

The Economics of Time as a Resource

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Abstract

The characteristics of time as a resource are examined in order to seek evidence of these characteristics in fundamental concepts of Economics. A series of thought experiments on time travel demonstrate that a constant irreversible rate of time usage underlies the concepts of opportunity cost, time preference, and interest. This leads to the startling suggestion that the root question in Economics concerns the choice of *how to spend time*. Thus, the principles of Economics are tied closely to the human perception of time and more closely to the human condition than is generally admitted in undergraduate classes on the subject.

Key words: time, choice, opportunity cost

JEL category: A11, A22, D01

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Need a minute? Take the time.

Need an hour? You can borrow mine.

The Subdudes (1996).

If, as we have said, economic choices create history, then it is that creation of history, the creation of outcomes in both the immediate and the longer-run future as a result of present decisions, that demands analytical attention.

Vickers (1994, 189).

But the solution to these errors does not lie in avoiding stories, for we do not have this option, given our essence (called “human nature”). We must, instead, become more aware of the stories that underlie our methods and choices of topics for research; and we must learn to recognize the constraints and prejudices that any particular story must specify.

Gould (1995, 354-55).

INTRODUCTION

The archetype for examining the role of time in economic analysis begins with a critique, then offers solutions. Alchian (1959), Georgesu-Roegen (1971), and Winston (1982) pursue this course in treating the microeconomics of cost and production, while Shackle (1972), Vickers (1994) and Kastner (1998) apply it to more macroeconomic themes. Here, I first examine the characteristics of time as a resource or commodity, then seek the implications of these characteristics for widely accepted, some might say fundamental, economic concepts.

Our common conception of time, as individuals and as a society, forms the bedrock on which much of the foundation of Economics rests. To an individual, time is scarce: time once consumed cannot be consumed again. The scarcity of time leads directly to the concept of opportunity cost, the source of many examples in Economic Principles classes and one of the most fundamental of all economic ideas. Moving further down this path leads to the startling suggestion that the root question in Economics does not concern consumption, production, distribution, or wealth accumulation, but the choice of *how to spend time*, in which these other concerns are rooted.

The analysis starts by identifying the characteristics of time as a good or resource taken from nature. To do this, one must define the term “good” or “commodity”, a revealing exercise in itself. Many of the characteristics of commodities are paradoxical when applied to time. Time has public good aspects from a social viewpoint; “consumption” of a period of time by one individual, does not preclude use of that same period by another. Conversely, for each individual consumption of time is exclusive and unexchangeable. It is rival “within” an individual, but non-rival across individuals. A lifetime is limited by death for an individual, but not for a society, which may outlive specific individual members. These imply that time cannot be borrowed, traded, sold, or stored; but only consumed at a constant rate.

Next, the assumption that time is consumed at a constant rate is examined. We measure time by natural (movement of celestial bodies) or artificial (clock mechanisms) mechanical events, which may or may not correspond to any individual’s experience of time. An outside observer, however, cannot distinguish between small variations in the rate of time “consumption” and variations in time perception and/or time preference across individuals. A series of thought experiments considers the implications of time travel to demonstrate that an

irreversible, (more or less) constant rate of time usage underlies our concepts of opportunity cost and interest. Hence, the principles of Economics are tied closely to the human perception of time and, thereby, more closely to the human condition than is generally admitted.

At this point, the Economics of spending time is considered. The principles of scarcity and opportunity cost narrowly focus the economic inquiry on the moment-to-moment decision points in which individuals decide “what to do next,” or choose a “best next move” (Vickers, 1994). The opportunity cost in this decision is the benefit, net of resource costs, from the second-best activity that is not chosen. If one is willing to focus down on a timeless moment of decision, then the usual microeconomic analytical tools can be applied with the usual results. If one wishes to examine trade-offs in choices across time, then the usual expected-utility analysis breaks down when confronted with the inability of individuals to know all the complete set of possible future outcomes with certainty. One must then adopt some index or ranking, such as “potential surprise” (Katzner, 1998; Shakle, 1972; Vickers, 1994), to replace the probabilities in expected utility theory.

Interestingly, the effect of focusing on the decision margin is to emphasize activities as the objects of choice, rather than resources directly, and to require individual to use imagination in the decision process. Individuals become active, creative entities who choose their actions based on the imagined set of future consequences for each alternative under consideration. Their decisions produce actions that become history. They become much more than passive, calculating devices who crank out maximized responses to given sets of information. ^{1/}

Let us take the first step toward that end.

TIME AS COMMODITY

To discover the characteristics of Time as a commodity first requires a definition of the term *commodity* itself. Many classic texts and textbooks (Samuelson, 1976(a) and (b); Thompson, 1973) manage to use the term commodity at great length, and in detailed analyses, without ever defining the term. Other definitions are inconsistent. As these inconsistencies bear on the nature of Time and consumption, they deserve closer inspection.

Ferguson and Gould (1975, p. 11) state, “Goods and services...are generically called commodities. It is convenient to think of commodities as providing a flow of consumption services over time. The objects of choice are then the services provided by the commodities rather than the commodities themselves.” And (p. 12), “...the theory allows us to analyze choices involving where to live, the allocation of time between work and leisure, the amount of income given to charity, and many other dimensions of consumer behavior.”

Here, the analysis of consumption as “all flows” of services is claimed to obliterate the distinction between durable and non-durable goods, as well as allowing investigations of the allocation of time, itself. This falls into Georgescu-Roegen’s (1971) criticism of confusing *instantaneous* rates of consumption over time with consumption occurring *within a given period*. The all-flow approach, aside from requiring consumers to make continuous instantaneous consumption decisions (inexorably leading to an infinite regress), is inconsistent in its analysis of time allocation. It suggests consumption of time per unit of time - a dimension-less number - while actually analyzing the allocation of a fixed period of time (Becker and Ghez, 1975).

More recent treatments borrow from the strategy literature in stating (Mas-Colell, Whinston, and Green, 1995; pp. 17-18), “The decision problem faced by the consumer in a market economy is to choose consumption levels of the various goods and services that are

available for purchase in the market. We call these goods and services *commodities*....[Each] entry of the commodity vector stands for the amount of [each commodity] ...consumed[T]ime (or, for that matter, location) can be built into the definition of a commodity. Rigorously, bread today and bread tomorrow should be viewed as distinct commodities....viewing bread in different “states of nature” as different commodities...”

This approach falls victim to the same failings as the explicit all-flow definition. In order to index consumption to a time and/or a state of nature, one must index all future instances of time and states of nature for every possible commodity. This leads, again, to an infinite regress as each instant of time can always be subdivided, as well as requiring continuous, instantaneous consumption decisions. The method of analysis of time allocation in this context is not obvious.

It may be fruitful, however, to skip a formal definition and consider the characteristics of commodities directly. Musgrave and Musgrave (1976, 50), for example, do not define commodities as such, but discuss at length the characteristics of private goods versus public goods. Private goods are excludable and exchangeable so that benefits are internalized and consumption is rival. Social goods are non-excludable and/or non-exchangeable; consumption is nonrival; and the costs and or benefits are external. Mixed goods combine some characteristics of private goods with external costs or benefits characteristic of social goods.^{2/}

Consider now the characteristics of Time in this context. Suppose that all individuals move through time at the same rate and in the same, irreversible, direction. Some consequences of relaxing this proposition are discussed in the following section. For now, note that if individuals experience time in the same direction, then variations in the rate of movement are observationally indistinguishable from variations in *time perception* and/or *time preference*. For example, if one perceives time as passing quickly, then the “cost” of waiting is lower, all else

equal. Decisions made on this basis will be indistinguishable from those based on a low time preference, and/or actual fast movement through time, other things equal.

In this context, individuals “consume” time while they are alive. To cease to consume time is to die. For an individual, then, the consumption of time is exclusive, but not exchangeable. Time consumption is rival “within” an individual’s life, but non-rival across individuals. One’s consumption of time does not prevent consumption of the “same” time by others. For a society, however, time is not necessarily limited by death, as a society may outlive the deaths of subsets of its members.

For an individual, there is some fixed, but unknown, amount of time to consume during life. The “trading” of time by an individual is reflected in our language when we say “buy time” or “spend time.” Buying time is essentially to put off one activity in order to spend time on another, an “internal” trade made by an individual entity. Spending time is to undertake an activity for some period. Since one cannot engage in two conflicting activities at once, to choose an activity is to exclude all others *for that period of time*. Hence, the opportunity cost of choosing an activity is the net benefit of the second-best activity that was excluded for that period of time. The benefit is “net” since activities may require physical resources which, having their own (market or shadow) prices, reflect the costs directly incurred in that activity.

In fact, living can be thought of as the act of spending time and Economics as the decision science of spending time using the primary conceptual tools of scarcity and opportunity cost. The characteristics of time are summarized in Table 1.

Returning to the discussion of commodities, it should now be clear that to index “consumption” by time must mean by specific time period. As Mas-Colell, Whinston, and Green point out, for practical purposes consumption quantities are observed over some period of

time, such as a week, month, or year. Thus, for practical purposes, both the indexing and all-flow approaches appear to collapse to “the quantities consumed in a given period” and not the “instantaneous rate” concept that is often intended or inferred. The alternatives are not bread today or bread tomorrow, but eating bread from 11:45 to 11:50 a.m. versus eating bread from 12:15 to 12:25 p.m. The time index must state, in some form, both a time and a duration for every alternative activity, reflecting the intentions of the decision-maker at the time. ^{3/}

It is becoming clear now that consumption decisions involve choosing activities, which require time and resources, for specific periods in the future. In order to do this, individuals must be able to imagine not only future alternatives, but the consequences of making a decision now that may facilitate, exclude, or hedge the possibility of choosing some of those alternatives later. This has moved Vickers (1994) and others to propose replacing the concept of expected utility with ideas such as “potential surprise” (Shackle, 1975), “potential confirmation” (Katzner, 1998), and “decision indexes,” in order to deal with the essential unknown-ness of the future which undermines the traditional expected utility approach. These subjects are beyond the scope of this article, although relevant and consistent with the analysis presented here. The idea of opportunity cost remains the driving force in these alternatives and that is where the discussion is centered below.

HISTORICAL TIME AND OPPORTUNITY COST: SOME THOUGHT EXPERIMENTS

Consider now the meaning of opportunity cost when the assumption of individuals’ unidirectional travel through time at a constant rate is relaxed. That is, suppose “time-travel” is possible, in that individuals may choose to move from the “present” to some past moment in historical time, experience some duration of time, then return to the “present.” For simplicity,

assume that this travel is costless, both directly and in terms of different “past” actions altering the “present.” How do the characteristics of time consumption change?

An individual’s experience of time remains exclusive and unexchangeable across individuals; there is still no cross-individual market in time. Now, however, one may “consume” the same period of time more than once. Choosing to undertake an activity during a period of time does not preclude the choice of another incompatible activity during the “same” time period. One may choose to travel back to a past period in order to undertake a different activity than that “originally” chosen. In fact, a time period is no longer of fixed length, since it could be “re-lived” as many times as desired. One can borrow time from one’s own history at will.

An individual still must choose what to do next, even in this environment. An individual experiences events in sequence, even though they may fall “out of order” relative to historical or mechanical clock time.⁴ Individuals must choose, as Vickers says, a best next move. Opportunity cost still arises as two incompatible activities cannot both be chosen “next” in the sequence of events. One must choose how to spend the next period of time, regardless of when in historical time that period may fall, as well as the length of the period itself if an infinite regress is to be avoided. In this way, a narrow and highly focused decision margin continues to confront individuals.

This illustration obviously avoids many of the difficulties of time travel, familiar to many readers of science fiction, in order to create an economically meaningful example. Consideration of time travel raises questions concerning the meaning of “same-ness” and whether the alteration of past events may change the present in unpredictable ways. These complications add costs to the time travel experiment considered above, but do not fundamentally alter it. Others are

inherent in consideration of time itself. As Heraclitus found, we cannot step twice into the same river.

Time travel also plays havoc with our conventional ideas of interest, money, and scarcity. If one can spend the “same” money or income multiple times by re-experiencing past time period, or by bringing money from the past into the present, and if money represents command of resources, then what meaning does scarcity have in this context? If one can travel into the future and back to the present, then how does interest represent a payment for waiting or for postponing consumption?

These suggestions are intended to demonstrate that the basic concepts of Economics, such as scarcity, are in a very real sense dependent upon our experience of time. See Table 2. The limitation of individuals to movement through time in the same direction at a constant (or at least similar and irreversible) rate, is one source of scarcity. Resources once consumed cannot be consumed again. It is also a source of payments for labor time, since an individual’s time is scarce and there is an opportunity cost associated with working rather than undertaking some other activity. In this special sense, time is a resource: Individuals may be compensated with material resources for the opportunity cost of spending time on an activity they may not otherwise choose. Interestingly, this notion of opportunity cost stands up to time-travel, requiring only a sequencing of events for an individual, independent of any sequencing relative to clock time, or lack thereof.

It goes too often without saying that living consumes resources. Economics focuses on resources that are sufficiently scarce to have implicit or explicit prices associated with them. Some resources are often overlooked due to lack of scarcity, such as the oxygen in air. For scuba divers and astronauts, however, air or oxygen supplies may be fixed and the time period

spent in these activities, without sacrificing life, determined by those supplies. The scarcity of resources thus enters individuals' decisions to choose activities on which to spend time.

Moreover, without a uni-directional time experience, waiting and the rate of interest would have very different meanings. Indeed, it seems there is an advantage to inevitability. A market based on lending access to resources with return of that access, plus a compensation for opportunity cost, at the end of, or over, a fixed period of time, is dependent upon it. Time travelers could get their hands on large sums and skip much more than just the country; or repeatedly "recycle" the time before the loan comes due. Special institutional arrangements might arise to deal with problems such as these, if our experience of time possessed these characteristics. This is just the point. If our experience of time were different, so too would be our Economics.

Thus, Economics is tied to the human experience of time in an inextricable, yet rarely discussed, manner. Some of the implications of this tie are explored below.

THE ECONOMICS OF SPENDING TIME

The discussion up to this point has identified the economic characteristics of time and their implications as shown in Table 3.

The basic economic choice is the individual's choice of the next best move. If one is willing to examine this decision margin in a timeless fashion, then the usual tools of neoclassical economics can be applied with similar results (Vickers, 1994; Katzner, 1998). Trouble arises, however, if time is incorporated by bringing the traditional expected utility analysis into the picture. This requires the heroic assumption that individuals can know the set of possible future

outcomes with certainty. As Vickers (1994) and Katzner (1998) discuss at some length, this assumption imparts an unrealistic stability to analyses based on this assumption.

Our interest here, however, is in the contribution of the human experience of time to Economics. When we observe economic data, we generally collect the artifacts of transactions derived from individuals' choices on spending time: the tons of wheat or numbers of automobiles sold and the associated revenues for a past period of time, such as a month or year. If we then use these and other data to statistically estimate demand curves, or cost and production functions, what do these relations mean?

If we are strict Heraclitians, these data are historically descriptive and no more. The individuals whose decisions are reflected in the estimated relations have moved on, have had new experiences and acquired new information, such that the "same" individuals no longer exist. This is defeatist at best. No social science can exist under such conditions, as there are not only no stable relationships, but no stable individuals.

If we take a somewhat more lenient view, knowledge of historical relations provides information to aid us in imagining possible future outcomes and in choosing our best next move. Stability of certain relations in the past is useful information for ordering future outcomes in a relevant way, as we cannot obtain the information necessary to calculate probabilities. This ordering - Katzner (1998) and Vickers (1994) suggests rankings in terms of potential confirmation or "potential surprise" taken from Shackle (1972) - is an imaginative aid in making decisions for an uncertain future.

The characteristics of time focus the economic inquiry on the moment of decision, rather than on the goals or conclusions of economic actions. Our current tool box can be used to construct the best responses to any of many sets of initial conditions. We may be able to divine

econometrically the most frequent relations in the past from the artifacts of past actions and transactions. We cannot tell what actually will be the best choice of action until after the fact.

Looking back over this discussion, we see that the emphasis of economic analysis has shifted. By putting the economic decision at the margin of the present and future, we emphasize choice of activities in the context of imagining possible futures. The fundamental economic question is “How to spend time?” This reflects the ultimate scarcity of time for individuals and the implied scarcity of resources. The fundamental determinant of decisions on this margin is the individual’s opportunity cost for the alternative imagined activities.

Moreover, resources are consumed as complements to spending time. The activities made possible by the access to resources are emphasized, rather than the acquisition of resources (that is, “wealth”) in themselves. Economists examine the historical records of transactions, the trading of scarce resources, and from those records attempt to infer the nature of past human activity. The emphasis is on *activity*, or how time is spent, rather than on the things that accompany that activity. The records of actions that individuals have taken in order to obtain goods and resources are clues to the activities in which those individuals chose to engage.

CONCLUSION

The human experience of life requires the consumption of both time and resources. This fact is so intrinsic to human existence that it is often overlooked, or at least not subjected to close scrutiny. As we have seen here, time and resources are both scarce. It follows that the act of living is an economic act, implicitly or explicitly involving consumption decisions and generating opportunity costs.

Our concept of time is fundamental to our economics. For an individual, time is limited, but not excludable or exchangeable. Consumption is non-rival across individuals, but rival within an individual's lifetime. Individuals move only forward in time at a relatively common rate. Future events in time are unknown and unknowable, but individuals must make decisions now by anticipating future outcomes. Even if "time travel" were possible, and time less scarce, the individual is still faced with deciding what to do next in a sequence of events.

Economic decisions are thus squeezed down in time to a decision point in which an individual chooses the best next move. At this timeless decision point, our usual economic results still hold true. If we must consider longer time horizons, then future uncertainty undermines the usual expected utility analysis, and some other method of ranking alternatives must be adopted. Some such methods developed elsewhere were noted here.

The end result of this inquiry into the economic nature of time is a richer view of the individual as an economic actor. No longer is the individual susceptible to characterization as a mere calculating machine. Individuals must be creative and imaginative in anticipating possible future consequences of present decisions. This holds not only for consumption decisions, but is inherent in entrepreneurial acts and business decisions.

The focus on choices of activities, in fact, allows a consistent analysis to underlie both consumer and business decision making. Indeed, the ability of the entrepreneur to imagine unique future possibilities and act accordingly, as captured here, produces much of the dynamic vitality of the market system in expanding consumer choices and satisfying consumer desires. Thus, the analysis undertaken here, although critical at times, eventually reinforces traditional economic conclusions.

NOTES

¹ / So a curious sort of circle is completed. Critics often begin with the proposition that the future by its very nature is unknowable and impossible to predict. But this very fact *requires* that individuals anticipate possible future events in order to make current decisions. Thus, the human dilemma in which the impossible must be at least attempted, perhaps by default, in the very process of life (that is, of spending time).

² / Samuelson (1976(b)) also seems to follow this approach, although not in as systematic a way as the Musgraves. Early on he discusses economic goods, which are scarce, in contrast to free goods (p. 18). Later he hastily addresses private goods versus public goods, with the emphasis on the identity of the producer. That is government as producer of public goods. He adds as almost an afterthought that public goods generally involve some external benefit that could not be captured by a private producer.

³ / The difference in the referents for this notation has received little serious attention from mainstream theory perhaps because the basic outcomes of mathematical models are not altered by these alternative interpretations. This may be mistaken for a difference of no consequence. To do so perpetuates modeling decisions on a basis which is logically inconsistent with the human experience, providing unnecessary fodder to those who seek to dismiss economic models as unrealistic. This is especially disturbing since basic economic concepts are, as argued here, firmly rooted in the human condition.

⁴ / This holds even if an individual, upon arrival in the past, loses all “memory” of the events between that point in time and the present.

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TABLE 1

Characteristics of Commodities

<u>Goods</u>	<u>Exclusive</u>	<u>Exchange</u>	<u>Consumption</u>	<u>Externalities</u>
Private	Yes	Yes	Rival	No
Public	No	No	Non-Rival	Yes
Mixed	Partly	Yes	Both	Yes
Time	No	No	Both	?

TABLE 2

**Thought Experiment:
Characteristics of Time Consumption with Time Travel**

	Constant Irreversible <u>Rate</u>	<u>Time Travel</u>
Scarcity:		
Time	Yes	No
Resources	Yes	No
Choices:		
Best Next Move	Yes	Yes
Time Ordering	No	Yes
Opportunity Cost:	Yes	Yes

TABLE 3

The Economics of Spending Time

1. Time progresses in one irreversible direction.
2. Time is scarce: once spent, the same time cannot be spent again.
3. Resources are scarce, in part, due to the scarcity of time.
4. Time is consumed by undertaking activities.
5. One activity is undertaken at any time.
6. All activities consume resources.
7. Choosing one activity generates an opportunity cost.
8. Opportunity cost is the net benefit of the next best move.
9. Choice of activity is economic.
10. Resource use derives from chosen activities.