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RICHARD H. THALER: INTEGRATING ECONOMICS WITH PSYCHOLOGY

The Committee for the Prize in Economic Sciences in Memory of Alfred Nobel

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RICHARD THALER'S CONTRIBUTIONS TO BEHAVIORAL ECONOMICS

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1. Introduction

Economists aim to develop models of human behavior and interactions in markets and other economic settings. But we humans behave in complex ways. Although we try to make rational decisions, we have limited cognitive abilities and limited willpower. While our decisions are often guided by self-interest, we also care about fairness and equity. Moreover cognitive abilities, self-control, and motivation can vary significantly across different individuals.[1]

In order to build useful models, economists make simplifying assumptions. A common and fruitful simplification is to assume that agents are perfectly rational. This simplification has enabled economists to build powerful models to analyze a multitude of different economic issues and markets. Nevertheless, economists and psychologists have documented systematic deviations from the rational behavior assumed in standard neoclassical economics. Incorporating insights from psychology into traditional economic analysis has spawned the field of behavioral economics, a flourishing area of research with significant impact on many subfields of economics.[2]

This year's Laureate Richard Thaler played a crucial role in the development of behavioral economics over the past four decades. He provided both conceptual and empirical foundations for the field. By incorporating new insights from human psychology into economic analysis, he has provided economists with a richer set of analytical and experimental tools for understanding and predicting human behavior. This work has had a significant cumulative impact on the economics profession; it inspired a large number of researchers to develop formal theories and empirical tests, which helped turn a somewhat controversial, fringe field into a mainstream area of contemporary economic research.

Thaler's vision for incorporating insights from psychology into economics was first laid out in his 1980 article "Toward a positive theory of consumer choice." In his well-known "Anomalies" series in the *Journal of Economic Perspectives,* as well as in many other articles, comments, and books, he continued to document and analyze how economic decisions are influenced by three aspects of human psychology: cognitive limitations (or bounded rationality), self-control problems, and social preferences. We organize this overview of Thaler's contributions around these three topics.[3]

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[1] For examples of research trying to understand the determinants and correlations of such traits, see Benjamin et al. (2013).

[2] For surveys of behavioral economics, see e.g. Rabin (1998), Camerer and Loewenstein (2004), Dellavigna (2009), and Camerer (2014).

[3] Thaler (2015, p. 258) himself refers to "the three bounds": bounded rationality, bounded willpower, and bounded self-interest.

A first contribution by Thaler is his pioneering work on how deviations from ideally rational behavior systematically shape economic decisions. In Thaler (1980), he coined the term *endowment effect* for the tendency of individuals to value items more just because they own them, and showed how this phenomenon relates to loss aversion in prospect theory (Kahneman and Tversky 1979). In subsequent work, he developed the theory of *mental accounting* (Thaler 1985, 1999) in order to understand the cognitive operations used by individuals to organize and evaluate their economic activities. This theory shows how individuals can overcome cognitive limitations by simplifying the economic environment in systematic ways, but also how such simplifications can lead to suboptimal decisions.

A second contribution relates to self-control problems that prevent agents from carrying out their optimal plans, even if they can compute them. In the *planner-doer model* of Thaler and Shefrin (1981), an individual is assumed to be both a myopic doer, who evaluates options only for their current utility, and a farsighted planner, who is concerned with lifetime utility. Later, Thaler and co-authors applied this model to understand the savings behavior of individuals and households. The planner-doer model is an early example of a so-called two-system or dual model of behavior, which is a common way of modeling human behavior in contemporary psychology and neuroscience.

Thaler's work on limited cognition and self-control has been influential among policy makers. This includes specific ideas, such as how to boost retirement savings (Thaler and Benartzi 2004), as well as the more general perspective of *libertarian paternalism* (Thaler and Sunstein 2003), which recommends minimally invasive policies that "nudge" people into making better economic decisions.

A third contribution by Thaler is to show how social preferences are essential for economic decision-making. Together with his collaborators, Thaler designed and implemented elegant and highly influential laboratory experiments, such as the dictator game for measuring social preferences. He also showed how concerns for fairness affect the behavior of individuals in consumer and labor markets, with important implications for optimal firm behavior (Kahneman, Knetsch, and Thaler 1986a,b).[4]

Finally, Thaler has provided empirical evidence suggesting that individual psychological aspects do not disappear when many economic agents interact together in markets. Together with Robert Shiller (2012 Laureate in Economic Sciences), he is considered the founder of the field of behavioral finance, which analyzes how investor psychology, in conjunction with limits to arbitrage, can affect prices in financial markets.[5] His work has also found wide applications in academic fields neighboring to economics, such as marketing and law.

[4] This inspired an important theoretical literature on social preferences, including Rabin (1993), Fehr and Schmidt (1999), Bolton and Ockenfels (2000), and Charness and Rabin (2002).

[5] Shiller's pioneering work in behavioral finance includes Shiller (1981, 1984). See Barberis and Thaler (2003) for a survey.

We now describe, in one main section each, Thaler's contributions to the study of bounded rationality (Section 2), limited self-control (Section 3), and social preferences (Section 4). We also briefly discuss Thaler's work on behavioral finance (Section 5).

2. Bounded rationality

In this section, we discuss Thaler's research on boundedly rational decision making. We start by briefly mentioning some important predecessors. Then we discuss the "endowment effect," a term coined by Thaler to describe the observation that a good often appears to be more highly valued when it is part of an individual's endowment, compared to when it is not. Finally, we turn to his mental-accounting model, which describes how boundedly rational individuals adopt internal control systems to evaluate and regulate their budgets, and predicts how this will affect spending, saving, and other household behavior.

2.1 Predecessors

Expected-utility theory was axiomatically derived by von Neumann and Morgenstern (1944) as a criterion for rational decision-making. This work was highly influential and still serves as the benchmark theory of individual decision-making. However, as Maurice Allais (1988 Laureate in Economic Sciences) pointed out as early as 1951, in some situations actual behavior differs systematically from the predictions of expected-utility theory (Allais 1953).

In the 1950's, Herbert Simon (1978 Laureate in Economic Sciences) explored the effects of limited cognition and analyzed the implications of individual bounded rationality on the design and performance of organizations (Simon 1955). Simon argued that, rather than finding optimal solutions that maximize lifetime expected utility, decision-makers typically try to find acceptable solutions to acute problems. The very difficult problem of finding an optimum is thus replaced by the simpler problem of satisfying a set of self-imposed constraints. This fruitful idea underlies Thaler's work on mental accounting, discussed below. Inspired by Simon's work, Reinhard Selten (1994 Laureate in Economic Sciences) investigated the impact of bounded rationality on firm behavior (Sauermann and Selten 1962) and provided early experimental evidence on deviations from rational economic behavior (Selten and Berg 1970).

In 2002, psychologist Daniel Kahneman received the Economics Prize for his research on human judgement and decision-making under uncertainty, much of which was done together with fellow psychologist Amos Tversky. Kahneman and Tversky's (1979) prospect theory aims to describe the actual behavior of individuals when making decisions under risk, which may not necessarily be rational or optimal. Their theory was motivated by a number of findings on how people systematically violate the predictions of expected-utility theory.[6]

[6] In later work, Kahneman and Tversky provided an important extension of prospect theory called "cumulative prospect theory" (Tversky and Kahneman 1992).

Prospect theory contains four main elements. First, individuals derive utility not from wealth (or consumption) levels, but rather from gains and losses relative to some reference point.[7] Second, individuals are more sensitive to losses than to gains, i.e., they exhibit *loss aversion.* The utility function captures the loss aversion of individuals in a kink at the reference point, with the function being steeper in the losses region compared to the gains region. Third, individuals exhibit *diminishing sensitivity* to gains and losses, i.e., moving from a $100 to a $200 gain (or loss) has a larger utility impact than moving from a $10,100 to a $10,200 gain (or loss). Fourth, the theory incorporates *probability weighting*: individuals weigh outcomes by subjective, transformed probabilities or decision weights, overweighting low probabilities and underweighting high probabilities.

Thaler (1980) was the first economist to apply prospect theory to economic issues and problems. While Kahneman and Tversky (1979) had focused on risky decisions, Thaler showed the importance of reference points and loss aversion in deterministic settings. His work inspired many followers and helped make Kahneman and Tversky's article (1979) one of the most cited in all of economics (see Barberis 2013 for an overview).[8]

2.2 Loss aversion and the endowment effect

While working on his Ph.D. thesis at the University of Rochester, which he defended in 1974, Thaler started experimenting with hypothetical survey questions to estimate the value of mortality risk reductions (Thaler 1974).[9] This methodology can be illustrated by the following two survey questions from his 1980 paper:

(a) Assume you have been exposed to a disease which if contracted leads to a quick and painless death within a week. The probability you have the disease is 0.001. What is the maximum you would be willing to pay for a cure?

(*b) Suppose volunteers would be needed for research on the above disease. All that would be required is that you expose yourself to a 0.001 chance of contracting the disease. What is the minimum you would require to volunteer for this program? (You would not be allowed to purchase the cure.)*

Both questions involve the evaluation of a 0.001 probability of death. However, as Thaler (1980, p. 44) describes the results, "many people respond to questions (a) and (b) with answers which differ by an order of magnitude or more! (A typical response is $200 [to (a)] and $10,000 [to (b)])." People seem much less willing to pay for "acquiring

[7] Apart from being consistent with experimental evidence, Kahneman and Tversky noted that our perceptual system is much better at detecting changes in attributes (e.g. brightness or temperature) than evaluating absolute levels.

[8] Kahneman (2011, p. 291-293) provides an account of Thaler's pivotal role in applying prospect theory to economics and, in the process, establishing the field of behavioral economics.

[9] Thaler's Ph.D. thesis contains one of the first wage-risk studies to estimate the "value of a statistical life." Based on the thesis, he published a joint paper with his Ph.D. advisor Sherwin Rosen on this topic (Thaler and Rosen 1976). This subsequently became a major topic in health economics. Today, value-of-statistical-life estimates are commonly used by government agencies in cost-benefit analyses (Viscusi 1993).

health," compared to how much they would require as compensation to "sell health." Thaler (1980) discusses several other scenarios where the price at which a person is willing to buy a certain good or service is considerably lower than the price at which the person would be willing to sell the same good or service.[10]

Neoclassical economic theory can hardly explain such a large difference between the willingness to pay (WTP) and the willingness to accept (WTA).[11] But Thaler (1980) found an explanation in prospect theory. He noted that if giving up an object is perceived as a loss, then loss-averse individuals will behave as if the objects they own are more highly valued than similar objects they do not own. This effect, which Thaler (1980) named the endowment effect, can explain the large differences between WTP and WTA.

Thaler also showed that the endowment effect implies a difference between out-of-pocket costs and opportunity costs. People tend to view out-of-pocket costs as losses, weighted more heavily, while opportunity costs are considered foregone gains, weighted less heavily. Thaler provided several examples of how firms utilize the endowment effect when marketing their products to consumers. One example is to refer to "cash discounts" rather than "credit-card surcharges" in order to portray the cost of using a credit card as a foregone gain rather than a realized loss.

Thaler's use of prospect theory to explain the endowment effect stimulated important subsequent work. On the theoretical side, Tversky and Kahneman (1991) as well as Kőszegi and Rabin (2006) modeled the endowment effect formally and derived additional behavioral implications. Loss-averse individuals have a strong tendency to remain at the status quo, because the losses from a change are weighted more heavily than the gains. This so-called status-quo bias was first documented by Samuelson and Zeckhauser (1988; see also Kahneman, Knetsch, and Thaler 1991). Status-quo bias was an important motivation for Thaler's subsequent work on pension plans and defaults, which we describe further in Section 3.3.

On the empirical side, Thaler's original evidence consisted mainly of answers to questionnaires with hypothetical questions. Subsequently, Knetsch and Sinden (1984) and Knetsch (1989) provided evidence for an endowment effect using real stakes. However, other economists argued that the findings were likely to disappear if subjects were exposed to a market environment, where they had the opportunity to learn over multiple rounds of trading.[12]

To settle this issue, Kahneman, Knetsch, and Thaler (1990) tested the robustness of the endowment effect in market experiments with real stakes and repetitions. They

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[10] For example (Thaler 1980, p. 43): "Mr. H mows his own lawn. His neighbor's son would mow it for $8. He wouldn't mow his neighbor's same-sized lawn for $20."

[11] In his recent book *Misbehaving: The Making of Behavioral Economics* (2015), Thaler writes: "To an economist, these findings were somewhat between puzzling and preposterous." In fact, Thaler (1980) was not the first to publish empirical evidence for a large WTP-WTA disparity. Earlier findings were reported by Hammack and Brown (1974), Sinclair (1978), Banford et al. (1979) and Bishop and Heberlein (1979). However, these studies did not interpret the WTP-WTA disparity in terms of loss aversion.

[12] For example, an early study by Coursey et al. (1987) found partially conflicting results: the WTP-WTA disparity decreased with repetition, using a Vickrey auction procedure to elicit WTP and WTA.

assigned subjects alternating roles as buyers or sellers: sellers received objects that they could sell at different prices, while buyers had the opportunity to buy at these prices. In the first three market periods, the objects were induced-value tokens, with different values for different individuals. After each period, the market-clearing price and the number of trades were announced, and three buyers and three sellers were randomly picked for real payments. After these periods of token trading, half of the subjects were given coffee mugs, which they could sell to the other half. This was followed by similar trials with trade in ballpoint pens. As predicted, no endowment effect was observed in the markets for induced-value tokens. However, the markets for mugs and pens exhibited sizeable endowment effects that showed no tendency to decrease with more trials. For coffee mugs and pens, the median reservation selling price (the WTA) was about twice as high as the median buying price (the WTP).

These results showed that market-like institutions can indeed exhibit the endowment effect. Moreover, repeated trading with feedback, allowing for learning, did not seem to eliminate the effect. By now, a substantial literature has established the existence of the endowment effect. A recent meta-analysis included 337 estimates of the WTA/WTP ratio from 76 different studies (Tuncel and Hammitt 2014). The geometric mean of the WTA/WTP ratio was 3.28. However, the WTA/WTP ratio varied systematically for different types of goods, with the highest ratios found for public and non-market goods and the lowest for goods with well-known monetary value. Thaler's original explanation based on loss aversion is still the leading explanation for the endowment effect, even though alternative explanations also have been offered (see e.g. Hanemann 1991, Shogren et al. 1994, Brenner et al. 2007, Ericson and Fuster 2014, Morewedge and Giblin 2015).[13]

Some evidence suggests that the endowment effect is less significant in markets dominated by professional traders. List (2004) confirmed the existence of an endowment effect in a sample of non-dealers recruited at a market for sports trading cards, but found no endowment effect for a sample of professional dealers from this market (when trading coffee mugs and candy bars). An explanation for this finding could be that professional traders are less likely to become attached to the goods they are trading; for them, trading coffee mugs is similar to trading induced-value tokens.[14,15]

The endowment effect has an important implication: the initial allocation of property rights will determine the final allocation of resources even if there are no transaction costs and the valuations are too small for income effects to matter. This contradicts the famous Coase theorem (Coase 1960), a cornerstone in the field of law and economics, which predicts that final allocations are independent of initial allocations, absent

[13] For example, Morewedge et al. (2009) suggest, on the basis of experimental evidence, that ownership and not loss aversion causes the endowment effect.

[14] The theoretical model of Kőszegi and Rabin (2006) is consistent with this finding. In their model, the reference point is a person's expectation about future outcomes. Since dealers expect to exchange objects that come into their possession, they do not experience much loss aversion when they trade them.

[15] Plott and Zeiler (2005) implemented an experimental protocol with substantial training in buying and selling before eliciting the WTP or WTA of a mug and found no significant WTA-WTP gap for mugs. However, as shown by Isoni, Loomes and Sugden (2011), the experimental protocol still resulted in a significant WTA-WTP gap for lotteries that were also traded in the same experiment.

transaction costs and income effects.[16] In a paper with Jolls and Sunstein, Thaler proposed a general behavioral-economics approach to law and economics (Jolls, Sunstein, and Thaler 1998). This field has grown substantially over the last two decades, and an extensive overview can be found in the *Oxford Handbook of Behavioral Economics and the Law* (Zamir and Teichman 2014).

2.3 Mental accounting

Like standard economic models, Thaler's (1980) explanation of the endowment effect in terms of loss aversion assumes that individuals maximize their preferences, although these preferences depend on a reference point (the endowment). A more radical break with the standard neoclassical model of utility-maximizing consumers came a few years later with the theory of mental accounting (Thaler 1985, 1999). Mental accounting is a psychological theory of how limited cognition affects spending, saving, and other household behavior. In the words of Thaler (2015, p. 56), this theory tries to answer the question "How do people think about money?" The key to the answer is to realize that decision-making is piecemeal rather than comprehensive. The theory is related to Thaler's work on limited self-control (described in Section 3), as mental-accounting strategies may mitigate self-control problems, and to his work on fairness (described in Section 4) through the concept of transaction utility.

One motivation for the theory of mental accounting is the empirical observation that people group their expenditures into different categories (housing, food, clothes, etc.), with each category corresponding to a separate mental account. Thaler argues that mental accounts are used more generally as a way for boundedly rational individuals to simplify their financial decision-making. Each account has its own budget and its own separate reference point, which results in limited fungibility between the accounts.[17] A key implication is then that the value a person attributes to a given amount of money may depend on the account it is assigned to, which in turn depends on context, framing, and situation.

Thaler (1985) suggests that the practice of maintaining separate accounts for different spending categories also provides a commitment device against overspending, especially for non-essential or addictive goods. Consider the common practice of simultaneously keeping money in a savings account and having credit-card debt (Thaler and Sunstein 2008, p. 51). In view of the substantially higher interest rate on the latter, this arrangement is hard to square with the standard model of rational behavior. However, a person who suffers from a lack of self-control (as discussed in Section 3

[16] Farnsworth (1999) provided evidence against the Coase theorem based on the lack of attempted negotiations between parties in civil law cases, even when the court fails to award the rights to the party willing to pay the most for them.

[17] To illustrate this, Thaler and Sunstein (2008, pp. 53-54) use an exchange between the actors Gene Hackman and Dustin Hoffman: "Hackman and Hoffman were friends back in their starving artist days, and Hackman tells the story of visiting Hoffman's apartment and having his host ask him for a loan. Hackman agreed to the loan, but then they went into Hoffman's kitchen, where several mason jars were lined up on the counter, each containing money. One jar was labelled 'rent,' another 'utilities,' and so forth. Hackman asked why, if Hoffman had so much money in jars, he could possibly need a loan, whereupon Hoffman pointed to the food jar, which was empty."

below) may be expected to quickly run up the credit-card debt again after paying it off. Maintaining savings as a separate account with a separate reference point (presumably its current amount) may deter the person from using his or her savings to pay off the credit card, thus providing a commitment against excessive spending.

In addition to loss aversion, the theory also uses the diminishing-sensitivity property (risk aversion for gains and risk seeking for losses) to predict when compound outcomes will be integrated (that is, added together) or separated before being evaluated. Specifically, if individuals try to edit outcomes to maximize their utility ("hedonic editing"), they will try to segregate gains and integrate losses, to cancel small losses against larger gains, and (under some conditions) to segregate small gains ("silver linings") from large losses.[18] As Thaler (1999) discusses, the evidence suggests that people by and large do behave as predicted by the hedonic-editing hypothesis, although integrating losses seems difficult for many people.

Building on the theory of reference points, Thaler (1985) separates sources of consumer utility into one component associated with consuming the commodity or service, called acquisition utility, and another component associated with the buy/sell transaction, called transaction utility. Acquisition utility is similar to standard consumer surplus: the value of the good to the consumer if received as a gift, minus the price paid. Transaction utility is the difference between the actual price and the expected or "fair" price called the reference price. The transaction-utility part implies that the consumer gets added value from a "good deal" (buying a product below the expected price), but suffers a loss in utility from buying at a high price perceived to be a "bad deal." Indeed, the consumer may abstain from buying a good that would otherwise yield a positive consumer surplus if the price is perceived as resulting in a particularly "bad deal"

In defining these concepts, Thaler ties the theory of reference points to the theory of social preferences. A shortcoming of the original formulation of prospect theory was its silence on how the reference point was determined. Thaler proposes that the reference price is determined by what is considered to be "fair" to both transacting parties. That is, a buyer suffers a particularly large loss in utility from a transaction if the price is considered unfairly high. The importance of perceived fairness was demonstrated by Thaler and co-authors in several studies (Thaler 1985, Kahneman, Knetsch and Thaler 1986a,b), discussed in Section 4.

Implications of mental accounting

Following Thaler (1985), a large amount of work by Thaler and by others has explored and documented the consequences of mental accounting. Hastings and Shapiro (2013) provide evidence for a key aspect of mental accounting: the lack of fungibility of money. They studied the choice between regular and premium gasoline when the price of gasoline fell by about 50% in 2008 and found that the shift from regular gasoline to

[18] The last prediction, which results from the fact that the value of a small gain can exceed the value of slightly reducing a large loss, depends on the exact parameters of the value function and the exact difference between the large loss and the small gain. Loss aversion per se favors integration in this case, but the diminishing sensitivity to the size of losses implies that the value of a small gain can still outweigh the value of slightly reducing a large loss.

premium gasoline was 14 times greater than predicted by a standard demand model. Mental accounting – with a specific account for gasoline – explains this excessive shift. Interestingly, and also predicted by mental accounting, they found no similar shifts from lower to higher quality products in other product categories for which prices had not changed.

The dynamics of mental accounting was further explored in Prelec and Loewenstein's (1998) *prospective-accounting* model. This "double-entry" mental-accounting theory analyzes the reciprocal interactions between the pleasure of consuming a good and the pain of paying for it. It leads to the notion of "coupling," which refers to the degree to which consumption calls to mind thoughts of payment, and vice versa. Shafir and Thaler (2006) provide evidence on these phenomena from individuals who collect wine. Advance purchases (e.g., buying a case of wine) are typically thought of as investments rather than purchases. At the same time, consumption of a good purchased earlier and used as planned (a bottle of wine opened for dinner) is often coded as "free," or even as savings. Decoupling spending and consumption in this way reduces the pain of buying, another example of hedonic editing.

In mental-accounting theory, consequences are perceived and evaluated depending on context,[19] as well as on how the decision-problem is "edited," such as when hedonic editing leads individuals to cancel the pain of a loss by grouping it together with a larger gain. Boundaries are also set in time; mental accounts must be "opened" and "closed."[20] For example, when a financial asset is bought, a new account is opened with a reference point set to its acquisition value. Since it is painful to close the account (sell the asset) at a loss, the theory has important implications for trade in financial assets (Shefrin and Statman 1985, Thaler 1999). If losses and gains are evaluated and experienced only when a mental account is closed, investors will more likely sell stocks that have increased in value than stocks that have decreased in value. Investors will tend to hold on to losing stocks, because selling implies closing the account and experiencing the loss. Shefrin and Statman (1985) provided the first empirical evidence for this effect, which they labeled the disposition effect. The disposition effect was confirmed by Odean (1998), using a large dataset from a discount brokerage firm.

Read, Loewenstein and Rabin (1999) coined the term "choice bracketing" to describe

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[19] Thaler (1999) illustrates the context-dependence with a hypothetical scenario from Tversky and Kahnemann (1981):
Imagine you are about to purchase a jacket for $125 and a calculator for $15. The calculator salesman informs you that the calculator you wish to buy is on sale for $10 at the other branch of the store, located 20 minutes' drive away. Would you make the trip to the other store?
Compare this with:
Imagine you are about to purchase a jacket for $15 and a calculator for $125. The calculator salesman informs you that the calculator you wish to buy is on sale for $120 at the other branch of the store, located 20 minutes' drive away. Would you make the trip to the other store?
Both questions concern whether it is worth driving 20 minutes in order to save $5. But in fact, most people say that it is worth it in the first scenario, but not in the second.

[20] The following (hypothetical) example illustrates this (Thaler 1980): a family that bought expensive tickets for a basketball game will drive through a snowstorm to get to the game, since not attending the game would imply closing the mental account at a loss, but they would have stayed home if they had received the tickets as a free gift.

the extent to which choices are separated (narrow bracketing) or grouped together in mental accounting. The piecemeal decision-making typically predicted by mental accounting is a form of narrow bracketing that has substantial empirical support (see Thaler and Johnson 1990, Read, Loewenstein and Rabin 1999, and Rabin and Weizsäcker 2009).

In a well-known study, Thaler and co-authors studied labor-supply decisions of taxi drivers in New York City (Camerer et al. 1997). They found evidence for reference-dependent preferences and narrow bracketing in the sense that drivers behave as if they try to attain a target income (the reference point) every day and thereby suffer from loss aversion if they fail to reach the target. In other words, each working day seems to correspond to a separate mental account. Drivers therefore drive less on days with high demand and more on days with low demand, which is the opposite of what standard economic theory would predict.[21,22]

Thaler and Johnson (1990) showed that even though individuals tend to be risk averse, they often become risk-seeking with money recently gained in, for instance, gambling. This "house-money effect" occurs because the gains are put into a special mental account, which is treated differently from other money. Thaler and Johnson (1990) also find evidence for a "break-even effect": an extra tendency for risk-seeking behavior in the loss domain when there is a chance to break even from a previous loss. In later work by Thaler and co-authors (Post et al. 2008), both the house-money effect and the break-even effect are confirmed in a high-stakes environment (based on data from the game show *Deal or No Deal*).

3. Limited self-control

Consuming more today usually means consuming less tomorrow, so the consumer must weigh current desires against future desires. The standard neoclassical model of rational intertemporal choice is the exponential discounting model of Fisher (1930) and Samuelson (1937). This model has served admirably for many purposes, both normative and descriptive. The standard exponential discounting model implies time-consistent preferences, however, which makes it hard to explain certain types of observed behavior, for example, preference reversals and the demand for commitment technologies.[23, 24]

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[21] This finding was challenged by Farber (2005, 2008) using another data set on New York taxi drivers. However, using Farber's data, Crawford and Meng (2011) found support for reference-dependent preferences with a daily evaluation period. Fehr and Goette (2007) also found support for reference-dependent preferences in a field experiment of bicycle messengers.

[22] Evidence for narrow bracketing in financial markets will be discussed in section 5.

[23] Willpower, however, may be implicitly involved in determining the discount factor. Böhm-Bawerk (1889) argued that discounting of future consumption may be due to a "defect of will." Pigou (1920) instead attributed it to a failure of imagination.

[24] In fact, as Thaler (2015) points out, Fisher (1930) himself had doubts about the descriptive validity of the neoclassical model.

In this section, we largely abstract from the cognitive limitations of people, and focus instead on the struggle between a person's different "selves." We begin by briefly reviewing some early work, including Thaler's empirical study of discounting. We then turn to the planner-doer model of Thaler and Hersh Shefrin. Finally, we consider policy making, including Thaler and Cass Sunstein's advocacy of libertarian paternalism.

3.1 Early work on self-control problems

As early as Aristotle's discussion of *akrasia* (weakness of the will), philosophers and social scientists have considered the possibility that people may fail to do what they know is right.[25] In the field of psychology, the study of self-control was energized by the work of Freud (1955). In the 1960's the psychologist Walter Mischel introduced his famous marshmallow test, where children can have one marshmallow immediately or two marshmallows after a delay (Mischel 2014).[26]

Strotz (1956) hypothesized that people are born with a tendency to overvalue current consumption. In contradiction of the standard model of exponential discounting, more discounting occurs between the present and the near future than between periods in the more distant future. A special case of this phenomenon is *hyperbolic discounting* (Ainslie 1992).[27] We use this term as shorthand for the more general kind of "present-biased" discount function studied by Strotz (1956). Strotz showed that hyperbolic discounting leads to a problem of time-inconsistency: the "present self" would like to save more in the future, but the "future self" will prefer not to implement the plan.[28] Allais (1947, Appendix 3) and Thomas Schelling (1960, 1978; 2005 Laureate in Economic Sciences) also discussed the possibility that intertemporal choice involves a conflict between different "selves." [29]

[25] For example, David Hume (1739, Book III, Sect VII) argued that imperfect self-control is one of the three reasons for why people need a government, and Adam Smith (1759) described self-control as a struggle between the passions and an impartial spectator. William James (1890) wrote that the "[e]ffort of attention is the essential phenomenon of the will. […] What constitutes the difficulty for a man labouring under a passion of acting as if the passion was wise? Certainly there is no physical difficulty. It is as easy physically […] to pocket one's money as to squander it on one's cupidities, to walk away from as towards a coquette's door. The difficulty is mental: it is that of getting the idea of the wise action to stay before the mind at all."

[26] Mishel's measure of self-control was later found to correlate with life-outcomes such as SAT scores and educational attainment (Mischel, Shoda and Rodriguez 1989, Mischel 2004). Thaler (2015) notes that Mischel's experiments inspired his own work on self-control and the planner-doer model.

[27] Phelps and Pollak (1968) considered what is now referred to as "quasi-hyperbolic" discounting. This formulation would later become highly influential via Laibson's (1997) study of commitment to prudent consumption through investment in illiquid assets, and O'Donoghue and Rabin's (1999, 2001) work on procrastination.

[28] At age 30, I might plan to start saving for retirement at age 35. When I turn 35, however, I do not want to start saving since that means less current consumption.

[29] This manifestation of time-inconsistency is different than the one treated in the macroeconomic literature, where rational policy-makers have incentives to deviate from their previous plans because the constraints they face are changing over time. Research on this second type of time-inconsistency was one of the motivations for the prize to the 2004 Laureates in Economic Sciences, Finn Kydland and Edward Prescott (Kydland and Prescott 1977).

Thaler (1981) provided the first experimental evidence of hyperbolic discounting in humans.[30] Thaler's subjects were asked to make hypothetical choices between payoffs at different horizons, and he found that discounting is in fact much steeper between the present and the near future than between periods in the more distant future. He furthermore found that gains are discounted more than losses, and that smaller outcomes are discounted more than larger outcomes.

Thaler's findings raised the interest among economists in self-control problems and time-inconsistent preferences. The discounting patterns identified by Thaler (1981) have since been confirmed in many subsequent studies; see Frederick et al. (2002) for a review. Hyperbolic discounting can explain many puzzling observations, e.g., that people who want to quit smoking keep postponing the decision. It also naturally creates a demand for commitment technologies, a demand which does not exist in the standard exponential-discounting model. Real-world examples of commitment devices include the "Christmas Clubs" mentioned by Strotz (1956) and Thaler (1981), where individuals commit to saving for Christmas; the drugs Xenical (that gives unpleasant side-effects when overeating) or Antabuse (that makes you sick if you drink alcohol); and commonly used rules of thumb like "do not shop when you are hungry" or "do not keep alcohol at home."

3.2 The planner-doer model

Motivated by the observed deviations from exponential discounting, Thaler and his collaborator Hersh Shefrin proposed the planner-doer model (Thaler and Shefrin 1981, Shefrin and Thaler 1988). In the planner-doer model, a person has two selves: a myopic doer and a farsighted planner. The planner is concerned with the maximization of lifetime utility (discounted present value), while the doer cares only about current utility. Because the doer is unconcerned with the future, her behavior tends to become short-sighted, just as hypothesized by Strotz (1956). However, while the Strotz model suggests a conflict between different selves that exist at different times (current self vs. future self), the planner-doer model suggests a conflict between different selves that exist simultaneously (planner vs. doer).

To maximize lifetime utility, the planner can either force the doer to reduce current consumption by applying costly willpower, or impose rules that limit the range of doer discretion. These self-imposed rules of thumb constrain the behavior of the doer, albeit imperfectly. The planner-doer model captures the idea that willpower can be applied to resist temptation, but this carries a psychic cost. That costly willpower is used to constrain the behavior of the doer implies that the effective degree of self-control is endogenous (in contrast to the exogenously given hyperbolic discounting of Strotz 1956). Individual characteristics will determine how effectively the planner can control the doer, such that different people will exhibit different degrees of self-control.

[30] Ainslie (1974) provided experimental evidence on time-inconsistent behavior in pigeons consistent with hyperbolic discounting, even arguing that (some) pigeons engage in impulse control by making commitments (see also Ainslie 1992). Ainslie (1975) also discussed impulse control in humans, informally arguing that single-player indefinitely repeated games could have multiple equilibria.

Thaler and Shefrin (1981) treated the self-control problem as a principal-agent problem, with the planner (principal) trying to constrain and incentivize the doer (agent) to maximize lifetime utility. The same approach has been used in subsequent theoretical analyses of self-control, such as Bénabou and Tirole (2004). The planner-doer model has recently been reformulated and extended by Fudenberg and Levine (2006, 2011, 2012) in a series of papers. Bénabou and Pycia (2002) also showed that the axiomatic theory of self-control by Gul and Pesendorfer (2001) can be reexpressed in terms of a planner-doer model.

The planner-doer model of Thaler and Shefrin (1981) encapsulates the modern neuroscientific view that the human brain is a collection of many interacting systems. Because these systems don't always work seamlessly together, behavior may not look like that of a fully rational agent with consistent preferences and beliefs (see, e.g., Kurzban 2012). Shefrin and Thaler (1988) noted that one could think of the planner as the prefrontal cortex and the doer as the limbic system. The prefrontal cortex has been identified as the location in the brain where long-run planning takes place (it is "the executive of the brain"; Fuster 1980), while the evolutionarily older limbic system generates short-term emotions and desires. Neuro-economics research, such as McLure et al. (2004), has provided evidence that self-control problems indeed involve the interaction of the prefrontal cortex and the limbic system.[31]

Along similar lines, the planner-doer model can be compared with dual-process theories in psychology. In these theories, decisions are assumed to be governed by intuitive processes (System 1), typically characterized as being fast, automatic and effortless; as well as by deliberative processes (System 2), characterized as being slower, controlled and effortful.[32] As alluded to above, the idea of different, conflicting "selves" in the brain has a long history in economics and was already articulated by Adam Smith (1759) in *Theory of Moral Sentiments.* But Thaler and Shefrin (1981) were the first to present a dual-self model of self-control.

The planner-doer model makes a number of predictions that have been supported in subsequent empirical work. For instance, it predicts that a mandatory pension plan will increase total savings (that is, the mandatory savings are not fully offset by a reduction in other savings), because the plan produces savings without the psychic costs of inducing willpower. This prediction is empirically supported in the recent study by Chetty et al. (2014). The model also predicts that the marginal rate of time preference will exceed the after-tax interest rate due to self-imposed borrowing-constraints. Thaler and Shefrin (1988) refer to several studies estimating the marginal rate of time

[31] Camerer (2007, p. C28) also notes that current neuroeconomics, by treating an individual economic agent like a firm, follows Thaler and Shefrin's lead: "The rapid emergence of various dual-self or dual-process approaches testifies to how well economic theory can be adapted to study the brain as an organization of interacting components."

[32] See Evans and Stanovich (2013) for a discussion of dual-process theories in psychology, and also Kahneman (2003a). See also the early contributions of Wason and Evans (1975), Schneider and Shiffrin (1977) and Shiffrin and Schneider (1977), and the more recent hot/cool two-system model of self-control by Metcalfe and Mischel (1999). The System 1/System 2 model is the basis for Kahneman's 2011 book *Thinking Fast and Slow*. Kahneman (2011) notes that he and Tversky did not have a dual system in mind when developing prospect theory, but later he interpreted prospect theory in terms of a dual-system model.

preference with estimates far exceeding interest rates. This pattern is also confirmed in more recent studies (Harrison et al. 2002, Attema et al. 2016).

3.3 Policy-making

Individuals with limited cognitive abilities and limited willpower will not always act in their own best interests. An individual may wish she could stop smoking, or save more for retirement, but finds herself unable to do so. What policies can help such individuals make decisions more in line with their own long-term interests? In many ways, Thaler has shown how behavioral economics can help answer this question.

Together with his collaborator Cass Sunstein, Thaler has been a leading proponent of libertarian paternalism (Thaler and Sunstein 2003, 2008, Sunstein and Thaler 2003). According to this view, beneficial changes in behavior can be achieved by minimally invasive policies that nudge people to make the right decisions for themselves.[33] This approach emphasizes the use of choice architecture, that is, the design of the environment where choices take place.

Nudging can have profound effects through the design of *default options*. For many decision problems, a default option is specified in advance by the organization or agent who designs the decision problem. This is an important part of choice architecture because many individuals will simply stay with the default option. Two highly important areas where the default option has been shown to be crucial are organ donations (Johnson and Goldstein 2003, van Dalen and Henkens 2014) and retirement savings (Madrian and Shea 2001, Choi et al. 2004). Madrian and Shea's (2001) contribution in particular stimulated the interest in the design of default options. The most noteworthy application of the idea is embodied in Thaler and Shlomo Benartzi's proposal to increase pension savings, to which we now turn.

Applications to pension savings

As early as 1994, Thaler proposed changing the default in defined contribution plans for pension savings offered by US employers, such as 401(k) plans (Thaler 1994). The prevailing default was that employees needed to actively sign up for the plan by filling in several forms, choosing a savings rate and deciding how to invest the money. Thaler (1994) suggested that the new default option should be joining the plan at some default savings rate and in some default investment strategy – that is, automatic enrollment.

In the absence of a sensible default option, pension savers can be led to highly suboptimal choices, depending on seemingly innocuous design choices. Benartzi and Thaler (2001) show that when individuals are faced with a number of possible funds to which they can allocate their pension savings, they tend to follow a naïve "1/N" diversification strategy, where they allocate their savings equally across the available funds. This leads to unintended economic effects, where the resulting risk profile of the individual's savings is strongly affected by the menu of funds offered; e.g., when there is

[33] A related idea of "asymmetric paternalism" was proposed by Camerer et al. (2003). They suggested that policies should be implemented if they create large benefits for individuals who make mistakes, without imposing substantial costs on those individuals whose decisions are perfectly rational.

a larger number of bond funds relative to equity funds, individuals will put more of their savings into bonds as a result. Cronqvist and Thaler (2004) use the introduction of the Swedish Premium Pension (PPM) system, where individuals can invest part of their public-pension savings in funds of their choice, to illustrate how different design choices can lead to desirable or undesirable economic outcomes.

A number of empirical studies have revealed substantial default effects on savings (Madrian and Shea 2001, Choi et al. 2004). In a pioneering study, Madrian and Shea (2001) found that automatic enrolment increased the participation rate in a 401(k) savings plan from 49% to 86%.

Thaler and Benartzi (2004) design and implement a mechanism that increases pension savings by overcoming self-control problems and other behavioral biases. Their "Save More Tomorrow" (SMarT) program has four main ingredients. First, employees decide whether to increase their savings a considerable time before a pay increase, so the decision does not involve a trade-off between current consumption and future consumption, but rather a trade-off between consumption at different times in the future. By the logic of hyperbolic discounting, this reduces the effective discount rate, and mitigates the self-control problem.

Second, if employees join, their contribution is increased beginning with the first paycheck after the pay raise. Because the increased savings comes out of a future gain (the pay raise), loss-averse individuals need not fear a reduction in take-home pay.

Third, there is automatic escalation: the contribution rate continues to increase on each scheduled pay raise until the contribution reaches a pre-set maximum, so that inertia and status-quo bias work toward keeping people in the plan.

Fourth, the employee can opt out of the plan at any time, which make employees more comfortable about joining. The fact that joining is voluntary, and opting out is allowed, also addresses the fact that individuals have heterogeneous preferences; a "perfectly rational" employee would not be hurt by the plan. On the other hand, for those employees who want to make a commitment to save more in the future, the fact that they can opt out does not undo the commitment – once they are enrolled, inertia and status quo bias work in favor of staying in.

Thaler and Benartzi tested three implementations of the SMarT program in three different companies, with variations on how the program was offered. The program was particularly successful when the program was offered in one-on-one meetings, resulting in substantially increasing pension savings. The SMarT program was important for the Pension Protection Act passed by the 2006 US Congress, which encouraged firms to implement automatic enrollment and automatic escalation in 401(k) retirement savings plans. The evidence suggests that this act has substantially increased US pension savings. Benartzi and Thaler (2013) estimated that about 4.1 million people in the US were enrolled in some kind of automatic escalation plan by 2011, and that this had increased annual savings by $7.6 billion by 2013. The UK recently launched a national personal saving plan with automatic enrolment, where the opt-out rate has been only about 12% (Thaler 2015). Using Danish data, Chetty et al. (2014) recently showed that automatic-enrolment saving plans neither crowd-out other savings nor increase debt.

Policy impact

Nudging is similar to marketing, in that it uses insights into human psychology to influence behavior. But it differs in that the intention is to raise the people's long-run welfare, as judged by themselves. This is the "paternalism" part. The "libertarian" principle is that people's choices should not be restricted; specifying a sensible default option does not mean people are forced to choose this option.

Especially after the publication of the book *Nudge* by Thaler and Sunstein (2008), policy-making in several countries (in particular the USA and the UK) has been influenced by this approach, not only in the area of pension savings but also in health care, education, and other areas where current choices have long-term consequences. On September 15, 2015, US President Obama signed an executive order for "using behavioral science insights to better serve the American people." It was clearly inspired by the libertarian paternalism paradigm. In fact, Sunstein served as the administrator of the US Office of Information and Regulatory Affairs for four years (Thaler 2015). A White House Social and Behavioral Sciences Team was formed, and in its first year embedded about a dozen field experiments into federal programs (Thaler 2015). Thaler also had an instrumental role in the UK Behavioural Insights Team, which uses behavioral economics to craft new policies. Similar "nudge units" exist in other countries. A recent study investigating the global spread of nudging found that "51 countries have central state-led policy initiatives that have been influenced by the new behavioral sciences. In addition, we found evidence of public initiatives that have been influenced by the new behavioral sciences (but were not centrally orchestrated) in a total of 135 states and Taiwan (out of a total of 196 possible states)" (Whitehead et al. 2014, p. 9).[34]

An important part of nudging is to collect evidence on which policies actually work as intended, before they are implemented on a larger scale. Ideally, the policies should be tested and evaluated in randomized field experiments.[35]

Libertarian paternalism has come under critique from some other economists. Robert Sugden and his co-authors articulated concerns with the deviations from consumer sovereignty they consider inherent in libertarian paternalism (Infante et al. 2016, Sugden 2013, 2015). They argue that libertarian paternalism, and "behavioral welfare economics" more generally, treats deviations from conventional rational-choice theory as mistakes to be corrected by policy-makers, implying that policy-makers can maximize the latent preferences of an "inner rational agent trapped in an outer psychological shell." They criticize the interpretation of deviations from the conventional model as "mistakes" and doubt whether policy-makers can know which latent preferences should

[34] For a partial list of successful applications, nudging has been found to improve farming in a developing country (Duflo et al. 2011), decrease the use of energy (Shultz et al. 2007, Ayres et al. 2013), Brown et al. 2013), increase tax compliance (Hallsworth et al. 2014), increase worker productivity (Hossain and List 2012), increase voter turnout (Nickerson and Rodgers 2010, Bond et al. 2012), increase charitable giving (Shang and Croson 2009, Breman 2011), increase compliance with malaria medication (Raifman et al. 2014), improve learning for children (Kraft and Rogers 2014, York and Loeb 2014), and increase savings in development countries (Karlan et al. 2016).

[35] Thaler (2015, p. 338) refers to this as "evidence-based policy."

be maximized. Sugden (2013) instead argues for a "contractarian" approach to welfare economics, trying to identify mutually beneficial agreements between individuals. Further, Arad and Rubinstein (2015) argue that libertarian paternalism may have negative effects on individuals who dislike being manipulated (independently of the material consequences of this). They provide some evidence for negative attitudes towards libertarian-paternalistic government interventions, based on data from online hypothetical choice experiments.

Thaler and Sunstein (2008) themselves argue that not all libertarian-paternalistic intervention is desirable; they constrain their recommendation to policies that "influence choices in a way that will make choosers better off, *as judged by themselves*." Given Thaler's distinction between the planner and the doer, this is best interpreted as the planner making the judgment. Also, their approach emphasizes the voluntary aspect, where individuals always have the choice not to participate or to opt out at a later time. This acknowledges that individuals differ in cognitive abilities and degree of self-control, and that they also have different preferences, so that the costs and benefits of defaults are not the same across individuals.

Recent studies generally have found relatively high public support for libertarian-paternalist nudging (Hagman et al. 2015, Yung and Mellers 2016, Reisch and Sunstein 2016, Reisch et al 2017, Sunstein 2017). Based on his findings for the US, Sunstein (2017) concludes that "there is widespread support for nudges of the kind that democratic societies have adopted or seriously considered in the recent past; surprisingly, that support can be found across partisan lines." Benartzi et al. (2017) calculated ratios of impact to cost for a large number of governmental interventions, including traditional policy tools such as tax incentives and other financial control mechanisms. They found that nudge interventions generally compare favorably with traditional interventions. They conclude that "nudging is a valuable approach that should be used more often in conjunction with traditional policies, but more calculations are needed to determine the relative effectiveness of nudging" (Benartzi et al. 2017).[36]

4. Social Preferences

Many situations can be reasonably approximated by assuming that agents behave in their own self-interest. In other situations, more socially oriented motivations such as a desire for fairness and equity may play a role, which was noted already by Adam Smith (1759).[37] More recently, Gary Becker (1992 Laureate in Economic Sciences) formalized

[36] The insights of behavioral economics can also be used to inform more traditional policy interventions, for example the taxation of "sinful goods" (i.e., goods that yield immediate gratification at the expense of long run welfare). Self-control problems provide an argument for such taxes, over and above traditional arguments based on externalities: a tax on cigarettes can make a smoker better off (as judged by himself) by helping him quit or reduce smoking. Gruber and Köszegi (2001) studied optimal cigarette taxation when individuals have self-control problems, and O'Donoghue and Rabin (2006) considered the role of taxation of sinful consumption in general in a world where some people have self-control problems and others do not.

[37] In *The Theory of Moral Sentiments*, Smith wrote extensively about sympathy (altruism) as an important passion, and he viewed fairness as an important motivation. For instance, he wrote about fairness that "[n]ature has implanted in the human breast, that consciousness of ill-desert, those terrors of merited

how people may care about the well-being of others (Becker 1974), while Amartya Sen (1998 Laureate in Economic Sciences) argued that both sympathy (altruism) and commitment are important motivations – the distinction being that sympathy has a direct effect on one's own welfare, whereas commitment involves moral principles about right and wrong (Sen 1977).

In the 1980s, Thaler's work was important in establishing fairness as a major research topic in economics. In the theory of mental accounting, perceived fairness determines the transaction utility (Thaler 1985). In joint work with Kahneman and Jack Knetsch, Thaler provided empirical evidence that fairness is important in consumer decisions. Their findings support the hypothesis that fairness is a constraint on profit maximization, preventing companies from fully exploiting their market power in pricing decisions. As a consequence, goods are sometimes allocated by quantity rationing, as when tickets to big sporting events instantly sell out at prices below market clearing, or when snow shovels are in short supply following a snowstorm.

Together with Kahneman and Knetsch, Thaler also invented novel experiments and uncovered three important manifestations of fairness preferences in interactions between individuals: first, some individuals will behave fairly towards others even in anonymous settings without reputational concerns; second, some individuals are willing to forego resources to punish individuals that behaved unfairly towards them; and third, some individuals are willing to forego resources to punish unfair behavior and norm violations even if the unfair behavior was directed towards someone else. Prior to this, economists had experimentally verified only the second of these manifestations, in the work of Güth et al. (1982) on the ultimatum game.

We now discuss Thaler's work on the role of fairness in pricing and wage-setting and other types of interactions.

4.1 Fairness in pricing and wage setting

Robert Solow and George Akerlof, Laureates in Economic Sciences in 1987 and 2001, respectively, have argued that fairness concerns may explain why companies are reluctant to cut wages in a recession (Solow 1980, Akerlof 1979). Okun (1981) pointed out that fairness concerns could also impact pricing decisions. Still, more direct evidence on the impact of fairness on prices and wages was lacking.

To provide evidence on the hypothesized role of perceived fairness in consumer markets, Kahneman, Knetsch and Thaler (1986b) collected data by telephone surveys of randomly selected individuals in the Toronto and Vancouver metropolitan areas. The respondents were asked about the fairness of different (hypothetical) scenarios. A typical question is their Question 1:

A hardware store has been selling snow shovels for $15. The morning after a large

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punishment which attend upon its violation, as the great safe-guards of the association of mankind, to protect the weak, to curb the violent, and to chastise the guilty." See Ashraf, Camerer and Loewenstein (2005) for an overview of the writings of Adam Smith on social preferences (as well as bounded rationality and limited self-control).

snowstorm, the store raises the price to $20. Please rate this action as: Completely Fair, Acceptable, Unfair, Very Unfair.

In this scenario, 82% of the respondents considered it unfair to raise the price, when "Unfair" and "Very Unfair" were grouped into one "unfair" category.

Kahneman, Knetsch and Thaler (1986b) distinguished three determinants of fairness attitudes toward an action taken by a firm: the reference transaction, the coding of the action, and the occasion for the action. The reference transaction refers to trading at some prevailing price or wage. Changes from this reference level are perceived as unfair. For example, if a current employee earns a wage of $9, then this would typically be his reference wage, but for a new employee, the reference wage may be lower. In a recession, lowering the current employee's wage from $9 to $7 would then be deemed more unfair than hiring a new employee at $7 if the current employee leaves.

When prices are evaluated relative to some reference level, how the price change is framed will be important, something that Kahneman, Knetsch and Thaler (1986b) confirmed empirically. For instance, a price increase of $200 for a new car is deemed more unfair if it is framed as an increase in the list price than if it is framed as a reduced discount on the list price. This is consistent with loss aversion, since an increase in the list price is coded as a loss, while a reduced discount is coded as less of a gain.

Finally, Thaler and co-authors found that the occasion that triggered the pricing decision influences perceived fairness. A consumer-price increase is typically acceptable if it is due to an increase in input prices, but not if it is due to an increase in market power. Raising the price of snow shovels after a snowstorm is an example of the latter.[38]

Kahneman, Knetsch and Thaler (1986b) discussed a number of implications and predictions of fairness considerations in consumer markets. Markets will fail to clear in the short run in response to demand shocks, as it is considered unfair to raise the price to the market clearing level. There will be a shortage of the most valued item when a single supplier provides a family of goods with no variation in input prices, as it is considered unfair to charge more for the most valued item if it costs the same. Prices will be more responsive to cost variations than to demand variations, as it is considered more acceptable to raise prices in response to cost increases than demand increases. Similarly, prices will be more responsive to cost increases than to cost decreases. Finally, price cuts will be labeled as discounts rather than decreases in list prices, due to the framing of gains and losses. Removing a discount is less likely to be perceived as a loss and thus less likely to be perceived as unfair, compared to an increase in the list price.

They also tested the effect of fairness on labor markets, where it can potentially explain the puzzle of sticky wages (for evidence of sticky wages, see for instance Akerlof et al.

[38] Another example is the following [Question 13 on p. 735 in Kahneman, Knetsch and Thaler (1986b)]: *A grocery chain has stores in many communities. Most of them face competition from other groceries. In one community the chain has no competition. Although its costs and volumes of sale are the same as elsewhere, the chain sets prices that average 5 percent higher than in other communities.* This scenario was considered unfair by 76% of the respondents.

1996). In recessions, employers are reluctant to cut (nominal) wages as the employees may view wage cuts as unfair (and perhaps retaliate by putting in less effort). Kahneman, Knetsch and Thaler (1986b) find that a nominal wage cut with no inflation is considered much more unfair than a constant nominal wage with inflation, even if the real wage decrease is the same. This suggests that inflation may have important real effects. The importance of this kind of money illusion is supported by subsequent experimental work of Fehr and Tyran (2001).[39]

4.2 Fairness in individual interactions

To study fairness and generosity in individual interactions Kahneman, Knetsch and Thaler (1986a) introduced an experiment, subsequently known as the *dictator game*. Students in an undergraduate psychology class at Cornell University were asked to divide an endowment of $20 between themselves and a randomly drawn anonymous classmate. The students could choose between two different allocations: an unequal split with $18 to self and $2 to the other, or an equal split with $10 to each. A selfish person, concerned only with his own monetary payoff, would take the $18. But it turned out that 76% of the students divided the money equally, as if they had a preference for fairness or equity. Apparently, not all individuals will maximize their own monetary payoff, even in anonymous interactions without reputational concerns.

There is now a large literature on the dictator game (see Camerer 2003 for an intermediate overview). Typically, the subject who divides the money (the "dictator") can freely divide the endowment (rather than being forced to choose between two different allocations, as in Kahneman, Knetsch and Thaler 1986a). A meta-analysis of dictator game studies published in 2011 included 129 papers and 616 experimental treatments (Engel 2011). On average, dictators gave away 28% of the endowment. Only 36% of dictators behaved as the conventional "selfish economic man" and took as much money as they could. And 17% of the dictators chose an equal split, suggesting strong preferences for fairness.

Kahneman, Knetsch and Thaler's (1986a) dictator experiment had a second part, where each student was told that she or he would be randomly matched with *two* other students. If those two students had made different decisions in the first part (the simple dictator game described above), then the first student was asked to choose between the following two allocations:[40]

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[39] Thaler (2015) mentions several real-life examples where the perceived unfairness of business decisions had striking consequences. When the First Chicago bank introduced a US$3 bank teller fee (to get consumers to use ATMs instead), it was met with consumer outrage and losses of market shares, and the policy was eventually abandoned (after the bank was purchased by a national bank). The CEO of Coca Cola tested a dynamic pricing scheme for vending machines where prices would depend on demand (for example, the price would increase in hot weather); the CEO was fired and the dynamic pricing was scrapped. Sometimes companies are in fact prohibited by law to "excessively" raise prices in response to demand shocks, so-called anti-gauging laws (Thaler 2015). These laws can be understood in terms of perceptions of fairness. Thaler (2015, p. 131) emphasizes that "perceptions of fairness are related to the endowment effect. Both buyers and sellers feel entitled to the terms of trade to which they have become accustomed and treat any deterioration of those terms as a loss."

[40] If the two other students had made the same decision in the first part, there would be no decision to make in the second part.

$5 to yourself, $5 to the student splitting equally in the first stage, and nothing to the student who took $18 in the first stage;

or:

$6 to yourself, nothing to the student who split equally in the first stage, and $6 to the student who took $18 in the first stage.

A student who chooses the first allocation foregoes $1 (takes $5 instead of $6), but gets to reward someone who was a fair allocator in the first part and punish someone who was selfish; as many as 74% of the students chose the first allocation. Thus, as in the first part, only a minority maximized their own monetary payoff when fairness was at stake. But what the second part suggests is that many individuals are willing to punish unfair behavior and norm violations, even if the unfair behavior had not hurt them personally. This experimental design is related to subsequent "third-party punishment" experiments, where a third party (not directly affected by the unfair behavior or norm violation) can punish unfair behavior among other individuals (Fehr and Fischbacher 2004). It is an example of behavior now commonly labeled indirect reciprocity (Nowak 2006).

Kahneman, Knetsch and Thaler (1986a) also included experiments involving the (now well-known) ultimatum game.[41] In the ultimatum game, the first player proposes an allocation of the endowment and the second player can accept or reject this proposal. If the proposal is accepted, both players get paid according to the proposal; if the proposal is rejected both players get nothing. Kahneman, Knetsch and Thaler (1986a) found that the typical first player's proposal was close to equal split. They also found that most of the second players would reject proposals that would give them less than about 25% of the endowment. These results are in line with those originally observed by Güth, Schmittberger and Schwarze (1982), as well as with those of the subsequent large literature on the ultimatum game (Camerer 2003). Many individuals are willing to pay a cost (get nothing) in order to punish individuals who made an "unfair" proposal to them, which is a form of negative reciprocity (Fehr and Gächter 2000b). Subsequent experiments have shown how the ability and willingness to punish can encourage pro-social behavior (Ostrom, Walker and Gardner 1992, Fehr and Gächter 2000a). In addition, Henrich et al. (2005) have found similar results of the ultimatum and related games in 15 small-scale societies from around the world.

The current literature on social preferences and reciprocity is substantial, with numerous laboratory and field experiments as well as theoretical models. Two important early contributions were Rabin's (1993) theoretical model of fairness equilibrium, and Fehr, Kirchsteiger and Riedl's (1993) laboratory experiments that provided support for the "fair wage-effort" hypothesis of Akerlof (1982). A few years later, two very influential theoretical models appeared: Fehr and Schmidt (1999) and Bolton and Ockenfels (2000). These authors argued that a large number of experimental

[41] The ultimatum game had previously been introduced by Güth et al. (1982). Kahneman, Knetsch and Thaler (1986a) were apparently unaware of that paper when they designed their experiment (Thaler 2015).

outcomes, including those from dictator and ultimatum games, can be explained by inequality aversion. In turn, a number of papers tried to distinguish between inequality aversion and other aspects of behavior, such as different kinds of reciprocity. A noteworthy contribution came from Charness and Rabin (2002). For further reading, see Fehr and Gächter (2000b) and Camerer (2003).

5. Market manifestations: Behavioral finance studies

While humans might behave irrationally in laboratory experiments or individual instances, it is far from clear that such irrational behavior would survive in competitive markets, since less rational agents might be outcompeted by more rational agents (Fama 1970). If irrational behavior can be shown to affect financial markets, this would be a particularly strong argument that behavioral biases affect prices and allocations everywhere in the economy.

Thaler has made numerous contributions to the study of financial markets, thereby becoming one of the founders of the field of behavioral finance.[42] This field uses behavioral economics to explain patterns in asset prices that are hard to reconcile with traditional concepts of investor rationality and market efficiency. Thaler introduced novel models of investor psychology in order to explain empirical puzzles such as the predictability of stock prices and the so-called equity premium puzzle. The disposition effect (Shefrin and Statman 1985, Odean 1998) discussed above (Section 2.3) is also predicted by the theory of mental accounting. In addition, Thaler has documented instances where prices appear to clearly deviate from fundamentals and are therefore hard to reconcile with market efficiency and investor rationality.

In their highly cited survey of behavioral-finance research, Barberis and Thaler (2003) emphasize that the irrationality of some investors in itself is not enough to affect asset prices. There also must be limits to arbitrage that prevent rational investors from exploiting the mispricing (Shleifer and Vishny 1997). Thaler's behavioral-finance work has thus focused on two issues: (1) investigating the asset-pricing implications of investor psychology and (2) documenting violations of the law of one price in financial markets, implying the importance of limits to arbitrage.

Asset pricing implications of investor psychology

In an influential study, De Bondt and Thaler (1985) questioned the assumption, inherent in the traditional finance model, that rational traders hold "correct" beliefs that are revised according to Bayes' rule when new information arrives. The work of Tversky and Kahneman (1974) suggests that many individuals systematically deviate from this assumption by overreacting to new information.

To test for stock-market overreactions to new information, De Bondt and Thaler compared returns of loser stocks (stocks that recently dropped in value) and winner

[42] Another leading figure in this field is Robert Shiller, 2013 Laureate in Economic Sciences. In 1991, Shiller and Thaler started co-organizing the semi-annual NBER workshop on behavioral finance, which became an important forum for promoting and stimulating research in this area (Thaler 2015).

stocks (stocks that recently increased in value). In line with the overreaction hypothesis, they found that the portfolio of loser stocks outperforms the portfolio of winner stocks. In a follow-up paper, De Bondt and Thaler (1987) tested the robustness of these results further, as well as a number of alternative explanations, finding robust support for the overreaction hypothesis. While the cross-sectional mean-reversion pattern discovered by De Bondt and Thaler has been shown to be robust in subsequent empirical work, their interpretation has been disputed. In particular, the higher returns of loser stocks are also consistent with these stocks exhibiting more systematic risk and investors' need for compensation for this risk in the form of higher risk premia.

Benartzi and Thaler (1995) offered a behavioral-finance explanation for the so-called equity premium puzzle: the finding that the historical return on stocks relative to bonds appears to be too large to be consistent with standard expected utility models (Mehra and Prescott 1985). Benartzi and Thaler propose an explanation based on narrow bracketing and loss aversion. In their model, the impact of loss aversion depends on how often investors reset their reference point (i.e., on how often they "close their accounts"), and Benartzi and Thaler (1995) found that loss aversion can explain the equity premium if the evaluation period of investors is one year.[43] This "myopic loss aversion" explanation has received some support from subsequent lab experiments (Thaler et al. 1997 and Benartzi and Thaler 1999). Barberis, Huang and Thaler (2006) argue that narrow bracketing can explain why a substantial fraction of households do not participate in the stock market, the so-called stock market participation puzzle. Although there is no general consensus among financial economists on whether the extensions of neoclassical models or the behavioral models best explains the risk premia observed in financial markets, studies of loss aversion remain an active strand in this literature.

Mispricing and limits to arbitrage

While the contributions above provide behavioral-finance explanations for observed financial-market returns, this does not mean that returns are in fact influenced by overreactions or other behavioral "anomalies." Indeed, there exist other explanations for these phenomena that are consistent with investor rationality and efficient markets. In his work on market mispricing, Thaler has looked for evidence that more clearly demonstrate violations of market efficiency.

Closed-end funds are investment funds, traded on the stock market, which own other financial assets such as shares in other publicly traded companies. The closed-end puzzle refers to the observation that the shares of closed-end funds typically are valued differently than the assets they own, violating the law of one price and implying limits to arbitrage. Building on Zweig (1973) and Delong et al. (1990), Lee, Shleifer and Thaler (1991) propose an explanation for the closed-end fund puzzle based on the existence of "noise traders" with incorrect beliefs. In some periods, these noise traders overestimate the expected returns (relative to rational expectations); in other periods they underestimate expected returns. These fluctuations in noise trader sentiment create

[43] Barberis et al. (2001) provide a multi-period extension the Benartzi and Thaler (1995) model, and incorporate the effect of past outcomes on risk-taking, in addition to loss aversion.

additional volatility in the price of closed-end funds. Rational traders will need to be compensated for this risk, leading to closed-end funds trading at a discount on average.

Consistent with their theory, the authors document that (1) there are significant co-movements in the discounts of different closed-end funds (they are driven by common investor sentiment); (2) new closed-end funds are formed when existing closed-end funds sell at a premium or at a low discount (periods with high investor sentiment); and (3) discounts of closed-end funds are correlated with prices of other assets affected by investor sentiment, such as small stocks. Still, the interpretation of closed-end fund discounts as measures of investor sentiment has been criticized, and there are alternative explanations of this discount based on rational investors (while maintaining the limits to arbitrage assumption), such as Berk and Stanton (2007). Still, following Lee et al. (1991), the discount on closed-end funds is a commonly used measure of investor sentiment that has been shown to be related to several other asset-pricing phenomena (see, e.g., Baker and Wurgler 2013).

Lamont and Thaler (2003) provide even clearer evidence that the law of one price is violated. They examine data on so-called equity carve-outs, in which a parent company (company Y) has sold a stake of a subsidiary (company X) on the public stock market and has announced the intention to spin off the remaining shares in company X at some point in the not-too-distant future. In these cases, the law of one price provides testable restrictions on the relation between the stock prices of X and Y. In particular, the market value of Y can never be lower than the value of the shares of X that it owns, and should generally be higher if company Y has additional assets apart from the shares in X. Lamont and Thaler examine the implied value of the additional assets of Y, the "stub value," by deducting the market value of the shares Y owns in X from the market value of Y. They found a positive stub value in nine companies, a marginally negative stub value in three companies, and an unambiguously negative stub value for six companies, a clear violation of the law of one price. Lamont and Thaler (2003) argue that the reason for limits to arbitrage in these cases is the difficulty of short-selling the overpriced carve-out shares.

6. Conclusion

Together with his collaborators, Thaler has given economists new insights into human psychology and new frameworks for understanding and predicting economic outcomes. His contributions include the theory of mental accounting, a new approach to boundedly rational behavior; the planner-doer model, with a new framework for self-control problems; and his work on social preferences, which has given us a new perspective on fairness. Last but not least, he has shown how policies based on insights from behavioral economics can help individuals make better decisions.

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