concept must be defined. Earlier, Böhm-Bawerk had catalogued four different possible meanings for the related term, "the productivity of capital":

> 1] Capital has the capacity of serving to produce goods.
>
> 2] Capital has the power of serving to produce *more goods* than could be produced without it.
>
> 3] Capital has the power of serving to produce *greater value* than could be produced without it.
>
> 4] Capital has the power to produce *value greater than that which it possesses itself*. (I, p. 75, italics original)

To say 'capital is productive' in the first sense merely means that it is related to production (rather than consumption); in this sense, the use of a grenade to knock

down and gather coconuts would be 'productive,' even though more coconuts could be gathered by one's bare hands, without the use of such a 'capital good.'

If we say that capital is productive in the second sense, we mean more physical output will occur when labor is aided with a (suitably chosen) capital good than without. For example, someone using a ladder can collect more coconuts than someone using labor alone, and thus the ladder would be considered productive in Böhm-Bawerk's second sense.

In the third sense, we mean that capital is *value* productive because the subjective value placed on the output of labor and capital goods is greater than the subjective value placed on the output of labor alone. For example, if someone can gather 100 coconuts with a ladder and one hour of labor, while only 20 coconuts with an hour of unaided labor—*and* if we assume that the person values 100 coconuts more highly than 20 coconuts[7]—then the ladder would be a capital good possessing (gross) value productivity.[8]

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[7] Strictly speaking, the person would need to value (100 coconuts + disutility of working with a ladder) more than (20 coconuts + disutility of working without a ladder) in order for the ladder to be productive in the third sense. If, for example, a particular ladder were very rickety and caused a great deal of anxiety for the user—more anxiety than the user would get from merely climbing a tree—then it is possible that this ladder would not possess value productivity, despite the (assumed) higher valuation of 100 versus 20 coconuts. I mention this only because it shows the difficulty of defining productivity in the *second* sense, since it is not clear what should be 'subtracted' from the physical output of the ladder to compensate for its greater psychic toll.

[8] A simple criterion for the third sense is to ask whether the person would *use* a particular capital good, given the (free) option. If so, then the capital good must confer value on the output, and so must be productive in the third sense.

Finally, in the fourth sense, we mean that capital possesses *net* value productivity, that the value placed on the products of a capital good exceeds the value placed on the capital good itself. In our example, the ladder would only be 'productive' in this fourth sense if the subjective value placed on the ladder were less than the subjective value placed on the additional 80 coconuts.[9]

Now for Böhm-Bawerk, a satisfactory productivity theory of interest must demonstrate that 'capital is productive' in the *fourth* sense (as defined above). Recall that Böhm-Bawerk requires the interest theorist to explain why the gross yield of capital (whether in goods or funds) is of greater value than the initial value of the capital itself. Therefore, if the productivity theorist could only show, for example, that capital is productive in the third sense—i.e. if the theorist could only show that people would prefer to work with capital goods than without—then this demonstration would not, by itself, explain originary interest. To be sure, it would explain why capital goods are valued, but not why they should be valued less than their subsequent products.

[9] We are here neglecting the possibility of marginal disutility from the use of ladders per se, discussed in footnote 7 above.

The naïve productivity theories

With the above distinctions in mind, Böhm-Bawerk defines *naïve productivity theories* of interest as those that posit the power of capital to generate a value surplus (which is necessary for the existence of originary interest), without offering a satisfactory explanation as to the origin of this power:

> There are productivity theories…which maintain that there is inherent in capital a straightforward capacity to produce value. And there are the theories…which, although they take their departure from the concept of physical productivity, nevertheless profess the belief that the phenomenon of surplus value is a necessary and inevitable corollary of that productivity. Both these types of theory have one point in common. That point is that without any intermediate or explanatory transition they leap from the assertion of a productive power to the conclusion of a surplus value. They simply state that capital is productive. Then they do, to be sure, tack on a description of its productive activity, though in this respect they are guilty of superficiality. But then they conclude very hastily by crediting the surplus value to the productivity which they have merely asserted to be present. I shall group these doctrines together under the name of the *naïve productivity theories*. (I, p. 79, italics original)

Critique of the first variant of naïve productivity theories

After grouping two different classes of theories under the same term, Böhm-Bawerk then critiques them separately.[10] The naïve theories falling in the first class simply assert that capital has the power to produce surplus value, and then cite this power to explain originary interest. Böhm-Bawerk points out that this type of explanation is circular:

> If we run through the writings of the naïve productivity theorists, we shall find in them a great many proofs of physical productivity, but almost nothing that could be interpreted as an attempt to prove that there is a direct value-creating power inherent in capital. They assert it, but they do not take the trouble to prove it, beyond mentioning the fact that the productive employment of capital is regularly followed by a surplus of value and so implying that we have empirical proof of the power of capital to produce value…
>
> Now how convincing is this empirical proof? Does the fact that the employment of capital is regularly followed by the appearance of surplus value actually furnish adequate proof that capital possesses a power to create value?
>
> Certainly not! No more than the regular rising of the barometer in the mountains after a summer snowfall proves that there is inherent in summer snow a power to cause a column of mercury to rise. That, incidentally, is a naïve theory which is often heard from the lips of the mountaineers. (I, pp. 89-90)

[10] The reason for this somewhat confusing approach is that, according to Böhm-Bawerk, "most of the naïve productivity theorists are so sparing of words that it is easier to say what they *may have* thought than what they actually *did* think, and often we can only conjecture whether a given writer held the [first variant] or the other" (I, pp. 88-89, italics original).

An excursus on value

After pointing out the elementary weakness in the first variant of productivity theories, Böhm-Bawerk provides a more fundamental (and eloquent) criticism. He argues that an alleged power of capital to create value is at odds with (the still revolutionary[11]) subjective value theory:

> Literally to ascribe to capital a power of producing value is to misunderstand the essential nature of value, and to misunderstand the essential nature of production completely. *Value* is not produced at all, and cannot be produced. We never produce anything but forms, shapes of materials, combinations of material, that is to say, things, goods. These goods can of course be *goods possessing value*, but they do not bring value with them ready made, as something inherent that results from production. They only *acquire* value from the wants and satisfactions of the economic world. Value has its source not in the past of goods, but in their future. It does not come out of the workshop where goods came into existence, but out of the wants which they will satisfy. Value cannot be forged like a hammer, nor woven like a piece of linen. If it could, our industries would be spared those frightful convulsions called crises, which have no other cause than that quantities of products, though manufactured to technical perfection, cannot achieve the value expected. The most that production can do is to create goods in the hope that, according to the anticipated relations of demand and supply, they will be of value. (I, pp. 90-91, italics original)

For Böhm-Bawerk, then, any legitimate productivity theory of interest would require an explanation of capital's ability to create physical goods that, when

[11] Naturally, Böhm-Bawerk drew heavily from the subjective value theory espoused by the founder of the Austrian school, Carl Menger (1994 [1871]).

appraised by consumers, allowed for the creation of a value surplus (and hence originary interest).[12] In the wake of the subjectivist revolution, those "naïve" theories that simply stipulated a power of capital to create value could be dismissed on purely methodological grounds.

Critique of the second variant of naïve productivity theories

After criticizing those theories that merely posited a power of capital to create surplus value, Böhm-Bawerk went on to the more formidable and important task, of refuting those (naïve) theories that explained interest on the basis of the *physical* productivity of capital. Inasmuch as some critics (especially members of the Austrian school) used this very reasoning to attack Böhm-Bawerk's own positive theory, it is appropriate to quote the critique at length:

> Now let us turn to the second interpretation of which the naïve productivity theory is capable. Here the productive power ascribed to capital is, in the first instance, to be understood as physical productivity only, that is to say, a capacity on the part of capital to furnish assistance which results in the production of more goods or of better goods than could be obtained without its help. But it is assumed as self-evident that the increased product, besides replacing the costs of capital expended, must include a surplus of value. Just how convincing is this interpretation?

[12] Of course, Böhm-Bawerk felt his *own* positive theory—which involved the greater physical productivity of "roundabout" processes—met this requirement. The grounds for his belief are explained below.

> I grant without ado that capital actually possesses the physical productivity ascribed to it, that is to say, that more goods can actually be produced with its help than without. I will also grant…that the greater amount of goods produced with the help of capital has higher value than the smaller amount of goods produced without it. But there is not one single feature in the whole set of circumstances to indicate that this greater amount of goods must be worth more *than the capital consumed in its production*. And that is the feature of the phenomenon of excess value which has to be explained.
>
> To put it in terms of Roscher's familiar illustration, I readily admit and understand that with the assistance of a boat and net one catches 30 fish a day, while without this capital one would have caught only 3. I readily admit and understand, furthermore, that the 30 fish are of higher value than the 3 were. But that the 30 fish must be worth more *than the pro rata portion of boat and net which is worn out in catching them* is an assumption which the conditions of the problem do not prepare us for, or even cause to appear tenable, to say nothing of making it obvious. If we did not know from experience that the value of the return to capital is regularly greater than the value of the substance of capital consumed, the naïve productivity theory would not furnish a single reason for regarding such a result as necessary. It might very well be quite otherwise. Why should not capital goods that yield a great return be highly valued on that very account and indeed, so highly that their capital value would be equal to the value of the abundance of goods which they yield? Why, for instance, should not a boat and net which, during the time that they last, help to procure an extra return of 2,700 fish be considered exactly equal in value to those 2,700 fish? But in that event, in spite of the physical productivity, there would be no excess value. (I, pp. 93-94, italics original)

Now that we have reviewed Böhm-Bawerk's celebrated critiques of the naïve productivity theories of interest, let us explore his own positive theory, in order to judge whether it too is susceptible to the above criticisms.

BÖHM-BAWERK'S AGIO THEORY

The *Positive Theory of Capital* presents Böhm-Bawerk's solution to the problem of originary interest. After three sections (Volume II, Books I-III, pp. 1-258) on capital, Böhm-Bawerk (in Volume II, Book IV, "Interest") offers the uncharacteristically blunt opening:

> *Present goods are as a general rule worth more than future goods of equal quality and quantity*. That sentence is the nub and kernel of the theory of interest which I have to present. All threads of the explanation of phenomena of interest lead through it, and it constitutes the focal point…of all the tasks we have to perform in the way of examination into economic theory. Half of the explanation is devoted to demonstrating the truth of that sentence. The other half will then consist in showing how the fact that present goods exceed future goods in value constitutes the source from which, naturally and necessarily, emanate all the variegated forms in which the phenomenon of interest manifests itself. (II, p. 259, italics original)

For the modern reader, the "other half" of Böhm-Bawerk's explanation is straightforward enough. Both the neoclassical mainstream (descended from Irving Fisher) and Austrian dissenters (descended from Frank Fetter) view interest as equivalent to (or at least generated by) a higher price of present versus future goods of comparable quality.[13] Furthermore, all major schools now subscribe to the

[13] Later on Böhm-Bawerk elaborates: "*Present goods have in general greater subjective value than future (and intermediate) goods of equal quantity and quality. And since results derived from the ascribing of subjective value determine objective exchange value, present goods have in general*

subjective theory of value, and so the higher market value of present goods must be ultimately grounded in the fact that market participants (both producers and consumers) all *subjectively* value present goods more highly than comparable future goods (on the margin).

If we accept for the moment that present goods are worth more than future goods, the solution to the Böhm-Bawerkian interest problem is obvious: The reason a capital good's price is systematically lower than its expected future revenues is that the price represents a *present* opportunity cost while the revenues will not accrue until the *future*. This difference in valuation generates interest most clearly in a simple consumption loan: If people generally value present dollars more highly than future dollars, it is clear that even after all arbitrage opportunities have been competed away, a loan of $100 today must be repaid by a greater amount (say $110) next year. The difference in valuation ($10 in this example) appears as a 'return' or 'dividend,' and is the prototypical example of interest.

A subjective premium on present goods would also explain "Roscher's familiar illustration," the case of the primitive fisherman: If we assume that the man values present fish more highly than future fish (i.e. if we assume that he would only trade present fish for a *greater* number of future fish), then it follows that a boat and net will appear to generate a fish 'surplus' over their lifetimes. Recall that Böhm-

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greater exchange value and a higher price than future (and intermediate) goods of the same kind and number" (II, p. 265, italics original).

Bawerk had asked, "Why…should not a boat and net which, during the time that they last, help to procure an extra return of 2,700 fish be considered exactly equal in value to those 2,700 fish?" (I, p. 94). We see now that there is no paradox of undervaluation at all; the boat and net *are* considered as "exactly equal in value to those 2,700 fish," *when the 2,700 fish are still appraised as future goods*. The boat and net are, to the fisherman, means to future consumption goods. If the fisherman would not offer 2,700 fish right now for an IOU promising 2,700 fish next year, then it naturally follows that he would not offer 2,700 fish right now for a boat and net (even though they will yield 2,700 fish over time). So the lower valuation (in terms of fish) of the boat and net allows a 'dividend' of fish over time, which is another example of (originary) interest.

Böhm-Bawerk's three causes

Although Böhm-Bawerk's "nub and kernel" may seem obvious to modern readers, his insights were quite revolutionary in treating the phenomenon of interest as an intertemporal exchange of real goods, and hence subject to the same methods of subjective marginal utility analysis as intratemporal exchanges. However, as Frank Fetter pointed out, the fact that present goods are worth more than future goods of like kind and number

> is but the fact which the interest theory is to explain logically. The proposition is not open to question: it is a novel, but unquestionably better, way of stating the nature of the problem. Explanations may differ after the nature of the problem is well agreed upon. Böhm-Bawerk shows…by devoting several hundred pages to setting forth his theory of interest, that he does not consider his work done when the proposition above quoted is stated. (Fetter 1977, p. 172)

We now proceed to a summary of Böhm-Bawerk's three causes for the higher valuation of present over future goods.

First Cause: Declining intra*temporal marginal utility in the future*

> A *first* principal cause capable of producing a difference in value between present and future goods is inherent in the *difference between the relation of supply to demand as it exists at one point in time and that relation as it exists at another point in time.* Present goods derive their value, as we know, from the relation between the supply and demand *in the present;* future goods derive theirs from the same relation in that *future* period in which they will become available. If a person suffers in the present from appreciable lack of certain goods, or of goods in general, but has reason to hope to be more generously provided for at a future time, then that person will always place a higher value on a given quantity of immediately available goods than on the same quantity of future goods. This situation occurs with very great frequency in our economic life. (II, pp. 265-266, italics original)

As a general rule, people expect to have larger incomes in the future, and on that account tend to value the marginal present dollar more highly than the marginal future dollar.[14]

Second Cause: Systematic undervaluation of future utility

> We must now consider a *second* phenomenon of human experience—one that is heavily fraught with consequence. That is the fact that we feel less concerned about future sensations of joy and sorrow simply because they do lie in the future, and the lessening of our concern is in proportion to the remoteness of that future. Consequently we accord to goods which are intended to serve future ends a value which falls short of the true intensity of their future marginal utility. *We systematically undervalue our future wants and also the means which serve to satisfy them.* (II, p. 268, italics original)

Thus, even if conditions of supply and demand are equivalent between present and future, so that a good will yield the same marginal utility *at the moment of consumption* in both the present and the future, the systematic discount of future

[14] Böhm-Bawerk does not need to even argue that the majority of people expect to have growing incomes, because of the asymmetry of time; present durable goods like money can serve future uses: "A clerk in an office…who is fifty years old and is earning sixty dollars a week must face the prospect that in ten or fifteen years he will have nothing of his own but a few hundred dollars a year from an annuity…For persons so situated it is obvious that a dollar spent in the present has less marginal utility than a dollar which will not become available and will not be spent until that future time in which they are less well provided for. It will seem, therefore, that for them a present dollar should be esteemed as having a value lower than that of a future dollar. And that would be the case if goods that *are on hand* in the present necessarily had *to be utilized* in the present. But they do not. Most goods are durable, especially money…hence they can be reserved for the service of the future" (II, p. 266, italics original).

wants would render the *prospective* utility of the future good lower than the utility of the present good.

Böhm-Bawerk offered three "partial causes for the lesser valuation of future utility; (a) erroneous valuation by reason of fragmentary imagery of future wants; (b) lack of will power and (c) consideration of the uncertainty of life" (II, p. 271). We will offer the following exposition of the third partial cause[15] to make Böhm-Bawerk's system more intelligible:

> And finally there seems to me to be a third subsidiary cause [of the systematic discount on future utility] at work and that is *consideration of the brevity and uncertainty of human life.* For even though actual realization of future goods may be a practical certainty, there is still the possibility that I, as an individual, shall not be alive when it takes place. That makes the utility of those goods uncertain for me, and causes me…to make a deduction from their value in accordance with the degree of uncertainty. Let us assume a utility of 100 with respect to which there is one chance in two that I shall not live long enough to realize it. I certainly will not value it to be on a par with a present utility of 100, but probably only on a par with a present utility of 50.[16] And I am convinced that every one of us, if

[15] To avoid confusion, let us summarize Böhm-Bawerk's scheme: Interest is caused by a higher valuation of present over future goods; i.e. a good in the present will offer more utility than the same good not available until the future. There are three main reasons for this higher valuation, the second of which is the discount placed on future utility; i.e. even if a good offered a utility of 100 both in the present and in the future *at the moment of consumption*, the future utility of 100 would be perceived in the present as worth less than a utility of 100, and so on that account the present good would offer "more" utility. Now, there are three partial causes of this discount on future utility, the third of which is the brevity and uncertainty of human life; e.g. a good that will yield a utility of 100 in the future at the moment of consumption may never in fact be enjoyed because of a premature death, and so on that account the future good would not be viewed as equivalent to a *present* utility of 100.

[16] Notice that Böhm-Bawerk's treatment relies on a cardinal conception of utility. This is no different from the mainstream approach, however. Böhm-Bawerk's second cause is comparable to

promised a birthday present of $100,000 when he reached the age of 100, would be very willing to exchange this munificent but somewhat uncertain gift for a very small fractional part thereof in present goods. (II, p. 270, italics original)

The (Notorious) Third Cause: Roundabout processes are more physically productive

> But there is a *third* main cause which exerts its influence in the same direction. It is built up on a fact which in a general way has been understood for a long time, but the essential nature of which has certainly been thoroughly misunderstood. And that fact, ensconced behind myriad errors, and going under the name of "productivity of capital," has customarily been dragged forth ever since the days of Lauderdale and Say to explain and justify interest….These facts may be boiled down to the following statement. *As a general rule, present goods are for technological reasons preferable means to the satisfaction of wants and for that reason they are a warranty of higher marginal utility than are future goods.*
>
> It is an elementary fact of human experience that time consuming roundabout methods of production are more productive. That means that, given equal quantities of the means of production, the more time a method of production consumes, the greater will be the output it produces. (II, p. 273, italics original)

Böhm-Bawerk then offers a somewhat tedious example (thankfully accompanied by a chart):

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the slope of a Fisher indifference curve (which reflects the quantitative marginal rate of substitution between present and future units of real consumption or psychic income) at a point on the 45-degree line from the origin, and it (Böhm-Bawerk's second cause) is virtually equivalent to the discount factor (often denoted by β) applied to future utils, found in modern mathematical models.

Let us suppose, for instance, that in the year 1956, we control the disposal of a certain quantity of means of production, say, 30 days' or one month's labor. In terms of the foregoing statements we can make certain assumptions. We shall assume then, that if the month's labor is expended in its least productive form of momentary, hand-to-mouth production, it will turn out only 100 units of product. But if it is expended in a production process covering one year, it will turn out 200 units though of course not until the year 1957. Similarly in a two-year production period it will turn out 280 units for 1958, and so on in ascending progression. It could perhaps be 350 units for 1959, 400 units for 1960, 440 for 1961, 470 for 1962 and finally 500 units for 1963.

Now let us compare with that the amount of output procurable from the same quantity of means of production[,] namely one month's labor, on condition that it be not available until one year hence. One month's labor available in 1957 will obviously produce *nothing* for the year 1956; for 1957 it can be employed only in momentary production of the least remunerative kind and hence will bear fruit only to the extent of 100 units. For the year 1958 it is possible to apply it in a one-year production method that returns an output of 200 units; for 1959 a two-year production method is possible, with its yield of 280 units, and so on. (II, pp. 273-274)

PRODUCTION OF ONE MONTH'S LABOR (In Units)								
Performed in…	*…Will Produce In The Economic Period*							
	1956	*1957*	*1958*	*1959*	*1960*	*1961*	*1962*	*1963*
1956	100	200	280	350	400	440	470	500
1957	—	100	200	280	350	400	440	470
1958	—	—	100	200	280	350	400	440
1959	—	—	—	100	200	280	350	400

Table 1—Output of Labor in Processes of Various Durations

(adapted from II, p. 274)

Before proceeding, we should be clear on what Böhm-Bawerk's figures mean. A unit of labor can be 'invested' in all sorts of processes which take varying lengths of time for completion. For example, a month of labor devoted to (directly) picking coconuts might yield 100 barrels' worth. But suppose instead that the month of labor is invested in the construction of a durable pole with a sharpened end. Suppose further that, when the pole is combined with eleven months of additional labor, it wears out completely, but has helped yield a total of 1,300 barrels of coconuts. Finally, imagine that a year (i.e. 12 months) of labor could be used to construct a sturdy axe, which lasts for one year and in that time (combined with an additional year of labor) helps to yield 4,660 barrels of coconuts (from felled trees).

If such were the technological constraints faced by a Robinson Crusoe, he would calculate that one month of his labor in 1956 would yield 100 units of output in 1956, 200 units in 1957,[17] or 280 units in 1958.[18] If Böhm-Bawerk is correct in his

[17] To arrive at this figure, Crusoe must isolate the contribution of the first month's labor (which is used, not to gather coconuts, but to construct a pole). Had he simply idled away that first month, and then devoted the remaining eleven months to picking coconuts by hand, Crusoe would have accumulated (at the end of the year) 1,100 barrels. Since we have stipulated that eleven months of labor with a pole allow him to accumulate 1,300 barrels of coconuts, we calculate the marginal (physical) productivity of the pole—and thus the marginal (physical) productivity of the first month of labor devoted to its construction—as 200 barrels.

[18] To arrive at this figure, Crusoe might reason that the marginal productivity of the axe is 3,360 barrels of coconuts, since he can accumulate 1,300 barrels during the second year without an axe (by constructing a pole instead), while he can accumulate 4,660 barrels with the axe. Given that the axe takes one year of labor to produce, Crusoe might further estimate that one month of labor invested in axe construction possesses a marginal physical productivity of 3,360 / 12 = 280 barrels of coconuts.

empirical generalization, then Crusoe could always find a more "roundabout" production process in which a given investment of labor would be more *physically* productive. When labor (and the other "original factor" of natural resources or what is generically classified by some economists as "land") is invested in a roundabout process, it is used not to achieve direct consumption ends, but to create capital goods—which in themselves may be quite useless—that will later serve to satisfy consumption ends far more effectively.[19] Böhm-Bawerk's third cause may be paraphrased by the claim: *As a general rule, there exist recipes for capital goods the physical productivity of which exceeds the sum of the physical productivities of the land, labor, and (if applicable) other capital goods used in their construction.*

From this rule, it follows that present goods possess a technical superiority over future goods:

> For the satisfaction of our 1956 wants, for instance, a month's labor in 1957 or 1958 makes nothing available, while for 1956 it at least makes 100 units available. In the economic year of 1961 the contribution to the satisfaction of wants by a month's labor done in 1958 amounts to 350 units, that of a month's labor out of

[19] Of course, the more roundabout process must be *suitably chosen*. The fact that process Y takes longer (or, more accurately, involves a greater number of intermediate steps) than process X does not guarantee that Y will produce more than X. But what Böhm-Bawerk *does* claim is that *there always exists* some process Z that is more roundabout and more (physically) productive than a given process X. His claim is similar to the statement, "Consumers can buy faster computers if they are willing to pay more." This claim is true, even though we can find examples of one computer that is both slower and more expensive than another model.

> 1957 amount to 400 units, that of a 1956 month to 440 units. It therefore becomes apparent that no matter which temporal period is chosen as the standpoint from which to make a comparison, the older (present) quantity of means of production is technically superior to the quantitatively equal more recent (future) one. (II, p. 274)

But how do these alleged facts concerning physical productivity relate to originary interest? After all, as Böhm-Bawerk himself demonstrated, interest is a problem of value, not product.

> Is this technological superiority matched by a superiority as to marginal utility and *value* as well? It most certainly is. For if the older means of production makes available a larger quantity of the means of satisfaction, regardless of the class of wants to which we are conceivably able or disposed to apply them, then they certainly must be of greater importance to our well-being! Oh yes, I am thoroughly well aware that a larger *quantity* of goods does not always necessarily have greater *value*. A bushel of grain in a year of famine can be worth more than two bushels after a copious harvest, and a pound sterling before the discovery of America had 10 times the value it now has in the middle of the twentieth century.[20] But for one and the same person at one and the same point of time, the larger quantity always has the greater value. No matter what the absolute value of a bushel or of a pound may be, one thing is certain, and that is, that for me *two pounds or two bushels that I have today* are worth more than *one pound or one bushel that I have today*. (II, pp. 274-275)[21]

[20] This illustration, as well as the years chosen for the chart, were obviously updated by the editor of Böhm-Bawerk's works.

[21] Böhm-Bawerk continues: "And exactly the same thing applies when we compare in value a present and a future quantity of means of production. It may very well be that the 470 units of product that could be turned out by a 1957 month's labor for the year 1963 are worth less than the 350 units to be obtained from that same month's labor for the year 1960, and that those 350, despite their numerical inferiority are the most valuable that can be derived at all from a 1957 month's labor. But even then the 400 units that can be obtained for 1960 from a 1956 month's labor are still more valuable. And so the older (present) quantity of means of production maintains its superiority

Summary

We now have an understanding of Böhm-Bawerk's solution to the problem of originary interest: Present goods are, as a general rule, valued more highly than future goods. Claims to future goods (whether literal claims specified in contracts or technological 'claims' in the form of capital goods) thus appreciate in value as they ripen into present goods, and this appreciation is what economists classify as interest.

This fact of a premium, or agio, on present over future goods has three main causes. First, the marginal utility of consumption may differ over time, and in general can be expected to fall, due to (generally) increasing income. These facts, coupled with the durability of many types of goods, cause present goods to have a higher marginal utility than future goods.

In the second place, any given amount of utility tends to be systematically discounted in its present appraisal, in proportion to its remoteness in the future Thus, even if we neglect the first cause, and suppose that an apple consumed now will yield the same (instantaneous) utility as an apple consumed next year,

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in this instance and in any other instances, no matter which variant of our example is chosen" (II, p. 275).

nonetheless the present *appraisal* of that future utility will make the present apple seem preferable.

And finally, there is a third cause of the agio on present goods, namely the greater physical productivity of roundabout processes. Thus, even if we neglect the first cause by supposing that an apple will yield the same (instantaneous) utility now as it will next year, and even if we neglect the second cause by supposing that present utility is regarded on an equal footing as future utility, it would still be the case that a present apple is preferred to an apple next year. This is because the present apple may be consumed now in order to 'free up' labor that would otherwise be devoted to a short production process (e.g. picking an apple off a tree), and which may now instead be devoted to a one-year production process which yields more than one apple next year.[22]

Now that we have summarized Böhm-Bawerk's agio theory, we will deal with critics of his third cause of the higher valuation of present over future goods.

[22] Although I believe this summary to be faithful to Böhm-Bawerk (see II, pp. 280-281), there is a definite problem in trying to argue that the third cause "is far removed from any necessity of borrowing strength and effectiveness" from the first two causes, and that the third "cause itself is capable of creating" an agio on present goods (II, p. 280). In the summary given in the text above, for example, I wrote that even if an apple yields the same utility in present and future, the third ground would cause the present apple to be preferred to a future apple. But in this case, the present apple must obviously yield a higher utility after all. It is difficult to evaluate Böhm-Bawerk's arguments on this point because of his habit of focusing on "subsistence" consumption; the man who lives hand-to-mouth is often depicted as not really *choosing* present over future goods (because of a higher valuation of the former), but rather as being *compelled* to do so (II, p. 280). (Mises [1966, pp. 487-488] points out the flaws in this type of reasoning.) We will return to this issue of independence in our discussion of Fisher, and in the simple model offered at the end of the paper.

KEYNES: "ROUNDABOUTNESS" IS AN ARBITRARY FEATURE

An interesting critique of Böhm-Bawerk's third cause comes from John Maynard Keynes in his celebrated *The General Theory of Employment, Interest, and Money* (1965 [1936]). To understand the context of Keynes' disagreement with Böhm-Bawerk, it will be useful to quote him at some length:

> It is much preferable to speak of capital as having a yield over the course of its life in excess of its original cost, than as being *productive.* For the only reason why an asset offers a prospect of yielding during its life services having an aggregate value greater than its initial supply price is because it is *scarce*; and it is kept scarce because of the competition of the rate of interest on money. If capital becomes less scarce, the excess yield will diminish, without its having become less productive—at least in the physical sense.
>
> …
>
> It is true that some lengthy or roundabout processes are physically efficient. But so are some short processes. Lengthy processes are not physically efficient because they are long. Some, probably most, lengthy processes would be physically very inefficient, for there are such things as spoiling or wasting with time. With a given labour force there is a definite limit to the quantity of labour embodied in roundabout processes which can be used to advantage….The ultimate quantity of *value* will not increase indefinitely, relatively to the quantity of labour employed, as the processes adopted become more and more roundabout, even if their physical efficiency is still increasing. Only if the desire to postpone consumption were strong enough to produce a situation in which full employment required a volume of investment so great as to involve a negative marginal efficiency of capital, would a process become advantageous merely because it was lengthy…
>
> Moreover there are all sorts of reasons why various kinds of services and facilities are scarce and therefore expensive relatively to the quantity of labour

> involved. For example, smelly processes command a higher reward, because people will not undertake them otherwise. So do risky processes. But we do not devise a productivity theory of smelly or risky processes as such. In short, not all labour is accomplished in equally agreeable attendant circumstances; and conditions of equilibrium require that articles produced in less agreeable attendant circumstances (characterised by smelliness, risk or the lapse of time) must be kept sufficiently scarce to command a higher price. (Keynes 1965, pp. 213-215, italics original)

Before proceeding to the heart of the matter, we should clarify a popular misconception. In Böhm-Bawerk's framework, a "roundabout" production process does *not* necessarily require more time than a direct production process.[23] A roundabout process merely means that it devotes labor and land factors towards intermediate goals rather than the immediate goal of consumption. Now, in practice—and for the very reasons given by Keynes—a longer process will only be chosen if it is more productive, and naturally (following the logic explained in footnote 19 above) the most productive process of a given duration will be more roundabout than any shorter process. So although there is usually no harm in treating the terms *roundabout* and *longer* as interchangeable, strictly speaking they are different (and this difference is relevant to the present dispute).[24]

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[23] This subtlety was missed in Lachmann's (sympathetic) critique of the third cause, when he claimed, "It seems to us that Boehm-Bawerk, in making time the measure of capital, was led to confuse a process with the dimension in which, *in very special circumstances*, it may take place. Time by itself is not productive, nor is human action necessarily more productive because it takes longer" (Lachmann 1978 [1956], p. 84, italics original).

[24] To illustrate the difference: It is possible for a roundabout process to be *shorter* than a direct process (and also more productive). For example, "take the case of an attempt to gather apples from a tall tree. The object will probably be accomplished sooner by first cutting a pole from another tree

Besides this slight inaccuracy, the fundamental problem with Keynes' critique is that his example of "smelly processes" is not at all analogous to Böhm-Bawerk's emphasis on roundabout processes. Keynes has pointed out one respect in which a 'productivity of smelliness' theory would be similar to Böhm-Bawerk's theory: In equilibrium, the smellier the process, the more productive it is; just as in equilibrium, the more roundabout the process, the more productive it is. From this similarity Keynes concludes that Böhm-Bawerk's theory must be as arbitrary (not to mention ridiculous) as a theory based on the productivity of smelly processes.

But Böhm-Bawerk's claim concerning the higher productivity of roundabout processes is *not* (merely) an equilibrium argument. He argues that, as an empirical fact, when we consider any particular production process, there always exists a more roundabout process that is more physically productive (although the increase in productivity diminishes as the process becomes more roundabout) (II, p. 83). This is much stronger than the claim that, when we consider the processes *actually employed in equilibrium*, we find a positive correlation between the roundaboutness of a process and its physical output.[25] To be truly analogous, Keynes would have

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with which to knock down the apples than by climbing the tree and plucking each apple by hand" (II, p. 82).

[25] Irving Fisher argued along similar (though not as amusing) lines as Keynes, and Böhm-Bawerk's response is applicable to both critics: "Fisher denies the existence of an objective rule that is based on technical facts; I maintain that such an objective rule exists. According to Fisher, the appearance of a rule is the consequence of selection. I maintain that the regularity lies in existing facts before and independent of our selection. Fisher concedes a regularity merely in the production processes actually *selected*. I maintain that such a regularity exists in all processes *eligible for selection*" (III,

to argue (as Böhm-Bawerk spends several chapters in his third volume arguing [Vol. III, Chapters I, III, IV, and V]) that for any given production process, there always exists a more productive—and smellier—process.

Finally, we can defend the relevance of Böhm-Bawerk's third cause on a historical basis. When he wrote, there was a rich tradition of explaining interest by reference to the "productivity of capital." All sorts of illustrations were offered, purporting to demonstrate how the superior yield of labor when directed to capital goods created originary interest. In his critique of rival productivity theories, Böhm-Bawerk showed that the particular expositions of his predecessors were confused. But Böhm-Bawerk did not think their observations were *irrelevant* to a discussion of capital and interest; he quite understandably thought that they were incorporating crucial insights (concerning the *net* physical productivity of capital goods) into a flawed theoretical framework.[26]

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p. 49, italics original). He goes on to write, "Now let us assume, and I am convinced the facts are such, that at a certain state of technology the objectively most productive among the 1-year methods is excelled in productivity by the objectively most productive among the 2-year methods, which in turn is surpassed by the best 3-year method…Thus we arrive at a rule of increasing productivity of the best possible processes, a rule based on objective facts [that is] valid before and independent of every selection…" (III, p. 51).

[26] In response to the objections of Fisher and others, who claimed that his third cause was redundant, Böhm-Bawerk said: "As I have repeatedly stated, the facts to which I refer in the deduction of my third reason basically coincide with the very facts on which the once commonly accepted productivity theory exclusively based its explanation of interest…I am particularly referring to the fact that utilization or employment of capital leads to higher productivity….In such a situation and in view of the notorious relationship so manifest in real life between the degree of capital productivity and the rate of interest obtainable for the use of capital, it is certainly not surprising if I concede to these facts a prominent place of their own in my explanation of the interest phenomenon" (III, p. 150).

Thus, even if it were true that on some level, Böhm-Bawerk's focus on roundabout processes as a "cause" of interest were arbitrary, this alone would not invalidate his approach. Economists must always construct somewhat arbitrary categories to highlight what they consider the essential features of the real world when offering explanations of economic phenomena. After all, Keynes would presumably have no problem with the claim that 'labor hours are productive.' Yet clearly there are some processes with more labor that are *less* productive than other processes. And, even more fundamentally, there is really nothing productive about labor hours per se; a worker must rather use his time in an efficient manner before his labor will yield anything. Despite these facts, economists could still justifiably discuss the enhanced productivity of processes receiving a greater input of man-hours. In the same way, we can defend Böhm-Bawerk's emphasis on the superior productivity of roundabout processes.

FETTER: THE THIRD CAUSE SUSCEPTIBLE TO BÖHM-BAWERK'S OWN REFUTATION OF NAÏVE PRODUCTIVITY THEORIES

A much more fundamental critique of Böhm-Bawerk's emphasis on roundabout productivity comes from Frank Fetter (and is elaborated later on by economists in the Austrian school). As Austrian economist Murray Rothbard explains in his Introduction to a collection of Fetter's works:

> In his 1902 review of Böhm-Bawerk…Fetter quite rightly pointed to the major textual contradiction in Böhm-Bawerk's theory of interest: Böhm-Bawerk's initial finding that interest stems from time preference for present over future goods is contradicted by his later claim that the greater productivity of roundabout production processes is what accounts for interest. (Rothbard in Fetter 1977, p. 7)

This claim is typical in the Austrian literature (e.g. Mises 1966, pp. 488-489). Many Austrians seek to save the "nub and kernel" of Böhm-Bawerk's theory by adopting a "pure time preference theory" (PTPT) of interest, which explains interest as due *solely* to considerations of time preference, rather than Böhm-Bawerk's "eclectic" focus on both subjective time preference and objective roundabout productivity (e.g. Fetter 1977, Mises 1966, Rothbard 1970). According to the PTPT, considerations of the productivity of capital determine the *rents* afforded by the services of a capital good, and it is these rents that are discounted by time preference to determine the present value of a capital good. If the time preference is positive, then the present price of a capital good will be lower than the sum of its future rents, and hence ownership of it will yield a flow of originary interest. As Fetter explains:

> Rent has to do with "production" or scarce and desirable uses of things. To the interest theorist this is in the nature, one might almost say, of an ultimate fact. The interest theory begins with the valuation of these different rents or incomes, distributed through different periods of time. The "productiveness" of a material agent is merely its quality of giving a scarce and desirable service to men. To explain this service of goods is the essence of the theory of rent. Given this and a

> prospective series of future services, however, the problem of interest arises, which is essentially that of explaining the valuation set on the future uses contained in goods. Interest thus expressing the exchange ratio of present and future services or uses is not and cannot be confined to any class of goods: it exists wherever there is a future service. It is not dependent on the roundaboutness of the process; for it exists where there is no process whatever, if there be merely a postponement of the use for the briefest period. A good interest theory must develop the fertile suggestion of Böhm-Bawerk that the interest problem is not one of product, but of the exchange of product,—a suggestion he has not himself heeded. It must give a simple and unified explanation of time value wherever it is manifest. It must set in their true relation the theory of rent as the income from the use of goods in any given period, and interest as the agio or discount on goods of whatever sort, when compared throughout successive periods. For such a theory the critical work of Böhm-Bawerk was an indispensable condition; but, the more his positive theory is studied, the more evident it is that it has missed the goal. (Fetter 1977, p. 188)

Two meanings of time preference

Ironically, the ostensible inconsistency in Böhm-Bawerk's theory is due to a basic confusion on the part of Fetter (and later Austrians). Contrary to Rothbard's claim, Böhm-Bawerk did not initially say that interest is due to time preference for present over future goods, and then later change his mind and say that interest is due to roundabout productivity. What Böhm-Bawerk claimed is that interest is due to an agio or premium on present versus future goods; interest only occurs if and when individuals place a higher value on a present good than on a present claim to the same future good. Then, after establishing this fact, Böhm-Bawerk sought to give

the reasons that this premium should exist. And the third of these reasons was the superior productivity of roundabout processes.

The confusion over Böhm-Bawerk's theory is perpetuated by the habit of the Austrians of using *time preference* to mean two distinct things.[27] Sense (i) of *time preference* (henceforth TP) corresponds to what Böhm-Bawerk meant when he said that present goods are worth more than future goods. That is, if an agent actually prefers a marginal present good over a marginal future good, we shall say that this agent possesses TP in sense (i). This is an endogenous concept (that may change with circumstances such as wealth), and can be represented by the slope of an indifference curve (with present and future real income as the two goods) on a Fisher diagram, or in modern models by the marginal rate of substitution between present and future consumption.

Sense (ii) of TP corresponds to Böhm-Bawerk's *second reason* for the higher valuation of present goods; it refers to the discounting of future utility because of its remoteness in time. This is usually considered an exogenous concept (that holds

[27] Even as clear a thinker as Hayek—no friend to the PTPT—misunderstood Böhm-Bawerk's theory, when he seemed to claim that without a "'psychic discount' of the 'true' future value," interest cannot occur in the Böhm-Bawerkian framework (Hayek 1975 [1941], pp. 413-415). This is not quite accurate. Although it is true that the "psychic discount"—what we will call TP in sense (ii) and what corresponds to Böhm-Bawerk's second cause—is necessary for interest under stationary conditions, in general there can exist a positive rate of interest, i.e. present goods can be valued more highly than the same number of future goods, even when the true utility of the future goods is correctly anticipated in the present. In the formal model at the end of the paper, we will see just such a case, where there is no discount on future utils, yet a positive rate of interest.

true regardless of changes in circumstances), and can be represented in mathematical economics by the subjective discount factor on future utils (usually denoted by β).

Now, if we use TP in sense (i), then Böhm-Bawerk would agree with advocates of the PTPT: Interest is indeed solely due to time preference. But if we use TP in sense (ii), then Böhm-Bawerk would *not* endorse the PTPT, since he believes there are at least two other possible causes of interest. That is, if TP means the discount of future utility, then Böhm-Bawerk would say that TP is unnecessary for interest: Even if a utility of 100 available next year is evaluated on a par with a present utility of 100, a present dollar might still be preferred to a future dollar by someone who expects to grow wealthier over time. In other words, Böhm-Bawerk would say that this person values present goods more than future goods because of differing marginal utilities of goods in the different time periods (and not because of "time preference" when the term is used in our sense [ii]).

An analogy with labor

To illustrate the confusion that has resulted from the dual meaning attached to *time preference*, let us construct an analogous, hypothetical argument over the theory of wage rates:

Imagine that Böhm-Bawerk had offered a new subjectivist theory of wage rates, in which he argued that an employer would only pay money units for labor hours if he valued the labor hours at least as much as the money units. Imagine that Böhm-Bawerk then proceeded to give reasons for *why* (and how much) an employer should value labor hours relative to money units, and concluded that the equilibrium wage rate was determined by the interaction of the subjective desires of consumers for goods, the subjective desires of laborers for leisure, and the objective productivity of labor in creating goods.

Finally imagine that Fetter criticized Böhm-Bawerk for this eclectic theory, and wondered why Böhm-Bawerk had lapsed into a productivity explanation of wage rates. After all, as Böhm-Bawerk himself initially declared, wage rates were determined solely by the subjective valuations of employers regarding labor hours and money units. Fetter would offer instead a 'pure leisure preference' theory of wage rates. In this theory, productivity considerations would play a role, to be sure, but only *indirectly* by affecting the subjective valuations of the employer. The objective fact of labor's productivity as such would have no direct bearing on wages.

The example of Mises

The above analogy may seem unfair to the critics of Böhm-Bawerk. As further proof that they have misunderstood his theory, let us examine the following passages from the great Austrian economist Ludwig von Mises:

> There is no question of an alleged productivity of capital goods. The difference between the price of a capital good, e.g., a machine, and the sum of the prices of the complementary original factors of production required for its reproduction is entirely due to the time difference. He who employs the machine is nearer the goal of production. The period of production is shorter for him than for a competitor who must start from the beginning. In buying a machine he buys the original factors of production to be expended in its reproduction plus time, i.e., the time by which his period of production is shortened.
>
> The value of time, i.e., time preference[28] or the higher valuation of want-satisfaction in nearer periods of the future as against that in remoter periods, is an essential element in human action. (Mises 1966, p. 493)

We see here that Mises is conflating the two meanings of TP. Böhm-Bawerk would agree entirely with the first paragraph; indeed, it merely expresses the "nub and kernel" of Böhm-Bawerk's explanation of originary interest. Mises seems to be arguing that time preference refers to the fact that present goods are preferred to future goods (i.e. TP in sense [i] as we have defined it above) and that this

[28] Mises' usage of *time preference* is a bit subtler than either of the two senses of TP that we have defined in the text. However, the point is that at best, Mises has come up with a rival theory of interest that relies on an idiosyncratic definition of TP; his arguments have not at all shown the weakness in Böhm-Bawerk's approach.

preference explains the higher prices for capital goods over the original factors required for their construction.

But in the second paragraph, Mises defines TP as the premium attached to present satisfaction or present utility *as such* (i.e. TP in sense [ii]). Böhm-Bawerk would *not* agree that TP in this sense explains the higher price of capital goods over the original factors used in their construction. For example, even if there were no TP in this sense—so that want-satisfaction or utility now is evaluated on a par with want-satisfaction or utility next year—nonetheless present goods could be preferred to future goods (because of relative future wealth, say), and this would still result in a higher price for capital goods than for their constituents.

Mises' failure to appreciate Böhm-Bawerk's theory is also evident in this passage:

> A lengthening of the period of production can increase the quantity of output per unit of input…But it is not true that the imputation of the value of this additional wealth to the capital goods required for the lengthening of the period of production generates interest. If one were to assume this, one would relapse into the crassest errors of the productivity approach, irrefutably exploded by Böhm-Bawerk. The contribution of the complementary factors of production to the result of the process is the reason for their being considered as valuable; it explains the prices paid for them and is fully taken into account in the determination of these prices. No residuum is left that is not accounted for and could explain interest. (Mises 1966, pp. 529-530)

In the first place, the last two sentences quoted are not quite correct. If Mises were to agree (if only for the sake of argument) with Böhm-Bawerk that a unit of present labor is more productive than a unit of future labor, then he would be conceding that productivity can generate originary interest. If (as Mises himself argues) the productivity of a factor explains its price, then (under our assumption) present labor would command a higher price than future labor, just as skilled (i.e. more productive) labor commands a higher price than unskilled labor available in the same time period. Because of this price ratio, a present unit of labor would exchange on the market for a greater number of claims to (comparable) future units of labor. But this is precisely the phenomenon of originary interest which Böhm-Bawerk sought to explain! Whenever a premium exists on present units over comparable future units of any good, a capitalist can invest funds in future claims. He then needs only to wait until the future arrives, then sell the claims for the (higher) spot price and reap the gain, i.e. earn interest on his capital investment.[29]

[29] We have carried out this elementary argument merely to highlight the problem with Mises' 'refutation.' Really what Mises would need to argue (as Fisher does, see below) is that without an independent preference for present consumption over future consumption, there is no reason for present labor to be considered technically more productive than future labor. Mises probably does in fact believe this. The point here is that Böhm-Bawerk's theory is fully consistent with a marginal productivity explanation of factor prices, and indeed relies on it to explain the role of roundabout productivity in generating interest.

Productivity and 'reproductivity'

The deeper issue here is the ambiguous term "productivity of capital." What Böhm-Bawerk (and especially later neoclassical models of interest) really emphasized was the *net* productivity of capital, i.e. the ability of capital goods to generate a greater output of consumption goods *than the (opportunity cost of) consumption goods required to construct them.* In another paper, I have labeled this second phenomenon as the "reproductivity of capital" to avoid confusion (Murphy 2000).

The difference between the productivity and reproductivity of capital is best illustrated by the modern neoclassical postulate of a capital good that automatically grows (without any other inputs) at a certain rate over time. (Historically this assumption has been defended as an approximation to Crusonia plants, sheep, and rice. See Kirzner 1996, p. 139.) For example, a capitalist may own a school of tuna fish that multiplies at a rate of ten percent per year. This capital stock would thus have a reproductivity of ten percent per year. But the fish would also possess productivity, since one fish can be used (with other inputs) to produce a certain amount of canned tuna (which can be sold to consumers). The productivity of this capital stock might thus be one can per fish.

Now, in such a world, a neoclassical economist would conclude that equilibrium can only be achieved when one present fish trades for 1.1 future fish. (This is because technologically speaking, one present fish can *produce* 1.1 future fish.) Since this is a necessary condition for equilibrium, it must be the case that consumers in their purely subjective evaluations *also* consider one present (canned) fish to offer the same utility as the current prospect of 1.1 (canned) future fish; this may be achieved by a growth in planned consumption over time. Further, the neoclassical—dutifully following Böhm-Bawerk by relating interest to the premium of present over future goods—would conclude that the 'interest rate on tuna fish' is ten percent per year. Finally, if (as is often the case in mainstream models) tuna fish were the only consumption good in the economy, then it would quite naturally follow that the (equilibrium) interest rate in this hypothetical world were fixed at ten percent per year. This is the reasoning used by modern proponents of productivity theories of interest.

We now proceed to Fetter's attempted refutation of such arguments.

Fetter vs. Brown

Fetter addresses the argument of Harry G. Brown, who had offered an example of fruit-producing, reproducing trees as an illustration of the potency of Böhm-Bawerk's third cause:

> Fruits can be expressed for economic purposes as a percentage of trees not as physical quantities, but only as value-relations in terms of some standard. Usually the money-standard is chosen: Dr. Brown chooses a present-fruit value standard and does not see that he is doing it. To say that 1,000 present fruit *equals* 1,100 future fruit is to express a value relation. Equal how? Evidently not in quantity, for they are unequal, but in value. It is a psychological not a physical ratio. If, now, the productivity part of the problem be considered, 10 present trees equal 1,100 future fruit. Again we ask, equal in what way? Evidently not in quantity, but only in value? Where then is the ten per cent ratio? The answer comes that 10 present trees equal 1,100 future fruit and *at the same time* equal 1,000 present fruit; herein lies a ten per cent rate of productivity. A certain value of labor invested in trees yields a ten per cent value surplus at the end of a year. Enter the value relation disguised as a rate of physical productivity. (Fetter 1977, p. 258, italics original)

Fetter is quite correct: The sense in which 10 present trees equal 1,100 future fruit (or 1,000 present tuna equal 1,100 future tuna) is one of value; the former can technologically produce the latter, and so the value assigned to the means is the same as the value assigned to the end. But since 10 present trees can *also* produce 1,000 present fruit (or, vacuously, 1,000 present tuna can produce 1,000 present

tuna), it is also the case that the value assigned to the latter end is the same as the value assigned to the former means. And thus we can conclude, with no relapse into objective theories of value, that the value of 1,000 present fruit must be equal to the value of 1,100 future fruit; i.e. we can conclude that these technological facts have 'caused' a ten percent premium on present goods.

Before closing this section, let us again note that the only real point Fetter has made in the above quotation is that the subjective evaluation of goods must enter the picture. In particular, he could point out that only if (in equilibrium) trees are used to produce *both* present and future fruit, can we conclude that the own-rate of interest on fruit is ten percent.

But in any static equilibrium setting—even the ones used by Fetter and the Austrians to illustrate the nature of interest (as distinct from pure profit)—present and future goods must be produced, lest the consumers *never* get to consume. In any event, to point out that present fruit must be produced in order for Brown's demonstration to work, is just as (ir)relevant as pointing out that only if widgets are produced in equilibrium, will labor's productivity in widget-production have any influence on wage rates. Such an observation would not disqualify productivity

theories of wages, and thus neither does Fetter's observation disqualify Brown's productivity theory of interest.[30]

Conclusion

In summary we see that Böhm-Bawerk's approach can withstand the particular attacks made by Fetter and members of the Austrian School. More generally, the above has shown that Böhm-Bawerk's theory does in fact survive his criticisms of the naïve productivity theories of interest. Böhm-Bawerk never claimed that physical productivity as such is irrelevant to interest; what he claimed was that the naïve theorists had offered *no satisfactory explanation* of why the physical superiority of capitalist processes should result in a higher valuation placed on the products of capital over the capital goods themselves.

Böhm-Bawerk's agio theory does (at least superficially) pass the tests that he himself set up for any productivity explanation. This is seen most clearly in the modern (and quite unrealistic) examples of reproducing capital goods, where a present unit of capital is *always* more productive than a future unit, for the simple

[30] Although Fetter's argument does not rule out a productivity explanation of interest, nonetheless he has raised an important point. For example, someone could carelessly apply the logic of Brown and claim that the own-rate of interest on, say, cans of soda must be close to zero, because present soda cans, if saved, physically transform one-for-one into future cans. The answer, of course, is that in an equilibrium with a positive interest rate, even nonperishable goods are consumed when produced, and future goods are produced afresh from new applications of raw materials, etc. In other words, in equilibrium no one produces soda cans using the 'technology' of a warehouse.

reason that a present unit can create a greater number of future units. Making no assumptions on consumer preferences (except that more is preferred to less), we can conclude that present goods would be preferred to future goods because of this technological fact. Such an explanation is not susceptible to Böhm-Bawerk's critiques of the naïve productivity theories of interest.

FISHER: THIRD CAUSE REALLY THE FIRST TWO IN DISGUISE

Finally we turn to Böhm-Bawerk's dispute with Irving Fisher. Fisher did not challenge Böhm-Bawerk on the grounds that he had violated his own strictures against productivity theories,[31] but rather on the smaller charge that Böhm-Bawerk's third cause for interest was not truly independent of the first two:

> Our conclusion is that if we eliminate the "other two circumstances" (relative underestimate of, and overprovision for, the future [i.e. second and first causes, respectively—RPM]), we eliminate entirely the superiority of present over future goods, and the supposed third circumstance of "technical superiority" therefore turns out to be non-existent. (Fisher qtd. in III, p. 177)

[31] Indeed, regarding the productivity vs. time preference debate, Fisher has to say: "If, then, I am asked to which school I belong—subjective or objective, time preference or productivity—I answer 'To both.' So far as I have anything new to offer, in substance or manner of presentation, it is chiefly on the objective side" (Fisher 1965 [1930], p. 182). Inasmuch as Fisher's definition of *time preference* is our sense (i) (see e.g. Fisher 1965, p. 62, though he incorrectly links his own definition to Böhm-Bawerk's second cause, i.e. TP in our sense [ii]), it would seem that productivity is not an "independent" cause of interest in Fisher's approach, either.

The arguments Fisher advances, and the responses given by Böhm-Bawerk, do not concern us here, for both economists relied on specific numerical examples; a more general defense (i.e. what Böhm-Bawerk *could* have argued more persuasively) is presented in the following section.

What *is* relevant for this paper are the differing *methods* of the two economists, their fundamentally different approaches to economic phenomena. In arguing that Böhm-Bawerk's third cause is redundant, Fisher seeks to prove (and, it must be admitted, appears to have successfully done so) that the third cause cannot generate interest without the presence of at least one of the other two causes. Böhm-Bawerk argues, on a self-admittedly "scholastic" level, that such a proof would *not* demonstrate that his third cause isn't really an "independent" factor:

> [Fisher] obviously assumes the following intermediary step: If my third reason cannot bring about the value advantage of present goods when the two other reasons are absent, this proves that it is no independent reason in addition to them. The effect must then *solely* be ascribed to the two other reasons. In other words, Fisher postulates the logical equivalence of "not without me" and "only through me," which is a fallacy based on an insufficient premise. It is a false conclusion similar to the one we often meet in the negligent manner of thought and speech of everyday life, which nevertheless constitutes negligent and incorrect thinking.
>
> [Let us illustrate this fallacy with] an example. On his first stroll out a convalescent passes a house from whose pediment a piece breaks off and injures him fatally. Certainly the man would not have been killed if he had postponed his first stroll, which perhaps was too early also from the point of view of his recovery. Nothing is more common in popular thought and expression than to

> make the following comment: "The man died only because of his obstinancy. If he had postponed his walk, which everybody advised him to do, he would still be alive." Of course, this comment is wrong materially and logically with respect to the word "only." In dialectic exaggeration it substitutes for the circumstance that the early stroll exerted an influence indispensable for the fatal effect the entirely different circumstance that the early stroll *alone* exerted the whole influence. It is obvious that the indispensability of one reason (the early stroll) for the fatal accident offers no satisfactory logical basis for denying at least the position of an equal independent reason to the fall of the pediment besides the early stroll. The falling stone is certainly not only "the early stroll in disguise." (III, pp. 170-171, italics original)

Those readers intrepid enough to analyze the actual arguments of Fisher and Böhm-Bawerk will find, somewhat paradoxically, that *both* seem to be correct: When looking at the interest problem from a certain abstract point of view, the fact that roundabout productivity is neither necessary nor sufficient (vis-à-vis the first two causes) for interest certainly seems to rule it out as an "independent reason" for interest.

Yet, surely one must agree with Böhm-Bawerk's logical analysis of the causes of a fictitious historical event.[32] If, then, the economist is offering the causes of interest as it exists in the real world, it would seem Böhm-Bawerk's third reason is indeed an independent factor.

[32] Cowan and Rizzo (1996) point out that, in the "genetic-causal tradition" in the social sciences (of which Austrian economics is a striking example), it is considered far too restrictive to insist that a "cause" must be necessary or sufficient to produce its effect (1996, pp. 291-292).

This methodological divide is illustrated by another exchange. In yet another demonstration of the ostensible redundancy of the third cause, Fisher writes:

> The fact is that the only reason anyone can prefer the product of a month's labor invested today to the product of a month's labor invested next year is that today's investment will mature earlier than next year's investment. If a fruit tree is planted today which will bear fruit in four years, the labor available today for planting it is preferred rather than the same amount of labor available next year; because, if the planting is deferred until next year, the fruit will likewise be deferred a year…It does not alter this essential fact to speak of the possibility of a number of different investments. A month's labor today may, it is true, be spent in planting slow-growing or fast-growing trees; but so may a month's labor invested next year. It is from the preference for the early over the late fruition of *any* productive process that the so-called "technical superiority of present over future goods" derives all its force. The imagined "third circumstance" producing a superiority in present goods is only the first two circumstances in disguise. (Fisher qtd. in III, pp. 177-178, italics original)

To this Böhm-Bawerk replies:

> I merely ask: is it or is it not true that in Fisher's example and in actual life the earlier labor month affords us the choice of obtaining for ourselves the same yield for an earlier period or a greater yield for the same period? If we have this choice, in the name of what law of logic are we to stare at the first alternative only and close our eyes to the second one as if it did not exist? **Fisher would be right if there were a law that forces us to employ our resources of the various years always in precisely identical ways.** He would be right indeed if we could choose freely according to Mephisto's motto in Goethe's *Faust*: "Man is free to choose the first but shall be slave to the following." (III, p. 178, bold added)

From these remarks, it is clear that what separates Fisher and Böhm-Bawerk is not so much a disagreement on the facts of the case, but rather in the method by which these facts shall be interpreted. Fisher is subtly employing a static equilibrium view of the economy, and using the method of comparative statics to test whether technical productivity can "cause" interest. Fisher can imagine a static equilibrium in which a preference for early consumption exists without the accompanying technical superiority of present goods, but Fisher cannot imagine the latter existing without the former.

Böhm-Bawerk, on the other hand, is using an entirely different notion of causality. He is analyzing the circumstances of real, individual actors, who do not mechanically carry out the equilibrium plan decided at some initial period in the past. On the contrary, these actors must make new decisions with every change in the situation:

> [Fisher is right; if] we choose whether we want to employ a labor month in production for the present, or in a 1, 2, or 3-year method, etc., but having decided in favor of a certain utilization, e.g., taking three years, [and our choices had to remain constant over time,] we must decide for the same employment also with respect to next year's labor month. If in such a case the present labor month evidences greater value than next year's labor month, we must ascribe it to the "sole reason" that we prefer the *earlier* enjoyment (of the same product quality) over *later* enjoyment.
>
> But our freedom of choice goes much further. We need not choose in a parallel way, we may also choose divergingly or convergingly. We can employ

> our means of production available in different years for the *same purpose*, that is, for the satisfaction of wants of one and the same period….Such converging choices in favor of a single purpose are very frequent in actual life. As the best open possibilities they play a role in our valuations. We readily perceive in them the "technical superiority" of older over newer productive forces which no dialectics can deny….When a timber dealer simultaneously clears a 100-year old and an 80-year old forest, he will value the older forest higher simply because it actually yields more timber. And when we drink "old" and young wine, we value the older wine higher simply because it is superior in quality. Is this or is this not a real technical superiority? (III, p. 178, italics original)

Böhm-Bawerk's argument shows the limited scope of Fisher's analysis. Fisher assumed that if, say, a present sapling would be cut in twenty years, then a sapling available next year would be cut twenty-one years from the present. Therefore, if the present sapling is preferred to the future sapling, it must be because its yield of x units of lumber available in twenty years is more valuable than the x units of lumber available in twenty-one years; i.e. the higher valuation of the present sapling would be due entirely to the preference for earlier consumption of the wood.

But Böhm-Bawerk cleverly points out that, in the real world, people do not always behave in such a repetitive fashion. Suppose that, for whatever reason, a man will urgently desire a definite quantity of wood in exactly eight years, and that all other uses of wood pale in comparison to this need. In this (somewhat contrived) case, the man will devote a present sapling to an eight-year process, a sapling next year

to a seven-year process, a sapling available in two years to a six-year process, etc. Because of the superior yield of longer processes, the present sapling will be more valuable than a sapling next year, which in turn will be more valuable than a sapling not available for two years, etc. Since their yields will become available on the same date, there is no question that this superior value of the earlier saplings is due to "impatience."[33] On the contrary, Böhm-Bawerk feels it is quite obviously due to the technical superiority of present goods.[34]

BÖHM-BAWERK'S VISION

As in so many academic disputes, the critics of Böhm-Bawerk seem to have proven, not so much that he was 'wrong' for including roundabout productivity in his explanation of interest, but rather that they can offer rival theories of interest that do not require such a feature. Let us summarize Böhm-Bawerk's theory, in order to demonstrate how 'natural' his choice of the three causes is:

[33] Of course, one could still argue that the earlier saplings are preferred because the man desires the wood in eight years, and not nine. But is this really "impatience"? After all, the man does *not* desire the wood in seven or fewer years; he desires it in eight.

[34] In contrast to Fisher's approach, Böhm-Bawerk's argument only works in a dynamic situation, i.e. one in which mistakes were made in the past. If the need for wood had been correctly anticipated, then presumably the man would set aside the proper number of saplings at the optimal time in the past, and would not cut immature saplings at all. In Murphy (2003b) I explicitly model a dynamic equilibrium to illustrate the true independence of Böhm-Bawerk's third cause.

Originary interest is caused by a subjective premium placed on present versus future goods. There are three main causes of this premium, i.e. three main reasons that a present good will yield more utility than a current, guaranteed claim to the same good at a future date. First, the marginal utility yielded in each time period by the good may change over time; whatever the pattern of change, the present good (assuming no storage costs) will be preferred since it can satisfy consumption in any time period that the future good can, while it can also satisfy consumption in the earlier time periods when the future good cannot.

Second, people tend to systematically discount future utility per se. Thus, even if the first cause were absent (i.e. if there were constant marginal utilities of consumption over time), a present good would yield more utility (as reckoned in the present) than the certain prospect of the same good available at a future date.

Finally, there exist technical methods for *transforming* present goods into a *greater number* of future goods. This is seen most clearly in natural goods such as fruits and herds of livestock. But it is also true (from an economic point of view) for virtually all other consumption goods, since they can be produced with various techniques, the more time-consuming of which will necessarily be more productive. Thus, even if the first and second causes were absent—so that the intraperiod marginal utility of consumption remained constant over time, and future

utility were not discounted relative to present utility—it would still be the case that present factors of production (including goods in process or "circulating capital"[35]) were preferred to future factors of production, since the former could generate more consumption goods in any period within the planning horizon.

A formal model

We shall close with a somewhat formal model to illustrate the above interpretation of Böhm-Bawerk's explanation of interest. Suppose an agent possesses an initial stock S_0 of Crusonia plant, which grows at rate R, and suppose that the agent must form his consumption plan for a horizon of T periods, where T is finite. Suppose further that his total utility in period 0 is given by $U = \sum \beta^t u(c_t)$, where $t = 1, 2, \ldots, T$; c_t denotes the amount of consumption in period t; u is the constant intraperiod utility function of consumption, which we assume is differentiable and has the properties that $u'>0$ and $u''<0$; and β is the numerical discount on future utility.

In such a single-good model, the equilibrium (gross) interest rate (following the Böhm-Bawerkian approach) is equal to the equilibrium ratio of $u'(c_t) \ / \ \beta u'(c_{t+1})$.

[35] To reiterate, Böhm-Bawerk considered even present consumption goods to exhibit a technical superiority, because they could be consumed and thus liberate factors that would otherwise be devoted to present needs. The difficulties with this step of his argument have been acknowledged above in footnote 22.

That is, the real (net) rate of interest is equal to the premium placed on present marginal consumption over (the present prospect of) future marginal consumption.

Now let us illustrate the 'independent' nature of Böhm-Bawerk's third cause:[36] Suppose $R = \beta = 1$. That is, suppose there is no net productivity of capital, and no discounting of future utility. In that case, the optimizing consumer will consume S_0/T of the Crusonia plant each period, and the net interest rate will be zero.

If we alter our assumptions and set $R > 1$, so that now capital has a net physical productivity, the optimizing consumer will pick his new consumption path such that $c_1 < c_2 < c_3 < \ldots < c_T$, making the equilibrium net rate of interest positive. Thus, although declining marginal utility (i.e. a condition falling under the scope of Böhm-Bawerk's first cause) is still *necessary* for the emergence of a positive net rate of interest, it is not *sufficient* (vis-à-vis the third cause), in the sense that there are circumstances when the first and third causes *in conjunction* will produce interest, while the removal of the third cause will reduce the net rate of interest to zero.

[36] This illustration is the weaker (but more straightforward) defense of the third cause's independence, because I will only show that there are cases in which the third cause is necessary for interest; I will not show (here) that the third cause can operate independently of the first two. In essence this explanation is the same that Böhm-Bawerk uses in his example of the fisherman living hand-to-mouth, who will only trade 180 future fish for 90 present fish because the construction of a boat and net will provide him with the means to repay the loan (II, p. 280-281). It is also similar to Böhm-Bawerk's argument (in response to Fisher) of the obstinate convalescent, discussed in the text above. In Murphy (2003b), I use a dynamic model (that is, a model in which there is an unexpected shock to which everyone then reacts) to capture more closely what Böhm-Bawerk may have had in mind in his response to Fisher concerning the cutting of timber.

CONCLUSION

Eugen von Böhm-Bawerk's three volumes on *Capital and Interest* are a magisterial work in the history of economic thought. His basic claim, that interest can be viewed as an intertemporal exchange of real goods, spawned both the neoclassical and modern Austrian theories of interest.

Beyond this insight, Böhm-Bawerk offered three explanatory causes of the premium typically placed on present goods. The third cause, the technical superiority of roundabout production processes, has generated inordinate controversy. However, if one accepts the Böhm-Bawerkian view on the essence of interest (i.e. that it is an exchange of present goods for a greater number of 'the same' future goods), then it is quite natural to incorporate, as an entirely independent factor, the observation that present goods can (economically speaking) *be transformed* into a greater number of the same future goods.[37]

[37] Böhm-Bawerk's observation is no more fallacious nor redundant than the analogous claim that 'a chainsaw is more expensive than an axe because the former can fell more trees per hour'; after all, this objective fact does not constitute an 'independent' reason besides the more fundamental fact that consumers place a higher marginal utility on chainsaws than on axes.

Chapter Two

Some Problems with the Pure Time Preference Theory of Interest

INTRODUCTION

In the late nineteenth century, Eugen von Böhm-Bawerk's magisterial work (1959 [1889]) on capital and interest provided the foundation upon which virtually all modern theories are built. Böhm-Bawerk began his study with the question, "Whence and why does the capitalist receive this endless and effortless flow of wealth?" (I, p. 1). Böhm-Bawerk then devoted his first volume, *History and Critique of Interest Theories*, to a classification and (in his mind) refutation of all previous explanations to this question.

In particular, Böhm-Bawerk criticized what he termed the "naïve productivity theory" of interest. The naïve productivity theory explained the net return earned by an investor, by reference to the *productivity* of the capital goods in which he invests. For example, a farmer might purchase a tractor for $8,000, even though it will last ten years and increase his profits by $1,000 for each of those years. The roughly twenty-five percent return on the investment would be due (according to

the naïve productivity theory) to the fact that tractors are productive; more can be produced with a tractor than without one.

Böhm-Bawerk considered this reasoning to be completely fallacious, for it conflated *physical* productivity with *value* productivity. The tractor's physical productivity does not (by itself) explain why the *value* placed on the tractor (i.e. its price of $8,000) should be *lower* than the value placed on its future products (i.e. the marginal revenue of roughly $10,000). The net rate of interest (roughly twenty-five percent in our example) does not correspond to the value of a capital good's services, but rather to the *ratio* of its value to the value of its (future) services.

Böhm-Bawerk's agio theory

After criticizing his predecessors, Böhm-Bawerk offered his own explanation ("agio theory") in his second volume, *Positive Theory of Capital*. The "nub and kernel" of his theory was the insight that, "Present goods are, as a rule, worth more than future goods of equal quality and quantity" (II, p. 259). Böhm-Bawerk argued that the market's objective undervaluation of physically identical objects in the future was due to individuals' subjective undervaluations of these temporally distant goods. In our example above, the price of a tractor represents an opportunity cost in *present* goods and services, and will only yield its returns in the

future (over the course of a decade). If individuals subjectively value present goods and services more than future ones, then it naturally follows that the price of a tractor ($8,000 in our example) will be lower than the total revenues (roughly $10,000) it is expected to generate. As such, an investment in tractors will yield a net financial return over time, and it is this appreciation in market value—as future income becomes transformed into more highly valued *present* income—that is the source of "originary interest."

Although elementary from a modern perspective, Böhm-Bawerk's explanation was the first to systematically apply the new insights of the marginal (and subjective) revolution (e.g. Menger 1994 [1871]) to the problem of interest. However, as Fetter pointed out,[1] Böhm-Bawerk hadn't really *explained* interest; he had just formulated the problem in a more satisfactory manner. Yes, positive interest rates could be viewed as equivalent to a subjective premium placed on present goods, but *why* should such a premium exist at all?

To explain the existence of such a premium Böhm-Bawerk offered three main reasons. First, in general people expect to grow wealthier over time, and thus on

[1] That present goods are worth more than future goods of like kind and number "is but the fact which the interest theory is to explain logically. The proposition is not open to question: it is a novel, but unquestionably better, way of stating the nature of the problem. Explanations may differ after the nature of the problem is well agreed upon. Böhm-Bawerk shows…by devoting several hundred pages to setting forth his theory of interest, that he does not consider his work done when the proposition above quoted is stated" (Fetter 1977, p. 172).

that account they value the marginal present good more highly than the marginal future good. Second, for various psychological reasons, in general people tend to systematically *discount* future satisfactions. And third, Böhm-Bawerk claimed that as a technological fact, more "roundabout" production processes were more *physically* productive, and so present goods (because they can be employed in processes that are more roundabout) possess a higher value (since it is always better to have more output than less). (II, pp. 265-273) (For a fuller discussion of Böhm-Bawerk see Murphy [2003a].)

Frank Fetter and the capitalization theory

Many of Böhm-Bawerk's peers criticized his work on capital and interest theory, in particular his notorious concept of an "average period of production." Of greatest importance for the present essay are the turn-of-the-century writings of the American economist Frank Fetter, a member of the so-called "Psychological School" (Pellengahr 1996, p. 28). Fetter claimed that Böhm-Bawerk had been a brilliant pioneer, showing the way to a true understanding of interest. Ironically, according to Fetter, Böhm-Bawerk had at the last moment fallen short of his goal, and instead fell into the same fallacies that had misled previous interest theorists:

> It has been a surprise to many students of Böhm-Bawerk to find that he has presented a theory, the most prominent feature of which is the technical

> productiveness of roundabout processes. His criticism of the productivity theories of interest has been of such a nature as to lead to the belief that he utterly rejected them….Böhm-Bawerk's theory, therefore, so far as it rests upon the productiveness of roundabout processes, is a productivity theory; and as such it is to be judged by the tests which he has set up, and rightly, in criticizing such an argument. (Fetter 1977, pp. 185-186)

In Fetter's view, Böhm-Bawerk needed only to elaborate on the "nub and kernel" of his explanation; interest is the result of a higher (subjective) valuation of present goods, period.[2] The productivity of capital goods explains their market prices or rents, and has nothing to do with interest per se:

> Rent has to do with "production" or scarce and desirable uses of things. To the interest theorist this is in the nature, one might almost say, of an ultimate fact. The interest theory begins with the valuation of these different rents or incomes, distributed through different periods of time. The "productiveness" of a material agent is merely its quality of giving a scarce and desirable service to men. To explain this service of goods is the essence of the theory of rent. Given this and a prospective series of future services, however, the problem of interest arises, which is essentially that of explaining the valuation set on the future uses contained in goods. Interest thus expressing the exchange ratio of present and future services or uses is not and cannot be confined to any class of goods: it exists wherever there is a future service. It is not dependent on the roundaboutness of the process; for it exists where there is no process whatever, if there be merely a postponement of the use for the briefest period. A good interest theory must develop the fertile suggestion of Böhm-Bawerk that the interest problem is not one of product, but of the exchange of product,—a suggestion he has not himself heeded. It must give a simple and unified explanation of time value wherever it is manifest. It must set in their true relation the theory of rent as

[2] Fetter referred to this phenomenon as positive *time preference*.

> the income from the use of goods in any given period, and interest as the agio or discount on goods of whatever sort, when compared throughout successive periods. For such a theory the critical work of Böhm-Bawerk was an indispensable condition; but, the more his positive theory is studied, the more evident it is that it has missed the goal. (Fetter 1977, p. 188)

Ludwig von Mises and the pure time preference theory

The economist Ludwig von Mises (of the so-called Austrian School) crystallized the pure time preference theory (henceforth PTPT) in his magnum opus, *Human Action* (1966 [1949]). Mises endorsed Fetter's capitalization theory except insofar as Fetter explained positive time preference with psychological and biological facts. Misesian economics (a branch of "praxeology" or the science of human action) was firmly rooted in an a priori method; for Mises (as well as many of the modern Austrians), an economic theory should possess the same degree of truth as a proof in Euclidean geometry:

> [A] universally true theory may never be attained via psychological paths. Psychology can show us that some persons, or even many persons, are guided by certain influences. But psychology can never demonstrate that a definite conduct is necessarily always and in the same way common to all men. As a matter of fact, what Böhm-Bawerk [and also Fetter—RPM] actually succeeds in demonstrating is only that it appears plausible for men to place higher values on present goods than future goods under some circumstances, while under other circumstances it appears no less plausible for the opposite to be true, i.e., for future goods to be more highly valued than present goods. (Mises 1940)

The modern Austrians and the PTPT

After Mises, the PTPT has become the default theory of interest for the Austrian School. Versions of the PTPT have been expounded by Austrian economists such as Murray Rothbard (1970), Walter Block (1978), Roger Garrison (1979), Israel Kirzner (1996), Peter Lewin (1999), and Hans Hoppe (1999). (For an excellent discussion see Pellengahr 1996.)

Despite slight differences in exposition, all of these authors strongly reject physical productivity as an explanation of interest. They consider interest to be a result of the underlying subjective preference (made by individuals) of present goods over future goods.

Notwithstanding this consensus, the PTPT has had its detractors (e.g. Pellengahr 1996 and Lewin 1997). However, most criticism has suggested an alternative framework, or has found problems merely with a particular exposition of the theory. The present paper, in contrast, takes the PTPT on its own terms, and seeks to demonstrate the shortcomings that are inherent in any version of the theory. In particular, I will argue that the PTPT is objectionable on precisely the grounds of subjectivism, dynamism, theoretical realism, ordinal conception of utility, and

heterogeneity of goods that are so characteristic of the Austrian method in other areas of economic theory.

SOME PROBLEMS WITH THE PURE TIME PREFERENCE THEORY

I. *Ambiguous and Inconsistent Definition of* Time Preference

The most striking deficiency with the existing body of PTPT literature is the confused usage of the term *time preference* itself. There are (at least) two distinct meanings of the term, yet many Austrians conflate them. I will first distinguish these separate concepts, and then offer examples of prominent Austrians who (apparently) do not appreciate the distinction.

In sense (i), *time preference* refers to the greater valuation, on the margin, of a present good over a future good, or of present 'consumption' over future 'consumption.' It is the "nub and kernel" of Böhm-Bawerk's theory of interest. If an individual possesses time preference in sense (i), then he values a present apple at time t_1 more than he values a risk-free claim (given to him at t_1) for an apple that will be delivered in t_2. In a Fisher diagram, the slope of an indifference curve (with present and future "real income" on the two axes) at a particular point corresponds to the degree of time preference (or "impatience") in sense (i) for the respective

levels of income. In a neoclassical model, an agent possessing time preference in sense (i) has a marginal rate of substitution of present for future goods that is less than one; i.e. he would have to be promised a greater number of future units in order to sacrifice one present unit of the good. Time preference in sense (i) is an endogenous concept, since it can be affected by factors such as the relative provision of goods in different time periods. In particular, under certain (perhaps unusual) circumstances, time preference in sense (i) can be *negative*—for example, it is possible that two present units of a good exchange for one future unit of the same good.

In sense (ii), *time preference* refers to the discounting of future utility per se, according to its remoteness from the present, solely *because* it is in the future. Time preference in sense (ii) corresponds to Böhm-Bawerk's "second cause" for the agio on present goods.[3] If an individual possesses time preference in sense (ii), then at t_1 he values a claim for an apple to be delivered in t_2 less than he *will* value that apple *when it is delivered*. In a Fisher diagram, the closest thing to time preference in sense (ii) would be the slope(s) of the indifference curves *along the*

[3] It is significant that Böhm-Bawerk himself never confused the two senses of time preference; indeed, he does not even use the term in (the English translation of) his positive exposition. To put his theory in the above terminology, we would say that for Böhm-Bawerk, interest is due to time preference in sense (i), which in turn is caused by relative abundance in the future, time preference in sense (ii), and the greater physical productivity of roundabout processes. (This interpretation will be justified in Section VIII below on cardinal utility. For a fuller discussion of Böhm-Bawerk's theory, see Murphy [2003a].) When couched in this light, it is no wonder that modern Austrians find Böhm-Bawerk's theory to be either redundant or contradictory: Since they fail to distinguish between the two senses of the term, modern Austrians interpret Böhm-Bawerk as arguing that "time preference" is only the second of three causes of "time preference."

45-degree line, that is, when all 'other things' (in the diagram) are held equal. In a neoclassical model, an agent possessing time preference in sense (ii) will discount (often by a constant factor denoted by β) future utils in order to compute the present marginal utility of expected future consumption; time preference in sense (ii) thus corresponds to the marginal rate of substitution between present and future units of utility (not goods). Time preference in sense (ii) is often treated as an exogenous, 'given' feature of individuals' preferences. In particular, it is usually considered to be completely independent of the supply of goods in each period, and is almost always treated as universally positive, regardless of other circumstances.

The above distinction captures the two senses of *time preference* (henceforth referred to often as TP) as it is used most frequently in economics.[4] Of course, proponents of the PTPT are entitled to use the term in a novel sense, which does not necessarily correspond to either of the above definitions. However, we will see that many Austrians do not employ the term consistently, very often using it in sense (i) for one argument, then in sense (ii) for another.

Let us start with Ludwig von Mises, the author of the modern PTPT, who writes:

[4] Uzawa (1991) defines the rate of time preference as "the instantaneous rate by which the marginal rate of substitution" between consumption in period t and consumption in period τ "is changed as the time τ at which future consumption is made is postponed" (p. 93). This definition is unhelpful for the present essay, because it mixes both the effects of different levels of consumption in periods t and τ, as well as the "constant rate of discount" of future utility when the latter exists (p. 94).

> Those contesting the universal validity of time preference fail to explain why a man does not always invest a sum of 100 dollars available today, although these 100 dollars would increase to 104 dollars in a year's time. It is obvious that this man in consuming this sum today is determined by a judgment of value which values 100 present dollars higher than 104 dollars available a year later. (1966, p. 486)

From these lines, it seems that Mises is using TP in sense (i). Since Mises tells us nothing more about the scenario, it is only "obvious" that 100 present dollars are more valuable than 104 (and a fortiori, 100) future dollars if we use a purely ex ante perspective. That is, all we can conclude from the man's decision to consume in t_1 is that he values (at that time) a marginal dollar more than a claim to the future delivery of a dollar in t_2. We can make no conclusions about the relationship between the valuation of such a claim at t_1, and the value the man *will* place on the dollar when he receives it in t_2. Clearly then, Mises cannot be using TP in sense (ii) in this passage.[5]

In other passages, however, Mises seems to be using TP in sense (ii). He claims that men "value fractions of time of the same length in a different way according as they are nearer or remoter from the instant of the actor's decision" (1966, p. 483).

[5] It is worth noting that, whichever definition of TP we choose, Mises' argument is obviously faulty. One can contest "the universal validity of time preference" without having to explain "why a man does not *always* invest" a sum of money rather than consume it. On the contrary, one can contest the "universal validity" of TP simply by finding *one case* of a man who prefers to save at a nonpositive rate of interest. For a thorough critique of Mises' arguments on time preference, see Pellengahr (1996, pp. 37-42).

Not only do men in fact possess time preference, but, according to Mises, "Time preference is a categorical requisite of human action. No mode of action can be thought of in which satisfaction within a nearer period of the future is not—other things being equal—preferred to that in a later period" (1966, p. 484). The ceteris paribus clause is presumably intended to ensure that it is the *same satisfaction* (available in either the present or the future) that is being compared. For example, a man who expects to be impoverished in the future and therefore trades away two present apples in exchange for one future apple would not be violating the law of time preference, because other things are not equal;[6] in this case (we can imagine Mises arguing) the marginal utility of apples is higher in the future, and so we are not really comparing the same satisfaction. If we interpret Mises as defining TP as the preference for the enjoyment of a given utility sooner rather than later, then he is clearly using TP in our sense (ii).[7]

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[6] We should note that Mises does deal explicitly with a similar case, the notorious ice-in-winter vs. ice-in-summer (1966, pp. 489-490). Mises argues that this scenario does not contradict the law of TP, but he does so by a rather curious (and troubling) argument. Rather than simply pointing out that other things are not equal, he argues instead that ice-in-summer is a different commodity because it cannot be produced through mere saving of ice-in-winter. (I say this argument is "troubling" from an Austrian perspective because it uses objective conditions of production to define commodities.) Mises apparently does not consider that in most cases of lending, it is not the same money units that are returned to the lender, nor does he deal with cases of nonperishable goods in which future units *can* be produced simply by abstaining from present consumption.

[7] In any event, Mises obviously cannot be arguing that it is logically impossible for the marginal rate of substitution between present and future goods to exceed one, and thus he is not here using TP in sense (i). This is inconsistent with his usage in his earlier block quotation, where Mises *is* using TP in (something very close to) our sense (i). Again, I fully acknowledge that Mises has in mind something different from both our senses of TP. But I claim that what Mises has in mind is ambiguous, and that his arguments using the term are inconsistent (and what is worse, often invalid). Indeed, the only way to make sense of Mises' arguments is to interpret TP for him as the desire of an individual to *not* postpone *all* consumption *forever*. It is unclear what use to make of

Similar ambiguity in the definition of TP is evident in the work of Hans Hermann Hoppe, who argues that "if a negative event such as a flood is expected, the marginal utility of future goods rises. The time-preference rate will fall and savings will increase" (1999, p. 458). Hoppe thus seems to be using TP in sense (i). However, Hoppe follows Mises in believing that TP must always be positive (Hoppe 1999, p. 456); even if a *great* flood were expected in the future, such that present units of goods traded for a fewer number of future units, Hoppe would not consider this an example of negative TP.[8]

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this concept, or its relation to interest theory. In particular, it does not show that interest rates must be positive, but only proves that we should not expect them to be negative infinity.

[8] One might defend the consistency of Hoppe's usage along the following lines: When Hoppe says that a future flood increases the marginal utility of future consumption, and therefore decreases the rate of TP, he does not necessarily mean that the rate of TP is equal to the inverse of the marginal rate of substitution between present and future goods. In other words (the defender might continue), Hoppe is not saying that an increase of the MRS from, say, one-fourth to one-half in any way *proves* that the rate of TP has declined from 200 percent to 100 percent; all Hoppe is saying (the defender might argue) is that these two effects are compatible, i.e. that when the marginal utility of future consumption rises, the rate of TP falls and the MRS rises. However, let us consider an analogy with 'leisure preference,' or its more common title, the disutility of labor: The fewer hours one works, the lower the disutility of a marginal unit of labor; yet no matter how little one works, labor is always irksome. At first sight this seems analogous to Hoppe's usage; the less consumption in the future, the lower the disutility of waiting (i.e. the lower the rate of TP), yet waiting is always irksome. However, upon closer inspection, we see that Hoppe's usage (even in the interpretation offered by his hypothetical apologist) is *not* analogous to the standard treatment of labor's disutility. For the truly analogous claim regarding TP would be, "The shorter the delay, the less disutility is suffered from a marginal unit of waiting." (Notice that *this* claim is entirely sensible, and is not at all what Hoppe is arguing.) Going the other way, the labor claim that would be analogous to Hoppe's TP usage would be, "The less income one has, the lower the marginal disutility of labor, and this is why a man will work more hours when he is poor than when he is rich. But whatever his income, a man always prefers less labor to more labor." This claim is not very compelling at all, and is just as confusing as Hoppe's TP usage.

Finally we turn to Israel Kirzner, who first poses the "interest problem" as the failure of the prices of capital goods to be bid up to the (expected spot) prices of their future output, and then explains:

> [The PTPT] solves the interest problem by appeal to widespread (possibly universal) positive time preference. If, in fact, people do prefer (other aspects of the situation aside) to achieve their goals sooner rather than later, then the dilemma posed by the machines and its rentals, or by the tree and its fruit, dissolves. The price paid for a tree tends systematically to fall short of the sum of its annual fruit yields, because when the tree is bought, the yields are only prospective yields. One is simply not prepared to pay $100 today in order to command $100 worth of fruit in five years or ten years time, no matter how ironclad the contract for the fruit delivery may be. The prospect of $100 available in the future has less attractive power than does the prospect of $100 available immediately. The PTPT argues that this solution of the interest problem is entirely sufficient to account for the interest phenomena we observe, in *all* their manifestations…After all, production processes do take time, hence the present price of input services must, given positive time preference, systematically and repeatedly, fall short of the nominal value yielded in the future by their marginal productivity. A portion of currently emerging output must then regularly be retained each year by the capitalist who has, some time in the past, advanced the sums needed to pay for the input services whose output is now emerging. (1996, p. 138, italics original)

Although the beginning usage ("people do prefer (other aspects of the situation aside) to achieve their goals sooner rather than later") is ambiguous, it is clear that the only way TP can solve the interest problem as posed by Kirzner is if we interpret it in sense (i). That is, only if by "time preference" Kirzner means that

present goods (and in particular, dollars) trade on the margin for a greater number of future goods (and in particular, dollars), will the existence of widespread or universal TP explain interest. (This claim will be elaborated in the following section.) Thus either Kirzner is here using TP in our sense (i), or his defense of the PTPT is flawed.

Yet only a few pages later, Kirzner explicitly *denies* that TP refers to what a neoclassical would call the "own-rate of interest" on a commodity, and what we have dubbed TP in sense (i). After explaining that the PTPT solution to the problem of interest disregards considerations of capital productivity, Kirzner addresses the objections of those who find such a position "simply incredible." After referring to the fanciful demonstrations of H.G. Brown, Irving Fisher, and Frank Knight (with their fruit trees, sheep, and Crusonia plant, respectively), Kirzner discusses in some detail a hypothetical example offered by Paul Samuelson. Samuelson imagined a rice crop that, without any other factor inputs, would grow (in physical terms) at a rate of ten percent per year, such that ownership of "rice capital" afforded a perpetual flow of real rice consumption. Samuelson believed that this simple counterexample demonstrated the possibility of "productive interest." (Kirzner 1996, pp. 139-140)

In response to these alleged demonstrations of productive interest, Kirzner concedes that they are indeed proofs of (positive) own-rates of interest (that is, TP in our sense [i]). But he then immediately claims that this is *not* what Austrians have in mind when talking about interest (and by implication, time preference):

> What these examples demonstrate is that physical productivity affects (or even 'determines') the intertemporal exchange rate (the own-rate of interest) on sheep, rice, and on Crusonia…One hundred units of 1987 rice exchange, in 1987, for 110 promised units of 1988 rice. With this trade repeated each year, the rice owner can consume 10 units of rice each year ('real interest income') without eroding the ('capital') base that yields this annual income. We shall attempt to show, however, that from the Fetter-Mises PTPT view, these demonstrations do nothing to advance understanding of the general phenomenon of interest… (Kirzner 1996, pp. 140-141)

After reiterating that the interest problem as conceived originally by Böhm-Bawerk is one of value, not product, Kirzner examines Samuelson's hypothetical example from the PTPT perspective:

> One hundred units of 1987 rice are expected to ripen into 110 units of 1988 rice. Suppose that the 'value' of the 100 units of 1987 rice has indeed risen to anticipate this physical growth. Then in terms of the interest problem (formulated at the outset of this paper) the perpetual annual rice consumption income so made possible *does not present an example of interest.* The annual flow of rice income is indeed adequately explained by productivity—more to the point, there was no 'problem' that demanded explanation, at all. There is, after all, no problem constituted by the circumstance that a tree yields fruit annually.

> The interest problem would begin, in the context of the rice example, only if in fact the 'value' of the 100 units of 1987 rice is somehow lower than that of 110 units of 1988 rice. *Then* we would have the possibility of a sum of abstract capital value serving as a financial source somehow generating a flow of *greater* subsequent value. *That* would indeed appear to fly in the face of economic intuition (since competition ought—absent a theory of interest—to be expected to exclude such a phenomenon). And it is of course *this* interest problem that PTPT solves by reference to the general subjective preference for the achievement of goals sooner rather than later. (Kirzner 1996, p. 142, italics original)

There are several problems with Kirzner's analysis,[9] but we shall focus here on his (implicit) inconsistency in the definition of time preference. Although the matter is somewhat ambiguous (and that is a problem with most of the PTPT literature), in the last paragraph above Kirzner must be arguing that time preference should be interpreted in our sense (ii). Consider: The 100 units of 1987 rice represent a (technological) claim to 110 units of 1988 rice. Kirzner is thus arguing that true interest only occurs when the value of this claim (in 1987) does not fully reflect the (future) value of the product once it is delivered in 1988. That is, Kirzner is claiming that time preference only exists if the subjective value assigned in 1987 to

[9] For example, Kirzner does not make it clear *when* these valuations are being made. Does Kirzner mean that interest only occurs when the value of 100 units of 1987 rice is "somehow lower" than the value placed on 110 units of 1988 rice *as judged in 1987* (when they are still prospective) or *as judged in 1988* (when the units are then present goods)? If the latter, then Kirzner is using TP in our sense (ii); this is the interpretation I will make in the text, and the next section will demonstrate its devastating implications for the PTPT. However, what is worse, if Kirzner means the former—i.e. that true interest occurs only when the subjective value placed on 100 units of 1987 rice is lower than the subjective value *placed in 1987 on the future prospect* of 110 units of 1988 rice—then there can never be an example of true interest, so long as people accord to a means the same subjective value that they accord to its end. We can shift examples to make the matter entirely obvious: Suppose 100 units of 1987 dollars trade for 110 units of 1988 dollars. This will still constitute an example of interest, even though in 1987, 100 present dollars have the same subjective value as a claim to 110 (future) 1988 dollars.

the prospective 1988 rice *increases* with the passage of time, as the future rice turns into present rice.

To reiterate, I admit that this interpretation of TP in sense (ii) does not follow automatically from the block quotation above. But this is the only possible interpretation that renders Kirzner's larger discussion sensible. For as we have seen, Kirzner has earlier explicitly *denied* that the premium on present rice in intertemporal exchanges—that is, the fact that 100 units of 1987 rice trade in the market against 110 units of 1988 rice—is (necessarily) an example of interest (and by implication time preference).

Therefore, in the last sentence quoted above, the "general subjective preference" for achievement of goals in the present cannot simply mean that the value of a unit of rice in 1987 must exceed the value placed *in 1987* on a (then prospective) unit of 1988 rice. We already know—and Kirzner has conceded—that 100 units of 1987 rice trade for the promise of 110 units of 1988 rice. In order for this to occur, it must be the case that individuals on the margin value a unit of 1987 rice more than a (future) unit of 1988 rice. Yet it is precisely this state of affairs that Kirzner says is not necessarily an example of true time preference.

The only conclusion we can draw from these considerations is that, for Kirzner, TP must be interpreted in our sense (ii). In other words, for Kirzner it is not enough that a present unit of a good in t_1 trades for a greater number of future units in t_2. Rather, Kirzner believes that TP occurs only when the subjective value placed on units to be delivered in t_2 *increases* as the date proceeds from t_1 to t_2, and these initially prospective units 'ripen' into present units (when the date becomes t_2).

In summary, Kirzner's explicit denial of the relation of own-rates of interest to TP shows that he clearly does *not* conceive of TP in our sense (i), and his further comments (as well as private correspondence with the present author) are consistent with his use of TP in our sense (ii). This represents an inconsistency in Kirzner's work, however, because (as argued above and will be elaborated in the next section) the only way "time preference" can truly "solve" the interest problem is when it is used in our sense (i).

II. *"Time preference is necessary and sufficient for positive interest rates."*

Closely related to the definition of TP—and to the confusion surrounding its usage—is the claim of the PTPT proponents that TP alone establishes a satisfactory and complete explanation of interest. Indeed, the "pure" in pure time preference theory is intended to emphasize that objective productivity considerations can play

no causal role in any theory that properly recognizes the interest problem as one of value, not product.

We have seen above Israel Kirzner's sole reliance on TP to resolve the interest problem. Another example is Murray Rothbard, perhaps the clearest and most prominent defender of the PTPT. In his Introduction to the work of Frank Fetter, Rothbard writes:

> Fetter demonstrated that the explanation [of lower prices for capital goods than the expected future spot prices of their products] can only be found by separating the concept of marginal productivity from that of interest. Marginal productivity explains the height of a factor's rental price, but another principle is needed to explain why and on what basis these rents are *discounted* to get the present capitalized value of the factor…That principle is "time preference": the social rate at which people prefer present goods to future goods… (Rothbard in Fetter 1977, pp. 3-4, italics original)

Unfortunately, the Austrians may be overrating the distinctiveness of their approach. For when they claim that TP is the essential explanation of interest, in which sense do they use the term? If they mean it in our sense (i), then they are undoubtedly correct (in the context of their discussions); but they are saying nothing new since Böhm-Bawerk first presented his theory, and (more important) they are saying nothing with which any neoclassical would disagree. On the other

hand, if the Austrians are using TP in our sense (ii), then their arguments are simply wrong: TP in sense (ii) is neither necessary nor sufficient for positive interest rates.

Time preference may[10] be considered necessary and sufficient for positive interest rates only when TP denotes a higher valuation of present over future goods, that is, TP in our sense (i). The connection between the higher valuation of present goods and a positive rate of interest was of course the "nub and kernel" of Böhm-Bawerk's explanation. If, on the margin, people prefer, say, present apples[11] over future apples (appraised in the present), then someone in possession of money capital can earn an interest return (in real terms) by investing in apples. Because (by stipulation) present apples are more valuable than future apples, that means one present apple has a market value higher than the price of a present claim to one future apple.[12] Therefore, if someone has the purchasing power to buy *x* apples for

[10] I say "may" be considered because, although I understand the sense in which the 'real' interest theorists make such a claim, I reject this entire approach. That is, I believe a good theory of interest must be couched in strictly monetary terms (see Murphy 2003c). However, for the rest of this discussion I will put aside my personal reservations and will take for granted the framework in which the argument is being waged between the PTPT camp and the so-called productivity theorists. In Sections IV and V we will see that the connection between a premium on present goods and the real rate of interest is not nearly as clear-cut as is generally believed.

[11] I am using a specific good, apples, for concreteness. However, Kirzner does have a point in his response to Samuelson: Just because a capitalist can turn one apple today into two apples tomorrow doesn't prove that his financial wealth has increased (since the spot price of apples may change over time, and thus we cannot conclude that the capitalist can buy more of some specified basket of commodities in the later time period). Therefore, once the reader has grasped the argument in the text as applied to apples, he should generalize apples to 'consumption goods.' (It is true that this latter step is awkward, but that is a problem with the PTPT; it relies on propositions that are only true when consumption goods available at any given time can be aggregated.)

[12] It is precisely *this* step that constituted Böhm-Bawerk's achievement, even though nowadays it is completely obvious. Böhm-Bawerk was perhaps the first to rigorously apply subjective value theory to intertemporal affairs. Böhm-Bawerk realized that "originary interest" was simply a matter

consumption in the present, he can instead choose to invest all of his funds on $x+y$ (cheaper) claims to future apples, in order to receive this greater number of apples in the future. The ratio y/x represents the net return on his capital invested in real terms, and is of course directly related to the price spread between present apples and claims on future apples. The greater the agio on present goods, the greater the price spread, and hence the greater the real rate of interest. Thus a higher valuation of present over future goods (TP in sense [i]) is sufficient for (real) interest.

Going the other way, a higher valuation of present goods is also necessary for (real) interest. Imagine that, for whatever reason, one must sell *two* present apples in order to purchase a claim to one future apple; that is, suppose future goods are on the margin more valuable than present goods, so that we have *negative* TP in sense (i). In this case, the real net interest rate is *negative* 50 percent. Someone with money capital that can purchase two present apples in t_1 can invest this in apple futures; by stipulation, he will only have enough money to buy one such claim. In t_2 he will then have only the purchasing power of *one* (then) present apple; therefore his money capital has dwindled in real terms to one-half its original size.[13]

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of price differentials between present and future goods, and from there he realized (as with any price differentials) that this spread must be caused by a difference in underlying subjective valuations.

[13] I have restricted the analysis to real terms in order to make the point as clearly as possible, but in case this strikes the reader as suspicious I will use money prices in an example that casts the worst possible light on my claim (in order to prove its correctness): Suppose the spot price of apples is \$1 in t_1 and \$4 in t_2. Since (by construction in the text above) the intertemporal MRS is two, the price

We thus see that—contrary to Kirzner but completely in accordance with Böhm-Bawerk[14]—a marginal rate of substitution less than one between present goods and their future counterparts is necessary and sufficient for a positive (real) rate of interest. There is nothing mysterious or controversial about this; recognition of this fact was indeed a great theoretical achievement of Böhm-Bawerk in the early days of the marginal utility revolution, but by now it is a fact so trivial as to hardly warrant mention. Indeed, the disputes between neoclassicals and proponents of the PTPT on this point are perhaps due entirely to the fact that the former regard the proposition as so obvious that they do not realize that it is merely this truism[15] upon which the PTPT is based.

The above claim may come as a surprise in light of the apparently profound disagreement between, say, Israel Kirzner and Paul Samuelson over the latter's rice example. However, this impression is due more to their different methods rather than their different views on interest. To see this, it will be instructive to spell out

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in t_1 of an apple future is \$2. Now, someone with \$2 in t_1 can either buy two present apples, or he can buy one claim to a future apple. If he does the latter, then in t_2 he will be delivered an apple, which he may then sell for the (stipulated) higher spot price of \$4. Thus the nominal interest rate is 100 percent; the investor has turned his initial \$2 into \$4. However, what Böhm-Bawerk (and every other 'real' theorist of interest) is concerned with is the *real* interest rate; the effects of price inflation must be accounted for. If we (arbitrarily) select apples to represent 'consumption,' then the 'price level' in this simplistic economy has quadrupled from \$1 to \$4. Therefore we see that, in contrast to the nominal return of +100 percent, the investor has in fact suffered a loss in real terms of 50 percent.

[14] The quotation from Böhm-Bawerk in Section VIII (below) on cardinal utility will make it clear that this is indeed how he viewed the matter.

[15] To avoid confusion, let me stress that the proposition is only a "truism" to all participants in the controversy under discussion. In Murphy (2003c) I offer my objections to such an approach; some of these are given in Sections IV and V below.

exactly what the neoclassicals have in mind when they claim that physical productivity can in hypothetical cases 'determine' the rate of interest.

In Samuelson's example, rice is the only commodity. Thus, the 'price level' at any time is simply the spot price of one unit of rice. The real rate of interest (technically, in any equilibrium with an 'interior solution') is thus the own-rate of interest on rice; that is, the gross real rate of interest is equal to the number of future units of rice that exchange for one present unit of rice (i.e. the inverse of the intertemporal MRS).

By hypothesis, 100 units of present rice in t_1 will physically transform into 110 units of t_2 rice. Therefore, in order for there to be no arbitrage opportunities, it must be the case that the market value of 100 units of present rice in t_1 is at least equal to the market value (in t_1!) of 110 units of future rice. If this were not the case, speculators could reap pure profits. For example, if the spot price of rice in t_1 were \$1 while the price of a rice future were also \$1—so that the current market value of 110 units of future rice were higher than the market value of 100 units of present rice—then a speculator could sell 110 futures and use \$100 of the proceeds to buy 100 units of present rice (which will transform into 110 units of rice in t_2 and allow him to satisfy his obligations), leaving him with a pure profit of \$10.

On the other hand, so long as there is at least one person in the community who plans on holding rice into the next period, then the market value of 100 units of present rice can be *at most* equal to the market value of 110 units of future rice. If it were higher, then those individuals who had planned on holding their rice (and reaping the ten percent physical growth) would do better selling all of their present units and buying futures. This would allow them to transform their 100 present units into *more* than 110 future units through exchange.

The above reasoning shows that, so long as at least one person in the community does not plan on consuming his entire stock of rice in the present,[16] the technological fact that 100 units of rice will grow into 110 units next period in a sense 'determines' the real rate of interest at ten percent. That is, someone can invest 100 rice-units of purchasing power in t_1 to achieve 110 rice-units of purchasing power in t_2 for a ten percent return on his capital. There is really nothing mysterious about this result, and it has nothing intrinsically to do with time. If a certain machine can produce either 100 widgets or 110 wadgets, and if both items are being produced, then equilibrium requires that the market value of 100 widgets equals the market value of 110 wadgets.

[16] The PTPT theorist may consider this caveat—i.e. that Samuelson's example only works if at least one person wishes to consume in the future—as the fatal flaw in productivity theories of interest. In this sense, yes, productivity considerations alone cannot 'determine' real rates of interest. However, Kirzner did not argue this point against Samuelson. Kirzner conceded that the intertemporal exchange rate would be 100 present for 110 future units of rice. And this fact too requires at least one person to plan on future consumption; if all rice were consumed in the present, then the intertemporal MRS would be indeterminate.

But what of subjective valuations? The above seems to focus on purely technical matters, and seems to commit the very error that so worries Kirzner. But it is precisely here where the neoclassical makes a move so quickly that Austrian onlookers can understandably be excused for missing it. For when Samuelson concludes that his hypothetical rice world must have a ten percent real rate of interest because of producers/speculators, that is really only *one* of the necessary conditions of equilibrium. For in equilibrium, not only must there be no arbitrage opportunities, but the consumers must also be maximizing their utility, given the market prices. Therefore, in equilibrium, it does indeed need to be the case that a consumer—who can be completely ignorant of the physical growth rate of rice—subjectively values 100 units of present rice as equivalent to 110 units of future rice. That is, in equilibrium *the consumer must believe that present goods (rice) have a higher value than future goods*; the consumer must possess TP in our sense (i).

How is this preference for present rice achieved? One way is to plan a steady growth in rice consumption over time. Because the amount of rice consumed grows in every period, the marginal utility of rice consumption declines in every period, so that this effect alone can yield the proper MRS between present and future units of rice. However, if agents possess TP in our sense (ii), then it is possible that a constant stream of rice consumption will still yield the proper MRS.

Thus we see that Samuelson's rice example relies on a fixed net productivity of capital (Böhm-Bawerk's "third cause") to determine the agio on present goods (and hence the real rate of interest) by working through Böhm-Bawerk's "first cause" and/or "second cause."[17]

Of course, the above approach to interest theory is completely anathema to the orthodox Austrian economist. However, I claim that this dissatisfaction rests with the formal neoclassical method *in general*, and has nothing to do with interest theory per se.[18] There is nothing wrong with Samuelson's example that would not

[17] A numerical example may be useful: Suppose consumers have the utility function $U_t = \ln(C_t) + \beta\ln(C_{t+1}) + \beta^2\ln(C_{t+2}) + \beta^3\ln(C_{t+3}) + \beta^4\ln(C_{t+4}) + \ldots$, where C_t is the number of rice units consumed in period *t* and $0 \leq \beta \leq 1$ represents the discount on future utils, and thus measures the rate of TP in our sense (ii). We already know from technical considerations that in equilibrium the consumer must value a marginal unit of rice in period *t* the same as 1.1 marginal units of rice available in period *t+1*. Because we have chosen a convenient utility function, the marginal utility from rice consumption in any period is given by $1/C_t$, i.e. it is the reciprocal of the level of consumption in that period. First consider the case where $\beta=1$, i.e. where there is no discounting of future utility. Then equilibrium requires that rice consumption increases by ten percent every period, so that $C_{t+1} = 1.1C_t$. This ensures that, in any period, a marginal unit of present rice confers as much utility as 1.1 marginal units in the following period. (If $C_t = 10$ and $C_{t+1} = 11$, then the MU of present rice is 1/10 while the MU of future rice is 1/11. Thus the MRS between them is 10/11.) Now consider the case where $\beta=10/11$, i.e. where future utility itself is discounted. In this case, in equilibrium rice consumption must remain constant over time in order to achieve the proper valuation between a marginal present and future unit of rice. (If $C_t = 10$ and $C_{t+1} = 10$, then the MU of present rice is 1/10 while the *current utility attributed to next period's rice consumption* is the discount factor times the MU of rice *as it will be experienced next period*, i.e. (10/11) * (1/10) = 1/11. Thus the MRS between present and future rice is once again 10/11, even though the MU of present rice consumption *as judged in each period* remains constant over time.) No matter what the size of β, i.e. TP in sense (ii), in equilibrium it is always the case that present rice is more valuable than future rice, i.e. we always have TP in sense (i).

[18] More generally, in mainstream models the net productivity of capital is not fixed, but diminishes with additional increments. Nonetheless, when neoclassicals say that in equilibrium, the interest rate is equal to the "productivity of capital," they are not committing the naïve productivity fallacy exploded by Böhm-Bawerk; they are thinking along the lines outlined in the rice example. Elsewhere (Murphy 2003a) I have used the term *reproductivity* to make the distinction clearer.

also be wrong with his explanation that the price of 100 widgets is 'determined' to be the price of 110 wadgets.

Now that we have exhaustively demonstrated the manner in which TP in sense (i) may be considered necessary and sufficient for interest, we can easily show why TP in sense (ii) is neither necessary nor sufficient. Just because someone discounts future utility or satisfactions per se does not ensure that he will value future *goods* at a discount, because other things may not be equal. For example, if a great flood is expected next year, someone might trade two units of present goods for one unit of future goods, even if, other things being equal, he would have preferred present goods to future goods. Thus such a person could have TP in sense (ii) but still value goods in such a way as to give rise to a negative rate of interest. On the other hand, someone could lack TP in sense (ii) and still prefer present goods on the margin (giving rise to positive interest rates). For example, if someone expected to grow wealthier over time, then he might trade one present good only for the promise of a greater number of future goods, and this could be true even with no ceteris paribus preference for present consumption. Thus we see that TP in sense (ii) is both insufficient and unnecessary (respectively) for a higher valuation of present over future goods, i.e. for a positive real rate of interest.

Before closing this section, let us review two examples of PTPT arguments in this vein, in order to demonstrate how the ambiguity in their usage of TP leads to confusion. In a "critical sampling" of the work of G.L.S. Shackle, Don Lavoie first explains that

> [t]he Misesian theory of universal time preference says that, other things being equal, the actor prefers satisfaction in the nearer to satisfaction in more remote time periods. In the actor's plan, a more or less complete calendar of actions is structured; some actions, such as going to work, must take place in definite calendar time slots, say 9 to 5 Monday through Friday….The structure of plans might be analogous to blocks on an incline, where the present time is at the base and the actor's horizon at the top. Plans must be fitted into this incline, some blocks must precede others, but other things equal, the blocks slide down toward the present. The force of gravity (time preference) brings actions as close to the present as possible. (Lavoie 1978, p. 129)

From these remarks it appears that Lavoie means TP in our sense (ii); he is not claiming that present goods are necessarily preferred to future goods (since other things may not be equal), but only that there is an overall tendency for this effect. Thus TP in Lavoie's sense can be neither necessary nor sufficient for positive interest rates, as we have seen above. Nonetheless, he goes on to argue:

> Goods are valued for their ability to fit into the plans of the actor as he moves through time. A good which fills an empty slot in his plans tomorrow will, other things being equal, be valued higher than an otherwise identical good which fills a slot next month. This preference is directly reflected in the discounting of future returns from assets. If I have an acre which yields me $100 a year in rent, the

> $100 coming up *this* year is more valuable to me than the $100 I expect next year. The 1978 rent fits into a slot on my planning incline at a nearer point to the present and thus is valued more to me than the 1979 rent which fills a more remote slot. The value of that acre to me depends on the intensity of my time preference (the slope of the incline), my calendar constraints (slots), my expectations upon which the plans are built, and (in a market economy) on the acre's selling price and the market rate of interest. But time preference alone is enough to explain the finite valuation of an infinite stream of returns. (Lavoie 1978, p. 129)

There are several problems with this passage. For example, just because "the 1978 rent fits into a slot on my planning incline at a nearer point to the present," it *does not follow* that it "thus is valued more to me than the 1979 rent which fills a more remote slot." For as Lavoie himself expressed the law of time preference, all we can conclude is that *other things being equal* the 1978 rent is valued more highly. Furthermore, Lavoie seems to imply that independent of the market interest rate, time preference alone can explain the finite valuation of an infinite income stream. This is rather confusing; if the market rate of interest were zero, then an individual would indeed place an infinite (dollar) value on a consol, since that is the market price he could fetch for the consol. But for our purposes, it is the last sentence that warrants our skepticism. For "time preference alone" (in Lavoie's sense) cannot explain the finite valuation of a piece of land unless we include the caveat that other things are sufficiently close to equality. My point is not that we should doubt

the truth of this caveat, but merely that its omission is a good example of the imprecise manner in which PTPT theorists generally make their case.[19]

In context, it is clear that TP 'explains' positive interest rates only insofar as it 'demonstrates' that people value present dollars more highly than future dollars. Lavoie says that bond prices are finite because "people discount the future; a dollar today is worth more (even without inflation) than a dollar in ten years" (p. 129).

This interpretation of the PTPT is borne out in a thought experiment devised by Charles Baird (and endorsed by Kirzner 1996, p. 147) in a section entitled, "The Primacy of Time Preference." Baird imagines that people in the present own units of two sheep. First, he supposes the sheep have a zero net productivity; that is, abstinence from present consumption merely allows for the provision of two sheep next year (because the first couple reproduces and dies). Still, if people have positive "time preference," Baird argues that the market value of the two sheep must be higher in the future in order to induce postponement of consumption, and hence the rate of interest will be positive. Baird then changes the scenario:

[19] To be entirely pedantic, I could also point out that lower valuations of future dollars—although sufficient for positive (though not necessarily uniform) rates of interest—are *not* in fact sufficient to guarantee finite land prices. For example, suppose the present dollar value of an infinite stream of \$1 payments were $1 + 1/2 + 1/3 + 1/4 + \ldots$. In this case, the present value placed on each dollar payment would decrease monotonically according to its futurity. Nonetheless, the present value of this stream would still be infinite; i.e. this particular sum diverges.

> [A]ssume that the net productivity of capital is positive (the two original sheep become three sheep in the future period) and that everyone's marginal rate of time preference is always zero. If the current market value of a pair of sheep were less than the prospective future market value of a unit of three sheep, every sheep owner would refrain from current consumption in order to attempt to capture the higher market value of the unit of three sheep in the future….People don't care when they consume the sheep, so current consumption will be sacrificed in order to pursue the promised gain. However, as the prospective future supply of sheep increases, the prospective market value of a unit of three sheep will decline until [there is no] difference between the current market value of a pair of sheep and the prospective future value of a unit of three sheep….At that time the measured rate of return from refraining from current consumption…will be zero. Even though the net productivity of capital is positive, the rate of interest measured in terms of market values is zero….Positive marginal rates of time preference are both necessary and sufficient for the existence of positive rates of interest. (Baird 1982, p. 305)

In the first place, this story doesn't make sense. Baird says that the increase in supply of sheep in any period will decrease their market value in that period. Presumably this must be due to the lower prices consumers will offer for additional units of sheep. But if the marginal utility of future sheep is reduced as the supply of future sheep increases, how can it still be true that the marginal rate of time preference (in sense [i]) is ("always") zero? Wouldn't the consumer wish to exchange a greater number of future sheep for a present one?[20] Moreover, Baird

[20] Probably Baird included this feature to prevent the 'absurd' result that no one would ever consume sheep. If in fact all anyone wants to do is maximize the total quantity of consumption (regardless of the date), then clearly the only thing to do is postpone consumption forever, allowing the number of sheep to grow without limit. To consume even one sheep *now* would have infinitely costly repercussions. We will see a similar snag in the "simpler demonstration" to be offered below, and similar hand-waving will be used to bypass it.

argues that because people don't care when they consume sheep, that therefore they will postpone consumption until the next period in order to "pursue the promised gain" (of higher prices). But which is it? If one consumes his sheep, he can't also sell them in the market.

In any event, the fundamental problem with Baird's 'proof' of the primacy of time preference is that it assumes what it is trying to demonstrate. For he supposes that owners do not care *when* they sell their sheep; they are only interested in the revenue they receive *at that time*. In other words, Baird believes that zero time preference for sheep consumption *is the same thing* as equal valuation of a present and future dollar. We can see this most easily by removing the sheep from the argument altogether and using a much simpler demonstration of the "primacy of time preference":

> Suppose we have a man who deposits a sum of money in a savings account. Now, the man has zero time preference, so he cares nothing for the time at which he withdraws and spends his money. If the prospective future market value of his savings account (i.e. his balance) is higher, he will postpone current withdrawal to reap the gain. If the prospective future market value is lower, he will withdraw his money now. In equilibrium, the interest rate must be such that the current and prospective future market values of his account are equal. This can only happen if the interest rate is zero. Therefore, time preference is necessary for positive interest rates.

In conclusion, TP only 'explains' positive interest rates when it is meant in our sense (i). To the extent that PTPT theorists often use the term in our sense (ii), they are simply wrong when they claim that TP is necessary and sufficient for interest.

On the other hand, if the PTPT theorists are using the term in our sense (i), then they are merely reiterating Böhm-Bawerk's "nub and kernel," and they are saying nothing with which any mainstream theorist would disagree. Furthermore, to the extent that they specifically include *dollars* among the present goods that have a higher valuation,[21] then the PTPT theorists can relax. Nobody—not even Paul Samuelson—would deny that a subjective premium on present over future dollars is necessary and sufficient for a positive interest rate.

III. *The Alleged Universality or Law of Time Preference*

Although not necessary for the PTPT—for example, Israel Kirzner's exposition does not include this feature—most PTPT theorists stress that (positive) time preference is an a priori (or at least self-evident) fact of human action. In this section we will briefly critique a few of the typical arguments.

[21] Peter Lewin (1999, pp. 101-102) explicitly reformulates the PTPT in dollar terms. Henry Hazlitt is even more candid: "In fact, it is almost supererogatory to say that time-preference…*causes* the rate of interest. Time-preference or time-discount *is* the rate of interest, looked at from another side" (Hazlitt 1959, p. 204, italics original). Surely if Austrians are defining TP such that it *is* the rate of interest, then they needn't invent scenarios with sheep to demonstrate that TP is necessary and sufficient for interest.

We start again with Mises, who claims, "The very act of gratifying a desire implies that gratification at the present instant is preferred to that at a later instant" (1966, p. 484). This observation is true, but it overlooks the fact that there could have been a preceding interval of *delayed gratification*, throughout which the (in that interval) future satisfaction had been preferred.

In a similar vein, Mises states that, "He who consumes a nonperishable good instead of postponing consumption for an indefinite later moment thereby reveals a higher valuation of present satisfaction as compared with later satisfaction" (1966, p. 484). Again, this is perfectly true, but Mises conveniently neglects to mention that he who *saves* a nonperishable good instead of consuming thereby reveals a higher valuation of later satisfaction. Both possibilities are equally plausible; there are real world cases of people who consume nonperishable goods, as well as real world cases of people who save them. If the former individuals demonstrate the existence of TP, why don't the latter demonstrate the existence of *negative* TP?

We finally turn to what (in my opinion) is Mises' strongest argument for the law of TP:

> If [one who acts] were not to prefer satisfaction in a nearer period of the future to that in a remoter period, he would never consume and so satisfy wants. He would always accumulate, he would never consume and enjoy. He would not consume

> today, but he would not consume tomorrow either, as the morrow would confront him with the same alternative. (Mises 1966, p. 484)

This argument is valid only when the "other things" that must be held equal are construed quite broadly. Mises has in mind an omniscient, immortal agent who behaves mechanistically according to external stimuli. If such an agent decides to postpone consumption in t_1 and (by construction) all relevant factors are the same in t_2, then the agent (to be consistent) must postpone consumption again. This is the sense in which Mises believes that valuing a good implies, ceteris paribus, the desire to consume it sooner rather than later.

The first thing to note about this argument is that it is quite odd from an Austrian point of view. Austrians usually deplore the mainstream approach of modeling agents as automatons who maximize given utility functions, yet this is merely a formalization of the approach Mises takes in the above quotation. Elsewhere in his book Mises says that even intransitivity of ordinal preference rankings is not evidence of irrationality, since preferences may change between acts of choice (1966, p. 103). Yet in the above argument, Mises must hold preferences constant for eternity.

Second, strictly speaking Mises has only proven that an agent cannot *prefer* to postpone consumption. For if an agent were indifferent and every period flipped a

coin to decide whether or not to consume, he would eventually consume (technically, 'with a probability of one'). Another purist quibble is that the agent could conceivably base his consumption decisions on the time index itself. Since we are dealing with an immortal being, who can say that the agent wouldn't prefer to consume everything on February 25, 2525? In this contrived example, today's decision to postpone consumption would not prohibit eventual consumption, even holding everything else equal.[22]

But the most serious drawback to Mises' argument is that it only proves the apodictic necessity of time preference *for such an immortal (and in essence, timeless) being*. Mises has not shown that actual human beings must exhibit time preference in his sense. On the contrary, Mises' argument doesn't even rule out universally *negative* time preference. That is, suppose that every human being prefers, other things equal, to postpone all consumption as long as possible. Does this entail an immediate cessation of consumption? Not at all! People still need to eat, or else they will starve and miss out on their planned future consumption. Moreover, people on a sinking ship will consume all they have, since other things will not be equal if they delay their gratifications. In fact, once we seriously consider the conditions of human life as they really are, there is nothing to rule out

[22] The obvious PTPT response involves us in rhetorical gymnastics. They would presumably respond that one of the other things that must be held equal is the agent's desire not to consume in the present day (for any day other than February 25, 2525).

the present world as one characterized by universally negative TP in the Misesian sense. Since other things are never equal, we do not need to fear the absurdity of all consumption postponed forever.

The above analysis of Mises' arguments demonstrates that, at best, he has proven the universal validity of "time preference" only when the term is couched in an entirely vacuous sense, in which, say, present hot dogs are preferred to future hot dogs because one can only eat a hot dog in the present. Needless to say, TP in this sense does not bear any relation to interest theory: It does not explain the discount on goods (such as hot dogs) available in the future, since even a decision to postpone current consumption would be viewed in this sense as "positive time preference" (at the eventual moment of consumption).

We next turn to Gene Callahan who, in his introduction to Austrian economics, also adopts a completely vacuous usage of 'present' and 'future' in order to prove the existence of time preference:

> Humans can only consume in the present. It is our present dissatisfactions that call out for relief. It is in the present that we experience pleasure and pain. Saving in the interest of infinitely postponed consumption is not saving at all—it is pure loss.
>
> Now we are faced with explaining the other side of the saving question—given that we can only consume in the present, why does anyone ever save? The answer is that, while we cannot consume in the future, we can imagine it. We can

> envision that in this future, we also will feel dissatisfactions and will want to alleviate them. In addition, we can imagine that a high enough degree of satisfaction on some future day might compensate us for some additional dissatisfaction today. (Callahan 2002, pp. 51-52)

Of course one understands what Callahan is driving at, but look at his actual words: "[W]hile we cannot consume in the future, we can imagine it." In the first place, how can we imagine the logically impossible (as 'future consumption' is in this context)? To be consistent, what Callahan really should have said is that, while we cannot consume in the future, we can imagine consuming in the present in the future (!). Second, Callahan's approach would not merely render future goods *less* valuable than present goods, but in fact would make them worthless; as Callahan says, you can't consume in the future, so a future good is useless. Finally, Callahan himself abandons this idiosyncratic usage and returns to the standard one[23] once he works with an actual example: When he returns to his running (and colorful) discussion of a contestant on TV's *Survivor* who must eat rats, Callahan says that if "Rich" decides to build rat traps then we know that "[a] 100-percent weekly rate of return was sufficient to persuade him to exchange present for future consumption. If he does not make the traps, we know that he values one present rat *more* than two future rats" (Callahan 2002, p. 55, italics original).

[23] Callahan has admitted (in private correspondence) his inconsistency, but believes his mistake was his reversion to the conventional usage!

We will end this section with one more argument from Callahan that ostensibly demonstrates the necessity of positive time preference:

> At one extreme, we have the hypothetical individual with zero time preference. For him, neither action nor consumption ever occurs. But no acting human will sacrifice today's satisfaction for the exact same satisfaction on some future date, all other things being equal. Imagine getting a call from a stockbroker, as you are about to leave for a vacation on the Riviera. "Listen," he says, "do I have a deal for you! If you postpone your vacation, and instead buy stock XYZ with the money you would have spent, in fifty years, I'll guarantee you…the exact same vacation on the Riviera." Who would accept such an offer? Unless we estimate that the future satisfaction resulting from an investment will be higher than the satisfaction we would have to sacrifice today in order to invest, no saving will occur. (Callahan 2002, pp. 52-53, ellipsis original)

Callahan's tale is typical of the PTPT literature. In order to 'prove' that all people prefer all satisfactions sooner rather than later, the reader is asked whether he would prefer ten dollars now or next week (Lewin 1999, p. 105), an apple now or two apples ten thousand years from now (Mises 1966, p. 527), or, above, whether he wants to take a vacation now or in fifty years. Not surprisingly, the PTPT theorists never prove their case by asking if the reader would prefer one apple at 3 a.m. to two apples at noon, or whether the reader would terribly mind delaying a vacation by fifty seconds.

But there is another, more fundamental flaw with these rigged tests of the "law" of time preference. For these examples always depict someone who is about to consume, and is then forced to postpone his consumption. But what if we consider someone who is *about to save* and is then *forced to spend*? Would such a person be indifferent to this change? Of course not, because the person could have spent his money voluntarily and yet decided against it.

Indeed, suppose someone made arrangements for a trip to the Riviera three months from now, only to have a stockbroker call and ask, "Would you like to bump up your plans and leave tomorrow?" In reality, the answer would almost certainly be no. Of course, the PTPT theorist could stipulate that other things (such as hotel reservations, babysitters, weather, time off from the job, etc.) were all held equal, but at that point one wonders what the demonstration is supposed to prove. Such a hypothetical choice has no bearing on the decisions that actual people make, and it has a very tenuous relation to interest theory.

IV. *"Interest is (due to) the higher valuation of present over future goods."*

This is Böhm-Bawerk's seminal insight, and constitutes the very foundation of the PTPT. We spent a great deal of time in Section II arguing that interest cannot be due to TP in sense (ii), but only in sense (i). However, though it is logically

coherent to claim that an agio on present goods is the cause of interest, the proposition is nonetheless riddled with serious difficulties for the Austrian economist.

First, the claim involves an aggregation just as heroic as that performed by any mainstream macroeconomist. After all, the PTPT compares the utility received from 'present goods' with utility from 'future goods.' On the face of it, this approach should seem very strange indeed to the Austrian.[24]

Second, the claim completely eliminates money from the explanation of interest. Interest is seen as a 'real' phenomenon;[25] the premium in money loans is considered a symptom, not the cause, of interest. In all other respects, Austrians are mindful of the "driving force" of money,[26] going so far as to argue that profit and loss are not really meaningful concepts in a world devoid of money (e.g. Mises

[24] If someone 'explained' the higher valuation of pounds versus yen by reference to 'geography preference,' or by the fact that 'British goods' were preferred to 'Japanese goods,' surely the Austrian would shudder. Yet this is precisely how the PTPT theorist explains the higher valuation of present dollars versus future dollars.

[25] This tendency is also exhibited by the contrast between money and "natural" rates of interest in the Austrian theory of the trade cycle: "Following Wicksell, Mises concluded that such expansion [of "fiduciary media" or unbacked bank deposits—RPM] would reduce the 'money rate of interest' ('the rate of interest that is demanded and paid for loans in money or money-substitutes') below the 'natural rate of interest' (the rate 'that would be determined by supply and demand if actual capital goods were lent without the mediation of money')" (Kirzner 2001, p. 140, quoting Mises 1953, p. 355).

[26] "The idea implied in the inappropriate term *level of prices,* as if—other things being equal—all prices could rise or drop evenly, is untenable. Other things cannot remain equal if the purchasing power of money changes" (Mises 1966, p. 222, italics original). This quote itself demonstrates the claim of this paper, that the PTPT is non-Austrian. In a world of change, other things cannot remain equal with the passage of time. Does this not render the idea of time preference untenable?

1966, pp. 201-206). Yet strangely, this does not stop Austrians from commenting on the magnitude of time preference independent of any mention of money prices. If it is only metaphorical to speak of *profit* in a barter economy, why is it meaningful to discuss *interest* in such a world?

Third, and most important, the claim presupposes that there is a *uniform* discount rate on future goods, both among individuals and across goods. For how could 'the' rate of (originary) interest possibly be equated with the (possibly different) *rates* of discount on various types of future goods? The PTPT proponent's attempt to solve this difficulty leads us to the next section.

V. *"There arises a uniform rate of originary interest among all individuals and across all goods."*

If the PTPT theorist explains 'the' interest rate by reference to 'the' preference for present over future goods, then naturally there must be (at least a tendency for) a uniform rate of excess valuation. Rothbard says that "in the ERE [evenly rotating economy] the interest return on monetary investment (the pure rate of interest) is the same everywhere in the economy, regardless of the type of product" (Rothbard 1970, p. 315). Referring to the Austrian concept of stages of production (a temporal hierarchy in which higher-order stages include activities such as mining

while lower-order stages include operations such as retail), Rothbard states the general rule that, "Not only must the interest rate be uniform for each good; it must be uniform for every stage of every good" (ibid., italics removed). To defend these claims, Rothbard first defines what he means by an "interest rate" in a given stage and then explains the tendency for equalization:

> It is important to realize that the *interest rate is equal to the rate of price spread in the various stages.* Too many writers consider the rate of interest as only the price of loans on the loan market. In reality…the rate of interest pervades all time markets…
>
> Not only will the rate of interest be equal in each stage of any given product, but the *same* rate of interest will prevail in *all* stages of *all* products in the ERE. In the real world of uncertainty, the *tendency* of entrepreneurial actions is always in the direction of establishing a uniform rate of interest throughout all time markets in the economy. The reason for the uniformity is clear. If stage 3 of good *X* earns 8% and stage 1 of good *Y* earns 2%, capitalists will tend to cease investing in the latter and shift to greater investments in the former. The price spreads change accordingly…and the interest rates become uniform. (Rothbard 1970, p. 317, italics original)

The above reasoning is perfectly correct; capitalists will shift their funds until the rate of monetary return is equalized across all investments. To put it more precisely: In equilibrium, at any time t_1 the ratio of (1) the current price for a claim on a good available in t_2 (i.e. the t_1 price of a t_2 future) and (2) the expected spot price of the good in t_2, must be the same for all goods.

However, PTPT theorists may draw from this an invalid extension, if they believe that in equilibrium, the ratio of (1) the price for a future and (2) the *current* spot price, must be the same for all goods. For example, Rothbard says, "[I]f the market time preference rate, i.e. interest rate, is 5% per year, then a present good worth 100 ounces on the market will be worth about 95 ounces for a claim on it one year from now" (p. 318). Rothbard's statement is only true if the current spot price is equal to the spot price of the good one year from now; if they differ, then his claim is incorrect.[27]

Now it is true, Rothbard is careful to restrict his statements to the "evenly rotating economy," in which "value scales, technological ideas, and the given resources [remain] constant," and hence "the same activities tend to be repeated in the same pattern over and over again" (p. 275). The ERE is thus a *stationary* general equilibrium, in which spot prices are indeed constant over time, and hence in which a uniform premium on present over future goods will emerge.

[27] Lachmann explicitly commits this error when he says that, "In a barter economy with free competition commodity arbitrage would tend to establish an overall equilibrium rate of interest. Otherwise, if the wheat rate were the highest and the barley rate the lowest of interest rates, it would become profitable to borrow in barley and lend in wheat. Inter-market arbitrage will tend to establish an overall equilibrium in the loan market such that, in terms of a third commodity serving as *numéraire*, say steel, it is no more profitable to lend in wheat than in barley" (Lachmann 1994, p. 161). In context, Lachmann is defending Hayek from Sraffa's claim that there is no reason for a unique "natural rate of interest." But Sraffa's whole point was that there are, in principle, just as many natural rates as commodities; the fact that the rates in terms of any one commodity, such as steel, must be equal does not rescue Hayek. (One cannot explain the trade cycle as a deviation of the money rate of interest from 'the' natural rate of interest if the rate calculated in terms of steel is different from the natural rate calculated in terms of copper.) The simple example offered in the text below will show that arbitraging alone will not establish a unique real rate of interest in the way Lachmann seems to think.

However, such a uniform premium need *not* emerge in a *dynamic* general equilibrium, in which changes occur over time, but in a perfectly predictable manner. In such a situation, the intertemporal price structure would contain no pure profit opportunities, just as in the more restrictive ERE. But changing spot prices *would* allow different exchange rates between present and future goods, as the following simplified example demonstrates. Thus the PTPT theorists' claims do not necessarily hold in a world of certainty (as they seem to believe), but only in a world of certainty *and* unchanging conditions over time.[28]

Imagine a simple, two-period, pure endowment economy. There are only two types of goods—apples and oranges—which can be picked from trees each period. The fruit must be eaten during the period in which it is picked, or else it will rot. (Note that there is neither production nor physical saving.)

Further suppose that, all else being equal, consumers are indifferent between apple and orange consumption, and also between present and future consumption. (There is thus no TP in sense [ii].) However, there *is* diminishing marginal utility; for example, if someone had more apples than oranges (in a given period), he would be

[28] This distinction may seem pedantic, since presumably the uncertainty of the real world is due precisely to the changes that inevitably occur with the passage of time. Yet surely there is some use for a theoretical construct (i.e. dynamic general equilibrium) in which future changes—e.g. growth in population and capital stock or the reduction in harvests during the winter—occur but are completely anticipated.

willing to sacrifice more than one apple to receive an orange in exchange (in that period).

Although there is no production or physical saving, there are still markets in which present apples and present oranges can be exchanged for each other, and for their future counterparts. For example, Joe can pick an apple today and give it to Sally (who eats it today), then Sally can pick an orange off of her tree *tomorrow* and give it to Joe (who eats it at that time). A convenient way to effect this trade is for Joe (in the first period) to buy a claim for a future orange (from Sally) at the price of one present apple.

Now suppose that, in the first period, the total number of apples is equal to the total number of oranges, while in the second period, there will be a much greater supply of apples and a much smaller supply of oranges. Suppose that these differences result in the following equilibrium real exchange ratios:

1 present apple	:	1 present orange
1 present apple	:	2 future apples
1 present apple	:	½ future oranges
1 present orange	:	½ future oranges
1 present orange	:	2 future apples
1 future apple	:	¼ future oranges

Table 2—Equilibrium Real Exchange Ratios

(calculated in first period)

There is nothing odd about these values, nor do they allow for any arbitrage. What then is the agio on present goods in this world? It depends on whether we look at apples or oranges; the marginal present apple is valued more highly than the future apple, while the marginal future orange is valued more highly than the present one. Indeed, the neoclassical (dutifully following Böhm-Bawerk by considering interest as a real phenomenon) would inform us that there is not one but *two* (own) rates of interest in this world: +100 and –50 percent.[29]

Perhaps this anomalous result is an artifact of the simplistic model, which abstracts from money. Suppose then that the fruit is traded indirectly against money, and that there is also a loan market. Further suppose that the nominal money rate of

[29] Hayek notes the same problem: "It is probably unnecessary to emphasise that there is no way in which this multitude of different 'own rates of interest' (as Mr. Keynes has called these rates of increase in terms of particular commodities) can be reduced to one single rate which has a stronger claim than any other to be regarded as *the* rate of productivity of investment" (Hayek 1975 [1941], p. 168).

interest established on this loan market is 100 percent.[30] Thus, if someone lends four dollars today, he will receive eight dollars in the next period. In equilibrium, it must be the case that he receives the same return if he 'invests' in either apples or oranges. The following price schedule (calculated in period 1) satisfies this condition, and also reflects the real exchange ratios computed above:[31]

1 period 1 apple (spot)	:	$2
1 period 1 orange (spot)	:	$2
1 period 2 apple (future)	:	$1
1 period 2 orange (future)	:	$4
1 period 2 apple (spot)	:	$2
1 period 2 orange (spot)	:	$8

Table 3—Equilibrium Money Prices

(calculated in first period)

For example, someone in the first period can invest $4 in four claims on future apples (since they cost $1 each). In the next period, the spot price of apples remains the same, so the four delivered apples can be sold for a total of $8. Or,

[30] This number is completely arbitrary, and that is precisely the point: By considering only real variables, one cannot pin down the nominal rate of interest. All one knows is the *relative* price ratios. Any nominal interest rate at all could be achieved (while still reflecting the same real exchange ratios) by appropriately adjusting the prices in the table.

[31] Due account must be made for interest. For example, we know that a present apple must be equal in market value to two future apples. Two future apples will sell (in period 2) for a total of $4 (since they are $2 each). But in *period 1*, this total is worth only $2 (because of the 100 percent nominal interest rate). And in fact, a period 1 apple sells for $2.

someone in the first period can invest $4 in one claim to a future orange. In the next period, the spot price of oranges will have risen to $8, and the person can then sell the delivered orange to reap this return.

We see that, in general, there is no reason for a uniform rate (or even sign!) of time preference (sense [i]) to emerge across goods, since price ratios may change over time.[32,33]

VI. *"Capital goods possess no independent productivity; all productive value (except for time preference) is 'swept back' to the original factors of land and labor used in their construction."*

Although the "original factors" doctrine is not necessarily related to the PTPT, the two often go hand in hand. I devote this section to its critique because the points made will underscore the difficulties of the PTPT view on capital and interest.

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[32] One cannot deduce the real rate of interest from the nominal rate since, as every Austrian knows, there is no way to construct a non-arbitrary price deflator; the price of apples has stayed the same, while the price of oranges has quadrupled.

[33] Keynes noted this possibility in his notorious Chapter 17 of the *General Theory* (1965 [1936], p. 223). (Irving Fisher also realized that there are "theoretically just as many rates of interest expressed in terms of goods as there are kinds of goods diverging from one another in value" [qtd. in Hazlitt 1959, p. 243, italics removed].) Henry Hazlitt devotes his own Chapter XVII to ridiculing Keynes' use of the concept of "own rates of interest," calling it a "strange notion" (p. 236), a "violent misnomer" (237), and "nonsense" (238). (One wonders whether Hazlitt—an admirer of Ludwig von Mises' development of the PTPT—would consider Rothbard's definition of price spreads in various capital goods markets as rates of interest, to be as equally strange, violent, and nonsensical.) The PTPT in fact encourages exactly the type of thinking that Hazlitt finds so absurd. Hazlitt's demonstration that own rates of interest in the real world can often be negative (p. 240) is the exact point I make in the text above.

The original factors doctrine is intimately related to the Austrian view of the capital structure, and can be traced at least as far back as Böhm-Bawerk. As Kirzner explains:

> Böhm-Bawerk…vigorously denied the possibility of distinguishing any independent third factor of production to stand side by side with labor and nature. Capital itself is not such a factor, it is merely the intermediate product of nature and labor. All production achieved with the help of capital must be ascribed to the nature and labor which, some time in the past, cooperated in the production of capital. No portion of the value of the final product can be imputed back to any other original factor. (Kirzner 1996, p. 87)

As usual, the clearest exposition of the original factors doctrine is given by Rothbard:

> All goods earn *gross rent*, since all have unit services and prices for them. If a good is "rented out," it will earn gross rent in the hire charge. If it is bought, then its present price embodies discounted future rents, and in the future it will earn these rents by contributing to production. All goods, therefore, earn gross rents, and here there is no analytic distinction between one factor and another.
>
> *Net rents*, however, are earned only by labor and land factors, and not by capital goods. For the gross rents earned by a capital good will be imputed to gross rents paid to the owners of the factors that produced it. Hence, on net, only labor and land factors—the ultimate factors—earn rents, and, in the ERE, these, along with interest on time, will be the only incomes in the economy. (Rothbard 1970, p. 503, italics original)

The original factors doctrine is perhaps the single most dangerous in all of the PTPT literature.[34] With equal justification, one could state: Consumer goods possess no independent value that is not swept back to the higher-order goods used in their construction. Although technically true, one wonders what the *purpose* of this statement is. Surely the claim is dangerous, in the sense that it might mislead one into thinking that the true source of value in a finished good derives from the value of its components, and not vice versa.

In the same way, Claim VI might mislead one into thinking that the original productive value resides in land and labor, and flows *into* a particular capital good. But this is exactly backwards. Suppose there is a particular mineral that has only *one* use, as a component in a machine. Then clearly, the mineral is productive only insofar as the *machine* is productive; the mineral has no 'independent productivity' at all.

Besides this quibble, there is a much deeper flaw with the original factors doctrine; it too is only true in a *stationary* equilibrium (i.e. an evenly rotating economy), and need not be true in a world merely devoid of arbitrage opportunities.

[34] To his credit, Kirzner (following Hayek) recognizes that viewing capital as "congealed waiting" is conducive to a "'cost-of-production' way of thinking about capital goods" (Kirzner 1996, p. 82).

Imagine a simple world in which umbrellas are constructed during a three-period process. In the first period, labor works upon raw materials (which are classified as 4th-order goods), forming 3rd-order goods. Labor is then applied to these goods in the next period to form 2nd-order goods, and finally umbrellas are formed when the finishing touches of labor are applied to 2nd-order goods. Starting initially from a stationary equilibrium, the market value of the original raw materials must be equal to the market value of a finished umbrella, discounted of course by three periods at the prevailing rate of interest. (We are neglecting the incomes of the laborers for simplicity.)

Now suppose that there is an unexpected increase in the amount of rainfall. This boosts demand for, and the price of, umbrellas. There is now a temporary arbitrage opportunity in the price structure: Even accounting for interest, the price of 2nd-order goods and the labor needed to transform them into finished umbrellas is lower than the new market price of umbrellas. Consequently, entrepreneurs bid up the price of labor and 2nd-order goods.[35]

The process does not stop there, of course. The prices of the goods of higher orders are also bid up. If the economy had simply moved to a new stationary equilibrium

[35] This exposition assumes a certain myopia of the people involved, in order for the reader to better understand what is happening. It may very well be that astute entrepreneurs quickly anticipate the effects of the increased rainfall. Thus, the producer of 3rd-order goods need not wait for the price of 2nd-order goods to be bid up before realizing that his own product will become more valuable in the dynamic equilibrium.

(i.e. if the rainfall settled down at this new amount forever) then the PTPT theorist would be perfectly correct: the prices of the capital goods used in the construction of umbrellas would possess no "value surplus" except that attributed to time preference. The increased value assigned by consumers to umbrellas would be entirely swept back to the original land (and labor) used in their construction.

In particular, the price, say, of a 3rd-order good would necessarily be equal to the price of a 4th-order good (plus the price of the labor used in the fourth stage), times the gross market rate of interest. Thus, the physical productivity of the 4th-order good (i.e. its technological ability to generate a 3rd-order good) cannot explain why investment in the 4th stage yields a financial return one period later.

But this result does not hold if the increased rainfall is merely *temporary*. Suppose that meteorologists report that the amount of rainfall will return to its previous level—and remain there forever—after, say, three periods. Then it is no longer true that the higher price of umbrellas will be imputed entirely back into the land (and labor) factors. Even after everyone has adjusted to the new situation, there will remain a 'gap' in prices between the 3rd and 4th stages. That is, the price of a 3rd-order good will be higher than the prices of its inputs, even accounting for (the stationary rate of) interest.[36] The price of a 4th-order good will not be bid up,

[36] We are assuming that the shock does not affect the rate of interest through any indirect effects.

because *by the time this good produces a finished umbrella*, the rainfall will have returned to its original level. Over the next three years, the 'gap' will move down the production process, until the economy returns to the original stationary equilibrium. This is illustrated in Table 4, which assumes an original 100 percent rate of interest. The shock in rainfall occurs in the beginning of period 3. (Note that the prices for period 3 are posted *after* everyone adjusts to the shock.)

Stage	**Market Value (Neglecting Labor Inputs)**						
4th	125	125	125	125	125	125	125
3rd	250	250	1250	250	250	250	250
2nd	500	500	2500	2500	500	500	500
1st	1000	1000	5000	5000	5000	1000	1000
Period:	**1**	**2**	**3***	**4**	**5**	**6**	**7**
	Stationary Eq.		Dynamic Equilibrium			Stationary Eq.	

Table 4—Umbrella Counterexample to Claim VI

To repeat: In period 3, the 3rd-order capital goods possess a "value surplus" that would seem to be impossible according to the PTPT literature. This is true even though the prices shown above (after period 3) are all *in equilibrium*; they are not mere transitory phenomena, and they do not reflect any error.[37]

[37] The true error occurred in period 2, when the owners of 4th-order goods sold for $125 when they should have insisted on receiving $625. Of course, had everyone anticipated the temporary spike in rainfall all along, then presumably umbrella production would have increased in the periods prior to the spike, greatly dampening the fluctuation in the market price of umbrellas.

This scenario serves two additional purposes. First, it shows the corollary flaw in the PTPT claim that a uniform discount rate will emerge for the same units of time. Second, it highlights again the tremendous difficulty in equating interest with the higher valuation of present over future goods.[38] In the stationary equilibrium, the PTPT theorist can easily deduce the interest rate simply by examining the price margins—the net rate must be 100 percent. This follows (so the PTPT theorist would say) from the fact that, for example, a 2nd-order good is really nothing but a 3rd-order good, *plus one unit of time*.[39] So any difference in their market values must be attributed entirely to time preference, that is, the rate of interest.

But how should the PTPT theorist describe the dynamic equilibrium periods? In each period, two of the stages exhibit the original 100 percent markup, while one of the stages exhibits a 900 percent markup. In period 4, it is still the case that a 2nd-order good represents a 3rd-order good plus one unit of time, so now the difference in market values between these items would lead us to believe the net rate of interest is 900 percent. But a comparison of the differences in the other stages would lead us to believe that the net rate were still 100 percent. We thus see a

[38] For example, Kirzner explains a quote from Mises by saying, "[Mises] relies on the reader's understanding of the Böhm-Bawerkian insight that the money rate of interest simply corresponds, in a smoothly running economy at a given level of production, to the excess value of consumer goods at a given date, over the value—the spot price—of the inputs invested at an earlier date in their production" (Kirzner 2001, p. 141). We are not arguing above that this "insight" is necessarily wrong, but rather that its qualifications are perhaps more serious than Kirzner may have realized.
[39] Again, we are neglecting labor inputs for simplicity.

difficulty similar to that demonstrated in Section V, in which it was shown that there need not arise a uniform rate of TP across goods.

Before closing this section, it should be noted that a scenario such as this demonstrates the truly independent nature of Böhm-Bawerk's third cause of interest, "roundabout productivity."[40] To avoid confusion, let me repeat that I am *not* claiming that the different price margins should be considered as interest; rather I am claiming that *Böhm-Bawerk* thought they should be (since he defined interest as the higher market value of present over future goods), and hence—as this scenario illustrates—Böhm-Bawerk must be acquitted of the charge (e.g. Mises 1966, pp. 527-528) that he subtly returned to the productivity fallacies.

VII. *Identical Objects, Different Goods? The Notorious Ice Example*

I will devote this section to the obvious counterargument to the claims made thus far. The PTPT theorist will probably find the above arguments to be unsatisfactory, and will conclude that they suffer from an incomplete subjectivism. Just because a

[40] To translate the scenario into Böhm-Bawerk's framework: A 3rd-order good in period 3 is more valuable than a 3rd-order good in period 4 because the former can produce one highly-valued umbrella in period 5, or one normally-valued umbrella in period 6 (because the finished umbrella in period 5 could simply be held for one period). The latter, however, can produce *no* highly-valued umbrellas in period 5, and one normally-valued umbrella in period 6. Thus, because of its superior technical productivity, the former is valued at $1250, while the latter at only $250. (Admittedly, Böhm-Bawerk did not seem to realize that he needed a dynamic equilibrium to achieve this result. Thus, although he was correct in his arguments with, e.g., Fisher, Böhm-Bawerk apparently did not know *why* he was correct.)

horticulturist considers two objects to be identical oranges does not render them two units of the same *good*; only the actor's subjective valuations determine *this* equivalence. Thus, the PTPT theorist will probably believe that the scenario of Section V misses its mark; the 'orange' of period 2 offers a higher marginal utility than the 'orange' of period 1, and hence the two must be treated as *different goods*. Similarly, in Section VI, the 'umbrella' of period 2 is a *different good* from the 'umbrella' of period 4, and thus the 2^{nd}-order good in period 4 is *not* the 3^{rd}-order good plus one unit of time. Once this distinction is made, all of the apparent troubles with the PTPT fall away.

There are several problems with this defense; three of the gravest will be documented below. For clarity, I will change the example to give the PTPT argument the fairest possible hearing. It is typical to 'refute' the law of time preference by citing the example of a man in the winter in possession of a unit of ice. Surely the man would be willing to trade away this object in order to receive a physically identical unit of ice the following summer. Is this not, the critic of the PTPT asks, a clear and reasonable case of someone preferring a future good to a present good? The PTPT theorist responds that no, the ice example makes the same mistake (ostensibly) made in this paper in Sections V and VI; because the man derives a higher utility from ice consumption in the summer than in the winter,

ice-in-the-winter is a *different good* from ice-in-the-summer. This standard PTPT defense[41] will now be criticized in the context of the ice example.

A. Constant Preferences

First, the defense relies upon a constancy in preferences. Remember, the defense runs in this fashion: The man receives a certain utility, say *W*, from consuming the ice in the winter. He conjectures that he *will* receive a certain utility, *S*, from consuming it in the coming summer. Now, the man still experiences time preference, so in evaluating the *present* utility of the summer consumption, the man discounts *S* to a lower value, *s*. Because the man decides to postpone consumption, we know that $s > W$. But there is still time preference; that is, $S > s$. It's just that *S* is sufficiently bigger than *W*, so that, even when its utility is discounted, the future ice consumption in the summer is more attractive than present ice consumption in the winter.

I believe that this approach, though at first quite reasonable, should give pause to the Austrian economist. Although one needn't interpret *W* and *S* as cardinal numbers, they *are* still comparable magnitudes on some scale, a scale that is held to

[41] E.g. Rothbard: "[A] common type of objection to the assertion of universal time preference is that, in the winter time, a man will prefer the delivery of ice next summer (future) to delivery of ice in the present. This, however, confuses the concept 'good' with the material properties of a thing…Since ice-in-the-summer provides different (and greater) satisfactions than ice-in-the-winter, they are *not* the same, but *different* goods" (1970, p. 436, italics original).

be constant over time.[42] Again, the PTPT defender is *not* merely comparing the present utility of winter ice consumption, with the *estimated current utility* of future ice consumption (that is, *W* with *s*). The PTPT theorist must *also* discuss the present utility of summer ice consumption (i.e. *S*), *as it will be experienced in the future*.[43] The difficulty with this approach will be elaborated in the next section.

B. No Relation to Action

Simply put, the statement "present ice-in-the-summer offers more utility than present ice-in-the-winter" should be *meaningless* to the Austrian economist; there is no way to relate this proposition to one involving the actions taken by an individual.

When we say that an apple offers more utility than an orange, we imply that, if faced with a choice between the two, the individual would pick the apple over the

[42] At the very least, it presupposes that an object's position in the present scale of values can be compared with its position in the (possibly different) future scale of values. E.g., consider the PTPT theorist's response to a different 'counterexample' to the law of time preference: A young boy, who has never tasted alcohol, would (if he were sufficiently well-informed) exchange a present bottle of beer for a future one, since presumably by that time his preferences will have changed. The PTPT theorist does not simply ask, "What is the boy's estimate of his current utility from future beer consumption?" No, the PTPT theorist *first* requires the boy to imagine *how much* ***present*** *satisfaction the beer will give him at that future date*, and *then* the boy must discount this value because of its remoteness.

[43] Neoclassical models avoid these difficulties by assuming a constant intraperiod utility function. Time preference (in sense [ii]) is modeled by multiplying future utility by a discount factor. In fact, it is very problematic to even *define* time preference (sense [ii]) without recourse to a constant scale of values over time.

orange. In the same way, when the man in winter decides to postpone consumption of his ice, the economist concludes that the man values 'future ice-in-the-summer' more than he values 'present ice-in-the-winter.'

But we can make *no* comparison of the utility between 'present ice-in-the-winter' and '*present* ice-in-the-summer,' for the simple reason that winter and summer never occur at the same point in time. An actor *never chooses* between present ice-in-the-winter and present ice-in-the-summer, and thus the PTPT theorist's comparison of the utilities offered by the two items is nonsensical. To compare a man's satisfaction from consumption in winter with his consumption in summer is to commit a subtle interpersonal utility comparison.[44,45]

[44] To avoid any confusion: This discussion is not denying that considerations of time and place matter in the definition of a good. For example, when explaining the social function of retailers, an economist may note that, to an Eskimo, an orange-in-Florida is a *different good* from an orange-in-Alaska. But the PTPT theorist wants to consider, not this distinction, but rather whether eating an orange in Alaska gives the same utility as eating the same orange in Florida.

[45] That the PTPT encourages interpersonal utility comparisons is seen most clearly in Callahan: "A person's time preference at thirty might be lower than the same person's time preference at eighty. At thirty, he may be quite willing to hold off on that trip to the Alps in order to save for a house for his new family, whereas at eighty he is much more likely to think, 'Hey, I'd better get over there now!' However… [t]he opposite progression of time preference could just as well occur: At thirty, one might think of nothing but 'living for the moment,' while at eighty, one's entire focus is on building up the grandchildren's trust funds" (2002, pp. 53-54). Inasmuch as the person will be long dead when the trust fund is consumed, Callahan's last case can be considered as low TP only because the person is sacrificing *his* present consumption for *his grandchildren's* (greater) consumption in the future.

C. Inconsistent with Intratemporal Definition

Most damaging of all, the PTPT definition of a *good* in an intertemporal context differs—and absurdly so—from the definition of a good in an intratemporal context. The PTPT theorist says that the marginal utility of the unit of ice in summer is higher than in the winter, and so the two physical items are not really units of the same good. But the Austrian considers the marginal utility of the 1st gallon of water to be higher than the marginal utility of the 100th gallon of water; are these items then different goods (rather than different units of the same good)?

Returning to the scenario described in Section VI: The PTPT theorist would no doubt claim that the 'umbrella' in period 2 is a different good from the 'umbrella' in period 3. But if we accept this distinction, we are thereby prohibited from ever saying that the demand for 'a good' has increased. For example, it was not the case that the price of gasoline increased during the oil shock of the 1970s; rather, the good gas-during-normalcy was transformed into gas-during-the-OPEC-crisis. The market price of the latter good was higher than that of the former, that is all.

In a related vein, the PTPT theorist would presumably claim that the original factors doctrine was not refuted by the scenario in Section VI. For "land" to the Austrian economist is not really the nature-given factors, but rather those items that

are non-reproducible from the actor's point of view (Rothbard in Fetter 1977, p. 6). Thus, in period 3, the 3rd-order goods really are land, in the sense that they can produce a highly-valued umbrella. This effect cannot be reproduced simply by taking a 4th-order good and waiting for one time period. So, after this subtle correction, it is still true that all value is swept back into the original factors; capital goods possess no independent productivity.

This move will certainly rescue the PTPT, but at what cost? For now we must say that, in the 3rd period, those man-made items that were previously considered capital goods have now become land, but will only remain so for one period. After that time, the identical (from a technological point of view) items will once again become capital goods. And all the while, the items are used in the same production process, with the only exception being the market price of the final product.

VIII. *Cardinal Utility?*

The discussion of the ice example has shown that the PTPT requires the economist to index satisfactions according to the time at which they are experienced; in time t_1 an actor must be able to compare present satisfactions with *present satisfactions as they will be experienced in* t_2. We have seen above the incompatibility of this approach with other areas of Austrian theory. More generally, there is the problem

of changing values; how can one compare present t_1 satisfactions with present t_2 satisfactions if preferences will change in the interim?[46]

But perhaps the clearest demonstration—and the one on which I will end this paper—of the non-Austrian character of the PTPT is that, quite simply, the PTPT invites a cardinal conception of utility. Modern Austrians typically insist on the ordinal nature of preferences, and many reject the representation theorems of mainstream microeconomics in which a cardinal utility function is used as a convenient proxy for ordinal preferences (e.g. Block 1999 and Hülsmann 1999). It is ironic, then, that most Austrians embrace the PTPT, for the notion *time preference* (in sense [ii]) is itself linked to a cardinal conception of utility.

As shown in earlier sections, the PTPT advocate does not believe that the marginal rate of substitution for goods over time will always favor the present good; for example, it is perfectly possible for two present oranges to trade for one future orange. What the PTPT advocate really means is that the same *psychic satisfaction* is always preferred sooner rather than later. To put it another way, the law of time preference claims that the utility from the present prospect of a given future satisfaction is always less than the utility from the satisfaction itself, at the moment

[46] Callahan recognizes the problem but does not see any negative implications for the PTPT: "[Rich] must estimate how much satisfaction his choice will bring to 'Future Rich,' whose knowledge and tastes are unknown to 'Present Rich,' and who will be living in a world that, for Present Rich, is filled with uncertainty" (2002, p. 50).

of consumption; i.e. the claim is that everyone possesses TP in our sense (ii). In the case of present vs. future ice, our hypothetical consumer in the winter must contrast the utility *S* he will ultimately receive in the summer from ice, versus the discounted utility *s* he will receive *now* for obtaining a claim to (future) ice in the summer. Analyzing the situation in this fashion certainly invites (if not requires) the notion of a unit of utility that can be used for intertemporal measurements or comparisons. I will illustrate this phenomenon with selections from several prominent Austrians.

The original exposition of Böhm-Bawerk quite explicitly uses cardinal units of utility, and it is in the discussion of his first two causes of the higher valuation of present goods—what have been considered the 'psychological' versus the 'objective' reasons—that their connection to his theory of interest is clearest. To reiterate, it is Böhm-Bawerk's second cause, i.e. "the fact that we feel less concerned about future sensations of joy and sorrow simply because they do lie in the future, and the lessening of our concern is in proportion to the remoteness of that future" (II, p. 268), that most directly captures the essence of time preference as used in the PTPT literature. Böhm-Bawerk's discussion of the interaction of his first and second causes leaves little room for an ordinal approach to the concept:[47]

[47] Koopmans (1960) specifically attempts to formalize Böhm-Bawerk's second cause through a purely ordinal approach.

> And now it can be easily demonstrated that this phenomenon [i.e. the second cause] necessarily contributes to enhance the effectiveness of our first principal cause of the lesser valuation of future goods…Consider once more all those persons who are less well provided for in the present than in the future, and for whom the *true* marginal utility of a quantity of future goods is therefore already smaller than the marginal utility of the same quantity of present goods. All such persons, through the functioning of the second main cause, will now in addition make their valuation of the future marginal utility still lower. As a result, the margin of difference in value becomes augmented in favor of present goods. Suppose, for instance, that the marginal utility of a certain present good is 100 and that the true marginal utility of a like good in a better-provided future period is only 80. In that case the second main cause will operate to bring the valuation to, perhaps, only 70 and thus the margin of difference in valuation will be augmented from 20 to 30. The same applies to the persons whose present and future are approximately equally well provided for….And of course in a market in which present goods are being exchanged for future goods the result in exchange value must be to the disadvantage of the *latter*. *The agio in favor of present goods goes up.* (II, pp. 272-273, italics original)

This passage illuminates the best and worst of Böhm-Bawerk's theory of interest. He can clearly distinguish between the higher value of present goods over future goods ("agio"), the higher valuation of present goods due to relative differences in supply and demand ("first cause"), and the higher valuation of present goods due to time preference in our sense (ii) ("second cause"). However, these sharp distinctions (lacking in much of the PTPT literature) rely on a cardinal conception of utility. Without an intertemporally comparable unit of psychic enjoyment (i.e. a

unit of utility), it is quite difficult (though not impossible[48]) to distinguish between (1) a present good being more valuable than a future good, (2) a present good being more valuable because of differences in supply and demand, and (3) a present good being more valuable *because* it is a present good. Much of the ambiguity in the PTPT literature is probably due to the desire to distinguish among these cases *without* using a cardinal unit of utility.

In reference to the Cambridge capital controversy, and the PTPT immunity from the neo-Ricardian challenge to the mainstream, Israel Kirzner writes:

> For the pure time-preference perspective, interest emerges in intertemporal exchanges in which freely acting market participants express their prospective relative valuations of receipts/sacrifices of different dates. Interest income so received is an entirely defensible reflection of consumer sovereignty (in regard to the *intertemporal allocation of utilities*). (Kirzner 1996, pp. 6-7, italics added)

To reiterate the possible danger: Above Kirzner is not merely saying that the interest rate is a reflection of consumer attempts to maximize (present) utility by allocating *goods* (or receipts and sacrifices) in an intertemporal framework. No, Kirzner goes further and says that consumers seek to allocate (present and future)

[48] Koopmans (1960) must assume stationarity in preferences to even *define* a notion of time preference (pp. 293-294). With this and a few other assumptions, Koopmans is able to represent intertemporal ordinal preferences by a cardinal utility function.

utilities themselves. In context, the claim could be taken to mean that the interest rate measures the exchange rate between present and future utility.

Finally, I will close with an example drawn from Ludwig von Mises. I find this quote downright shocking, since it so blatantly demonstrates that the PTPT forces even Mises to (inadvertently) employ a cardinal conception of utility: "Originary interest is the ratio of the value assigned to want-satisfaction in the immediate future and the value assigned to want-satisfaction in remote periods of the future" (Mises 1966, p. 526).

There is no getting around Mises' words. The PTPT has led him to *literally divide one subjective value by another*. Obviously Mises does not 'mean' to actually place subjective values in a ratio, but that is what he wrote. What clearer evidence could there be that the pure time preference theory of interest does not belong in Austrian economics?

CONCLUSION

Carl Menger considered Böhm-Bawerk's theory of interest to be "one of the greatest errors ever committed." PTPT advocates cite this as evidence of the superior subjectivism of their own approach. However, it may very well be that

Menger objected more to the time preference element of Böhm-Bawerk's theory, rather than his emphasis on roundabout productivity.

In all other respects, Austrians are the most dogmatic of schools concerning the heterogeneity of goods and dynamism of the real world. Yet the pure time preference theory is built upon propositions that are only valid within a stationary framework.

Austrians should reject any theory of interest that deals only with 'real' phenomena, to the exclusion of money. A positive interest rate is simply a higher price for present money units versus future money units. To label this phenomenon "time preference" is entirely unnecessary[49] and can only lead to confusion.

[49] For example, we could construct a completely analogous 'pure size preference' theory of consumer goods prices: Other things being equal, a consumer prefers a bigger good to a smaller one. (We can prove this apodictically; if, ceteris paribus, a consumer didn't prefer a good to the same good but half its size, then he also wouldn't prefer a good to the same good one quarter its size, or one eighth, etc. We thus see that lack of size preference would imply no valuation at all of goods, since goods need to possess some size in order to be consumed.) The pure size preference theory obviously explains the correlation between market prices and the size of television sets, limousines, jet planes, etc. Ostensible 'counterexamples' are in fact comparisons of different goods; the law of size preference is upheld.

Chapter Three

A Monetary Approach to Interest Theory

INTRODUCTION

Economists have typically defined interest as the higher price of present (versus future) consumption. In this approach, the real rate of interest equals the premium placed on present vs. future goods in intertemporal exchanges. This framework of a 'barter fiction' abstracts from money altogether.

The present paper rejects this conventional approach. I argue that real (versus monetary) theories of interest are only sensible within a stationary setting, and are of little use once this unrealistic assumption is relaxed. Barter models always involve a deviation from reality, but they are particularly dubious when describing intertemporal affairs. Moreover, these models cannot pin down the nominal rates of interest, even though these are what we actually observe on the market.

In contrast to the real theories, I offer a monetary theory of interest. In this approach, I do not model the real interest rate,[1] but instead deal with the exchange

[1] The "real interest rate" has at least two meanings in modern economics. On the one hand, it can refer to the premium on present consumption in a formal model; it corresponds to the (equilibrium) intertemporal exchange rate of present consumption goods for future consumption goods. On the

ratios of present and future units of currency, i.e. the nominal rates of interest. I explore the demand for cash balances, and argue that money is an evolved institution that allows individuals to cope with radical uncertainty. This fact leads me to conjecture that (positive) interest rates are a reflection of the loss in liquidity during the transaction period.

Finally, I suggest an equilibrium concept appropriate in settings involving true uncertainty. I demonstrate the intuitive result that increased future uncertainty leads to higher interest rates. The paper closes with a discussion of possible applications of my approach to doctrinal controversies as well as business cycle theories.

A CRITIQUE OF REAL THEORIES OF INTEREST

Real theories of interest abstract from money altogether, and view interest as an intertemporal exchange between present and future (real) goods. Most modern versions of this approach can trace their roots to the classic work of Böhm-Bawerk, who wrote:

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other hand, the "real interest rate" may be computed using Fisher's relation between the nominal interest rate and inflation; it is a statistical measure. However, the latter concept is subordinate to the former; what the empirical techniques are supposed to be measuring is the theoretical exchange rates depicted in formal models. For the present paper, either definition of "real interest rate" will work, although for most arguments I had the former in mind.

> *Present goods are as a general rule worth more than future goods of equal quality and quantity*. That sentence is the nub and kernel of the theory of interest which I have to present. All threads of the explanation of phenomena of interest lead through it, and it constitutes the focal point…of all the tasks we have to perform in the way of examination into economic theory. Half of the explanation is devoted to demonstrating the truth of that sentence. The other half will then consist in showing how the fact that present goods exceed future goods in value constitutes the source from which, naturally and necessarily, emanate all the variegated forms in which the phenomenon of interest manifests itself. (1959 [1881] II, p. 259, italics original)

Böhm-Bawerk explained the higher valuation of present goods on the basis of relative scarcity, the subjective discount of future utility, and the greater output of roundabout production processes.[2] His theory thus contained all of the elements of the standard mainstream approach (as developed by Fisher [1907 and 1930], Samuelson [1937], and Koopmans [1960]), and it also inspired the modern Austrian pure time preference theory of interest (as developed by Fetter [1977] and Mises [1966 (1949)]). Despite their (great) differences, all of these theories share a common feature: They all view interest as a real phenomenon, and thus seek to explain (or compute) the exchange ratio between present and future consumption. It is only as an afterthought (if at all) that these theories try to explain the actual market rates of exchange between present and future *money* units. We now examine the shortcomings of this method.

[2] For a fuller discussion of Böhm-Bawerk's theory, see Murphy (2003a).

Real theories must assume cyclical environment

To be applicable, a real theory of interest must impose some degree of regularity over time on the economy. This is done most starkly in the baseline neoclassical model, in which one and the same consumption good is allocated over future time periods, and in which consumers possess the same (intraperiod) utility function in every period.[3]

However, the imposition of regularity (in prices and/or preferences) is required for *any* real theory of interest, since there must be a way to identify some unit of 'consumption' or 'goods' in each time period, in order to see the difference in value ascribed to each. To illustrate this, we can imagine a two-period, two-good, pure endowment model, consisting of 'apples' and 'oranges.' Imagine that in the first period, the quantities of apples and oranges are equal, while in the second period the quantity of oranges falls and the quantity of apples rises. In such a setting, the following real exchange ratios (calculated in the first period) are entirely plausible equilibrium (i.e. arbitrage-free) values:

[3] This does not mean that consumers must have the same marginal utility from consumption in every period. But there must be some means of comparing utility experienced in different time periods (in order to plan an optimal consumption sequence), and the standard practice is to assume that the same function can summarize (the stationary) preferences in each time period.

1 present apple	:	1 present orange
1 present apple	:	2 future apples
1 present apple	:	½ future oranges
1 present orange	:	½ future oranges
1 present orange	:	2 future apples
1 future apple	:	¼ future oranges

Table 5—Equilibrium Real Exchange Ratios

(calculated in first period)

Now, what is the real rate of interest[4] in this model? The own-rate of interest on apples is 100 percent, while the own-rate of interest on oranges is -50 percent. We cannot say that present goods are more valuable than future goods, nor can we say that future goods are more valuable than present goods.[5]

This problem typically does not arise in mathematical models, which usually contain only one consumption good or, at the very least, assume constant (relative) spot prices for all goods over time. But when we relax these unrealistic assumptions (which we can still do in a [dynamic] equilibrium setting in which

[4] Of course, in the actual market there is no such thing as 'the' rate of interest. We will address this complication in a later section.

[5] Keynes recognized the possibility of different own-rates of interest, but did not draw from this the same conclusions that I do (Keynes 1965 [1936], p. 223). On this point Hayek writes: "It is probably unnecessary to emphasise that there is no way in which this multitude of different 'own rates of interest' (as Mr. Keynes has called these rates of increase in terms of particular commodities) can be reduced to one single rate which has a stronger claim than any other to be regarded as *the* rate of productivity of investment" (Hayek 1975 [1941], p. 168).

future changes are foreseen), we can no longer unambiguously determine 'the' real rate of interest.

One solution to this problem is to construct a price index. In the above model, if we define a basket of one apple and one orange as the unit of real consumption, then the real rate of interest is -20 percent. However, why should this basket be chosen?[6] After all, it is possible that only a small proportion of the population eats oranges, so that the rise in their price shouldn't be weighed as heavily as the fall in apple prices. If the basket is changed to two apples and one orange, then the real rate of interest is zero. And if the basket is constructed out of three apples and one orange, the real rate of interest is roughly +14 percent.

It is true that in actual markets, quantities of goods do not normally fluctuate as violently as in the above example. Therefore the arbitrariness of price deflators is not as significant; we will not normally change the *sign* of the real rate of interest simply by making a slight adjustment to the commodity basket.

[6] Mises argues that all price deflators are arbitrary; there is no "scientific" way to pick one over the other (Mises 1966, pp. 221-222). I note with some irony that the one thing that would *never* be included in a commodity basket is the money commodity, even though market rates of interest deal with intertemporal exchanges of money.

Even so, the very *construction* of a basket of commodities implies some regularity over time.[7] But what of the following transactions? We can imagine someone laboring over the course of several years, all the while investing (part of) his wages to earn interest. Then, once he has saved enough, the man buys a state-of-the-art computer. Thus, in terms of real goods, the man has sold hundreds of hours of labor over the course of a few years, and purchased one future computer.

How do we compute the real rate of return on his savings? We cannot simply compare spot and future prices of labor and computers, in order to compute the relative prices of an appropriately weighted commodity basket (as in the fruit case above). This is because, by assumption, the new computer is a *different good* from the previous models. It simply was not available until the time the man purchased it. This fact makes the very concept of a real interest return inapplicable to the transactions described.

Of course, the way economists solve this problem in practice is to first translate all goods into their money prices, and then apply the standard deflator on money units to compute the real rate of return. But it is worth noting that even when using a

[7] In discussing Fisher's famous diagram, Blaug admits, "We assume, of course, that we can speak of income as if it were a composite commodity always made up of exactly the same proportion of goods" (Blaug 1978, p. 561).

real theory, once we allow for the introduction of new goods over time, nominal prices are indispensable in the calculation of (real) interest rates.

Although not necessary for a real theory of interest, most models employ some notion of regularity in preferences. This is required in order to define *time preference*, a concept used in many real approaches. Time preference usually refers to an exogenous feature of preferences, in which present consumption per se is preferred, other things being equal.

The concept of time preference can only be meaningful if there is some method by which present and future consumption can be compared. However, in order to distinguish a preference for present consumption due to accidental factors (such as relative scarcity), further assumptions must be made. Böhm-Bawerk illustrated the discount of future utility (the second of his "causes" for interest) through the use of cardinal utility (II, pp. 272-273). The modern neoclassical models, following Samuelson (1937), do the same with the subjective discount factor (often denoted by β) on future utils. Koopmans (1960) formalizes Böhm-Bawerk's concept with a purely ordinal approach. However, in order to define time preference, it is necessary for him too to impose some assumptions of "stationarity" on preferences (1960, pp. 293-294).

The assumption that consumers have cardinal units that allow meaningful comparisons of utility in different periods, and even the weaker assumption that ordinal preferences are constant over time, are obviously false. However, the difficulty with models that rely on these concepts is not simply one of unrealism: If preferences change over time—as they surely do in the actual world—then the concept of time preference (or Fisherian "impatience"[8]) is literally undefined and non-operational. "Time preference" requires the evaluation of two *equal* (except for their dates of availability) psychic satisfactions; such equality cannot be defined if preferences are different on the two dates.

Money integral to intertemporal exchange

It is a common and indispensable practice to abstract from the role of money when analyzing market exchanges. By removing the 'veil' of money, the economist can often gain a clearer insight. However, this approach has its limitations. For if the assumptions underlying standard models were to obtain, there would be no need for

[8] The slope of a Fisher indifference curve measures the tradeoff between present and future *real income*. Since for Fisher, real income is ultimately a matter of psychic satisfactions (Fisher 1965, p. 4), he wants to compare how much psychic satisfaction must be offered next year in order to make an individual indifferent to a certain sacrifice of satisfaction this year. It is not clear how to compare psychic satisfactions available in different time periods, if the agent's preferences have changed in the interim. Even if the comparisons are done purely from an ex ante viewpoint, Fisher's approach implicitly relies on a cardinal notion of utility.

money in the first place.[9] Workers would not sell labor for dollars, and consumers would not buy food with dollars; instead workers would sell their labor directly for consumption goods (just as in the models). David Laidler has summarized the situation of modern mainstream economics with regard to money:

> In the economics of Keynes, as in Classical economics, money was a means of exchange; and textbook macro-economics even now refers to 'transactions' and 'precautionary' motives for holding money, which are said to derive directly from that role. However, when monetary economists adopted Walrasian general equilibrium…as their basic vision of economic activity, they adopted a model that could not generate such motives internally…
>
> The monetarist counter-revolution…did nothing to interrupt the process…of integrating monetary theory with Walrasian value theory. The further this process was pushed, the more the representative model of a monetary economy came to resemble one of a barter economy in which there happened to exist a peculiar asset called 'money' whose 'real' (i.e., 'utility'-yielding) quantity varied in inverse proportion to its price in terms of goods. The utility in question was said to arise from money's role as a means of exchange, of course, but there was no such role for it to play within the logical structure of the representative macro-economic model. (Laidler 1988, pp. 688-689)

[9] Indeed, if the modern economist wishes to model the demand for money, he often builds this into the utility function in a completely ad hoc fashion, treating the holding of cash balances as akin to consumption. For example, Dutkowsky and Foote (1992) describe their model accordingly: "Although money and equity both earn a rate of return, money provides utility from its ability to facilitate consumption. The representative consumer derives utility at any date *t* from same period real consumption, transactions services rendered by real money balances, and leisure" (p. 333). No attempt is made to model the nature of these transactions services. As will be discussed below, the neoclassical model of money demand in Kiyotaki and Wright (1989) comes closest to the approach taken in this paper.

If we view money as a means by which market participants deal with uncertainty, and if uncertainty is inherently connected with the passage of time,[10] then analyzing intertemporal exchanges from a real perspective is particularly dubious. When it comes to generic exchanges, the real approach necessarily abstracts from one side of all transactions. But when it comes to *interest*, the real approach necessarily abstracts from *both* sides of the actual market exchanges.[11] Rather than trading present for future money units, market actors are analyzed as trading (entirely fictitious) present units of 'consumption' for future units.

The problem with this procedure is not merely that it involves a doubling of the degree of unrealism. The fundamental problem is that the real approach masks the influence that purely monetary factors have on the rate of interest. For example, if a (suitably defined) average of spot prices remains constant over time, then the real approach would treat a persistent premium on present (vs. future) money units as indicative of a premium placed on present consumption. But this observed pattern would *also* occur if there were something intrinsic to the nature of money that caused present units to enjoy a premium over future units. In this case, the real approach would entirely miss an essential cause of positive interest rates, and

[10] These propositions will be elaborated in the sections below.
[11] Keynes makes a similar observation regarding the "classical" theory: "The perplexity which I find in Marshall's account of the matter is fundamentally due, I think, to the incursion of the concept 'interest,' which belongs to a monetary economy, into a treatise which takes no account of money. 'Interest' has really no business to turn up at all in Marshall's *Principles of Economics*,—it belongs to another branch of the subject" (Keynes 1965, p. 189).

would erroneously attribute interest to the timing of (guaranteed) consumption plans.

Real models (generally) cannot pin down nominal rate

Related to the above problems is the fact that real theories of interest (generally) remain silent on the question of nominal rates of interest. Usually money does not appear at all in general equilibrium models, and one (consumption) good is chosen as a numéraire. But this convention masks any fluctuations in nominal rates, since general equilibrium models only determine relative price ratios.[12]

The problem is perhaps most serious in business cycle models. If the business cycle is (as we shall argue below) a disequilibrium phenomenon, and if interest rates serve any role in coordinating economic affairs in an intertemporal setting, then fluctuations in nominal rates may give the economist valuable information about actual market conditions. In particular, movements in the nominal rates of interest may indicate widespread changes in the uncertainty of expectations. By adopting the real approach, the economist cannot model a possibly significant relationship between interest rates and the intertemporal equilibration process.

[12] For example, if one country has a nominal (net) interest rate of 200 percent and an estimated inflation rate of 100 percent, while another country has a nominal interest rate of 50 percent and no estimated price inflation, the typical theorist would view these countries as identical in all "real" respects. The fact that the actual market rate of interest is four times higher in the first country would be thrown out as an illusion.

Real theories obscure the social function of interest rates

To the extent that real theories mask the (possible) role interest rates play in the process of coordinating intertemporal activities, economists cannot fully 'justify' interest as a social phenomenon. In debates such as the Cambridge capital controversy, when critics contend that interest involves exploitation,[13] apologists for capitalism can only mount a weaker defense when one of the vital functions of the market rate of interest is assumed away for modeling convenience.

METHOD

This paper will approach interest theory through the genetic-causal method, rather than the functionalist method of simultaneous determination. The genetic-causal method has historically emphasized (1) the purposiveness of economic actors, (2) the requirement that any explanation of market outcomes be built upon the actions of individuals, and (3) the notion that "a cause is not simply something that always precedes its effect; it creates a unidirectional *process* the outcome of which is the effect." (Cowan and Rizzo 1996, p. 274) Rather than interpreting market prices as the solution to a system of simultaneous equations, we shall view them as *caused*

[13] The Cambridge debate is discussed in detail in a later section.

by the actions of individuals, actions which in turn can be understood as attempts to achieve a more desirable future state.

At this level of analysis, we will not seek to characterize specific equilibrium rates of interest in hypothetical models. Instead we will try to gain a clearer understanding of the 'nature' of interest by engaging in somewhat abstract reasoning. My point here is not to offer a rival neoclassical[14] model, built upon more realistic assumptions, but rather to designate the limited scope of all such models. I will argue that neoclassical models of interest necessarily obscure the true nature, or 'essence,' of interest as a social phenomenon. Israel Kirzner gives a good defense of the "essentialist" approach to economic theory:

> [A]n essentialist approach to the interest problem…would focus not on the list of elements which together determine specific interest rates, but on those elements upon which the interest phenomenon essentially depends….(Rush-hour traffic as a phenomenon may indeed be vitally affected by the timing of traffic lights; nonetheless we understand why it is accurate to describe the phenomenon of rush-hour traffic as 'people getting to work', rather than as 'the result of traffic-light timing'). (Kirzner 1996, pp. 148-149)

Working within a genetic-causal framework, this paper will rely on many insights from the so-called "radical subjectivist" school (typified in the work of Shackle

[14] By "neoclassical" I refer to the modern Walrasian approach of mainstream economics. The typical neoclassical model has agents with given preferences and deterministic behaviors, and its solution concept is a simultaneous determination of the necessary values that the endogenous variables must possess in an equilibrium state.

[1992]). Although all major schools now subscribe to subjectivism in regard to consumer preferences, the radical subjectivists take this approach one step further, and allow for heterogeneity and idiosyncrasy in individuals' theories about the world and expectations of the future. According to Littlechild, the radical subjectivists

> emphasize the imagination needed to create the alternatives between which decisions are made, and hence the inevitable uncertainty associated with the outcomes of decisions. In this view, the future is not so much unknown as it is non-existent or indeterminate at the time of the decision. The agent's task is not to estimate or discover, but to create. He must therefore exercise imagination. The agent is aware of the flimsiness of his conjectures about the future and the vulnerability of his plans to the independent imagination of other agents. The agent's environment thus exhibits a qualitative as well as quantitative uncertainty—what Langlois…has referred to as "structural" rather than "parametric" uncertainty. (Littlechild 1990, p. 29)

As we will see, the arguments of the radical subjectivists have particular relevance in the realm of interest theory. Consequently the approach offered in this paper will be mindful of their viewpoint.

An excursus on subjectivist method

Although they often take it for granted, economists must always remember that their science deals not with physical objects as such, but with purposeful

individuals and the *subjective valuations* they make. As Hayek points out, the "facts" of the social sciences are mental ones; a weapon or a sentence is not defined by its physical properties, but by the *meaning* attached to it by a purposive actor (Hayek 1972b [1948], pp. 59-60). Consequently, when classifying different objects as types of goods (or services), economists cannot rely on 'objective' measurements of physical characteristics. It is ultimately the subjective appraisals of objects or actions that determine their value to acting individuals, and consequently it is on these subjective appraisals that the economist should focus. The challenge is to link these unobservable mental phenomena to the exchanges of goods we see in the market.

This principle is evident in the very classification of objects as units of a particular type of good. The economist does not rely on the physicist or chemist to tell him if two quantities of a certain liquid should be considered as equivalent units of the same good. The economist instead chooses his definition to coincide with the behavior of potential consumers of these liquids.

For example, a physicist may inform us that liquid A is 8.010 oz. of spring water, while liquid B is 8.011 oz. of spring water. They are for him clearly distinguishable. However, we can easily imagine consumers who do not

discriminate with such precision, and the economist is thus perfectly justified in classifying both items as 'units of spring water.'

On the other hand, we can imagine a chemist analyzing a chalice of wine before and after it is consecrated (blessed) by a priest. The chemist could inform us that nothing 'real' had changed, and that the blessed and unblessed quantities of wine were 'equivalent.' Yet clearly the social scientist, if he wished to understand the behavior of (Catholic) individuals, would need to distinguish between consecrated and unconsecrated units of wine.

Thus it is clear that the subjective frameworks of market actors should guide the economist in forming his theoretical constructs. It might appear from the above that items that are interchangeable (from the consumers' point of view) should be classified as different units of the same good, while items among which consumers distinguish should be classified as different goods altogether.

However, the above generalization is too ambiguous and liable to misinterpretation. Consider that on the margin, it may be the case that one apple exchanges for one orange. That does not (necessarily) mean that consumers view apples and oranges equivalently, and that therefore the economist should broadly classify all of these items as units of 'fruit.' For most applications, the marginal rate of substitution

between apples and oranges changes with their quantities. Thus for two items to be classified as units of the same good, it is not enough that the consumer is indifferent between them on some margin.

At the same time, it is possible (in models that specify marginal utilities rather than simply the rates of substitution) for subsequent units of the same good to offer different marginal utilities. In a sense, consumers do not view the n^{th} unit of a good as equivalent to the $(n+1)^{th}$ unit. Yet just because a consumer does not buy all of the cartons of milk in front of her, does not mean the economist should consider the ones she purchases as different goods from the ones left unsold. They may all still be classified as units of milk.

Being mindful of the above considerations, we can classify a set of objects as units of the same good if and only if all such objects are considered equally serviceable for whatever ends the relevant consumers wish to use them.[15] A useful test for this is to determine whether the consumer would object to a 'swapping' of the various objects devoted to particular ends. For example, if object A is 1.01 gallons of tap water and object B is 1.02 gallons of tap water, and a consumer wishes to use water to flush the toilet and to do the dishes, then objects A and B might be considered as equivalent units. (This is because A or B can be used for either task, as far as the

[15] I believe my treatment is consistent with the original Austrian approach to subjectivism given in Menger (1994 [1871], pp. 128-131).

consumer is concerned. This is true even if the consumer places a much higher importance on the first task.) On the other hand, even if the market price of apples is the same as oranges, the two would still be classified as different goods (for most applications) since, for example, apples can't make orange juice and oranges can't make apple pie.

Classification of goods in an interspatial and intertemporal framework

In many applications, economists wish to group similar objects as 'the same' good except for one feature that is allowed to vary. For example, when explaining the social function of merchants and middlemen, an economist might explain that transporting goods from the site of production to the site of retail sale is a useful service. The economist could argue, for instance, that 'oranges in Florida' are less valuable than 'oranges in the local grocery store.'

Such terminology raises the question of what it *means* for a good to be 'the same' except for its geographic location. Clearly we do not require the same physical orange to be compared in Florida and in the local grocery store. Furthermore, to say that "oranges in Florida are less valuable than local oranges" does not imply

that the experience of *eating* oranges in Florida is less pleasurable than eating an orange in one's home town.[16]

We can avoid these pitfalls by using the technique for classification outlined in the previous section. One particular object in Florida and another particular object at the local grocery store may both be called 'units of oranges' if the relevant consumers would be indifferent to a (magical) swapping of these units with any other units of their orange stock. However, given that the consumer in practice *cannot* instantly swap such units, and given that this difference in location matters to the consumer, we may define 'oranges in Florida' as a *different good* from 'local oranges.' Yet we retain the label of 'orange' in order to emphasize that the difference in valuation is due *solely* to the difference in location.[17,18]

[16] There are cases in which this *is* what we mean. For example, when explaining the higher price of Manhattan theater productions, an economist might say, "Watching *Cats* on Broadway is more pleasurable than watching it elsewhere, even though it's the same actual show." In this construction, we can still use the swapping technique; to determine whether the shows really are 'the same' we can imagine the set, actors, costumes, orchestra, etc. of each show all being swapped between locations. But when in this case we say the Broadway performance is preferred to (say) the Montreal performance, we must keep in mind that we are allowing the consumer to move as well. We do not require that the Broadway patron must (attempt to) watch the Montreal show from Manhattan.

[17] After all, a grapefruit in Florida is *also* a different good from a local orange, but we would lose a valuable tool if we were unable to identify goods that were distinct *only* because of their locations.

[18] The distinction we are making in the text above should not be confused with the situation in which a consumer distinguishes between Florida and California oranges; what happens here is that even when the different items are located in the same place, a consumer might definitely prefer one to the other (presumably because of different qualities of the items arising from their different growing conditions).

We may use the same approach when classifying goods in an intertemporal context. To identify a particular good as, say, a 2010 bushel of wheat, means that consumers *right now* would be indifferent to a (magical) swapping of this promised bushel with any bushel of wheat in their current stock. To call the item a 2010 bushel of wheat, we are implying that the only relevant distinction between the item and bushels available right now, is the difference in time of availability.

Having said this, caution is in order. We do not require that *consumption* of wheat gives the same marginal utility in the two respective time periods, in order to classify the items as equivalent (in all things but time) bushels of wheat. That is, we shall call a certain item available in 2010 a '2010 bushel of wheat' if and only if consumers right now would be indifferent to a magical swapping of it with current bushels of wheat. This holds true even if there is an expected famine in 2010, or even if a future tax on wheat is expected. These types of considerations (as well as others) will certainly influence the *current judgment of the value* of 2010 bushels of wheat; the point is that they are still 'bushels of wheat,' i.e. they are units of the same good as present 'wheat' (but for the time difference). Of course, 2010 bushels may be preferred to 2015 bushels, and in that case they are different goods overall. The swapping technique allows us, however, to understand the relationship between the following goods: a 2010 bushel of wheat, a 2015 bushel of

wheat, and (say) a 2015 bushel of rice. Care must be taken with a subjectivist approach, lest we lose the ability to distinguish the first two goods from the third.[19]

Money as an intertemporal good

In light of the above discussion, we can consider two items available in different time periods as (possibly future) units of money if and only if consumers would be indifferent to a (magical) swapping of these items with current units of money.[20] This approach paves the way for an entirely *nominal* theory of interest: What we shall attempt to understand is the process in which actual market rates of exchange between present and future dollars is established.

This stands in sharp contrast to the (standard) real approach, in which the analysis is based on the exchange rate between present and future units of consumption or

[19] In other words, we do not need to create a different category of goods such as '2010 bushels-of-wheat-during-a-famine,' since this would be redundant. The time index is adequate to handle such considerations. Thus the consumer might prefer a 2010 bushel of wheat to a 2015 bushel *because* of the famine in 2010; in this case the former good would be preferred. The point of this discussion, however, is that when determining the relevant qualities of the items *other than their date of availability*, we do not need to consider their marginal utility at the time of consumption. This is consistent with our treatment of different units of water as equivalent goods despite the higher importance placed on flushing versus dishwashing, and with our treatment of Florida versus local oranges (in which the utility of consumption of the goods in the different locations was never the issue).

[20] Admittedly, there is a slight technical problem with this definition if we are dealing with dated money units (rather than bars of gold, for example). Someone in the year 2010 would *not* swap his current money units for ones dated 2020, because others would suspect counterfeiting. However, we will overlook problems such as this, for they would similarly upset an attempt to define present and future bottles of milk (because of stamped expiration dates). The subjectivist economist must exercise judgment when determining what qualities of a good to hold constant for purposes of intertemporal classification.

purchasing power.[21] In our nominal approach, the influence of future events, such as expected inflation, is handled by the present value ascribed to future money units, just as we can handle the possibility of future famine by appropriately adjusting the present value ascribed to future bushels of wheat. Consequently, the nominal approach does not need to invent fictitious goods such as inflation-adjusted dollars (which would be analogous to the good 'wheat-during-a-famine').

Equilibrium, radical uncertainty, and the passage of time

Mainstream economics rests on equilibrium analysis. In static settings, equilibrium analysis can be justified as an approximation to reality, since (presumably) sub-optimal behavior will be eliminated over time. In a dynamic setting, on the other hand, the assumption of correct (even in a stochastic sense) expectations is far more dubious.[22] To assume that consumption and production plans in a changing world, formed by individuals with access to private knowledge, will all fit together into a

[21] Hicks (1961) agrees that the two approaches are not equivalent. After noting that economists largely agree that the rate of interest is determined by the supply and demand for "capital," he says: "Does capital mean 'real capital' in the sense of concrete goods and the power to dispose over a given quantity of them? If this interpretation is taken…we get a theory such as that worked out elaborately by Böhm-Bawerk. Or does 'capital' mean 'money capital' in the sense of loanable funds—power to dispose over a given quantity of money? It makes a great deal of difference which interpretation we take" (Hicks 1961, p. 153).

[22] Fisher (1983) provides a remarkably formal analysis of some of the problems involved. For example, certain stability results (which serve to justify the assumption of general equilibrium) require households to (attempt to) immediately implement excess demands for commodities even though the (optimized) consumption plan may not require their acquisition until the distant future (Fisher 1983, pp. 34-35).

coordinated, equilibrium outcome is to assume away the very problem that an economic system actually solves (Hayek 1972c [1948], pp. 77-78).

The method of constrained optimization, employed in modern mathematical models, is of limited use in intertemporal settings. Most of these models assume that agents have a complete understanding of the 'world' in which they operate.[23] Although agents may not know the future with certainty, they *do* know the probability with which certain future events will occur. As such, there is no room for genuine error, surprise, or innovation in these models (Kirzner 2000, pp. 58-59).

The problem with this approach is not merely that it is unrealistic. Rather, the notion that agents can move through time without revising their belief structure (and set of possible actions) is logically nonsensical.[24] In the words of Hayek, "The mind can never foresee its own advance" (1960, p. 24).

[23] A rare exception is Nyarko (1991). However, even here the agent fully understands the structure of the world; the agent's only mistake is an incorrect initial belief in the range of an unknown parameter of his demand function.

[24] "Reason unfolds the meaning of the premisses [sic]. It can do no more. But if one of the premisses should be: There are things unthought of, that time in its operation will suggest, what can reason tell us about that entirety, which contains both the visible premisses and the unknown things?" (Shackle 1992, p. 25)

Karl Popper, relying on his earlier philosophical argument that no machine can fully predict its future state,[25] claims that, "We cannot predict, by rational or scientific methods, the future growth of our scientific knowledge" (Popper 1997 [1957], pp. vi-vii). Popper believes the claim is self-evident, because "*if there is such a thing as growing human knowledge, then we cannot anticipate today what we shall know only tomorrow*" (1997, p. vii, italics original). Indeed, to truly predict future knowledge would render it current knowledge, making true learning impossible.[26] Similarly, an agent who could successfully predict at t_1 the state of his knowledge at t_4 would therefore be incapable of learning anything in periods t_2 and t_3. O'Driscoll and Rizzo have spelled out the implications of these considerations for neoclassical models of (intertemporal) behavior:

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[25] O'Driscoll and Rizzo (1996) also adapt these technical arguments of Popper to make the same point. O&R argue that, so long as prediction tasks take a finite period of time, then an agent can never fully calculate his future knowledge beforehand; every intermediate result would yield new knowledge, the effects of which would have to be evaluated in another round of time-consuming calculations (O&R 1996, p. 25). However, as Popper himself admits (1950, pp. 175-176), this type of argument (by itself) still allows for mistakes in prediction to be made arbitrarily small (though never eliminated). What is worse, the argument must be strengthened with the possibility of "Goedelian sentences" (Popper 1950, p. 179), i.e. the argument must use mathematician Kurt Gödel's famous incompleteness proof to rule out the possibility of an agent using self-referential labels to elude the infinite regress problem noted by O'Driscoll and Rizzo. I believe that the looser arguments given in the text above are better at conveying the notion of radical uncertainty.

[26] This type of argument may seem too sweeping; after all, surely if one wishes to learn the birth date of Teddy Roosevelt, he can predict that he will know it after consulting an encyclopedia. Yet this observation does not change the result argued in the text. In the first place, even in such a straightforward case as this, genuine surprise may occur. (For example, it could turn out that historians are in dispute over Roosevelt's date of birth, a fact that would only be learned after consulting the encyclopedia.) Second, cases such as this are far from paradigmatic; much of what is learned in actual life is due to sheer accident. Thus deterministic models would only explain the repetitive situations of economic affairs, and would be at a loss to handle truly novel occurrences. Third (and most fundamental), this example simply begs the question of how one comes to know that encyclopedias will have the information desired. Pushed to its logical extreme, the deterministic model implies that all infants can foresee (at least the structure of) their future knowledge.

> Mind constructs that yield the required behavior as a determinate implication of initial conditions and a theory cannot be genuinely dynamic. If we allow time to pass, then we must in effect be claiming that the individual can predict his own decisions. Consider, for example, a determinate choice-theoretic model of a process. This would require the postulation of a mind whose decisions at t_2 are perfectly determined by its own self-conscious state at t_1. If this is logically impossible, as we have argued, then such a model would be inconsistent, or, more exactly, would be based on inconsistent foundations. "Surprise" is thus integral to the lives of individual actors. (O&R 1996, p. 26)

The future is open-ended, and contains presently undreamt-of opportunities. The neoclassical assumption of known choice sets is thus inapplicable in dynamic settings. (Shackle 1992, pp. 25-27) Standard equilibrium constructs, relying as they do on optimization of known functions subject to known constraints, are equally inapplicable.[27] Yet in the face of radical uncertainty, can economists use *any* notion of equilibrium in dynamic models?

The work of Hayek (1972a [1948]) suggests a solution. He first points out that fulfillment of one's planned actions requires not only correct expectations regarding future exogenous facts, but also correct expectations of the actions of

[27] An example may illustrate the difference between standard learning models and the arguments in the text: A macroeconomist can develop a typical model in which the central banker chooses an optimal monetary policy based upon certain stochastic variables. In particular, the banker at time *t* would not know the rate of inflation and unemployment at time *t+10*, and hence the banker could not predict beforehand his behavior at time *t+10*. However, the banker *would* know, with certainty, what his response would be *as a function of* these variables. In contrast, the method employed in this paper would rule out such certainty. After all, a future Nobel laureate might publish an ingenious breakthrough in macroeconomics at *t+3*, changing the very theory employed by the central banker in future macro models. Almost by definition, an "ingenious breakthrough" is not something that others can predict beforehand.

others. Hayek then defines equilibrium as a set of mutually compatible plans, which all rely on correct expectations regarding exogenous facts. (1972a, p. 38)

At first glance, this approach seems no better than the neoclassical construct. However, the difference lies in the *specificity* of the individual plans. If future plans and knowledge are couched in sufficiently abstract terms, then the critiques of perfect foresight lose much of their force. Rather than an exact coordination of plans, we can rely on the weaker construct of "pattern coordination":

> [Pattern coordination] makes use of both the original Hayekian "compatibility of plans" and the distinction between typical and unique aspects of future events. The plans of individuals are in a pattern equilibrium if they are coordinated with respect to their typical features, even if their unique aspects fail to mesh.
>
> Consider, as an illustration,[28] Professors A and B, who teach in the same department and who plan to discuss their forthcoming jointly authored book. Their plans are coordinated with respect to the typical features of their activities if, for example, each expects the other to be in his office on the day he actually plans to be there. Since neither has decided his position on the book's central concern beforehand, the contents of their discussions can be seen as the unique feature. What they will say depends on the "insights" that will arise only in the course of conversation. These insights are surely time-dependent. The plans of A and B are coordinated, therefore, in the sense that each will come into the office on the

[28] For a different illustration, imagine that an analyst wishes to model a chess tournament. It would be rather inconsistent to use a Nash equilibrium construct, in which each agent could correctly forecast the actions of opponents (contingent on the sequence of moves in a given game). In such an equilibrium, where everyone knew everyone else's strategy, the winner of any pair of players could be determined beforehand, and there would be no point in holding the tournament. On the other hand, the analyst could assume that agents' actions are sufficiently coordinated that they all sit at the proper tables, all follow the rules of chess, etc. The analyst could define this state of affairs as a pattern coordination, and (unlike the stronger concept of Nash equilibrium) its use would not preclude the very purpose of the tournament.

> proper day and at the proper time, but they are not coordinated in the sense that each has planned what to say to the other. There is an open-endedness to their plans that allows for spontaneity or novelty. This is a pattern coordination. (O&R 1996, pp. 85-86)

In this paper I shall use the concept of pattern coordination in my analysis of interest. Although the looseness of the approach makes quantitative predictions impossible, we can still draw general conclusions from it. Hopefully this modest attempt will lay the foundation for future research along these lines.

A MONETARY THEORY OF INTEREST

In contrast to the real theories, I offer a monetary theory of interest. In this approach, we do not need to abstract from the role of money in actual market transactions; we can quite simply view interest rates as the exchange ratio between present and future units of money.

The role of money and the demand for cash balances

In standard models, money serves no purpose. In more sophisticated approaches involving "cash in advance constraints,"[29] money is desired, but only because of

[29] A good survey of cash-in-advance models, as well as "shopping-time" models, of money demand can be found in Bohn (1991). The "shopping-time" models assume that cash balances allow for

somewhat ad hoc restrictions.[30] Before offering an alternative model, it will be useful to inquire into the historical origin of money.

Menger (1994 [1871]) argued that money emerged, not as the result of governmental fiat, but as the result of decentralized decisions of individuals acting in their own interests. Even before the existence of money—i.e. before there existed a commodity that was widely accepted as a medium of exchange—individuals still traded. Some goods were naturally more salable (i.e. liquid) than others. Whenever offering one's own wares in trade, there would be a natural preference, other things equal, to be paid in more liquid assets. The process was reinforcing, since the greater demand for the salable assets made them even more desirable as a medium of exchange. Eventually a few goods (e.g. gold and silver) outstripped all rivals, and became genuine monies. (Menger 1994, pp. 257-262)[31]

If we interpret the desire for liquidity (and hence money) as a consequence of the inherent uncertainty of the future, then neoclassical models do not capture the true function of money. Indeed, in a world where all production and consumption

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more leisure when financing a given amount of purchases. As such they are hardly less ad hoc than the standard approach of placing cash balances directly in the utility function.

[30] In the world of neoclassical models, it is hard to see why firms would insist on cash in advance. After all, the models usually entail the creation of an infinite number of product and service markets (if only one per period forever), and do not (typically) allow for agents to break contracts or to make mistakes in gauging the creditworthiness of other agents. Given a rich enough institutional structure, it is hard to imagine such an economy requiring money (i.e. cash) at all.

[31] Kiyotaki and Wright (1989, p. 935, fn 7) acknowledge that their approach is similar to Menger's.

decisions are specified (perhaps contingent on stochastic outcomes) in the initial time period, there is no need for a unit of account.[32] Once these equilibrium plans are drawn up, agents follow them mechanically[33] for the rest of time. Money is unnecessary because the initial contingency plans specify precisely how goods and resources should be allocated in every time period (conditional on the realizations of random variables).

But in a world where the future is open-ended, the evolution of money, and Menger's account of it, are far more comprehensible. The market's selection of one (or a few) commodities as money becomes intelligible as the spontaneous creation of an institution for dealing with radical uncertainty. Yes, individuals sell goods and services in exchange for money, ultimately in order to sell the money in exchange for future goods and services. But it would be a mistake to say that

[32] For example, in typical neoclassical models, money is not necessary to solve the problem of a "double coincidence of wants." A trilateral exchange (where A sells to B sells to C sells to A) is nothing but a general equilibrium phenomenon involving dated commodities. The difficulty of trilateral exchanges in actual practice results from the requirement that various parties first *discover* the opportunity for gain, and then successfully coordinate their actions in order to seize it. Kiyotaki and Wright (1989) do indeed achieve a general equilibrium in which goods can serve as media of exchange, but this is supported only by assuming away credit transactions (p. 931). The point in the text is that money is particularly useful *in situations outside of equilibrium*. The approach of Kiyotaki and Wright shows that money may ameliorate the problem of missing markets, but it sheds no light on the possible role of money *during the process of reaching the various equilibria* studied by the authors. As Fisher (1983) notes, "In [the Arrow-Debreu] world, commodity dates are but one more way of distinguishing commodities, no different from commodity colors in this respect. But a world in which all markets open and close before anything else happens is not a world in which disequilibrium consumption or production can be analyzed" (p. 43).

[33] It is true that on a formal level, the agents possess just as much 'free will' in subsequent periods as they do in the initial period. But the definition of equilibrium requires that every agent correctly predicts the future behavior of every agent (including himself). Thus the equilibrium profile of strategies (in a game theoretic treatment) in the initial period contains the information necessary to predict the allocation of all future goods and resources (conditional on random variables).

market actions were *merely* intertemporal exchanges, for when individuals buy money, they are not sure *which* future goods and services it will allow them to consume.[34,35]

In the spirit of O'Driscoll and Rizzo, we can define an equilibrium construct appropriate for this model. We shall say that an individual has chosen his cash balances optimally if he does not *regret* his choice during the implementation of his plans.[36] In particular, we do not require that he correctly anticipate all of his future purchases (since this would be impossible and in such a world, money would serve no role).

More generally, we shall say the money market exhibits pattern coordination (for a specific time period) if all participants, ex post, do not regret their initial decisions, i.e. if all participants have chosen their cash balances optimally (for the period in

[34] A simple test will illustrate this point: Does the reader currently know *precisely* how the cash in his or her possession will be spent, even in a probabilistic sense? Or is (at least a portion of) it being held for as-yet unknown future expenditures?

[35] Littlechild agrees: "[Neoclassical] analysis incorporates the transaction-cost element but does not give adequate weight to the role of money as a generalized store of value. That is, wealth may be held in the form of money in order to buy something in the future that cannot yet be specified" (1990, p. 35).

[36] The no-regret criterion used in the text is not quite congruent with the "regret theory" of decision making under uncertainty. Mainstream regret theory assumes that agents may not receive merely the 'absolute' utility from a particular action after the realization of a random variable, but may compare the payoff in the actual state of the world with the payoff from a different action. Realizing this, agents may choose different actions ex ante, because they are maximizing not only the expected future payoff from present actions, but rather the expected future payoff *adjusted for feelings of regret*; see Loomes (1988). In the present paper, in contrast, we are using a no-regret criterion since it passes the methodological hurdles of indeterminacy and subjectivism. That is, we leave it to the agents to decide whether their previous expectations of the need for money were sufficiently accurate.

question). In particular, this equilibrium construct does not require that merchants, e.g., correctly predict which consumers will buy which products and when. All it requires is that the merchants anticipate the future flows of expenditures and receipts *well enough* so that they do not regret their initial choice of cash holdings.

The demand for cash balances and the rate of interest

If individuals demand cash balances in order to deal with the uncertainty of the future, it immediately follows that, other things equal, there exists a preference for present over future money units.[37] Because of their high durability,[38] money units available at earlier points of time offer strictly greater flows of service than money units available later, and the greater the time difference, the greater the premium on present units.[39]

[37] Compare to Hicks (1961): "The nature of money and the nature of interest are therefore very nearly the same problem. When we have decided what it is which makes people give more for those securities which are reckoned as money than for those securities which are not, we shall have discovered also why interest is paid" (p. 163).

[38] "Durability" is here used congruously with the notion of future goods. That is, a present money unit is durable because it can turn into a future money unit (as we have defined the term in the methodological section). (In contrast, a present apple is not durable because it will *not* turn into a future apple; if uneaten, it will spoil.) In particular, this notion of durability does not require money units to retain their *exchange value* over time.

[39] Even if a particular sum is earmarked for a certain future expenditure, holding the cash until that date still offers advantages. This is because something might happen in the interim period to disrupt the initial plan. Even if the original expenditure is retained in the revised plan, the earmarked money can still be used for another transaction, so long as the purchased goods can be 'turned over' back into money before the date of the original expenditure. Except in unusual circumstances (e.g. if widespread crime made money 'perishable'), there will always exist at least a slight preference for present money.

The widespread, subjective premium placed on present money units creates, even in the absence of any real factors,[40] a tendency for a market premium on present money, i.e. a tendency for positive (nominal) rates of interest.[41,42] An alternative description is that lenders must be compensated for the loss of liquidity during the loan period. Our results mirror those of Shackle:

> Money, otherwise than as a mere accounting unit to express the price-pattern of a general equilibrium, has no place in the value-construct [i.e. neoclassical paradigm]. Money, as something which can introduce a time-interval between selling one thing and deciding what to have in exchange for it, can evidently have no place in a system whose logic requires all its choices to be comprehensively simultaneous in order that they may be pre-reconciled and thus fully informed. Money is the means of stopping half-way in the complete transaction of exchange, the means of avoiding or postponing the hazardous and expectational choice of a concrete, specialized asset whose value is a conjecture about the relation of its design to future technology and markets. *Liquidity* is a denial of the rationality of the only economic world we have evolved. Value-theorists, balking at the open

[40] Maclachlan (1993, pp. 53-57) argues that liquidity preference is sufficient for the existence of interest, though I do not endorse the arguments by which she claims that capital productivity and time preference are insufficient (pp. 37-53).

[41] My explanation of the interest 'problem' is thus quite similar to the approach of Böhm-Bawerk. However, whereas Böhm-Bawerk explained interest as a result of subjective preferences for present goods in general, I claim that it is sufficient (and less problematic) to posit a subjective preference for present money units. See Murphy (2003a) for a fuller description of Böhm-Bawerk's theory.

[42] Of course, at any given time there are actually multiple (nominal) rates of interest established on the market. This fact does not invalidate our approach, but only makes it more difficult to apply. (After all, there are multiple prices for hamburgers, yet the subjectivist explanation of demand and supply is still applicable.) I should clarify, however, that we are here concerned with the uncertainty of the future as such, and *not* with the uncertainty of the delivery of future money. If we wish, we can define the risk-free interest rate as one attached to a virtually certain bond. (Recall that there was nothing in our concept of pattern coordination to rule out certainty with regard to particular details; it was only *complete* and perfect foresight that was ruled out.) I would argue that, even though the bond itself will be certainly redeemed, the uncertainty concerning other events will still cause a premium on present money and hence a positive interest rate. If, on top of this pervasive uncertainty, we also consider the possibility of default on a bond, then the promised return on such a bond will naturally exceed the risk-free rate.

> acknowledgment of timelessness in their construct, have sometimes invoked perfect foresight. It is, of course, simply another name for timelessness. If every event can be perfectly foreseen, there is no event. An event is something which *becomes* known. To look down the complete vista of all relevant history-to-come is to see a still picture where nothing happens. In such a world, as in the overtly timeless world, there would be no need for postponement of choice, no need for liquidity…[A]n interest-rate, the price of liquidity, is itself the expression of the fact that lending is the exchange of a known for an unknown sum of money.[43] (Shackle 1992, pp. 164-165)

A process explanation of interest rates

In the genetic-causal tradition, a theory of group action must be firmly grounded in the subjective judgments of individual actors. When seeking to explain the behavior of people in the various futures markets, therefore, the first logical step is to decompose the totality of interactions into the constituent actions of a typical individual.

It is standard practice in modern economics to assume that individuals possess ordinal preference rankings over every possible bundle of consumption goods (e.g. Varian [1992, pp. 94-95]). If such rankings are specified for each individual trader in a market, it is relatively straightforward to determine the market price(s) at

[43] By this expression Shackle refers to the fact that a bondholder cannot be certain of the price he will fetch (in the future), should he need to sell the bond before its maturity (Shackle 1992, p. 189). This connection between the desire for liquidity and the uncertainty of future interest rates was noted by Keynes (1965, pp. 168-169).

which quantities supplied will equal quantities demanded.[44] (Even without the neoclassical assumption of infinitesimal units, a range of resting prices can be determined in an individual market from the antecedent ordinal rankings of the various participants in the market. See Menger [1994, pp. 194-197].)

The monetary approach which I advocate in this paper proceeds along these standard lines. Individuals are assumed to have ordinal preference rankings over *claims* to commodities and money units available at different points in time. At the highest level of generality, we impose no conditions of stationarity on these preferences; there is nothing illogical about an individual in period t preferring (even ceteris paribus) claims to apples over claims to oranges delivered in $t+1$, while preferring claims to oranges over claims to apples delivered in $t+2$.

Where a monetary theory departs from the traditional approach is the explicit inclusion of money units in these ordinal rankings. Just as a consumer has antecedent rankings of bundles containing future apples and oranges, so too do we assume that the consumer can evaluate the relative utilities of bundles containing claims to money units at different dates. Thus the (nominal) market rate of interest arises from the exchanges made by individuals with their subjective valuations and objective possession of goods (including money units). At this level of analysis,

[44] We make no assumptions to guarantee "equilibrium" prices. If the valuations and endowments of the traders are such that the market price moves ceaselessly, then that is what will happen.

there is nothing different from the theory of barter prices; one of the intertemporal goods just happens to be money. Hence the "own rate of interest" on claims to money units constitutes the nominal market rate of interest.

Although the above procedure gives a formal and abstract explanation of the formation of market interest rates, it is still unsatisfactory as an economic theory. As Lachmann explains:

> [I]n examining the causes of liquidity-preference we are actually side-stepping from the highroad of economic science, where preferences are identical with motives and must not be further analyzed. Whereas, in general, economic theory strives to reduce all economic phenomena to consumers' (and savers') preferences, in the case of money this procedure will not do. Why the connoisseurs of modern painting prefer pictures by Picasso to pictures by Utrillo is a question with which it has been generally agreed that the economist is not concerned. But why sometimes owners of wealth prefer holding their assets in [the] form of cash-balances to other forms of investment is a problem which the monetary theorist cannot afford to shirk. (Lachmann 1994, pp. 29-30)

It is in this respect, the explanation of the relative importance placed on dated claims to money units, that the theory of this paper differs from the standard approaches. In a real theory of interest, a unit of money available at some future date *T* will be valued according to the inverse of the price level expected at *T*; that is, the money will be converted into "real" goods and services available for consumption at *T*. This (usually discounted) marginal utility will then be compared

with the marginal utilities offered by other prospects, and the optimizing agent will buy or sell money futures to finance the consumption path that maximizes his current expected utility.

The situation is quite different in the radical subjectivist approach offered in this paper. In our theory, the limits of computation and imagination prevent agents from forming fully specified consumption plans from now until the end of time (with declining weights assigned to distant periods). Rather, agents peer into a murky future, where not only the prices and types of goods available are uncertain, but so are the future preferences of the agent liable to change. In this environment, money takes on a qualitatively more important role than in the conventional real approach. In our approach, money is not merely an accounting device to effect intertemporal exchanges of real goods; on the contrary, money is valued as a superlative means of coping with radical uncertainty.

In an uncertain world, the technical fact that money is extremely durable gives an obvious advantage to money claims with earlier dates of delivery. Even if an agent possesses no "time preference," so that he currently considers the consumption of real goods in period *t+5* to be just as good as consumption in *t+6*, he will still value (even at a zero rate of interest) a unit of money delivered in *t+5* more than a unit of money delivered in *t+6*. This is because the agent *need not spend his delivered*

money units on (then) current consumption. In period *t+2*, for example, the agent may become aware of a future opportunity (or crisis) of which he had previously been ignorant. No matter how his preferences change, the earlier claim on money will be capable of performing any service that the later claim can, but will also provide liquidity during the interval from *t+5* to *t+6*.

In our approach, therefore, individuals value future money units not merely as a proxy for future consumption, but as a store of purchasing power that allows for the postponement of decisions about future consumption. If an individual currently offers $10 for apples today but only $1 for apples delivered in twenty years, we do not interpret this as a higher expected utility from earlier apple consumption. (It *is* of course evidence of a higher utility from earlier *claims* to apples; this follows tautologously from our genetic-causal procedure.) In our approach, an individual who allocates ten apples to present consumption and one apple to future consumption is not demonstrating a preference for earlier apple consumption, because he is *also* allocating some of his current wealth to provide himself with future money. As time passes and uncertain events are resolved, the individual knows he can supplement his previous decisions (such as the purchase of one future apple), armed with better information.[45]

[45] Anyone who has planned a major event, such as a wedding, knows that all decisions are not made in one fell swoop. The subjective plans of all relevant individuals become more and more concrete as the event approaches. Decisions made earlier in the process do not at all correspond to those

Of course, this logically antecedent preference for earlier claims to money will give rise to a positive nominal rate of interest, which itself will alter individuals' relative valuations of dated money claims. Certain relationships will tend to exist in the intertemporal price structure, because deviations from these relationships would lead to pure arbitrage opportunities. But this alone gives us no reason to treat the "real" intertemporal exchange rates as somehow more fundamental than the nominal rates; on the contrary, it is the "real" rates that are artificial constructs, relying on an arbitrary definition of the "price level."

Uncertainty, liquidity, and the rate of interest

When individuals perceive greater uncertainty[46] in the impending future, their desire for liquidity (on the margin) will increase.[47] Whereas previously an individual may have been willing to exchange 1,000 present dollars for the (nearly certain) prospect of 1,050 future dollars, due to the changed conditions (or rather, his perception of them) the individual may now only be willing to exchange 1,000

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items deemed more valuable. It is unclear how to even apply the notion of "time preference" to such real-world planning.

[46] I remain agnostic on how to define "greater uncertainty." It is not useful to define it, say, as the increase in the variance of some variable, for this would relate to actuarial risk, and not true uncertainty. As Loasby explains, the mainstream notion of uncertainty "itself implies a remarkably complete knowledge; for, like risk, it requires a complete listing of all relevant outcomes, and also a full listing of all possible courses of action….When someone says he is uncertain, what he usually means is not just that he doesn't know the chances of various outcomes, but that he doesn't know what outcomes are possible" (Loasby 1976, p. 9). See Knight (1965 [1921], p. 233) for the classic treatment of the distinction between risk and true uncertainty.

[47] This section does not consider perverse cases in which, e.g., the future uncertainty relates to the incidence of robberies, a situation in which people might desire to unload their cash holdings.

present dollars for the (nearly certain) prospect of 1,100 future dollars. In short, the supply curve of loanable funds shifts to the left, driving up the (nominal) rate of interest.

Inflation

The fact that a monetary approach to interest deals with nominal market rates should not be interpreted as a dismissal of the tremendous importance actors place on expected inflation. Obviously, if the government is expected to inject huge quantities of money into the economy, this will affect the exchange rate between present and future money units.

Nevertheless, the approach in this paper still treats individual valuations of money units as the proper starting point of analysis, in contrast to standard approaches in which agents evaluate units of "real" purchasing power. The two approaches are not equivalent in a world of change and uncertainty, because there is no such thing as "the" level of prices. Someone planning a vacation will make different decisions depending on his expectations of monetary growth, but this doesn't mean he is necessarily comparing current "consumption" with future "consumption." If, for example, the trip is to the 2004 Olympics, there is no currently available spot price

against which he can compare the expected 2004 spot prices for Olympic-related products (such as t-shirts).

APPLICATIONS

The monetary theory of interest outlined above is intended primarily to elucidate the essential or fundamental cause of interest, rather than (say) the determination of hypothetical equilibrium rates of interest. Despite this admittedly unorthodox approach, our discussion may shed light on two major areas of traditional capital and interest theory, namely the Cambridge debate and business cycle research. These possible applications are sketched below.

The Cambridge capital controversy

The real theories of interest, stemming from the work of Böhm-Bawerk and Fisher, suggested an obvious explanation or 'justification' of the return earned by capitalists on their funds. In equilibrium, capital owners require a net return on loans because of subjective time preference ("impatience"), and capital borrowers are willing and able to repay the premium plus interest because of the productivity of roundabout processes ("investment opportunities"). This explanation was completely analogous to the description of (positive) wage rates in equilibrium, in

which the market price of a marginal unit of labor is determined by its subjective disutility to the worker and its objective physical productivity to the employer. Just as wages were necessary to induce workers to engage in productive (yet onerous) labor, so too it seemed that interest was necessary to induce capitalists to engage in productive (yet onerous) postponement of consumption (i.e. real saving).[48]

The Cambridge (UK) critique challenged this orthodox view by offering rival models (such as those in Sraffa [1960]) in which the "profit rate" (i.e. return on invested financial capital) was a "free variable" that could be lowered (to the benefit of wage earners) without disturbing the underlying technical relations in the economy. In fact, the so-called neo-Ricardian critics entirely rejected the marginal productivity approach to the determination of interest payments:

> Capital in neoclassical analysis enters the production function as a known homogeneous input quantity. Since, in reality, all capital is physically different, its measurement is either left undefined or taken in value terms, i.e. the summation of the prices of the individual capital goods, in the typical neoclassical model. To obtain these values, however, the prices of all capital goods in existence must be known. If the value of capital could thus be determined, and all the prices could be shown to be consistent, then the marginal net product of this quantity would set the rate of profits. But, as Sraffa has shown, it is impossible to measure any economic quantity without first knowing the rate of profits. It is thus logically impossible to derive a rate of profit from a quantity that requires the rate of profit

[48] Joan Robinson declared that, "The unconscious preoccupation behind the neoclassical system was chiefly to raise profits [i.e. interest] to the same level of moral respectability as wages" (qtd. in Kirzner 1996, p. 150).

> before its magnitude can be determined….The results of the Sraffa analysis are particularly important in demonstrating that *the value of capital is not independent of the rate of profit*. (Kregel 1971, p. 46, italics added)

The most famous episode of the controversy involved the possibility of technique "reswitching." In the traditional Böhm-Bawerkian approach, a fall in the rate of interest (due to increased savings, for example) presumably led to the adoption of more roundabout processes, in which labor and land inputs would be invested (on average) for longer periods, leading to higher output and real wages per worker. Levhari (at Samuelson's suggestion, according to Kreger) claimed that he had discovered a "Non-switching Theorem" (Levhari 1965), but Pasinetti (relying on Sraffa's work) disproved these results (Kreger 1971, p. 7).

In what Blaug (1978, p. 552) terms "unconditional surrender," Samuelson (1966) retreated and admitted the logical possibility of reswitching, in which a certain production technique *A* would be preferred to a production technique *B* at both very low and very high rates of interest, but *B* would be more profitable at intermediate rates.[49] Because of this possibility, production processes cannot be ranked in terms of "capital intensity" or "roundaboutness" according to purely physical facts, and

[49] Specifically, Samuelson (1966) imagines that technique *A* requires seven man-years of labor applied in the 2nd year, while technique *B* requires two man-years of labor in the first year and six man-years in the third year. At a rate of interest greater than 100 percent, technique *A* is the more profitable. For a rate of interest between 50 and 100 percent, technique *B* will be cheaper. But as the interest rate falls below 50 percent, technique *A* is once again the preferred method of production. Thus, whichever technique is judged more capital-intensive, it will be abandoned in favor of the less capital-intensive method after a fall in the interest rate for certain ranges.

the Böhm-Bawerkian account of savings and capital accumulation is therefore incomplete.

Due to the explicit error of the neoclassicals on the reswitching issue, and the circular argument involved in (the empirical application of) mainstream growth models at that time, it appeared that interest payments were *not* returns to the marginal product of anything. Consequently the justice of the capitalists' income was called into question.[50]

It is clear that what plagued the defenders of neoclassical orthodoxy was their belief that (real) interest is a return to the marginal (real) productivity of physical capital goods; such a defense was hampered by the possibilities of capital reswitching and reversal (Lewin 1999, p. 83). It is my contention that a monetary theory (such as the one offered in this paper) easily sidesteps the neo-Ricardian objections.[51] In our approach, a sum of money lent at interest does not 'represent' a

[50] "[The Cambridge] critics see the distribution of income between wage-earners and interest-receivers as being determined by such considerations as the power balance between workers and capitalists, rather than by marginal products, consumer preferences, and factor supplies" (Kirzner 1996, pp. 149-150).

[51] A monetary approach can easily handle Samuelson's reswitching example (see footnote 49 above): Rather than determining which production technique requires the investment of fewer real goods (and hence is the less 'costly' in terms of postponed consumption), we instead determine which technique requires the investment of fewer money units. Money investments required at different points in time can be reduced to a common unit through use of the interest rate; once this has been done (e.g. by reducing the total stream of money inputs to present dollars) the technique requiring the lower investment is (obviously) chosen. Because we are dealing with a monetary theory of interest, it is not surprising that alterations in the exchange rate of present for future money can affect which technique requires the greater total investment.

quota of physical machines or any other real goods; instead the money units are themselves the actual good and are directly valued by actors as such. It is true that particular borrowers may desire loanable funds in order to purchase productive equipment, but their motives do not offer a justification of interest payments to capitalists.

What we *can* do with a monetary theory, however, is view capitalists as 'entitled' to interest on their funds for the same reason that *any* owner is entitled to the rents afforded by his property. From this perspective, the rental price of money capital is indeed equal to its marginal productivity in equilibrium, in the admittedly tautologous sense that a resource is 'productive' whenever people are willing to pay for it.[52,53] If borrowers do not subjectively value the service offered by present cash holdings, why then do they pay for it?[54]

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[52] An economist would consider (at least in a competitive market) a controversial artist's (or even a fortune teller's) earnings as equal to her marginal productivity, regardless of the economist's personal opinions as to the validity of this 'service.'

[53] Thus I am not fully endorsing the Sraffian critique. I agree that the neoclassicals have failed to distinguish physical capital from financial capital, and therefore they are wrong to explain the return on the latter by the marginal product of the former. However, this does not mean we need a non-marginal explanation of interest rates. In the appendix to Murphy (2003a), I formally develop a neoclassical model in which machine owners earn rents in accordance with their machines' marginal productivity, but capitalists earn (real) interest returns that are entirely a function of the subjective discount on future utility. The real culprit is not the neoclassical's marginal approach, but rather the standard use of one-good models in mainstream growth theory. When capital and consumption are the same good (or what is the same thing, when they can be costlessly and instantly converted into each other one-for-one), they trade one-for-one and the problem of valuing capital without an interest rate disappears. Kreger too notes that the interest rate equals the marginal product of capital in mainstream models only because of their "use of homogenous jelly capital or its corollary, jelly output" (Kreger 1971, p. 94).

[54] Böhm-Bawerk's argument against the exploitation theory of interest is just as compelling for a monetary as for a real approach. Recall that the exploitation theories claim interest robs workers,

Business cycles

One of the weaknesses of the theory here offered is its ambiguity; it can only offer general insights rather than quantitative conclusions. However, this is not a limitation when it comes to the study of business cycles, since (if the theory of this paper is correct) the traditional macroeconomic prescriptions are not so much wrong, but rather they result from a misdiagnosis.

In contrast to the equilibrium-always view of mainstream models,[55] we can interpret the boom-bust cycle as a disequilibrium phenomenon in which the intertemporal plans of consumers and producers fail to mesh (e.g. Lewin [1999]

since they are not paid their 'true' marginal product, but only their *discounted* product (since the contribution of workers will only yield revenue in the future, when the product or service is sold). If, for example, the rate of interest is ten percent, then a worker would only be paid $100 now for work that will yield $110 in marginal revenue in a year's time. To counter the charge of exploitation, Böhm-Bawerk pointed out that, if any worker feels cheated out of his 'true' product, he can himself invest his wages at interest and be assured of his full product at the moment when his labor actually bears fruit for the employer (I, p. 265-266). (In our example, the worker could choose to invest his current wages and would have $110 in a year's time.) Indeed, this argument is even more compelling in a monetary theory of interest, because in this approach the interest rate is simply the market rate of conversion between two different currencies (present and future money). To claim exploitation would be akin to the owner of a silver mine complaining about the high price of gold in terms of silver.

[55] Boyan Jovanovic has pointed out that Fischer Black (1995) offers a similar theory of business cycles (though he ironically considers them as a topic for general equilibrium theory). Black explains the Great Depression by saying: "Firms made investments during the 1920s based on their beliefs about what tastes and technology would be, along many dimensions, during the 1930s. Those beliefs turned out to be very wrong, so the investments were not worth much and ability to produce what people wanted was low" (1995, p. 82).

and Garrison [2001]). In this case, business cycle research must focus on the causes of these recurrent failures of coordination.[56]

What is the role of the interest rate in business cycles? As the price governing the exchange of present versus future money, the interest rate pervades virtually all markets, and as such its movements can, in principle, influence all markets. Going the other way, we might expect any macro disturbances to be reflected in the interest rate. For example, a sharp drop in confidence in the future—i.e. an increase in uncertainty—could cause a jump in nominal interest rates. The approach of this paper easily incorporates such commonsense explanations into a more theoretical framework.[57]

As alluded to above, the real contribution of a monetary theory of interest is not its ability to prescribe solutions, but rather its ability to clearly rule out business cycle

[56] Despite the references to Roger Garrison and Peter Lewin, I should clarify that I am not fully endorsing the Austrian business cycle theory. The ABCT blames recessions on prior unsustainable boom periods, which in turn are explained by an artificially low (real) interest rate that causes entrepreneurs to overestimate the amount of (real) savings in the economy. All I argue in this paper is that the interest rate connects all markets, and thus it is not surprising that e.g. Federal Reserve manipulation of interest rates will cause greater uncertainty and make the intertemporal coordination process that much harder. In contrast to the Austrians, I am *not* claiming that the interest rate alone serves to coordinate present and future activities, and a major theme of this paper is that indeed it makes no sense to contrast present and future 'consumption' (a typical feature in Austrian macroeconomics).

[57] In contrast, such an intuitive description cannot be so easily represented in mathematical models. For example, the approach of Savage views agents as possessing subjective beliefs concerning the probability of future events. But this technique does not allow us to specify the *confidence* with which these beliefs are held. In a real goods framework, there is no clear analog to the increase in liquidity preference in a monetary theory of interest. (On the confidence of expectations see Keynes [1965, p. 148]. For a critique of the use of second-order probabilities on the subjective probability distributions themselves, see Shackle [1952, p. 115].)

explanations that abstract from money. It was precisely against such explanations that Keynes[58] chafed:

> [I]t has been supposed that any individual act of abstaining from consumption necessarily leads to, and amounts to the same thing as, causing the labour and commodities thus released from supplying consumption to be invested in the production of capital wealth…
>
> …The conviction, which runs, for example, through almost all Professor Pigou's work, that money makes no real difference except frictionally and that the theory of production and employment can be worked out (like Mill's) as being based on "real" exchanges with money introduced perfunctorily in a later chapter, is the modern version of the classical tradition. Contemporary thought is still deeply steeped in the notion that if people do not spend their money in one way they will spend it in another. (Keynes 1965 [1936], pp. 19-20)

Our results are unfortunately negative in character; all we can conclude with certainty is that the traditional stories of the interest rate's role in matching real savings with real investment are not very plausible.[59] "If one is to accept a liquidity preference theory of interest…then one is forced to abandon the idea of the interest rate serving to coordinate the demand for consumer goods relative to the demand for producer goods" (Maclachlan 1993, p. 154). All is not lost, however:

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[58] This observation should not be construed as an endorsement of "Keynesian" macroeconomics.
[59] For example, Marshall argued that a general rise in the demand for capital would increase the interest rate. Keynes wondered why it would not, instead, increase the supply-price of capital goods, and pointed out that the increased demand for capital goods could result from an initial *fall* in the rate of interest, rendering Marshall's explanation all the more dubious. (Keynes 1965, p. 187 fn 2)

> To reject the idea that the interest rate serves to coordinate intertemporally does not imply a totally nihilistic approach to economic theory that says that since everything is in a constant state of flux there is no hope for any deductive economic reasoning. One can still accept that in individual markets—in the markets for welders, overcoats, hairdressers, loanable funds, etc.—there are equilibrating tendencies. One can even accept that sometimes in some markets something approximating an equilibrium exists. But one must be a little more sceptical [sic] about the possibility of a general equilibrium in which all scare resources are fully employed. (Maclachlan 1993, pp. 155-156)

Indeed, viewing the intertemporal coordination problem as one of multiple markets, rather than a giant 'time market,' is more consistent with intratemporal coordination. For example, in a static setting, when consumers unexpectedly switch their demand for product X to product Y, producers eventually switch from making X to making Y because of the change in profitability of the two lines. This type of 'invisible hand' process does not depend on, say, changes in the purchasing power of money.

In the same way, when consumers unexpectedly switch their demand from current product X to future product Y, the producers of Y do not need a falling interest rate to 'signal' them to increase production. If nothing else, the higher demand for Y (in the future) will signal the change in consumer tastes, just as in the static

setting.[60] Of course, reestablishing coordination may take longer in the dynamic setting, but this is only to be expected, as the problem is far more complex.

If money is viewed as a market solution to future uncertainty, then interest rates must play a central role in any business cycle theory. However, if actual money is abstracted out of the theory in favor of real exchange rates, the explanation will assume away one of the very problems to be analyzed.

CONCLUSION

We have seen the shortcomings of the real approach to interest theory. Interest is quite simply the price of borrowing money or (what is the same thing) the exchange rate of present versus future money units. Consequently it is rather dubious to describe interest rates with a model in which money is absent.

More generally, the standard mainstream (neoclassical) approach to economic theory is of limited usefulness in intertemporal affairs. The issue is not merely one of realism. As we have seen, there are serious methodological problems with

[60] The market response to this will not necessarily be a reduction in the nominal rate of interest. For example, a higher spot price of Y (fueled by the increased demand) will also make production of Y relatively more profitable than production of X, even with constant interest rates. (In a simple model, the two explanations are equivalent; the rising price level lowers the *real* interest rate.)

viewing future knowledge and behavior as being in a sense 'determined' by present information and choices.

In contrast to the real approach, we have outlined a monetary theory of interest that seeks an understanding of the process by which individuals value money units available at different time periods. If we believe that money is an institution that helps actors cope with the radical uncertainty of the future, it naturally follows that a tendency for positive nominal rates exists.

This theory of interest has applications to broad areas such as doctrinal controversies and business cycle research. By treating money as a good in its own right (rather than an annoying complication of the real world), apologists for capitalism can gain a much simpler intellectual defense of the payment of interest. Finally, we have argued that no progress can be made in understanding the business cycle without a proper conception of the role of money in intertemporal affairs.

APPENDIX
Dangers of the One-Good Model

INTRODUCTION

The modern reader may find Böhm-Bawerk's verbal reasoning ("literary economics") difficult to evaluate. In particular, the modern economist may consider Böhm-Bawerk's critique of the "naive productivity theory" to be rather anachronistic, in light of standard growth models which show a close relationship between the marginal productivity of capital and the equilibrium rate of interest.

This appendix will attempt to illustrate Böhm-Bawerk's arguments through the use of a few simplified, general equilibrium models. We will see that the standard one-good model of neoclassical growth theory obscures the subtleties in Böhm-Bawerk's critique. Only in a model with multiple goods can one fully appreciate the "Austrian" approach to capital and interest theory.

THE ONE-GOOD MODEL

The apparently straightforward connection between capital productivity and the interest rate is explained in David Romer's (1996) discussion of the Ramsey-Cass-Koopmans baseline growth model. In this model, a large number of identical firms has access to a production function $Y = F(K, AL)$, where

K represents the firm's capital stock, L represents the firm's labor supply, and A is the technology parameter measuring the "effectiveness of labor" (1996, p. 39). When describing firm behavior, Romer explains:

> As described in Chapter 1, the marginal product of capital, $\partial F(K, AL)/\partial K$, is $f'(k)$, where $f(\cdot)$ is the intensive form of the production function. Because markets are competitive, capital earns its marginal product. And because there is no depreciation, the real rate of return on capital equals its earnings per unit time. Thus the real interest rate at time t is $r(t) = f'(k(t))$. (Romer 1996, p. 41)

Romer seems to claim that capitalists earn a return due to the technological productivity of their capital goods. Although he is not trying to "explain" interest in any philosophical sense, Romer's analysis seems quite complimentary to the "naive productivity theory" that Böhm-Bawerk criticized so harshly.[1]

[1]Romer also apparently embraces the "naive productivity theory" in his empirical application of the Solow model. After obtaining an equation for the marginal product of capital, Romer says: "[This equation] implies that the elasticity of the marginal product of capital with respect to output is $-(1-\alpha)/\alpha$. If $\alpha = \frac{1}{3}$, a tenfold difference in output per worker arising from differences in capital per worker thus implies a hundredfold difference in the marginal product of capital. And since the return to capital is $f'(k) - \delta$, the difference in rates of return is even larger...[T]here is no evidence of such differences in rates of return. Direct measurement of returns on financial assets, for example, suggests only moderate variation over time and across countries." (Romer 1996, p. 24)

This quote demonstrates that Romer believes the rates of return on financial assets, i.e. particular rates of interest, in some sense measure the physical productivity of capital goods. This is clearly the "naive productivity theory" in modern form.

This raises the obvious question: Was Böhm-Bawerk's critique of the naive productivity theory valid? After all, Romer has made no mistakes in deriving his equations.

The answer I will offer is that, paradoxically, both Böhm-Bawerk and Romer are correct. The fallacy against which Böhm-Bawerk warned is not relevant in an economy with a single good. The significance of Böhm-Bawerk's insights are only manifest in a model with distinct capital and consumption goods, as we will see in the next section.

MULTIPLE-GOOD MODELS

In this section we will briefly examine a few variants of a simple multiple-good model to gain a better appreciation for Böhm-Bawerk's critique of the naive productivity theory of interest.

One agent, fixed capital stock

In this first model, we will analyze an economy consisting of one agent who lives for a finite number of time periods from 0 to T. The agent starts with an initial endowment, E, of the consumption good, and the agent possesses a fixed stock of machinery, $\overline{K}$, which does not depreciate with use. Each period the agent is endowed with a fixed labor supply, $\overline{L}$, which can be expended with no disutility.

Each period the agent combines capital and labor to yield output[2] according to the function

$$Y_{t+1} = f(K_t, L_t) = K_t^{\alpha} L_t^{1-\alpha},\ 0 \leq t \leq T-1,$$

where K_t and L_t are in the appropriate units (since capital, labor, and output are all distinct items). Suppose further that the agent has a utility function of the form

$$U_\tau = \sum\nolimits_{t=\tau}^{t=T} \beta^{(t-\tau)} u(C_t),\ 0 \leq \tau \leq T,$$

where $0 \leq \beta \leq 1$ is the discount on future utils, C_t is the amount of consumption in period t, and $u(\cdot)$ is differentiable, strictly increasing, and strictly concave.

Because of our grossly simplifying assumptions–namely, that labor carries no disutility, and that the stock of machines is fixed–it is obvious that the maximizing agent will produce $Y_t = f(\overline{K}, \overline{L}) = \overline{K}^{\alpha} \overline{L}^{1-\alpha} \equiv \overline{Y}$ units of the consumption good in every period t, where $1 \leq t \leq T$. For simplicity, we will assume that the initial endowment $E = \overline{Y}$. The agent's problem can

[2]Notice that, in the spirit of "Austrian" capital theory, we have explicitly modeled the time involved in production; capital and labor applied in time t will only yield units of the consumption good in the following period $t+1$. This approach does not affect our main results.

thus be reduced to his formulation of a consumption plan when there is no production at all, and a fixed endowment of $\overline{Y}$ units of the consumption good in each period t between 0 and T, inclusive. If we wish, we can let δ^C, where $0 \leq \delta^C \leq 1$, denote the depreciation rate *of the stock of consumption goods*. However, our choice of utility function ensures that, regardless of β and δ^C, the agent will choose $C_t = \overline{Y}$ for all t.[3]

The fixed capital stock model in a market setting

Because there are no externalities, we can easily tranform the above model into one with separate capitalists and laborers who rent and sell machines and labor on a competitive market. If we normalize the spot price of consumption to 1 for all periods, then the equilibrium wage rate at time t is given by

$$w_t = \frac{f_2(K_t, L_t)}{1 + i_t} = \frac{(1-\alpha)\overline{K}^{\alpha}\overline{L}^{-\alpha}}{1 + i_t}, \ 0 \leq t \leq T-1,$$

where $f_2(\cdot, \cdot)$ denotes the partial derivative of f with respect to its second argument, and where i_t is the net real rate of interest. If we define p_y^x as the period x price of a unit of consumption good delivered in period y, then

[3]Consider first the case where $\delta^C = 0$ and $\beta = 1$, so that the consumption good can be stored costlessly and future utils are not discounted. Even so, because of the strict concavity of $u(\cdot)$, we know that the maximizing agent will not choose to carry any units of consumption from some time t forward to any time $t + \tau$. A fortiori, the maximizing agent will never save any of the consumption good if storing it carries a penalty, i.e. when $\delta^C > 0$ and/or $\beta < 1$.

$i_t \equiv \frac{p_t^t}{p_{t+1}^t} - 1$. That is, the net rate of interest is defined as the relative premium on consumption in period t versus consumption in period $t+1$.

Similarly, we can define r_t as the rental price, in period t, for a unit of machinery for one period. That is, the owners receive r_t in period t for lending out a marginal unit of machinery and receiving it back, in perfect condition, one period later in $t+1$. As with labor, the capitalists receive their discounted product in equilibrium, so that

$$r_t = \frac{f_1(K_t, L_t)}{1+i_t} = \frac{\alpha \overline{K}^{\alpha-1} \overline{L}^{1-\alpha}}{1+i_t}, \ 0 \leq t \leq T-1.$$

We now solve for the equilibrium rate of interest:

$$1 + i_t \equiv \frac{p_t^t}{p_{t+1}^t} = \frac{MU_t^t}{MU_{t+1}^t},$$

where MU_{t+1}^t is the marginal utility of consumption in period $t+1$, *as perceived in period* t. With our choice of utility functions we know that $MU_{t+1}^t = \beta MU_{t+1}^{t+1}$. Finally, because $C_t = \overline{Y}$ for all t (as we argued in the single agent setting),[4] we know that $MU_x^x = MU_y^y$ for any x, y. We therefore

[4]To make the conceptual transition from the single agent setting to the current model as clear as possible, we can assume that the machine owners possess an initial endowment of consumption goods $\alpha \overline{K}^{\alpha} \overline{L}^{1-\alpha}$, while the laborers possess an initial endowment of $(1-\alpha)\overline{K}^{\alpha} \overline{L}^{1-\alpha}$. In equilibrium, the machine owners will lend r_0 of their endowment in period 0 to entrepreneurs, laborers will lend w_0, and they will consume the rest of their initial endowments. The entrepreneurs then use the loans to hire machines and labor, thus returning this real income right back to the original lenders in the form of rents and wages. Each period the entrepreneurs pay the interest on these original loans. In the final period,

conclude that

$$1 + i_t = \frac{MU_t^t}{MU_{t+1}^t} = \frac{MU_t^t}{\beta MU_{t+1}^{t+1}} = \frac{1}{\beta},\ 0 \leq t \leq T-1.$$

Discussion

Although the above model employed some very strong assumptions, it serves to conceptually distinguish the physical productivity of capital goods from the real rate of interest. Far from being equal to the "marginal productivity of capital," the equilibrium interest rate is entirely a function of the representative agent's subjective discount on future utils.[5]

To be sure, the (discounted) marginal productivity of machines determines the rental payments to the machine owners (just as the marginal productivity of labor determines the "rental price" of a worker's body). But this does not in any way correspond to the rate of return on their *financial* capital. Consider the case where $\beta = 1$, so that there is no discount on future utils and the real

T, the entrepreneurs make their interest payment and return the principal as well. The point of this contrivance is to verify that $C_t = \overline{Y}$ for all t, just as in the single agent setting. (Recall that in period T, the world is ending and so $r_T = w_T = 0$.) In the next variant of our model, we will explicitly introduce a banking sector, so that (as is more natural) each period laborers only consume their discounted product.

[5] Proponents of the modern Austrian theory of interest, the "pure time preference theory," should be careful in interpreting this result. There is a distinction between the rate of interest (i.e. the market's discount on the price of future goods versus the same present goods) and the subjective time preference factor (i.e. the individual's discount on future utility). The two are logically linked in this particular model only because of the strong assumption of a fixed capital stock (and hence constant level of consumption over time).

interest rate is zero.[6] Each period the machine owners receive $\overline{K}r_t = \alpha\overline{Y}$ in total payments; econometrists would find that the owners received an α share of total income.[7] Nonetheless, the rate of return on financial assets is zero, despite the obvious physical productivity of the machines. What happens is that the total market value of the capital stock $\overline{K}$ declines with each successive period, so that the rental payments accruing from ownership of the machinery exactly offset the decline in market value of the stock.[8] This distinction–between physical productivity of capital goods and the rate of return on financial capital–is at the heart of Böhm-Bawerk's critique of the naive productivity theory of interest. But the distinction cannot be seen in a single-good model.

Finally, we note that Böhm-Bawerk's own explanation of interest–namely, that it is intimately tied to the higher valuation of present over future goods–is valid in this model. Consider the more reasonable case where $\beta = \frac{1}{2}$, so

[6] To reiterate, Austrian readers should remember that the one does not always follow the other; it is perfectly possible to have a model in which there is no subjective discount on future utils, but nonetheless the market rate of interest is positive.

[7] The reader should not worry that this analysis possibly conflates the return to the owners from their machines, and the interest return on their loan (made initially in period 0). In the text we are considering the case where $i_t = 0$, and so the machine owners' income is due (for $0 \leq t \leq T-1$) entirely to the rents earned by their machines. The owners have (financially) transferred, at a zero rate of interest, their initial endowment $\alpha\overline{K}^{\alpha}\overline{L}^{1-\alpha}$ to the last period T, when their machines will be worthless.

[8] To be more specific: At $t = 0$, the stock of machinery will be valued at $\alpha\overline{Y}T$ units of present consumption. At $t = 1$, the entire capital stock will be valued at $\alpha\overline{Y}(T-1)$. So if capitalists invested $\alpha\overline{Y}T$ units of purchasing power at $t = 0$ in the stock $\overline{K}$ of machines, they would receive a return of $\alpha\overline{Y}$ as rental payments in $t = 0$ (which could be invested at the prevailing interest rate of zero percent). Consequently, the total market value of their investment at $t = 1$ would be $\alpha\overline{Y}(1+0) + \alpha\overline{Y}(T-1) = \alpha\overline{Y}T$. I.e. the capitalists, although earning gross rents on their investment, would earn no net rents.

that the real interest rate is 100 percent. In equilibrium, it must be the case that capitalists who invest in machinery still receive the return from their machines' (discounted) marginal productivity, while also earning a net return of 100 percent per period on their financial assets.

We can most easily illustrate this by working backwards. First, define π_y^x as the period x price of a machine delivered at time y. At $t = T$, the stock of machinery will be useless; the world is ending and there is no point in producing for a non-existent future period $T + 1$. Consequently, $\pi_T^T = 0$. At time $T - 1$, a particular unit of machinery will still yield one last increment of marginal output, which the market will currently value at some constant $r_{T-1} \equiv \overline{r}$. Thus $\pi_{T-1}^{T-1} = \overline{r}$. In period $T - 2$, a unit of machinery will yield an immediate return $\overline{r}$ and will be worth π_{T-1}^{T-1} in the following period. Therefore its present price π_{T-2}^{T-2} is $\overline{r} + \frac{\pi_{T-1}^{T-1}}{(1+i_{T-2})} = \overline{r} + \frac{\overline{r}}{2} = \frac{3}{2}\overline{r}$. Thus we see that, when present consumption is twice as valuable on the margin as future consumption, the rate of return on financial assets is also 100 percent per period: A capitalist investing $\frac{3}{2}\overline{r}$ units of purchasing power in period $T - 2$ would be able to purchase one unit of machinery. He could immediately lend it out to producers, earning an immediate return of $\overline{r}$ (which could then be lent out on the loan market). In the following period, $T - 1$, he would have $(1 + i_{T-2})\overline{r} + \pi_{T-1}^{T-1} = 2\overline{r} + \overline{r} = 3\overline{r}$ units of real purchasing power, i.e. a 100 percent return on his original investment.

Multiple agents, variable capital stock

Of course, the most obvious objection to the above analysis is that it seems to rule out, a priori, the possible influence of capital productivity on interest rates. However, as we will now demonstrate, the basic Böhm-Bawerkian analysis holds up even in the general case, where labor and machinery can be used, not only to produce units of the consumption good, but also to produce additional units of machinery.

Suppose there are an infinite number of time periods, from $t = 0$ to $t = \infty$. At any time t there exists a fixed labor supply $\overline{L}$ and a variable stock of machinery K_t. In any period, labor and machinery can be combined to yield, in the next period, units of (extremely perishable) consumption or units of new machinery. There is no depreciation of machinery in either line of production. Finally, we explicitly model a bank,[9] which provides a loan of consumption goods to the machine owners and laborers in period $t = 0$ (since the machines and labor will not yield consumption goods until $t = 1$). The bankers earn a perpetual flow of interest payments on this principal. We thus have the following relations:

[9] To reiterate, we omitted this complication in the previous model (fixed capital stock in a market setting), since it was not relevant to our point. Some third party is necessary in order to complete the model, since (at positive interest rates) the machine owners and laborers do not earn their entire product, but only their *discounted* product. (This is what leads many writers to deplore interest as "exploitation.") In this section, we will refer to "bankers" and "machine owners," since the more common term "capitalists" is often used to mean both groups.

$$C_{t+1} = f(K_{c,t}, L_{c,t}) = C_{l,t+1} + C_{m,t+1} + C_{b,t+1},$$

$$K_{t+1} = K_t + g(K_{m,t}, L_{m,t}),$$

$$K_t = K_{c,t} + K_{m,t}, \text{ and}$$

$$L_t \equiv \overline{L} = L_{c,t} + L_{m,t},$$

where $C_{l,t+1}$ denotes the consumption of laborers in period $t+1$, $C_{m,t+1}$ the consumption of machine owners, and $C_{b,t+1}$ the consumption of the bankers. $L_{c,t}$ and $K_{c,t}$ are the amounts of labor and machinery devoted in period t to production of the consumption good (which of course will not be available until the next period), while $L_{m,t}$ and $K_{m,t}$ are the amounts of labor and machinery devoted in period t to the production of machinery.

Assuming competitive markets and that $f(\cdot, \cdot)$ and $g(\cdot, \cdot)$ are differentiable and yield an interior solution, we know that in equilibrium the following relations must hold:

$$w_t = \frac{f_2(K_{c,t}, L_{c,t})}{1+i_t} = \frac{(\pi_{t+1}^{t+1}) g_2(K_{m,t}, L_{m,t})}{1+i_t} \text{ and} \tag{1}$$

$$r_t = \frac{f_1(K_{c,t}, L_{c,t})}{1+i_t} = \frac{(\pi_{t+1}^{t+1}) g_1(K_{m,t}, L_{m,t})}{1+i_t}. \tag{2}$$

Once again, we have normalized the spot price of consumption to one. Relations (1) and (2) simply require that labor and machines earn their (discounted) marginal products, and that their returns must be equal whether they are used to produce consumption or machinery.

Finally, we have the following relations between the prices of capital goods (machinery) in different periods:

$$\pi_t^t = r_t + \pi_{t+1}^t = r_t + \frac{\pi_{t+1}^{t+1}}{1+i_t}. \tag{3}$$

The equations in (3) require that the period t spot price of a machine equals its immediate yield, r_t, plus the current price for a machine available in period $t+1$, i.e. π_{t+1}^t. (In equilibrium $\pi_{t+1}^t = \frac{\pi_{t+1}^{t+1}}{1+i_t}$ because of arbitrage.)

Using the first equation in (2), we can substitute for r_t in (3) to obtain

$$\pi_t^t = \frac{f_1(K_{c,t}, L_{c,t})}{1+i_t} + \frac{\pi_{t+1}^{t+1}}{1+i_t}.$$

Rearranging yields

$$i_t = \frac{f_1(K_{c,t}, L_{c,t}) - (\pi_t^t - \pi_{t+1}^{t+1})}{\pi_t^t}. \tag{4}$$

Equation (4) is completely intuitive. It expresses the fact that the net (real) rate of interest is equal to the net (real) yield of capital *divided by the market price of the capital good.*

Discussion

It is perhaps fair to say that Böhm-Bawerk's critique of the "naive productivity theory" of interest was nothing more (nor less) than his insight that equation (4) has a denominator. Notice that his insight has no relevance when capital and consumption are the same good. In this case, a unit of capital always trades one-for-one against units of consumption, because (obviously) they are units of the same thing. Thus $\pi_x^x = 1$ trivially in any one-good model, and equation (4) reduces to the standard $i_t = f_1(K_{c,t}, L_{c,t})$. The "danger" of one-good models, therefore, is that economists may forget that there is a denominator in (4), and proceed to apply their one-good models to a world in which the denominator need not be one.

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