

# CHOICE OVER TIME

*Edited by*

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## The Fall and Rise of Psychological Explanations in the Economics of Intertemporal Choice

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**I**N RECENT years, despite lingering skepticism, the influence of psychology on economics has steadily expanded. Challenged by the discovery of individual and market level phenomena that contradict fundamental economic assumptions, and impressed by theoretical and methodological advances, economists have begun to import insights from psychology into their work on diverse topics. This influence has been most pronounced in the area of decision making under uncertainty, but recently it has extended to the cognate topic of intertemporal choice.

Economists have joined psychologists in using experimental methods to address fundamental questions about time preference. Moving beyond the usual attempts to measure discount rates, this research seeks to test critically the predictions and assumptions of the discounted utility model (DU), the most widely employed model of intertemporal choice. These studies have generally not affirmed the descriptive validity of DU; observed patterns of choice violate virtually every one of the model's basic assumptions and, therefore, its implications.

The exchange between psychology and economics has also occurred at a theoretical level. The descriptive inadequacies of DU have led economists and other social scientists to develop alternative theoretical models that incorporate psychological insights. Some of these

retain DU's multiplicative formulation, introducing specialized discount or utility functions. But others adopt radically different frameworks, modeling intertemporal choice as a collective action or principal-agent problem between temporally situated "selves."

Although commonly credited to psychology, many of the insights currently enriching the economics of intertemporal choice were prefigured in the work of nineteenth- and early twentieth-century economists. In a period when the border between psychology and economics was less sharply defined, economists like Rae, Senior, Jevons, and Böhm-Bawerk addressed such fundamental questions as "Why do people discount the future?" In some cases their answers reveal a sophisticated grasp of psychology.

It is possible to discern four basic historical stages in the evolution of the economics of intertemporal choice. In the first stage, nineteenth-century economists such as Senior and Jevons explained time discounting in terms of what psychologists now label *motivational effects*; these refer to emotional and/or hedonic influences on behavior. Both Senior and Jevons believed that willingness to defer gratification depended on immediate emotions experienced by decision makers.

In the second stage, which was dominated by contributions from Böhm-Bawerk and Fisher at the turn of the century, intertemporal choice was viewed in cognitive terms, as a tradeoff between present and future satisfactions. Discounting was attributed mainly to inadequacies in the decision maker's ability to imagine the future.

The third stage entailed an attempt to eliminate psychological content from the economics of intertemporal choice. In the first decades of the twentieth century, a distaste for psychology became widespread among economists. In part because of their dismay over new developments in psychology that did not seem amenable to interpretation as utility maximization (e.g., Freud's theory of unconscious motivations), economists sought to stake out the independence of their profession.<sup>1</sup> The psychological richness that characterized early discussions of intertemporal choice was supplanted by mathematical and graphical analyses that seemed to render psychology superfluous. Psychological concepts reflecting motivational and cognitive influences—*willpower* and *imagination*—gave way to nonevocative terms such as *time preference* that were deliberately agnostic about underlying causes.

Finally, in the last few decades, a fourth stage has emerged characterized by a renewed interest in psychology by economists interested

<sup>1</sup>See, for example, Davenport (1901).

in intertemporal choice. The shift in perspective has benefited from research by contemporary psychologists. Much of this work is represented in the chapters of this book.

This chapter follows the economics of intertemporal choice from its infancy to the present. The first section discusses the nineteenth-century contributions of Rae, Senior, and Jevons. The second examines the pivotal work of Böhm-Bawerk and Fisher at the turn of the century. Section 3 examines the ordinal utility revolution and its consequences for intertemporal choice.

### Rae, Senior, and Jevons: Three Early Perspectives

John Rae, an obscure and tragic economist of Scottish descent,<sup>2</sup> provided the first in-depth treatment of intertemporal choice. Rae's interest in the topic, like that of other economists of the period, arose from his desire to understand changes in the standard of living over time and differences across countries. Earlier economists such as Smith had argued that such discrepancies derived from differences in the accumulation of capital. They believed that such differences depended on the proportion of the surplus product of labor devoted to production of *capital* as opposed to *consumption* goods. Rae recognized that such accounts, although not inaccurate, were incomplete. If capital accumulation depended on the allocation of surplus product between consumption and production, on what did that allocation depend?

Rae argued in the 1834 volume, *Statement of Some New Principles on the Subject of Political Economy*,<sup>3</sup> that the allocation of the surplus prod-

<sup>2</sup>The exceptionally creative Rae was repeatedly undermined by a chain of misfortunes. At 20 he dropped out of Edinburgh University, where he was studying medicine, disappointed with his professors' response to his thesis topic, and convinced (correctly, as it turned out) that it was ahead of its time. Five years later, disillusioned, impoverished by his father's bankruptcy, and ostracized for marrying the daughter of a shepherd, he emigrated to Quebec, where he taught school and established himself in Montreal's Scottish expatriate community. During this period he published his magnum opus, *Statement of Some New Principles on the Subject of Political Economy*. His book was initially poorly received, in large part because of its vitriolic attacks on the inviolable Adam Smith. Having failed to establish his intellectual credentials, he was forced to take a job as headmaster in Hamilton, Ontario, at that time a rural outpost. Later dismissed in a power struggle, he drifted to California, where he took part in the 1848 gold rush, and then to Hawaii. In the last year of this life, he moved to Staten Island, New York, to live with a former student from Hamilton. He appears to have died unaware that his work was already widely cited and praised by the major economists of his time. For a superb account of Rae's life and works, see James (1965).

<sup>3</sup>Later renamed *Sociological Theory of Capital*.

uct depended on the public's willingness to defer gratification—on the "effective desire of accumulation." If this desire for accumulation were high, then people would be willing to allocate the surplus product to capital rather than consumption. Rae identified four major determinants of the effective desire of accumulation, the first two limiting the desire for accumulation, and the second two promoting it. First, he cited the brevity and uncertainty of human life:

Were life to endure for ever, were the capacity to enjoy in perfection all its goods, both mental and corporeal, to be prolonged with it, and were we guided solely by the dictates of reason, there could be no limit to the formation of means of future gratification, till our utmost wishes were satisfied. A pleasure to be enjoyed, or a pain to be endured, fifty or a hundred years hence would be considered deserving the same attention as if it were to befall us fifty or a hundred minutes hence. (1834, p. 119)

In support of this argument, he cited numerous examples:

When engaged in safe occupations, and living in healthy countries, men are much more apt to be frugal, than in unhealthy, or hazardous occupations, and in climates pernicious to human life. Sailors and soldiers are prodigals. In the West Indies, New Orleans, the East Indies, the expenditure of the inhabitants is profuse. The same people, coming to reside in the healthy parts of Europe, and not getting into the vortex of extravagant fashion, live economically. Wars and pestilence, have always waste and luxury, among the other evils that follow in their train. (1834, p. 57)

Rae's second factor limiting the effective desire for accumulation was the psychological discomfort of deferring gratification—what Senior was to call *abstinence*:

Such pleasures as may now be enjoyed generally awaken a passion strongly prompting to the partaking of them. The actual presence of the immediate object of desire in the mind by exciting the attention, seems to rouse all the faculties, as it were to fix their view on it, and leads them to a very lively conception of the enjoyments which it offers to their instant possession. The prospects of future good, which future years may hold out to us, seem at such a moment dull and dubious, and are apt to be slighted, for objects on which the daylight is falling strongly, and showing us in all their freshness just within our grasp. . . . Everywhere we see, that to spend is easy, to spare, hard. (1834, p. 120)

Counterpoised against the brevity of life and the psychological discomfort of deferral were two factors contributing to the effective desire of accumulation: "the prevalence throughout the society of the social and benevolent affections" (in contemporary parlance, the "bequest motive"), and "the extent of the intellectual powers, and the consequent prevalence of habits of reflection, and prudence, in the minds of the members of society" (1834, p. 58). It was to this last factor that Rae devoted most of his book. Perhaps because of his personal experience with different cultures, Rae saw culture as the critical determinant of differences in the effective desire of accumulation: "The mass of the individuals composing any society, being operated on by the same causes, and having similar manners, habits, and to a great extent feelings also, must approximate to each other, in the strength of their effective desires of accumulation" (1834, p. 198). As a result, much of his book is devoted to anecdotes about different countries, social classes, and historical epochs, all illustrating a simple point: that in early times, more primitive societies, and "lower" orders of society, intellectual powers, habits of reflection, prudence, and, hence, the effective desire of accumulation were less well developed.

Although cited cursorily by Senior, Rae first gained prominence in 1848 with the publication of J.S. Mill's *Principles of Political Economy*.<sup>4</sup> Mill devoted an entire chapter titled "Of the Law of the Increase of Capital" to Rae's work, in the process citing vast passages verbatim. Indeed his coverage of Rae was so extensive that it may have discouraged people from examining the original work; later commentators tended to cite the passages that were presented in Mill's book. This is unfortunate because Mill focused almost exclusively on Rae's sensational sociological observations—in the process neglecting to credit him for his fundamental insights into the determinants of time preference.

### Senior

Two years after Rae published his book, the English economist N.W. Senior came out with his influential *Outline of the Science of Political Economy*, in which he expounded a new theory of capital that, like Rae's, emphasized the psychological element. Senior's analysis of intertemporal choice (like much recent work) was motivated by a paradox: Why should interest be paid on a capital sum? As expressed

<sup>4</sup>Mill credited Senior for having brought Rae to his attention.

by Smart (1891, p. 675):

The striking aspect which interest presents when one's critical attention is first drawn to it is, that it is an income got apparently from simple possession of wealth. There seems some reason why *rent* should be paid:—is it not the price of the original and indestructible powers of the soil, from whence must come all food and raw material? There is even stronger ground for paying wage:—does not labor involve sacrifice of time, brain, and body, and is there not a visible return to the labor of every man who can put a spade into the earth? But [why should] the owner of wealth, whose tangible property, perhaps, consists in a few securities locked away in a safe, be able for all time to draw income without work and, practically, without risk?

Early treatments of capital had skirted this problem by noting that most loans went to capital creation and that capital generally provided a positive rate of return; it seemed natural that those who provided funds for the capital would earn a return. However, as Senior recognized, this perspective did not explain why the rate of interest was positive. Why didn't investors continue to invest in increasingly low-yield investments until the rate of return fell to zero?

Senior was the first to provide a psychological explanation for interest. In Senior's "abstinence theory," interest was viewed as compensation to the holder of capital for enduring the pain of abstaining from consumption, which he viewed as "among the most painful exertions of the human will" (1836, p. 60).<sup>5</sup> In this view new investment ceased when, at the margin, its return could no longer compensate for the pain of deferring consumption.

However, Senior went further, when perhaps he should have quit while he was ahead; he actually defined abstinence as an input into production rather than a determinant of the supply of loanable funds: "By the word Abstinence, we wish to express that agent, distinct from labor and the agency of nature, the concurrence of which is necessary to the existence of Capital" (1836, p. 49).

The notion of abstinence as a factor of production later came under blistering attack from Irving Fisher and Böhm-Bawerk, both of whom were inclined to separate the production side of capital from the

<sup>5</sup>This view of the agonies of deferral was attacked by socialists such as Lassalle, who noted the evident absurdity of the notion that wealthy investors suffer great privation while they forestall from consuming their entire income at once. But, as Cassel (1903) later rebutted, this criticism fails to draw the appropriate distinction between total and marginal privation. In fact, the wealthy are prone to abstention precisely because they suffer, on average, little privation in doing so.

psychological side. Senior's inclusion of abstinence as a factor of production was distasteful to them because it assimilated the psychological element into the production perspective.

Senior's abstinence perspective remained popular during the remainder of the century, but there were few efforts to develop further his scant psychology. Besides the observation that the pain of abstinence is inversely related to wealth, debate among subscribers to the abstinence view was confined to an often tedious back and forth about whether *abstinence* was the best term for the concept it represented. Cairnes (1874) suggested the term *postponement*, Macvane (1887) proposed *waiting*, while others insisted on the superiority of expressions such as *forbearance* and *frugality*.

### Jevons

Thirty years after Senior proposed his abstinence theory, Jevons advanced a characterization of intertemporal choice that turned Senior's perspective on its head. Whereas Senior had viewed equal treatment of present and future as the baseline and asked why people commonly deviated from that baseline, Jevons implicitly asked a more fundamental question: Why do people take the future into account at all?

Jevons' answer can be understood only in the context of a paradox bequeathed him by Bentham. Benthamite man, as interpreted by later commentators such as James Mill, was highly self-centered with respect to other individuals and centered in the present with respect to himself at other points in time. This characteristic presented Jevons, a Benthamite who sought to develop a theoretical account of intertemporal choice, with a problem: Why should such a myopic decision maker ever defer consumption into the future? His solution was to identify specific presently felt pleasures and pains that resulted from contemplating future consumption:

Bentham has stated, that one of the main elements in estimating the force of a pleasure or pain is its *propinquity* or *remoteness*. It is certain that a large part of what we experience in life depends not on the actual circumstances of the moment so much as on the anticipation of future events. As Mr. Bain says, "the foretaste of pleasure is pleasure begun." (1871, p. 40)

Pleasures and pains associated with the future, but realized in the present rescued the Benthamite decision maker from total myopia. In Jevons' view, the decision maker who deferred consumption did

not defer pleasure but substituted pleasure from anticipation—what Bentham had referred to as “pleasures of expectation”—for pleasure from current consumption.

Jevons was convinced that his theory was not qualitatively different from Senior’s, and argued that Senior’s abstinence was simply the inverse of his pleasures of expectation. And the two perspectives do indeed share important commonalities. Unlike later perspectives, which were to view intertemporal choice as a tradeoff between utility at different points in time, Senior and Jevons saw decision makers as highly anchored in present and influenced by immediately experienced emotions. The theories are, however, strikingly different in the way that they characterize these emotions; Senior focused exclusively on the immediate pain of deferral, Jevons on the immediate pleasure of deferral.

Jevons, like Senior, viewed equal treatment of present and future as a norm of behavior, and wanted to understand why human behavior deviated from the norm. But, whereas Senior’s explanation for discounting centered on the pain of abstinence, Jevons’ hinged on imperfections in the translation of future events into present utility. In his framework, the ideal would only be realized if “all future pleasures or pains should act upon us with the same force as if they were present” (1871, p. 76). But he recognized that “no human mind is constituted in this perfect way.”

Jevons went to great lengths to describe the mechanics of pleasure and pain from anticipation. For example, he noted that rate of devaluation of the future relative to the present would likely be greater for short time delays than for long ones,<sup>6</sup> an insight taken up a century later by Strotz (1955) and Ainslie (1975): “The intensity of present feeling must, to use a mathematical expression, be some function of the future feeling, and it must increase as we approach the moment of realization. The change, again, must be less rapid the further we are from the moment, and more rapid as we come nearer to it” (1871, p. 41).

Although Jevons’ conceptualization of intertemporal choice was rapidly displaced by newer contributions, elements of his perspective can be discerned in the work of later economists. For example, although Marshall’s views on intertemporal choice were very close to those of Böhm-Bawerk, his writings contain passages that sound distinctly Jevonian. In a chapter of his *Principles* titled “Choices Between

<sup>6</sup>This does not mean that the distant future is devalued less than the immediate future, but rather that the amount of devaluation *per unit of time delay* is smaller

Different Uses of the Same Thing: Immediate and Deferred Uses,” he states, somewhat ambiguously, “When a person postpones a pleasure-giving event he does not postpone the pleasure; but he gives up a present pleasure and takes in its place another, or an expectation of another at a future date” (1898, p. 121). In this passage it is unclear whether the tradeoff is between present utility from present consumption and present utility from future consumption (as Jevons saw it), or between present utility from present consumption and future utility from future consumption (Böhm-Bawerk’s perspective, which is discussed in the next section). The first part of the statement—that deferral of consumption does not involve postponement of pleasure—is clearly Jevonian; the second part, where it is acknowledged that the substitute pleasure could occur at another date is more in line with Böhm-Bawerk.

Noting this inconsistency, Böhm-Bawerk, in a late edition of *Capital and Interest*, classified Marshall as an “eclectic” who, “unable to make one of his own [theories], or equally unable or unwilling to align himself completely with one of the available theories, selected from two or three or even a greater number of heterogeneous theories such features as appealed to him, and wove them together into a whole that was for the most part lacking in unity” (1914, p. 322).

Pareto, too, in spite of his central role in the depsychologizing of the utility concept, evinced a Jevonian perspective in his discussion of intertemporal choice. For example, in considering the problem of why seldom used goods may nevertheless fetch high prices, Pareto noted:

If a woman has ten dresses, she need not wear them all at once; also it is not customary to wear all the gowns one possesses. . . . But granted that, the meaning of the quantities regarding goods which enter into the formulas of pure economics changes somewhat. They are no longer quantities consumed, but quantities which are at the individual’s disposal. . . . For the sensation of present consumption we substitute, as the cause of the actions of the individual, the *present sensation of the future consumption* of the goods which are at his disposal (*italics added*). (1909, p. 181)

Finally, the contemporary economist Shackle adopts a pure neo-Jevonian perspective in his book *Time in Economics*. In a section titled “Enjoyment by Imaginative Anticipation,” he writes, “The enjoyment or satisfaction which the decision-maker seeks to maximize by his choice of one action-scheme rather than others is a pleasure of the imagination” (1958, p. 41).

## Böhm-Bawerk, Fisher, and the Discounted Utility Model

The second stage in the evolution of the economics of intertemporal choice witnessed an Indian summer of psychological insight. Böhm-Bawerk and Fisher's accounts of intertemporal choice were profoundly psychological and illustrate the potential for fruitful interaction between economics and psychology. Böhm-Bawerk introduced a radically new, cognitively based theory of intertemporal choice, while at the same time assimilating the psychological observations of his predecessors.

Nevertheless, specific features of their contributions—Böhm-Bawerk's view of intertemporal choice as essentially comparable to atemporal choice, and Fisher's indifference curve analysis—paved the way for the subsequent stripping away of psychology. Böhm-Bawerk and Fisher, therefore, occupied pivotal positions in the history of the economics of intertemporal choice.

### Böhm-Bawerk

Until Böhm-Bawerk turned his attention to the problem, all treatments of intertemporal choice were subsidiary to discussions of capital and interest. This tie hindered progress on intertemporal choice because the psychological determinants of time preference were always discussed in connection with the productivity of capital. Böhm-Bawerk eliminated this connection by observing, in *Capital and Interest*, that the interest rate could be viewed entirely independent of capital—as the relative price of current as compared with future consumption. It followed logically that this single price could play the role of equilibrating the demand for capital (determined by willingness to delay gratification) and its supply (determined by technical factors). Böhm-Bawerk assailed Senior and others who had attempted to incorporate the psychological factor into the supply side:<sup>7</sup> “Nothing is further from my thoughts than to follow the example of Senior

<sup>7</sup>Böhm-Bawerk was a victim of his own personality; he lacked the willpower to resist denigrating all previous intellectual contributions. This enraged his contemporaries and inspired countless efforts to demonstrate that his views were derivative. The most common charge was that Böhm-Bawerk had gleaned most of his insights from Rae, whose work he denigrated in the later editions of *Capital and Interest*. Böhm-Bawerk took pains to note, in later editions, that “when the first edition of *Capital and Interest* appeared, his [Rae's] book was completely unknown to me” (1889, p. 209).

and attempt to claim that saving constitutes a third factor of production arrayed beside nature and labor. It does not stand beside them, but in the background behind them . . . saving does not belong among the *means* of production but among the *motives* which determine the direction that production shall take (1889, p. 117).

Böhm-Bawerk's second major contribution was to provide a new account of intertemporal choice based on what would now be considered a “cognitive” perspective. Like Senior and Jevons, Böhm-Bawerk believed that interest resulted from a difference in the evaluation of present and future consumption. However, his psychological analysis was radically different. Senior's and Jevons' decision makers were intrinsically oriented to the present; their deficient evaluation of the future resulted from presently experienced emotions—in the one case deprivation, in the other, the insufficient potency of immediate utility from anticipation. Böhm-Bawerk envisioned a much more evenhanded choice between present and future. Instead of maximizing immediate well-being, his decision makers traded off satisfactions at different points in time. He attacked the Jevonian notion that intertemporal choice actually involved a maximization of current utility: “It can hardly be maintained, as some of our older economists and psychologists used to be fond of assuming, that we possess the gift of literally *feeling in advance* the emotions we shall experience in the future” (1889, p. 260).

In Böhm-Bawerk's writings, the distinction between utility from immediate sensation and from anticipation disappears; rather, gratifications stemming from all points in time are thought to be comparable because placed on a cognitive plane: “*These imagined future emotions are comparable*. Indeed, they are comparable not only with present emotions experienced at the moment, but also with each other; and that comparability, furthermore, obtains irrespective of whether they belong to the same or different future periods of time” (1889, p. 261).

Böhm-Bawerk, like Senior and Jevons, viewed equal treatment of present and future as an ideal: “What is going to happen to us in a week or in a year is no less something touching us, than what happens to us today. It is therefore equally entitled to be considered in our own economy, for the object of that economy is to provide for our well-being” (1889, p. 262). But, like his predecessors, he acknowledged, “Whether this equality of rights as a matter of principle is matched by a full equality of rights as a matter of practice is another question” (1889, p. 262).

Böhm-Bawerk provided a list of the determinants of time preference, which he divided into two categories. The first was “the rela-

tion of supply and demand as it exists at one point in time and that relation as it exists at another point in time" (1889, p. 266). This is simply the impact of the temporal distribution of consumption on marginal utility at different points in time. Because people tend to become wealthier over time, Böhm-Bawerk believed that the marginal utility of wealth would be lower in the future than in the present, leading to a disproportionate valuation of current wealth. He saw this factor as one that would decrease effective impatience. This factor is, however, in some ways uninteresting, because the distribution of consumption over time is largely a matter of choice—of individual decisions to borrow and save. The argument that time preference depends on the marginal utility of consumption, which in turn depends on the outcome of a decision that depends on time preference, has a certain circularity.

Far more interesting was Böhm-Bawerk's second set of causes, which encompassed several distinct psychological determinants including those mentioned by Rae, Senior, and Jevons, plus one of his own.

Böhm-Bawerk's original contribution was a "systematic tendency to underestimate future wants" based on a rather sophisticated cognitive psychology similar to modern concepts such as "availability" (Tversky and Kahneman, 1973):

We feel less concerned about future sensations of joy and sorrow simply because they do lie in the future, and lessening of 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. . . . It may be that we possess inadequate power to imagine and to abstract, or that we are not willing to put forth the necessary effort, but in any event we limn a more or less incomplete picture of our future wants and especially of the remotely distant ones. And then there are all those wants that never come to mind at all. (1889, pp. 268–269)

A final cause of discounting was a failure of willpower, in effect the obverse of Rae's "reflection and prudence":

It occurs frequently, I believe, that a person is faced with a choice between a present and a future satisfaction or dissatisfaction and that he decides in favor of lesser present pleasure even though he knows perfectly well, and is even explicitly aware at the moment he makes his choice, that the future disadvantage is the greater and that therefore

his well-being, on the whole, suffers by reason of his choice . . . how often does each of us "give in to weakness" and allow himself to be swept along into acquiescence or action which he knows immediately he is going to regret on the morrow.

In introducing willpower—a psychological element that implies that deferring gratification requires effort—Böhm-Bawerk clearly deviated from his intention to depict intertemporal choice in purely cognitive terms. If time preference arose solely from a tendency to undervalue future satisfactions, there would be no need for willpower because discounting would reflect what appeared to be a rational tradeoff. If they mobilize willpower ("moral effort") to defer consumption, people must want, at some level, to delay consumption but find it difficult to implement that preference. Inclusion of the willpower element implicitly acknowledges that intertemporal choice does involve an emotional element.

Later writers have sometimes mistakenly attributed to Böhm-Bawerk the belief that people tend to view time itself in distorted terms. This view, in fact, comes from Pigou. In a frequently cited passage in his *Economics of Welfare*, Pigou referred to time discounting as a perspective phenomenon analogous to an optical illusion: "Our telescopic faculty is defective, and . . . we, therefore, see future pleasures, as it were, on a diminished scale." The difference between this and Böhm-Bawerk's failure of imagination can be seen by analogy between time perspective and a driver's view of objects on the road. On the one hand, analogous to Böhm-Bawerk's failure of imagination, objects in the distance may seem blurry, or not be visible at all. On the other hand, and in line with Pigou, we may actually misestimate the distance of remote objects; objects may appear to be more distant than they actually are.

### Fisher

Irving Fisher's main contribution was to clarify and formalize Böhm-Bawerk's analysis. Fisher was the first to apply the indifference curve apparatus to intertemporal choice and to express Böhm-Bawerk's theory in mathematical terms. Figure 1.1 reproduces a temporal indifference diagram of the type first presented by Fisher in *The Theory of Interest*. Consumption in the current year is represented on the abscissa, and consumption in the following year is represented on the ordinate. A series of indifference curves or "willingness lines" (as Fisher called them) for a single person are depicted in the figure.

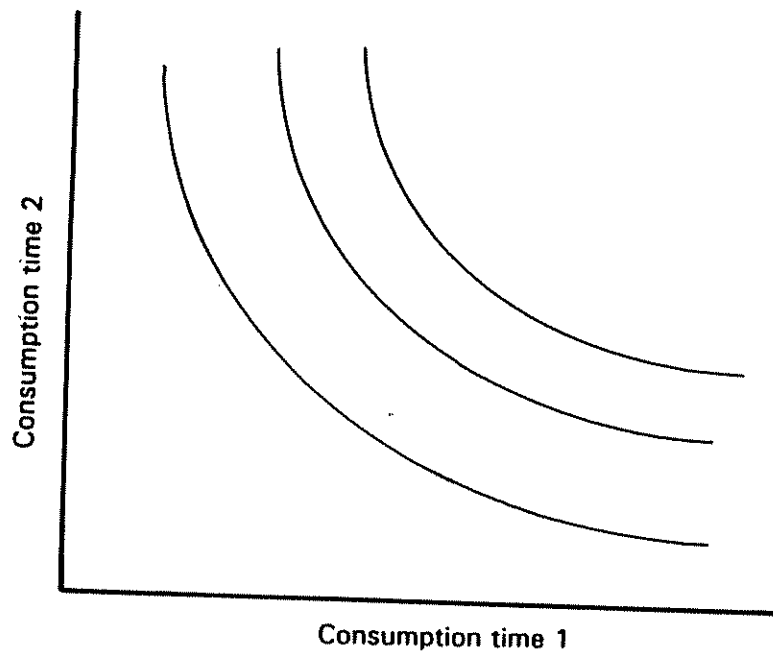


Figure 1.1.

Each curve represents different levels of current and future consumption that the individual is indifferent between. Lines lying to the northeast are preferable to those to the southwest.

The slope of the tangent to any indifference curve corresponds to time-preference or "impatience";<sup>8</sup> it represents the individual's willingness to give up current consumption in exchange for future consumption. The steeper the curve, the less the willingness to sacrifice current for future consumption and, hence, the greater the rate of time preference.

The lines become steeper toward the northwest because time preference becomes more pronounced, the greater is consumption in the future relative to consumption in the present. This curvature reflects

<sup>8</sup>Fisher used "impatience" interchangeably with "time preference," an unfortunate practice that continues to the present. This definition of impatience created semantic problems when he discussed the various determinants of impatience. Fisher wished to state that self-control is one factor that determines time preference. However, because of his equating of impatience with time preference, he was forced to speak of self-control as a determinant of impatience rather than, as is conventional, the act of resisting impatience.

Böhm-Bawerk's first cause of time discounting. The slope of the tangent at points intersecting the 45° line emanating from the origin represents the individual's rate of time preference when consumption is equal in the present and future. This can be seen as a proxy for the "pure rate of time preference" and corresponds to Böhm-Bawerk's second set of causes.

Fisher's exposition then introduced "investment opportunity" lines into the graphical analysis. These lines represented the economy's ability to transform consumption physically in one period into consumption in the other. The forces of supply and demand would then equate the average of individuals' marginal tradeoffs between current and future consumption to the economy's ability to transform one type of consumption into the other at the margin.

Expressing intertemporal choice in terms of indifference curves had two consequences. First, it suggested that intertemporal choice was not qualitatively different from atemporal choice, because the graphical representations of choice in the two domains were virtually indistinguishable before one labeled the axes. Second, Fisher's analytical separation of "willingness" (time preference) and "investment opportunity" lines made crystal-clear the separation of the supply and demand for capital and the role of interest in equilibrating supply and demand. Fisher denounced those who persisted in emphasizing one at the expense of the other:

Any attempt to solve the problem of the rate of interest exclusively as one of productivity or exclusively as one of psychology is necessarily futile. The fact that there are still two schools, the productivity school and the psychological school, constantly crossing swords on this subject is a scandal in economic science and a reflection on the inadequate methods employed by these would-be destroyers of each other. (1930, p. 312)

Fisher's writings included extensive discussions of the determinants of time preference. Like Böhm-Bawerk he divided his list of determinants into two major categories: objective factors, and psychological determinants that he called "the personal factor." Objective factors included the time path of income, which he acknowledged to be identical to Böhm-Bawerk's "first cause," and the influence of risk, a factor not discussed by Böhm-Bawerk. Fisher's view was that

"the risk of losing the income in a particular period of time operates, in the eyes of most people, as a virtual impoverishment of the income



in that period, and hence increases the estimation in which a unit of certain income in that particular period is held. If that period is a remote one, the risk to which it is subject makes for a high regard for remote income; if it is the present (immediate future), the risk makes for a high regard for immediate income" (1930, pp. 78–79)

The impact of risk on time preference, therefore, could not be determined a priori, because it depended on its incidence over time. However, Fisher believed that in general, the future tends to be riskier than the present and the distant future riskier than the near future. As a result, he thought, the overall impact of risk would be to increase appreciation for the future and therefore to reduce time preference.

Fisher's list of "personal" determinants of time preference included foresight (the inverse of Böhm-Bawerk's "systematic tendency to underestimate future wants"), and four factors first mentioned by Rae: (1) self-control, (2) habit, (3) life expectancy, and (4) concern for the lives of other persons. Fisher's new contribution was what he called *fashion*, which he believed to be "of vast importance to a community, in its influence both on the rate of interest and on the distribution of wealth itself" (1930, p. 88):

The most fitful of the causes at work is probably fashion. This at the present time acts, on the one hand, to stimulate men to save and become millionaires, and, on the other hand, to stimulate millionaires to live in an ostentatious manner. . . . In whatever direction the leaders of fashion first chance to move, the crowd will follow in mad pursuit until almost the whole social body will be moving in that direction. (1930, p. 87)

Despite evident similarities, Fisher's view of psychological factors differs in one important respect from those of Rae and Böhm-Bawerk. They had viewed culture, social class, and racial differences as the most important determinants of the psychological factors responsible for time preference. Fisher, in contrast, paid much greater heed to situational factors. For example, whereas Rae and Böhm-Bawerk saw poverty mainly as the *product* of high time preference,<sup>9</sup> Fisher recognized that causality might run in the opposite direction. While "poverty bears down heavily on all portions of a man's expected life," Fisher wrote, "it increases the want for immediate income *even more*

<sup>9</sup>In one of many passages to this effect. Rae commented that "all members of any society, whose accumulative principle is lower than the average, are gradually reduced to poverty" (1834, p. 199).

than it increases the want for future income" (1930, p. 72). To illustrate the lack of class-based inborn impatience, Fisher cited the example of the English poor, who had been widely viewed as spendthrifts, but who had rapidly developed the habit of saving following the introduction of postal savings banks. And he wryly commented that the English upper class could be induced to display extremes of self-denial or profligacy, depending on the vicissitudes of fashion. He also attacked Rae's imputation of Chinese improvidence based on the flimsiness of their housing, noting the "large accumulations of capital made by Chinese living abroad where they are freed from the exactions of arbitrary governors and from the tyranny of the clan-family system" (1930, p. 378).

Despite the sophistication of his psychological reflections, Fisher had difficulty integrating the psychology with his analytical and graphical analysis. The value of the psychological insights are not dependent on the validity of the analytics, and the implication of the psychology for his equations or graphs is unclear. The two contributions are segregated into separate chapters in his book with little cross-referencing.

This bifurcation turned out to be convenient in the next phase in the development of the economics of intertemporal choice, with its antagonism toward psychology. Fisher's analytical contributions were adopted and further developed in the decades following the publication of *Theory of Interest*, but his psychological insights were all but forgotten.

## The Discounted Utility Model and the Ordinal Utility Revolution

The next critical step in the economics of intertemporal choice was the formulation of the discounted utility model by Samuelson in 1937. In its most restrictive form, the discounted utility model states that consumption sequence  $(c_1, c_2, \dots, c_n)$  is preferred to sequence  $(d_1, d_2, \dots, d_n)$  if and only if,

$$\sum U(c_t) \delta^t > \sum U(d_t) \delta^t,$$

where  $U$  is a "ratio scale" utility function with positive first and negative second derivative, and  $\delta^t$  is the discount function with  $0 < \delta < 1$ . The discounted utility model, in effect, partitions Böhm-

Bawerk's first and second causes of time discounting. His first cause—variations in marginal utility arising from differences in level of consumption at different points in time—is captured in the utility function. His second set of causes leading to a systematic tendency to undervalue the future are captured in the discount function, which is independent of consumption plans. The discount rate is sometimes referred to as the "pure rate of time preference," indicating that it is invariant with respect to a person's immediate wealth or consumption plans.

Samuelson was very cautious in presenting his new model, pointing to potential problems at every step of his exposition, and stressing the arbitrariness of the underlying assumptions: "It is completely arbitrary to assume that the individual behaves so as to maximize an integral of the form envisaged in [DU]. This involves the assumption that at every instant in time the individual's satisfaction depends only upon consumption at that time, and that furthermore, the individual tries to maximize the sum of instantaneous satisfactions reduced to some comparable base by time discount" (1937, p. 159). But despite its arbitrariness, the simplicity and elegance of his apparatus were irresistible. The discounted utility model was rapidly established as the framework of choice for analyzing decisions with a temporal component.

Almost as soon as it was proposed, however, DU confronted a serious challenge to its scientific status. The concept of utility maximization in economics had undergone a transformation during the past half century, which culminated in the so-called ordinal utility revolution that swept the field of economics in the early 1940s. DU relies on a strongly cardinal (ratio-scale) form of utility of a type inimical to the ordinal perspective.<sup>10</sup> The ordinalists proposed replacing DU with the more general assumption that decision makers maximize some arbitrary function of current and future consumption— $U(c_1, \dots, c_n)$ —which was a generalization of Fisher's two-period indifference curve formulation. However, this formulation proved insufficiently restrictive in practice, and has enjoyed little popularity outside of advanced microeconomic textbooks.

<sup>10</sup>The ordinal utility revolution reflected the belief that motivational concepts could be dispensed with to explain individual behavior. In the ordinalists' view it was only necessary to know an agent's preference ranking of alternative consumption bundles in order to explain her behavior. Ordinal utility constituted a repudiation of theories of behavior based on psychological concepts such as maximization of well-being or satisfaction of desires. Ironically, Samuelson, whose discounted utility model was thrown into scientific limbo by ordinal utility, was one of the triumvirate who initiated the revolution.

The work of Koopmans (1960) can be viewed, in part, as an attempt to restore DU to its former stature. Following von Neumann and Morgenstern's (1949) similar efforts in decision making under uncertainty, Koopmans formulated a set of axioms governing the manner in which people rank temporal sequences of consumption that, taken together, are logically equivalent to the DU model. Restricted in this manner, the DU framework can be shown to be compatible with the ordinal approach. The rehabilitation of DU, however, was not completely successful. As both Samuelson and Koopmans recognized, DU and its axioms are deficient either as normative standards or positive descriptions of choice.

At the core of the discounted utility model are two basic assumptions—a strong form of preferential independence, and a property called *stationarity*.<sup>11</sup> The independence property states that if two temporal prospects,  $X \equiv (x_1, \dots, x_n)$  and  $Y \equiv (y_1, \dots, y_n)$ , share a common outcome at a given point in time, then preference between them is determined solely by the remaining  $(n - 1)$  outcomes. In combination with a series of technical axioms collectively referred to as "completeness," outcome separability implies that preferences can be represented by the *general additively separable* (GAS) formula:

$$U(X) = \sum u_t(x_t).$$

The stationarity condition states that if the first outcome in both  $X$  and  $Y$  is the same,  $x_1 = y_1$ , then preference between  $X$  and  $Y$  will be preserved by dropping the first outcome and shifting the remaining outcomes by one period.

Stationarity and intertemporal independence (along with the technical axioms) imply that any representation of preferences over temporal prospects can be monotonically transformed into a discounted-utility representation.

At a normative level, DU has many appealing features. Stationarity, which implies logarithmic discounting at a constant rate, is attractive in the sense that it implies a neutral attitude toward time delay; a given time delay has the same impact on preferences, regardless of when it occurs. The additive separable form implied by independence has, from a normative perspective, one desirable and one undesirable consequence. The desirable consequence is that it implies that different outcomes are discounted at the same rate; time preference is independent of atemporal preference. To see why this is desir-

<sup>11</sup>This discussion is adapted from an early draft of Prelec and Loewenstein (1990).

able, imagine the intertemporal allocation problem of an individual for whom this is not the case. Imagine a person who must allocate a fixed bundle of apples and oranges between present and future. Suppose she prefers apples to oranges in the present and in the future, but prefers oranges in the present to oranges in the future and apples in the future to apples in the present. The person's time preferences would lead her to delay apple consumption and speed up orange consumption, which would conflict with atemporal preference for apples.

The undesirable consequence of preferential independence is the implication that consumption in one period has no effect on preferences in other periods. It is easy to construct counter-examples that are normatively compelling. For example, consider a gastronome who is indifferent between chicken and beef. Independence implies that such a person would be indifferent between beef today, beef tomorrow, and beef the day after, on the one hand, and beef today, chicken the day after, and beef on the third day. There is no good reason, besides analytical simplicity, to assume that such indifference would hold.

At a descriptive level, DU's problems are far more striking. Numerous behavioral tendencies have been observed that are incompatible with DU. There is a common tendency to bite the bullet, to get unpleasant outcomes over with quickly rather than to defer them as predicted by DU (Loewenstein, 1987) (see Chapter 9). Losses are generally discounted at a lower rate than gains (Thaler, 1981). People have asymmetric preferences for the speedup and delay of consumption (Loewenstein, 1988) when, according to DU, these preferences should be symmetrical. A list of discounted utility "anomalies" has been enumerated, including these and a variety of other phenomena (Loewenstein and Thaler, 1989; Prelec and Loewenstein, 1991; Loewenstein and Prelec, Chapter 5 and 1991). Recognition of these anomalies has been one of the factors stimulating the reintroduction of psychology into the economics of intertemporal choice.

### New Evidence for Old Theories

Although the psychological analyses of nineteenth- and early twentieth-century economists were derived from introspection or casual empiricism, many of the insights of these economists have been confirmed in recent research. Psychologists since the early 1960s and, more recently, economists, have conducted empirical research ad-

ressing basic issues of time preference. Most of the speculations of Rae, Senior, Jevons, Böhm-Bawerk, and Fisher have been evaluated empirically.

### Rae and Senior

All four of the determinants of time preference cited by Rae—the brevity and uncertainty of life, the bequest motive, the painfulness of deferring gratification, and the impact of socioeconomic and cultural factors—have been examined in empirical research.

It is difficult to test for the effect of life expectancy on time preference cross-sectionally, because people who differ in life expectancy often differ in other respects that may be associated with attitude toward the future. However, one empirical analysis has avoided this pitfall by employing a time-series approach. Slemrod (1984, 1986) found a small but systematic relationship between changes in the threat of nuclear war as measured by the setting of the "doomsday" clock published monthly in the *Bulletin of the Atomic Scientists* and changes in the national savings rate—a proxy for time perspective; the savings rate tends to drop when the clock setting approaches zero. He has also found an inverse relationship, cross-sectionally, between saving rates in different countries and fear of nuclear war. Although only suggestive, these results are consistent with the notion that life expectancy influences time preference.

Evidence concerning the bequest motive is mixed. Some economists have argued that bequests play a key role in saving behavior (Kotlikoff and Summers, 1981), at least among those at the upper levels of income (Moore, 1978). The bequest motive has been used to explain why the elderly continue to save after retirement rather than dissaving as predicted by a stripped-down life-cycle model (Danziger, v.d. Gaag, Smolensky, and Taussig, 1982). But others have argued that observed dissaving is illusory (Diamond and Hausman, 1984), and one empirical study that compared savings by those with and without living children found no difference (Hurd, 1987). Although Rae's assertion that the benevolent affections influence time preference seems intuitively plausible, the effect is remarkably difficult to demonstrate.

Numerous articles in the 1960s and early 1970s examined the relationship between some of the socioeconomic characteristics discussed by Rae—social class, wealth, and ethnicity—and time discounting. However, most of these analyses were severely flawed methodologically and suffered from what modern cognitive psychologists term

*confirmation bias*. Studies correlating time perspective with demographic characteristics almost disappeared from mainstream journals after Mischel (1968) demonstrated that differences in situations have a greater effect on willingness to delay gratification than differences between persons. However, Mischel's more recent work—mainly his finding of strong continuity in delay of gratification over a person's lifetime (Mischel, Shoda, and Peake, 1988)—once again highlights the importance of individual differences.

Whether there are strong socioeconomic correlates of time preference, and the cause of such differences if they exist, has not been addressed satisfactorily. Hausman (1979) did find a striking negative relationship between income and discounting, as measured by the tradeoff between immediate purchase price of air conditioners and delayed energy payments. But his results could plausibly be explained by liquidity constraints at low income levels or simple ignorance of the tradeoff rather than discounting per se.

Finally, Rae's notion that people find it painful to defer consumption, which also underlay Senior's abstinence perspective, has received considerable support. Social psychologist Mischel and his colleagues view delay of consumption in much the same way as Senior did: as a cause of frustration. Their aim is to understand the conditions that intensify or attenuate that frustration. In Mischel's two-stage theory of intertemporal choice (or "delay of gratification"), the first step is reminiscent of Böhm-Bawerk, the second of Senior. The first stage consists of the decision to defer, and depends on a relatively dispassionate assessment of costs and benefits. The second stage entails the implementation of the decision to defer during which the decision maker must actually endure the pain of abstinence.

In a series of experiments using children as subjects, Mischel (1974) focused on the implementation stage. In a typical experiment, a child is placed in a room and learns that he or she can summon the experimenter by ringing a bell. The experimenter then shows the child an inferior and a superior object and explains that the child will receive the superior object if he or she can wait for the experimenter to return, but that he or she can obtain the inferior object at any time by ringing the bell. The dependent variable in these experiments is the length of time the child is able to wait, limited by a fixed interval (typically 15 minutes) after which the experimenter returns with the promised reward.<sup>12</sup>

<sup>12</sup>In earlier experiments subjects were not informed of the exact duration of the delay period. Recently, however, Mischel has run several experiments in which chil-

In his early work, Mischel examined the effect of the visible presence or absence of the immediate and deferred rewards on waiting times. These experiments demonstrated that children wait less in the physical presence of either reward than when the rewards are absent. In later experiments, children were instructed to distract themselves while waiting or to transform the rewards cognitively (e.g., to think of marshmallows as little white clouds or chocolate bars as logs). Mischel found that both distraction and cognitive transformation lengthened waiting times.

These results can be easily assimilated into the abstinence perspective. Factors that increase privation during waiting, such as the presence of the reward, appear to decrease the ability to wait. However, when subjects are distracted from the privation of waiting, or when privation is reduced by denigration of the reward, ability to delay is enhanced.

### Jevons

Perhaps even more than the abstinence perspective, the Jevonian view has many connections to current theories and observations. To the modern economist, Jevons' views on intertemporal choice seem rather extreme. Clearly, we often defer consumption without immediate compensation in the form of pleasure from anticipation. Our conception of self extends forward in time so that we do not perceive deferral as a sacrifice to an alien other, and do not require immediate compensation (in the form of pleasure from anticipation) for such deferral. Nevertheless, there is considerable truth in Jevons' perspective. Much of our pleasure and pain in life *does* stem from expectations of the future as Bentham and Jevons argued, and these pleasures and pains have profound implications for behavior.

One of the most persuasive modern arguments in favor of the Jevonian perspective is presented by Cottle and Klineberg (1974) in *The Present of Things Future*. They argue that the ability to imagine the future is not sufficient for voluntary deferral and that, as Jevons argued, deferral will only occur if such imagery is associated with immediately experienced emotions. They cite evidence ranging from animal behavior to the myopic behavior of people who have had frontal lobotomies in support of their claim.

The so-called immediacy effect (Prelec and Loewenstein, 1991)—

dren are informed of the delay period, and has not observed any substantial differences in behavior under the two conditions.

the finding that people give far greater weight to current consumption than to consumption delayed for any length of time—is also congruent with Jevonian perspective. While emphasizing the importance of pleasure and pain from anticipation, Jevons keenly recognized the greater power of immediate experience over anticipation of the future. The former is immediate and highly salient; the latter is hypothetical. This difference is analogous to that between actual and “statistical” accident victims. It has been observed that people are willing to expend large amounts to save the life of an identifiable accident victim, such as a child who has fallen into a well, but resist expending resources on preventive measures that benefit statistical victims.

Substantial evidence bolsters the notion of an immediacy effect.<sup>13</sup> Consumption items that are immediately available seem to exert a disproportionate pull; similarly, it is very difficult to impose pain on oneself, even when it is known that the pain will be short-lived and the beneficial consequences prolonged. Witness, for example, the difficulty of plunging into a swimming pool even when other swimmers can be seen paddling about with no apparent discomfort. In a study that illustrates this point, Christensen-Szalanski (1984) elicited expectant mothers’ preferences for anesthesia during childbirth. When asked at various intervals leading up to labor, a sizable majority stated a preference for childbirth without medication. However, preferences shifted abruptly following the onset of labor. Christensen-Szalanski explained these reversals by the tendency for discounting to increase as time delay diminishes (Ainslie, 1975). However, a simpler explanation follows from the distinction between pleasure and pain from anticipation and that arising from current sensation.<sup>14</sup>

<sup>13</sup>A similar point has been made by Phelps and Pollak (1968) in an intergenerational context. In their intergenerational welfare analysis, they use two distinct discount factors to balance the competing utility of successive generations: the first a conventional discount rate that simply refers to a generation’s distance from the present, and a second that overweights the utility of the current generation relative to all other generations. The latter, which suggests that the current generation does not put the consumption of hypothetical future generations on an equal footing with its own immediate consumption, is analogous to the notion that people are unable to treat their own immediate and hypothetical future consumption as perfectly commensurable. This analogy between the intergenerational and intraindividual cases was proposed by Elster (1985).

<sup>14</sup>The preference shift does not appear to be due to the decrease in time delay prior to labor per se, as suggested by the standard account of time inconsistency but rather to the actual experience of pain. If the declining discounting explanation was correct, we would expect to observe some women reversing their preference at intermediate

This same logic also provides a simpler explanation for various other examples of time inconsistency. For example, Schelling notes the difficulty of responding to the alarm clock, cavalierly set to an early hour the night before. When set, the pain of waking and the benefits of early rising were both on the same cognitive plane. But when the alarm drones, the pain of waking is immediate and real, while the benefits of early rising remain abstract and in the future.

A second phenomenon that resists interpretation by DU, while easily explicable in Jevons’ terms, concerns time preferences for undesirable outcomes (Loewenstein, 1987). DU, with positive discounting, predicts that people should always prefer to defer undesirable outcomes, because doing so moves the negative impact on utility to a time that is less heavily weighted. However, considerable evidence suggests that the opposite—a preference for getting losses over with quickly—is a common, perhaps even typical, pattern of preference. For example, Thaler (1981) found that an unexpectedly high proportion of respondents to a hypothetical choice questionnaire preferred to pay parking tickets immediately rather than defer payment, despite considerations of interest. Carlsmith (1962) and others (Barnes and Barnes, 1964; Knapp, Krause, and Perkins, 1959; Mischel and Grusec, 1967) discovered that subjects, given a choice, prefer to experience aversive stimuli, such as an unavoidable electric shock, sooner rather than later. The usual explanation for such behavior is that waiting for unpleasant outcomes induces anxiety that can be avoided by getting the outcomes over with quickly. Such an explanation is consistent with a Jevonian tradeoff between reduced pain from anticipation and increased immediate pain.

Recent advertising, in which “peace of mind” allegedly flows from the purchases of automobile maintenance contracts,<sup>15</sup> universal life

points prior to the onset of labor. But as noted, virtually all shifts occurred only after labor had begun. It also can’t be argued that the preference reversal observed by Christensen-Szalanski was caused by unfamiliarity with and, thus, an underestimation of future pain. The effect was observed equally often in women giving birth for a second or subsequent time, when women should be familiar with the pain and when, in fact, labor is typically less painful than initial childbirth.

<sup>15</sup>For example, a recent advertisement for an automobile maintenance contract read, “Backed by GM and honored at GM dealerships throughout the US and Canada, the protection plan gives you added convenience and peace of mind.” GM’s competitor in this area, USAA, advertised, “Only you can decide if a service contract is worth the price to you, but if peace of mind is what you need, an extended warranty is a wise investment.” A variant of this is the slogan of the French insurance conglomerate GAN on cartoon posters that juxtapose the potential chaos of an accident with the smug satisfaction of a man who has anticipated it: “Un homme assuré est un homme tranquille.”

insurance, and other current expenditures, also attests to the significance of pain deriving from anticipation. Similarly, lottery ticket purchases may be viewed not simply as uncertain investments yielding high potential payoffs, but as a certain investment—in pleasurable anticipation. As M. Landau, the former director of the Israeli lottery, commented, "In spite of the great unlikelihood of winning the desirable sum of money, an individual may still be willing to pay a relatively high price for a lottery ticket because of the satisfaction he is deriving from the thrill of anticipation" (1968, p. 36). The common "buy a dream" sales pitch reinforces such nonpecuniary motivations for buying lottery tickets.

### *Böhm-Bawerk and Fisher*

The psychology underlying the second phase of the economics of intertemporal choice, epitomized by Böhm-Bawerk and Fisher, was predominantly cognitive. Although there was lingering discussion of motivational elements such as willpower, Böhm-Bawerk and Fisher believed that cognitive limitations were predominantly responsible for time discounting. Such a perspective is well represented in modern work on intertemporal choice and in the various chapters of this book.

Mischel, Ebbesen, and Zeiss (1972) found that, while actual presence of a desired reward decreased waiting time, viewing a photograph of the reward actually enhanced deferral of gratification. Apparently the photograph increases the reality of the reward for delaying without increasing frustration to the same extent as the sight (and perhaps smell) of the actual object.

Research on intertemporal framing (Loewenstein, 1988) also corroborates the cognitive perspective in the sense of demonstrating that how a person internally represents (frames) a choice can have a major impact on willingness to delay. For example, people dislike delaying scheduled consumption but are relatively indifferent to speedup. As a result, when deciding between an inferior immediate and superior delayed consumption objects, they may select the immediate object if the alternative is expressed as delayed, but later object if the immediate object is described as having been sped up. The theory of melioration (Herrnstein and Prelec, Chapter 13) is also reminiscent of Böhm-Bawerk's perspective in its assertion that people tend to ignore (or at least underweigh) information about the future consequences of decisions.

Although difficult to evaluate empirically, the concept of willpower, which appeared in Böhm-Bawerk and Fisher's work, and the

idea that deferral of gratification involves as Schelling (1984) expresses it, an "internal struggle for self-command," has received empirical support. For example, Sjöberg and Johnson (1978) repeatedly interviewed smokers who attempted to quit (see, also, Sjöberg, 1980). They found that subjects who resumed smoking often were aware of "cognitive distortions of reality"—rationalizations—that occurred prior to the resumption of smoking. According to Sjöberg and Johnson, the stress engendered by quitting smoking "may leave the door open for a corrupt, twisted, and shortsighted reasoning which generates excuses for changing the initial decision" (1978, p. 151). Rook and Hoch (1985), in interviewing consumers who purchase on impulse, obtained numerous testaments to inner conflict: "The pants were shrieking 'buy me,' so I knew right then that I better walk away and get something else done." "It gnaws at me until I buy it. If I want to get it I keep thinking about it. It won't get out of my mind until I buy it." Ainslie (1987) elicited college students' and prisoners' endorsement of various types of self-control tactics. These included extrapsychic devices (e.g., taking pills to change appetite), attention control (distraction), emotional control, and private rules (e.g., a rigid diet). He found that all four of the self-control devices were approximately equally endorsed, but that the types of strategies endorsed by a particular individual correlated in an intuitively sensible way, with measured personality traits.

There is also some evidence supporting Pigou's notion that people view time in a distorted fashion. Ekman and Lundberg (1971) asked people to rate the "subjective temporal distance" of a range of different objective time delays and to also rate their emotional involvement with different periods. From both of these judgments they estimated psychophysical time functions that were not linear, but conformed closely to a power function of the form  $t_s = t_o^\alpha$ , with  $0 < \alpha < 1$ , where the subscripts *s* and *o* stand for "subjective" and "objective."

### *The Ordinalists*

Even the third stage in the economics of intertemporal choice, despite its antagonism toward psychology, makes connections to modern psychology. Among contemporary psychologists, there are those who adhere to a perspective that is closely analogous to the ordinal approach. Behavioral psychologists such as Herrnstein and Rachlin (in their earlier work) and, more recently, Mazur (1987), Logue (1987), and many others, eschew cognitive and motivational psychology, restricting themselves to encoding behavior mathematically. These psychologists have sought to estimate mathematical functions repre-

senting the desirability of rewards as a function of time delay. The research has generally involved animals instead of humans, presumably with the goal of avoiding the idiosyncratic concerns that inevitably come into play with human subjects. Interestingly, even the animal work has tended to reinforce some of the observations made by early economists. For example, in line with Jevons' observations, neither animals nor people discount the future at a constant rate; most species are disproportionately sensitive to short as opposed to long time delays. As Strotz (1955) demonstrated, such a discount function implies time inconsistent behavior; we always plan to be more farsighted in our future behavior than we are in the present. In confronting the problem of how people deal with the problem posed by time consistency, behavioral psychologists have fallen into the same trap as Böhm-Bawerk in his attempt to reduce intertemporal choice to a cognitive plane. Concepts such as "self-control" (Rachlin and Green, 1972) are not easily reduced to equation form.

## Concluding Remarks

In his essays on the history of economic thought, Stigler (1965) argues that, to take root, an economic theory must meet the triple criteria of generality, manageability, and congruence with reality. Because, in his view, ideas compete with one another in the intellectual marketplace, the most general, manageable, and realistic must inevitably triumph. The case of intertemporal choice chronicled here points to a more cyclical pattern of scientific progress.

The early history of intertemporal choice demonstrates a relatively unself-conscious cooperation between psychology and economics, which was followed by a century of work that attempted—never with full success—to expunge the psychological content from the economics. In recent decades, however, economists have begun to reawaken to the possibility that the discarded psychology was not quite as superfluous as had been supposed.

Rather than an evenhanded balancing of Stigler's three criteria, the economics of intertemporal choice has bounced between the three extreme points on the triangle. In the first critical transition, from the psychological perspectives of Senior, Jevons, and Böhm-Bawerk to the formulation of DU by Samuelson, realism was sacrificed for manageability; in the second, albeit only partially successful transition from DU to the ordinalist approach, manageability was sacrificed for generality. Thus, the economics of intertemporal choice has not evolved toward Stigler's ideal.

Until recently, economists who sought a descriptive theory of intertemporal choice were caught in an uncomfortable dilemma. On the one hand, they could plead ignorance of the intricacies of intertemporal choice and treat time simply as an additional dimension of choice over which preferences are defined, an approach compatible with the ordinalist perspective. The problem is that the ordinalist alternative suffers from excessive generality and ignores what is known about the economics and psychology of intertemporal choice. As Samuelson notes, "functions that allow unlimited interrelationships become so general as to be almost vacuous" (1937, p. 155). Another problem is its intractability, which probably explains the infrequent appearance of the generalized formulation in economic modeling.

Alternatively, economists could rely on the discounted utility framework. However, DU's psychology is dubious: Few people are willing to accept the axioms of Koopmans either as descriptions of, or as prescriptions for, intertemporal choice behavior. DU is not an explanatory theory; it cannot explain why objects lose or gain in value when delayed. It is simply a way of summarizing and encoding intertemporal preference. But as a method of encoding preferences, it is also deficient. Its behavioral implications are contradicted by empirical research and common experience.

The new borrowings from psychology offer the possibility to transcend the conflict between tractability and realism. Economists need a more refined model of intertemporal choice than that offered by the ordinalist approach. But they want a restrictive model that is realistic. This is where modern psychology can play a constructive role. The speculations of Freud and LeBon have been largely displaced by a contemporary academic psychology that is much closer to economics, both theoretically, and in terms of research methods. During much of the time that economics was purging itself of psychological content, these psychologists have been studying empirically, and in many cases validating, the very insights discarded by economists.

In order to formulate a more realistic theory of intertemporal choice, economists must grapple with the problems confronted by their predecessors and by modern psychologists. Why do individuals take account of the future? How is utility from future consumption experienced in the present? What are the determinants of pleasure from anticipation and privation? They must become aware of the distinction between cognitive and motivational determinants of time preference and of their implications for intertemporal choice.

This book provides a sample of work from a group of psychologists and economists who have met annually to discuss issues relating to

intertemporal choice. It is one example of the growing number of exchanges between the two disciplines (see, e.g., Hogarth and Reder, 1987). If the exchange, so far, has tended to be unidirectional, economists can take comfort in the observation that, in borrowing from psychology, they are, in effect, rediscovering their own past.

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