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Time-inconsistent Preference and Reference Dependence*

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The paper explains time – inconsistent preferences by particularly focusing on the concept of reference dependence. The objective is to propose a short survey on various features of reference dependence and different causes that lead to the change of reference level. The emphasis of the paper is on the interpretation of the concepts and their behavioral implications. JEL Code: D9

1. Time – inconsistent behaviors

A standard assumption in economics is that individuals exhibit *time-consistent preferences*. Simply stated, inter-temporal marginal rates of substitution remain constant over time and are equal to the discount factor. However, ample evidence demonstrates that individuals sometimes exhibit a transient change in their preference. For example, before going to a restaurant, the individual may have in mind a low-carbohydrate dish consistent to her/his recurring dietary preference. However, upon arriving at the restaurant, the person may not be able to resist the temptation of pasta and instead orders a high-carb entrée. Such inconsistent behaviors may be observed throughout a range of everyday activities and have implications in a variety of economic problems.

Procrastination is a very familiar behavior to all of us. Almost everyone puts off some duty or activity to some future time, sometimes with little reward or reason. While in some instances, the individual may gain a slight benefit (such as sleeping in or gaining an additional half-hour for lunch), the triviality of the reward may imply that the procrastinator is simply lazy. The individuals often procrastinate on seemingly significant tasks such as writing reports. This form of procrastination incurs immediate costs and delayed rewards. The cost of working today seems more salient than the cost of performing the same task tomorrow. In another words, benefits gained today weigh more than the same benefits gained tomorrow.

To explain such behavior, Akerlof (1991) offered a salience-cost model, in which one chose t^* to minimize $V = c(1 + \delta) - (T - t^*)x$ for $t^* = t$ and minimize $V = c - (T - t^*)x$ for $t + 1 \leq t^* < T$. The model contains the following features: a salient present which creates a temporary preference for the short term; at each period t there is salient costs δc for undertaking the job rather than later; the daily benefit from undertaking the job, x , is small; irrational expectation about one's decision in the future; an individual task. Akerlof demonstrates that with a salient cost today and no salient tomorrow, one always postpones the action even though an immediate action maximizes utility.

Motivated by Akerlof's model, O'Donoghue and Rabin (1999) furthered the examination of procrastinating a task with salient costs by allowing expectation to be rational or naïve. They have shown that naïve people would procrastinate on activities with immediate costs and preproperate the activities with immediate rewards, and sophistication would lessen the effect of procrastination, but deepen the effect of preproperation. However, in both Akerlof and O'Donoghue-Rabin models, it is assumed that the tasks are indivisible and there is only one type of discounting.

Fisher (1999) explored the issue of procrastination by considering a divisible task and two types of discounting: *hyperbolic discounting* and *differential discounting*. Hyperbolic discounting relates to a salient present, that is, short-term discount rates are higher than long-term ones; while differential discounting arises from salient costs, which implies that utility from leisure is discounted at a higher rate than rewards from work. The results show that both types of discounting cause people to do more work in the future. However, with differential discounting one would work harder as a deadline nears while with hyperbolic discounting one works steadily from day to day.

Habit formation and addiction are another time-inconsistent behavior that may be witnessed in those who partake of substances and/or actions which often prove ruinous to their health and well-being. Such activities not only include the consumption of drugs, alcohol, and cigarettes, but also actions such as working, eating, gambling, and spending.

Most "habit-formation" models assume that a current consumption has some influence on future behaviors (Duesenberry, 1952; Pollak, 1970; Stigler and Beck, 1977). Becker and Murphy (1988) first introduced the unstable steady-state consumption levels caused by strong complementarities between two period consumptions in addiction. They showed that individuals who discount the future are more likely to exhibit addiction behavior. Additionally, they showed that permanent changes in prices of addictive goods may have modest short-run effects on the consumption of addictive goods, which may be the reason why addicts do not often respond to drastic changes in price. Later on, the result was supported empirically by Becker, Grossman and Murphy (1991, 1994).

Shi (2006) built habit formation into a principal-agent model. She presented a dynamic principal-agent model based on a habit process in which the worker falls into a productive work path because of a higher initial productivity level. The primary purpose of the paper was to discover to what extent that habit formation influenced the principal-agent interaction and how that might account for some facts regarding training, trial period compensation systems, and graduate school class settings. In the model, the utility of the manager is:

$$\begin{aligned} U_t &= W_t - C(x_t) - (x_t - x_{t-1})v(x_{t-1}) && \text{if } x_t \geq x_{t-1} \quad \text{and} \\ U_t &= W_t - C(x_t) && \text{if } x_t < x_{t-1} \end{aligned}$$

where $(x_t - x_{t-1})$ is the change of productivity from the last period. When the manager works harder this period (which is the case $x_t \geq x_{t-1}$), he has to exert extra effort to adapt to the new working style in addition to the effort he had to put into the work anyway. This extra disutility not only depends on the increase of

productivity, but also the reference level of productivity $v(x_t)$, which measures the marginal effects of the change of productivities. When the last period's productivity is very high, the changes seem negligible since the increase of the productivity is trivial compared with previous productivity. The result demonstrates how setting up a workload in the period often seen in training and trial period compensation system, plays an important role when the worker was previously nonproductive. It is because the productive habit, created by locking the worker into a productive path, leads her/him to an optimal working path which could never be reached when there was no fixed level of productivity. The model of the paper captures the concept of *diminishing sensitivity*, which is the one of the important features of *reference dependence*.

2. Reference dependence

The concept of *reference dependence* is a familiar one to social scientists. Research shows that human beings are more sensitive to changes which deal with reference levels than those which include absolute values (Helson 1964). Interestingly, these changes are asymmetric. For example, it is more difficult for most individuals to adapt to a frugal style of living from a life of luxury than vice-a-versa.

2.1 Loss aversion

One pervasive feature of reference dependence is *loss aversion*, that is, people are significantly more averse to losses than they are attracted to same-sized gains (Kahneman, Jack Knetsch and Thaler 1990 and Tversky and Kahneman 1991). Loss aversion says that the value abruptly changes the slope at the reference level. For instance, most people prefer their status quo to a 50/50 bet of losing \$10 or gaining \$11. The standard concave-utility function simply cannot explain such behavior.

Tversky and Kahneman (1991) presented a reference-dependence theory of consumer choice, which explains such behavior by a determination of indifference curves about the reference point. The major assumption of the theory is that losses and disadvantages have a larger impact on preferences than gains and advantages. In the paper, Tversky and Kahneman defined loss aversion and diminishing sensitivity in terms of "preference orders".

Loss aversion is also related to *endowment effect* identified by Thaler (1980), which states that once a person possesses a good, she/he immediately values it more than before possessing it. Kahneman, Knetsch, and Thaler (1991) illustrated this phenomenon in a series of experiments. They randomly gave mugs (worth \$5 each) to one group of students. This group of students had the option of selling it at a price acceptable to them. The result indicated that their decision for prices ranged from .50¢ to \$9.50. They called the first group *sellers*. Another group of students were not given mugs directly, but rather had the option of receiving either a mug or a sum of money. It was shown that the preferences between a mug and a sum of money ranged between .50¢ to \$9.50. They called the second group *choosers*. The sellers and choosers faced precisely the same problem between a mug and a sum of money, but they had different reference states. The sellers treated the mug as their possession or endowment and experienced a loss by giving up the mug, whereas the choosers felt a sensation of status quo by leaving without a mug. So leaving without a mug was considered a loss to sellers, but merely kept a point of reference for choosers.

Loss aversion implies that the value of a mug against money is higher to the sellers. Indeed, the median value of the mug was \$7.12 for the sellers and \$3.12 for the choosers. The difference is due to the endowment effect.

The behavior from the examples above can also be explained by some individuals' tendency to prefer a status quo opposed to a change. To demonstrate this effect, Knetsch and Sinden (1984) and Knetsch

(1989) used an experiment, in which they randomly gave students either chocolate or decorated mugs. Later, each was offered a chance to trade the gift for the other choice. Given that the transaction cost was very small, about 90% of students kept their gift. Their behaviors reflected preferences that were induced by the initial allocation.

Samuelson and Zeckhauser (1988) also obtained the evidence of status quo bias in a field study of the choice of medical plans by Harvard employees. They found out that new medical plans are more likely to be chosen by new employees even though there is a yearly opportunity to change the decision and minimum changing cost. Also, employees favor minor changes over big changes. People who transferred from a Blue Cross/Blue Shield plan favored a new variant of that plan over other alternatives. Samuelson and Zeckhauser also observed that the pension reserves to TIAA and CREF are very stable over years in spite of large variation in rate of returns. Loyalty and pioneer company advantage as status quo bias offer a good explanation for this phenomenon.

Tversky and Kahneman (1991) mentioned another effect implied by loss aversion – *improvement versus tradeoff*. In one experiment, a group of students was given the gift package of “one free dinner at MacArthur Park and a monthly Stanford calendar.” The other group was given “one 8 x 10 professional photo portrait and a monthly Stanford calendar.” All of the students were informed that some winners would be given the opportunity to exchange their gift with one of the followings: X – two free dinners at MacArthur Park Restaurant. Y – one 8 x 10 professional photo portrait plus two 5 x 7 and three wallet size prints. As implied by loss aversion, people with the first gift package would be more likely to favor x over y than people with second gift package since people are averse to giving up their original gift. The results from the test confirmed this implication.

In addition to “*status quo bias*” and “*improvement versus tradeoff*”, Tversky and Kahneman (1991) introduced another effect of loss aversion – *advantage and disadvantage* effect. They argued that the same difference between two options will be given greater weight if it is a difference of disadvantages than if it is a difference of advantages. In an experiment, individuals were given two alternative job opportunities x and y then asked to choose one. Both x and y are better than the current one in the aspect of social contact and y is the best in this aspect. On the other hand, both x and y are worse than the current one in the aspect of travel time and y is the worst in this respect. The result showed that 70 % of participants chose x over y, which confirmed the argument that a given difference between two options has a bigger impact when the option is a difference between two losses than when it is a difference between two gains.

2.2 Diminishing sensitivity

In addition to loss aversion, another important feature of reference dependence is *diminishing sensitivity*, which suggests that the impact of a difference is attenuated when both options are remote from the reference point for the relevant dimensions (Tversky and Kahneman, 1991). For example, we are more sensitive to the difference between 0 and 3 than the difference between 20 and 23. With diminishing sensitivity, the slope of a person’s utility function over wealth becomes flatter as his/her wealth gets further away from the reference level (Rabin 1998). Diminishing sensitivity implies that while people are likely to be risk averse over gains, they are often risk-loving over losses. An experiment done by Kahneman and Tversky (1979) confirmed this notion. In the experiment, 70 percent of subjects reported that they would prefer a lottery with $\frac{3}{4}$ chance of losing nothing and $\frac{1}{4}$ chance of losing \$6000 to a lottery with $\frac{1}{2}$ chance of losing nothing and $\frac{1}{4}$ chance of losing \$4000 and $\frac{1}{4}$ chance of losing \$2000. Because the chosen lottery is a mean-preserving spread of the less preferred lottery, behaviors of 70% of subjects are not consistent with the standard concavity assumption.

3. Change of the reference level

In general, reference level changes are caused by a process of *accommodation* or *adaption* (Hoch and Loewenstein, 1991). People who are exposed to a persistence stimulus adapt to that stimulus often before they realize it. Once the adaption occurs, the reference level is changed.

Mechanisms causing such adaption have been discussed by Hoch and Loewenstein (1991). One mechanism is called *Physical Proximity*, which is considered the most potent cause of reference level changes. The effect of physical proximity on impulsivity has been well documented by Mischel (1974). In an experiment by Mischel and Grusec (1967), children were put in a room and told that they could call the experimenter by ringing the bell. They were given a choice between an immediate reward (a single marshmallow) and a delayed reward (two marshmallows). If they could wait for the experimenter to return without ringing the bell they were to receive the better reward. The impulsivity level was measured by determining how long the subject waited before ringing the bell. The object was placed in front of some children, but not others. The result shows that viewing the reward made subjects less willing to delay. Thus, placing an object in view leads to a change of reference level.

The second mechanism is called *Temporal Proximity*¹, which implies that the desire of obtaining the object increase as the object becomes imminent. Loewenstein (1990) designed an experiment to examine the effects of Temporal Proximity. In the experiment, high school sophomores either expected an early (e.g. four weeks) or a late delivery (e.g., eight weeks) of a \$7 gift certificate from a local record store. After two weeks, subjects were given \$7 at early date or \$8.50 if they delayed until the late date. The results have shown that the subjects with expectation of an early delivery are less likely to wait than those with expectation of a late delivery, which confirmed the notion that impatience is exacerbated by a temporary change of reference level. As mentioned by Hoch and Loewenstein (1991), many marketing practices take advantage of this effect to increase impatience by selling imminent opportunity. Examples include pizza-delivery services with a promise of a discount if the pizza is not delivered within a certain amount of time; toll-free hotline allowing immediate ordering of a product; online ordering with express delivery.

The third mechanism mentioned by Hoch and Loewenstein (1991) is *Social Comparison*. People often want what their peers already have and do not wish to wait to obtain the same or similar item for themselves. Various studies² show that people tend to compare themselves with others in many aspects of their lives. Knowing their superior peers can trigger a feeling of deprivation and often lead to a higher level of impatience. In an experiment by Loewenstein (1990), fifth graders who won a lesser prize of \$4 versus their opponents who won 8\$ appeared to be more impatient than subjects who won the same prize, but whose opponents won only \$2. People who lost were willing to give up more to get the reward immediately (.43¢ versus .12¢). The outcome shows that people used their peers' awards as the standard and adapted to a new reference level. Knowing that their opponents have won triggered greater feelings of deprivation for the people who lost, thus people who lost became less patient to get the reward than winners.

Barken and Busemeyer (1999) discussed the effect of experience on the reference point. In an experiment, participants were asked to play a sequence of two identical gambles, where the participant is either going to gain \$200 or lose \$100 with a probability of ½ in each gamble. The participant was first asked to make a planned choice about the second gamble. After the first gamble is played, the same participate was

¹ Related literature on the topic includes Ainslie and Haendel (1983), Benzion, Rapoport, and Yagil (1987), Chung and Herrnstein (1967).

² Related studies include Brickman and Bulman (1977), Easterlin (1974), Merton (1968), Stoouffer et al. (1949), Zajonc (1968).

asked to make a final decision on the second gamble. The results showed that the participants' final choice were inconsistent with their plans. Experiencing a gain in the first gamble tends to make the participant switch from accepting the second gamble to rejecting it, while experiencing a loss in the first gamble tends to make the participant switch from rejecting the second gamble to accepting it. Under the circumstance of unknown outcome, the decision is made without incorporating any information in the first gamble. Therefore, when the outcome of the first gamble is unknown, the final evaluation is made against a current position of zero (because no gain or loss has happened). When the outcome of the first gamble is known, the final evaluation is made against a different position corresponding to an actual gain or loss in the first gamble. This result implies that the reference points play an important role in the evaluation of second gamble.

4. Other explanations for time – inconsistent preferences

The previous sections reviewed the explanations for time – inconsistent preferences by particularly focusing on the concept of reference dependence. Another explanation for time – inconsistent behaviors is *isolation effect* by Tversky and Kahneman (1979). People generally discard components that are shared by all prospects under consideration. This tendency leads to time–inconsistent preferences when the same choice is presented in different forms. Tversky and Kahneman constructed a two-stage game to demonstrate this point. In the first stage, there is a probability of 3/4 to end the game and a probability of 1/4 to move into the second stage. In the second stage, there are two choices: one is to win \$3000 for sure; the other is to win \$4000 with a probability of 4/5. So the chance to win \$4000 is 1/5 and the other chance to win \$3000 is 1/4. Among 141 subjects, 80 percent chose the first one whereas 65 percent chose the latter one if they were just asked to choose between the game 1/4 chance to win \$3000 and the game of 1/5 chance to win \$4000. The reason is that after moving into the second stage, the decision maker faces a choice between a risky and a riskless prospect. The outcome of winning \$3000 has a certainty advantage in the sequential game, which does not exist in the one shot game. The outcome indicates that the contingent certainty of a fixed return enhances the attractiveness of this option, relative to a risky venture with the same probabilities and outcomes (Tversky and Kahneman, 1979).

5. Policy implications

Time-inconsistent preferences are observed in behaviors ranging from smoking, drinking, fast food consumption to saving money. To remedy or alleviate the problems, the self-control devices such as rehabilitation programs and commitment can be used in policies and regulations.

Licenses and taxes are among those forms of self-control that have been utilized as both a source of revenue for governments and as a commitment device. However, it is difficult to find a subsidy or tax policy that is Pareto efficient (Phelps and Pollak (1968), Goldman (1979)). To address this issue, Bhattacharya and Lakdawalla (2004) suggest alternative taxation policies where smokers could be allowed to purchase “smoking licenses” when they start to smoke, and in exchange commit their future selves to face compensated cigarette taxes. Their idea is to shift the cost of taxation entirely onto the people with the highest willingness to pay, namely younger people, while continuing to target the effect of taxation toward the future selves. They have shown that this scheme improves the welfare of current and future smokers and generates positive revenue for the government.

In the context of savings, social security has served as a commitment device to prevent poverty among the individuals who have insufficient savings during their working years. However, the studies³ have shown

³ Related studies include Docquier (2002), İmrohoroğlu et al. (2003), Cremer et al. (2008), Bucciol (2008), Kumru and Thanopoulos (2008), Findley and Caliendo (2008), Caliendo and Gahramanov (2009), and Findley and Caliendo (2009), etc.

that a social security system with a negative present value cannot be rationalized. Caliendo (2011) furthered the study by putting no restriction on discount function and allowing tax and transfer scheme. Once again, he has shown that it is impossible for consumer to benefit from participating in a social security program with a negative net present value even with tax and transfer scheme.

Self-control models were also utilized to study the issue of privacy protection. Acquisti (2004) has shown that it is unlikely for individuals to act rationally when facing privacy sensitive decision. In particular, he found that individuals have a tendency to under-protect themselves against privacy risks and over-provide personal information. The results suggest that regulative policies may be needed to enforce the liabilities and increase individuals' welfare.

In addition to the above mentioned behaviors, time-inconsistent preferences are also observed in the consumption that is related to environment. For example, as the level of pollution increases, it is likely that more consumers will choose to consume electricity generated by green energy like wind power and solar panel than the electricity generated by fossil fuels. Cropper and Laibson (1998) studied related issue in the context of project evaluation. They have shown that by subsidizing the discount rate that is applied to environmental projects, the government can help prevent from the overconsumption of the environmental goods.

Despite numerous theoretical and experimental papers on time-inconsistent preferences, the research on their policy implications is slim. A further analysis on time-inconsistent behaviors and their policy implications remains to be done.

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