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Economic Consequences of Mispredicting Utility

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ECONOMIC CONSEQUENCES OF MISPREDICTING UTILITY

Bruno S. Frey and Alois Stutzer*

January 14, 2008

Abstract: A framework is proposed for organizing phenomena related to the (mis)prediction of utility, in particular neglecting adaptation. A categorization is introduced that accounts for asymmetries in misprediction. In decision-making, goods and activities satisfying extrinsic desires are more salient than those serving intrinsic needs. Accordingly, there is an over-consumption of the former compared to the latter. The theoretical analysis is consistent with econometric evidence on commuting choice using data on subjective well-being. People show substantial adaptation to a higher labor income but not to commuting. This may account for the finding that people are not compensated for the burden of commuting.

JEL classification: A12, D11, D12, D84, I31, J22

Keywords: adaptation, extrinsic/intrinsic attributes, individual decision-making, misprediction, subjective well-being, time allocation

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Economic Consequences of Mispredicting Utility

I. The Issue

Consider a job offer promising an increase in income of $ 30,000 a year, but which is farther away from where you live. Due to a longer commute, you will have less time available for your family and friends, hobbies, gardening and dancing. How will you decide?

We argue that individuals systematically mispredict utility in such choice situations. They underestimate the utility relating to aspects of consumption satisfying intrinsic needs (time spent with family and friends or on hobbies). In contrast, the characteristics relating to consumption satisfying extrinsic desires (income and status) are overvalued. As a consequence, individuals tend to under-consume goods and activities with strong intrinsic attributes, compared to those with strong extrinsic attributes. According to their own subjective evaluation, individuals make distorted decisions when they choose between different options and obtain a lower utility level than they otherwise would.

The argument is based on the notion that individuals find it difficult to make comparisons between attributes, whose salience shifts over time. Specifically, people fail to make an accurate prediction of adaptation. Moreover, adaptation and the degree of its prediction systematically differ across goods and activities. We propose the nature of needs that choices are satisfying as differentiation criteria, emphasizing the intrinsic and extrinsic attributes of choice options. It is hypothesized that people adapt less to intrinsically rewarding activities and goods than to extrinsic satisfiers. We take two propositions that are derived from our arguments and empirically test them when applied to commuting decisions. First, we study whether people commute too much in the sense that they are not fully compensated for the burden of commuting. Second, we analyze whether there is differential adaptation to a higher labor income and an increase in commuting time. Our findings, based on panel data on reported life satisfaction for Germany, show substantial adaptation to a higher labor income, but sensitization, albeit small, to commuting. This result can account for the paradoxical observation that people are not fully compensated for the burden of commuting.

This paper intends to make three contributions. First, a simple conceptual framework is proposed to organize a multitude of phenomena related to the prediction of utility in research in economics and psychology. This allows them to be introduced into economics. Second,

based on the categorization of goods and activities as predominantly characterized by extrinsic or intrinsic attributes, testable predictions are derived about the economic consequences in terms of distorted choices. Third, an empirical strategy is developed, based on data on reported subjective well-being to test for utility misprediction.

Section II discusses individual decision-making, where the salience of the characteristics of goods and activities differs from the moment when people make a decision to the period of consumption. Section III gives reasons why people mispredict utility and undervalue the intrinsic attributes of choice options when compared to the extrinsic attributes. We draw on both psychological and institutional insights and refer to related phenomena. The following section IV raises the question why there is little or no learning in utility misprediction. Section V provides an econometric analysis for a specific, but important example; the income/commuting trade-off discussed at the outset. Section VI draws concluding remarks.

II. Individual Decision-Making When the Salience of Attributes Changes

Standard economic theory assumes that individuals are able to compare the future utilities provided by the goods and activities consumed, and that they maximize their own utility in a rational consumption decision. In certain cases, it has proved useful to distinguish between the various characteristics of goods and activities (Lancaster 1966, Becker 1965) or the different attributes of options (e.g. Keeney and Raiffa 1976). However, this differentiation is not taken to affect the evaluation of future utility. The utility of a chosen combination is simply the sum of the weighted value of each characteristic.

The standard economic model of consumer decisions is appropriate for most goods and activities and for most situations. It is also appropriate when individuals make random prediction errors, or when the extent of misprediction is the same for *all* goods and *all* activities.

This paper diverges from the assumptions of the revealed preference approach underlying standard economics in two significant ways:

First, we allow for the fact that people mispredict utility[1]; i.e. ex ante predicted utility from different choice options (that is supposed to guide people's behavior) does not match with actual ex post experienced utility.[2] In order to generate a tractable framework, we simply represent this misprediction as a change in the salience (or the weight) given to different attributes of goods and activities in people's evaluations (ex ante and ex post). Different sources of utility misprediction are discussed in the next section.

Second, we argue that there are systematic differences in misprediction and focus on the attributes of choice options. Only with this additional presumption is a directed hypothesis about distorted behavior possible. In this second conceptual step, we differentiate between two types of attributes characterizing various options.[3]

- Attributes of the first type relate to 'intrinsic needs'. A comprehensive view of the main aspects of intrinsic needs is provided in the self-determination theory of Deci and Ryan (e.g. 2000). First, there is a need for relatedness, referring to the desire to feel connected to others through love and affection (having family and friends and being in a social setting). Second, a need for competence refers to the propensity to control the environment and experience oneself as capable and effective. Third, a desire for autonomy involves the experience of being in charge of one's actions or being causal.[4] Intrinsic need attributes are also characterized as providing "flow experience" (Csikszentmihalyi 1990), i.e. when one is completely immersed in an activity, often a hobby.

- The second type of attributes relates to 'extrinsic desires'. Extrinsic attributes serve people's goals for material possessions, fame, status or prestige. Income thus becomes a crucial aspect of options in the choice set. A high income allows for a high standard of living in material terms.

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[1] The misprediction of utility has recently also been introduced in the series on anomalies in the *Journal of Economic Perspectives* (Kahneman and Thaler 2006).

[2] This terminology follows the work of Kahneman et al. (1997) in which utility is interpreted as a hedonic experience. Both utility measures – predicted and experienced utility – diverge from traditional decision utility that is derived from individual behavior.

[3] We borrow these categories from a large literature in humanistic or value psychology (e.g. Maslow 1968, Rogers 1961).

[4] The underlying theories are manifold, and include the urge to master one's environment for its own sake (White 1959) to be an origin (DeCharms 1968), to resist loss of control (Brehm 1966) and the reflection of perceived control in more effective behavior and higher positive affects (Bandura 1977, Seligman 1992).

Each option, activity and even good is multidimensional; in general, a particular choice alternative has both intrinsic and extrinsic need attributes or, in short, intrinsic and extrinsic attributes. But some goods and activities are more intrinsic by nature (e.g. time spent with friends)[5], while others are more extrinsic by nature, like consumer articles that go beyond basic material needs (e.g. designer clothes). In this analysis, we neglect the satisfaction of physiological needs and concentrate on the gratification of needs through time and income that are available for discretionary use.

Our main proposition is that, when *making a decision*, the extrinsic attributes are relatively more salient than the intrinsic attributes of different options. When it comes to decision-making, individuals therefore tend to undervalue the future utility of intrinsic attributes compared to extrinsic attributes. This distortion leads to a systematic discrepancy between predicted utility and experienced utility.

III. (Asymmetric) Adaptation and Other Potential Sources for Mispredicting Utility

1. Underestimating Adaptation

There is convincing empirical evidence that individuals are not good at foreseeing how much utility they will derive from future consumption (e.g. Loewenstein and Adler 1995). For an extensive survey, see Wilson and Gilbert (2003).[6] Research on affective forecasting shows, in particular, that people tend to overestimate their reactions to specific events because they are embedded within other daily life events that they are not currently aware off: for instance, seeing their favorite soccer team win is experienced simultaneously with other events occurring in the environment. Another example of errors in predicting emotions is that people

[5] When people spend time with friends because they are famous or important, the extrinsic dimension becomes more prevalent.

[6] Standard research designs are prospective longitudinal studies about self-reported emotions. People are asked how happy they expect themselves to be after an event has occurred or after an option has been chosen. These predictions are then compared with reported subjective well-being when actually experiencing the new situation. There are several limits to this design: (i) Usually only predictions for changes in the near future are assessed. (ii) The way in which scales of measurement are interpreted can change over time, e.g., due to maturation or a change in the anchor. (iii) Predictions might also affect actual feelings or even become self-fulfilling prophecies. Some of these problems can be eliminated by conducting studies between subjects, where one group's predictions are contrasted with another group's actual reports.

underestimate their ability to successfully cope with negative events.[7] The general notion is that people usually have biased expectations about the intensity and duration of emotions, in the sense that the emotional impact is often lower than predicted because people adapt more than they foresee.

We argue that adaptation is more likely to be underestimated for extrinsic aspects than for intrinsic aspects. People adapt less to goods and activities with strong intrinsic components because the (positive) experience tends to be renewed with every new act of consumption. Getting together with a good friend is always rewarding, and one does not get used to it in the sense of valuing this experience less and less. Rather, the opposite is true. Each interaction with the friend provides fresh pleasure and enjoyment. Similarly, many scholars have a flow experience when they immerse themselves in writing a paper or book they always wanted to write. The corresponding utility does not wear off. Thus, many senior scholars, who have written numerous papers and books in the past, experience the same flow as when they were young.

The differential effect on the intrinsic and extrinsic attributes of goods and activities is consistent with much of the recent empirical evidence (for a survey, see Frederick and Loewenstein 1999). It has been found that individuals do not adapt their utility evaluation in the case of undesirable experiences that inhibit intrinsic need satisfaction. In particular, severe health problems, like chronic illness, or illness that gets progressively worse, reduces autonomy and leads to lasting reductions in reported subjective well-being (e.g. Easterlin 2005). People also do not fully adapt to positive intrinsic need fulfillment. This is, the case, for example, for marriage supporting the desire to be connected to others through love and affection (Clark et al. 2008, Stutzer and Frey 2006). Having a job is related to many aspects that provide flow experiences and satisfy intrinsic needs, like being in the company of workmates, applying expertise and experiencing autonomy. Accordingly, being unemployed is repeatedly found to have high negative non-pecuniary effects on people's subjective well-being, with little habituation (Clark et al. 2001). By way of contrast, having a job with a high degree of autonomy, as in the case of self-employed people, is related to high job satisfaction.

[7] Young academics might be particularly worried about life after a negative tenure decision. Gilbert et al. (1998) asked assistant professors how happy they thought they would be after a positive and a negative tenure decision. The answers were compared with the reported subjective well-being of academics affected by a tenure decision made five or less years previously. Although assistants predicted they would be less happy in the first five years after being turned down, there was no statistically significant difference between those who had and had not gotten tenure. Similarly, assistants also overestimated the positive impact of receiving tenure on their subjective well-being.

Thus Benz and Frey (2004) show that self-employed people derive more utility from their work than people employed by an organization, irrespective of income earned or hours worked. Moreover, they can explain this difference by people's evaluation of the use of initiative at their work place and their satisfaction with the actual work itself. Intrinsic attributes also characterize volunteer work. It is found that people doing volunteer work are more satisfied with their life in general, even when the possibility of reverse causality is accounted for (Meier and Stutzer 2008).

In contrast, there is empirical evidence that individuals experience a considerable extent of adaptation in the case of goods and activities in which the extrinsic aspects are dominant. In particular, this has been demonstrated for income (van Praag 1993, Easterlin 2001, Stutzer 2004, Di Tella et al. 2006). When individuals experience a rise in income, their utility level at first increases but, after a year or so, most of this beneficial effect has evaporated. It has been estimated (van Herwaarden et al. 1977) that around 60% of the utility increase due to a higher position in the income distribution disappears over time.

The evidence of little adaptation for goods and activities characterized by intrinsic aspects, and strong adaptation for those characterized by extrinsic aspects, suggests that individuals who underestimate adaptation, or even disregard adaptation altogether, tend to make a bigger mistake when predicting future utility from extrinsic attributes than from intrinsic attributes.

2. Distorted Memory of Past Experiences

When individuals - in the absence of information on current experience - make decisions about future consumption, or allocation of time, they have to refer to past experiences. People reflect on specific moments from the past or access generalizations about likely emotions in a particular type of situation (for a discussion, see Robinson and Clore 2002). If specific information is available, it has priority in people's judgment. Thereby, the more memorable moments of an experience disproportionately affect retrospective assessments of feelings (Kahneman 1999). What counts as " more memorable" tends to be the most intense moment (peak) and the most recent moment (end) of an emotional event. This peak-end rule or duration neglect has been established in many experimental tests (Kahneman 2003).

Intrinsic attributes are seen to relate to long-term experiences of moderate but enduring positive feelings. In order to be open to renewed enjoyment of the type of interactions mentioned above, as well as to be able to immerse oneself in a flow experience, time is needed. In contrast, extrinsic attributes are related to short-term experiences, in particular peak emotions. As a result, we argue that the intrinsic aspects of goods and activities related

to their duration (compared to the extrinsic aspects related to peaks) are underestimated when people predict utility based on retrospection.

3. Rationalization of Decisions

Individuals have a strong urge to justify their decisions, both to themselves and to other people (for pre-decision justification, see Shafir et al. 1993). Not only does predicted consumption utility affect, for instance, consumption decisions, but also whether people think that they are getting a bargain (Thaler 1999). There is a general tendency to resist affective influences and to take rationalistic attributes into account when making decisions. Hsee et al. (2003) call this reason-based choice "lay rationalism". In experiments, they find, for instance, that people focus their decisions on absolute economic payoffs and play down non-economic concerns. Other experiments find that people emphasize aspects of events that are easy to articulate and neglect aspects that are important for experience when asked to give reasons during the decision-making phase (e.g. Wilson and Schooler 1991). Similarly, people seem to base their choices on rules and principles, and to bypass predictions on the experiential consequences of their choices (e.g. Prelec and Herrnstein 1991). These arguments imply that people do not optimally consider the various attributes of different options so that predicted utility would be maximized.

We argue that, for extrinsic and intrinsic attributes, there is a similar inconsistency when it comes to decision-making. It is much easier to provide rationalistic justifications for extrinsic rather than intrinsic characteristics. Consider again the job offer providing more income but less leisure-time. Most people will find it much easier to justify both to themselves and to others why they should accept the job offer, as the extrinsic monetary dimension is salient. In contrast, it is quite difficult to justify why the intrinsic characteristics provided by more leisure-time (even when its hedonic utility might be correctly predicted) are important enough to refuse the large increase in money. As a result, goods and activities characterized by strong intrinsic attributes tend to carry little weight when it comes to decision-making, compared to extrinsic components.

4. Intuitive Theories about the Sources of Utility

People have very diverse intuitive theories about what makes them happy (for a discussion see Loewenstein and Schkade 1999). These beliefs have a direct influence on people predicting future utility and can cause them to make mistakes. Moreover, these beliefs play a

role because they shape the reconstruction of past emotions and make them consistent with current self-conceptions or beliefs (Ross 1989). Thus, intuitive theories interact with the three previously discussed sources of misprediction.

An important belief refers to acquisition and possession as important goals on the way to happiness, i.e. materialism (e.g. Tatzel 2002 for a discussion in economics). It is found that people with material or extrinsic life goals report lower self-esteem and life satisfaction than people with intrinsic life goals (e.g. Kasser and Ryan 1996, Sirgy 1997). This correlation is probably partly due to confounding factors, like unobserved personality traits and reversed causality due to a compensatory reaction of people with low subjective well-being. However, it might also indicate that people who believe intuitively in extrinsic attributes are prone to mispredict future utility. In contrast, people with intrinsic life goals for personal growth, relationships and community spirit apply intuitive theories that emphasize intrinsic attributes, which in turn lead to fewer mispredictions in future utility. Our argument thus includes heterogeneity among individuals that leads to additional testable predictions when combined with previous reasons for misprediction.

5. Institutional Conditions

The differential effect of misprediction between intrinsic and extrinsic attributes also depends on the extent to which the market enters into the matter. The monetarization of a good or activity induces individuals to focus more on extrinsic attributes than they otherwise would. This applies to both work and consumption. It has been argued that introducing pay for performance leads employees to regard those performance aspects, which are relevant for the compensation they receive, as predominant. In contrast, aspects of performance irrelevant to pay are crowded-out (see Frey 1997 and, for a survey of empirical evidence, Frey and Jegen 2001). In the area of consumption, advertising is often aimed at extrinsic aspects of the goods to be sold. In comparison, lobbies for intrinsic values tend to be weak and sometimes do not exist at all. To the extent to which “commercialization” occurs (see e.g. Kuttner 1997, Lane 1991), individuals are induced to mispredict the future utility of goods. They are led to believe that the extrinsic characteristics will make them happier than is actually the case compared to the intrinsic characteristics.

6. Related Phenomena

The propositions developed in this section link up to various strands of literature where related phenomena have been identified:

- The aspect of underestimated adaptation to new situations has been neatly introduced into theoretical models of intertemporal decision-making (Loewenstein et al. 2003). Based on their model of projection bias, various phenomena can be modeled like, e.g., the misguided purchase of durable goods or consumption profiles with too high consumption early on in life. Misprediction of utility thus provides an alternative to seemingly irrational saving behavior that is usually addressed in a framework of individuals with self-control problems. In Loewenstein et al. (2003), however, there is no explicit modeling of differences in adaptation *across* goods, attributes of different options or people.
- It has been argued that the "work-life" balance of individuals nowadays is distorted. People are induced to work too hard, and to disregard other aspects of life. This proposition has been forcefully put forward for the United States, where individuals are said to be "overworked" (Schor 1991). This is consistent with our hypothesis that individuals tend to focus too much on options characterized by strong extrinsic attributes, in particular income, rather than on intrinsic attributes.
- Competing for status involves negative externalities and therefore too much effort is invested in gaining status and acquiring "positional goods" (Frank 1985, 1999). Such goods are characterized by very strong extrinsic attributes. The saying "Keeping up with the Jones's" reveals that consumption is externally oriented. Thus, misprediction of utility is likely to magnify the distortions of status competition through consumption.
- Procedural utility, i.e. the satisfaction derived from the process itself rather than from its outcome, refers to innate needs. The utility derived from a particular process contributes to competence, relatedness and autonomy, and is therefore closely related to the intrinsic attributes of goods and activities (see the survey by Frey et al. 2004). According to our propositions, sources of procedural utility are likely to be underestimated in people's decision-making. Consistent with this idea, it has been empirically shown (Tyler et al. 1999) that, when making decisions, individuals tend to prefer institutions promising favorable outcomes. But they state *ex post* that they would have preferred an institution putting more emphasis on (just) procedures.

- There is a long tradition in economics arguing that individuals tend to focus too much on material goods and disregard goods providing non-material benefits (see Lebergott 1993, Lane 1991). Most importantly, Scitovsky (1976) claimed that "comfort goods" are over-consumed compared to goods providing "stimulation". Comfort goods are described as defensive activities, protecting against negative affect. They have a strong extrinsic component, consisting of the consumer goods achieved through rapid productivity growth. In contrast, stimulation comes from creative activities providing novelty, surprise, variety and complexity. These aspects accentuate the renewal of pleasurable experiences, as it is also emphasized for intrinsic attributes. Unlike our theory, stimulation is at a competitive disadvantage compared to comfort goods because of the higher access costs and because consumers are myopic about the future benefits from stimulating activities.

IV. Why Is There Little or No Learning?

Systematically mispredicting future utilities, even if they differed between goods and activities, would be of little consequence for economics if individuals would learn quickly in repetitive choice situations.[8] If this were the case, mispredicting would be a disequilibrium phenomenon, not basically affecting the notion of rational decision-makers maximizing individual utility.

A large literature suggests, however, that learning is a complex process, which does not necessarily lead to overcoming mispredictions. It is likely to do this if multi-dimensional goods and activities are reduced to essentially one dimension, which can be expressed in monetary terms. In that case, the individual can be expected to be able to rectify his or her mistakes to a large extent within a short period of time. Standard economic models then apply fully.

In the choice situation considered here, where the importance of various attributes differ between the point of time when people have to make a decision and actual consumption time, learning is much more difficult. Where decisions on future consumption are concerned, learning must often be based on the recollection of past feelings. They are therefore subject to the same misperceptions as remembering the utility of past experiences (see previous section on distorted memory). Learning is particularly hampered when there are too few episodic

[8] In contrast, learning is not an option when it comes to once-in-a-lifetime choices. Biased decisions can then well affect one's life path. We believe that misprediction of utility matters greatly when it comes to important life decisions (like career choice), but we have not studied them here.

memories and people rely to a large extent on their intuitive theories (Robinson and Clore 2002). In consequence, remembered utility and predicted utility become similar and relatively independent of the utility actually experienced. Mitchell et al. (1997), for example, document this phenomenon in three survey studies of different types of vacation; tourists traveling to Europe, students going home for Thanksgiving and students making a cycling tour in California. Participants in the studies were asked how much enjoyment they anticipated, actually experienced and later remembered in connection with their vacation. Although participants enjoy the actual trip less than predicted, they report enjoyment levels similar to the ones predicted before the trip when they recall the experience later.

Learning, in contrast, is easier when people can access their feelings directly, i.e., while still experiencing a particular situation. It might even inspire them to adopt institutional preconditions to sustain optimal decisions after the event. Most of us are familiar with the experience of not getting together with friends as often as we would really like when reflecting on it immediately after the meeting. It is difficult to imagine how enjoyable it was once we are back in our daily routine and have to find time in our busy schedules. One of the authors experimented with trying to overcome this particular problem by fixing a new date whilst still with the friends and aware of the pleasure of being in their company. It resulted in getting together more frequently and enjoying the meetings to the same extent as before. On another note, moments of pure bliss and very traumatic experiences can abruptly change people's intuitive theories about what constitutes happiness.

In general, however, a more elaborate learning process is required. The individual needs to step back from his or her actual decision-making activity, where the extrinsic characteristics dominate over the intrinsic characteristics. He or she should attempt to make an overall evaluation, including undertaking some critical self-examination, or resort to what has been called "double-loop learning" (see Argyris and Schön 1978). As such elaborate learning is more costly, and is itself subject to errors, individuals are not able to fully correct their mispredictions within a reasonably short period of time. In many cases, they are not capable of making any correction, so that the misprediction of future utilities persists over time.

Limited learning can well co-exist with people's partial awareness of themselves or others mispredicting utility.[9] Many people talk, for example, about the difficulties and mistakes they

[9] Systematic differences between self-evaluation and the assessment of others' decisions are likely due to over-optimism (Weinstein 1981). Thus people are overly confident about their own ability to make the right decisions, while at the same time being aware that the average person mispredicts utility.

experience in balancing their working life with their personal life. Yet, on a case-by-case basis, they still make decisions underestimating intrinsic attributes relative to extrinsic attributes.[10]

A more fundamental reason for a person's limited learning capacity might lie in the functionality of misprediction in the evolutionary process. Rayo and Becker (2007) model how humans' utility functions formed in order to maximize success in genetic replication. Their model rationalizes that people neglect adaptation (described as self-inflicted externality). However, in today's world, this utility function with an inbuilt misprediction may no longer be helpful in guaranteeing an optimal mix between experienced utility and motivation for success in society.

V. Empirical Application to Commuting Choice

When people choose between different jobs and different possible places of residence, they face the difficult decision of how far they are prepared to commute.[11] It involves challenging trade-offs, often along the line that housing further away would be more exclusive for the same price, or a job further away would come with a higher salary. Based on the hypothesis that, when making decisions, people systematically underestimate future utility from the intrinsic attributes of goods and activities compared to extrinsic attributes, it is possible to predict individuals' choices concerning different jobs and different places of residence. He or she can be expected to underestimate an important aspect, namely commuting time. Time spent commuting is no longer available for spending with friends and family members or indulging in a favorite hobby, i.e., intrinsically rewarding activities. People mispredict utility when they choose a job/housing situation and end up spending too much time commuting. Job

[10] This argument is similar to the ones about sophisticated and naive people, who are fully or not at all aware of their future self-control problem (for a discussion of self awareness, see O'Donoghue and Rabin 2003).

[11] In an empirical analysis, Simonsohn (2006) provides related evidence for the inherent complexity of commuting choice. He argues that commuting behavior can be better understood in a framework of constructed preferences. People come up with some reference level of commuting time or commuting radius that they are only prepared to give up after experiencing negative effects on their well-being. In a challenging study on people moving from one US city to another, Simonsohn finds that people coming from a city where the average commuting time of the population is high (or low) also choose to commute more (or less) than average at their new place of residence (keeping individuals' own past commuting experience constant). In the latter model, people can end up either commuting too much or too little.

and housing choices are often costly to correct, so that people are trapped afterwards in an unfavorable commuting situation with a burden that is not compensated.

In order to empirically test the general hypothesis of "too much commuting", first a benchmark of optimal commuting is necessary. Second, to substantiate the claim that commuting time is underestimated, evidence for a specific asymmetry in people's evaluations needs to be found. In the following, empirical tests are proposed, encompassing both directions, panel data for Germany are introduced and the results are shown.

1. Constructing an Empirical Test for Full Compensation

The prediction in neoclassical economics of individuals making perfectly rational decisions is taken as a reference standard for optimal commuting. In standard economics, people are assumed to have little difficulty with optimization when goods and activities have multiple characteristics. Commuting is like any other characteristic. Monetary costs involved and physical or mental stress[12] enter negatively into the evaluation, and have to be offset by other characteristics, like income or lower housing costs. Only then is it likely that a job offer involving a longer commuting time may be chosen. This basic idea of compensation is the driving force behind the notion of equilibrium in urban location theory (e.g. Alonso 1964, Moses 1962), as well as in public economic theory, based on Tiebout's (1956) model of fiscal competition between jurisdictions. Accordingly, commuting is determined by an equilibrium state of the housing and labor market, in which people's utility is equalized over all actual combinations of alternatives in these two markets.[13]

Utility U is thus equal to $\overline{U}$ for realized combinations of income y_i, time spent commuting D_i and rent r_i across individuals indexed by i

$$U_i = u(y_i, D_i, r_i) = \overline{U} \qquad \forall i \tag{1}$$

[12] It is well documented that commuting is both physically and mentally stressful (e.g. Novaco et al. 1990). The strain of commuting is associated with raised blood pressure, musculoskeletal disorders, lowered frustration tolerance, increased anxiety and hostility, being in a negative mood when going to work in the morning and coming home in the evening, increased lateness, absenteeism and turnover at work, as well as adverse effects on cognitive performance (Koslowsky et al. 1995).

[13] The strong notion of equilibrium has only been partially tested so far. It has not been studied whether there are systematic rents: rather, derived hypotheses within the equilibrium framework have been analyzed. There is considerable evidence for capitalization of transportation infrastructure in the price of land and for compensating wage differentials due to commuting distance. However, these findings do not require an equilibrium situation, and can also be explained by the law of marginal substitution (e.g. Timothy and Wheaton 2001, van Ommeren 2000).

Totally differentiating this equilibrium condition leads to

$$dU = \frac{\partial u}{\partial y} dy + \frac{\partial u}{\partial D} dD + \frac{\partial u}{\partial r} dr = 0 \tag{2}$$

For variation in commuting time D, this implies that

$$\frac{dU}{dD} = \frac{\partial u}{\partial y}\frac{dy}{dD} + \frac{\partial u}{\partial D} + \frac{\partial u}{\partial r}\frac{dr}{dD} = 0 \tag{3}$$

The left hand side of equation (3) states that the overall change in utility due to a change in the disamenity cost of commuting time is zero. A decomposition of the total change is provided on the right hand side of equation (3). There are three effects from an increase in commuting time: there is a marginal gain in utility due to a higher level of consumption that is reached because jobs that require longer commutes offer a higher income. Moreover, longer commuting time reduces rents for housing and thus leaves additional money for consumption. Besides these two positive effects, there is a marginal decrease in utility due to the burden of spending more time commuting. Given that incomes and rents for housing exclusively reflect compensation for commuting conditions, the three effects add up to zero.

The prediction in equation (3) can be directly tested, provided utility is observable. Stutzer and Frey (2008) set up such a test, taking commuters' reported satisfaction with life as a proxy measure for individually experienced utility.[14] The idea for the empirical test is captured in the following regression equation

$$u_i = \alpha + \beta D_i + \varepsilon_i \tag{4}$$

The coefficient β measures the total change in utility due to a change in commuting time. Under the null hypothesis $\beta = 0$, commuting time is entirely compensated either by higher salaries or by lower rents for housing. This is the prediction of standard economic theory, assuming full compensation of the cost of commuting through higher income and lower housing costs. The alternative hypothesis $\beta < 0$ states that commuting time is not fully compensated on the labor and housing market. $\beta < 0$ is predicted when commuters systematically underestimate the costs of commuting and accept jobs or choose housing that do not fully compensate them.

[14] This approach follows a substantial recent literature on reported subjective well-being, satisfaction and happiness in economics (e.g. Frey and Stutzer 2002a,b, Layard 2005, Di Tella and MacCulloch 2006), as well as in psychology (e.g. Kahneman et al. 1999, Diener et al. 1999).

The actual regression estimated below with panel data takes individual heterogeneity into account. In particular, a large set of covariates X of reported life satisfaction, as well as individual and time specific effects λ_i and τ_t are controlled for:

$$u_{it} = \alpha + \beta D_{it} + \varphi X_{it} + \lambda_i + \tau_t + \varepsilon_{it} \tag{5}$$

No job or housing related variables (most importantly labor income) are included. This is crucial, because income is one of the variables through which people are expected to be compensated for their daily journey to and from work. Equation (5) only makes a clear prediction of $\beta = 0$ if all sources of compensation remain uncontrolled.[15]

2. Construction of the Empirical Test for Differential Adaptation

A crucial aspect of whether trade-offs lead to systematically distorted decisions because of utility misprediction rests on some sort of asymmetry in the degree of misprediction across choice options. We emphasize the differential adaptation to goods and activities that satisfy intrinsic and extrinsic needs. In the case of commuting, commuting time refers to intrinsic needs while labor income is one possible variable that refers to extrinsic needs.

Adaptation to repeated stimuli can be studied using multiple reports of a person's subjective well-being. As we want to understand misprediction involved in people's more or less deliberate choices, we study adaptation to variation in circumstances that are brought about by the normal course of life rather than by some external shocks. Moreover, the set of covariates of reported life satisfaction is extended to include working hours and labor income in order to separate adaptation to the major characteristics of someone's work and commuting situation.[16] For the empirical analysis, equation (5) is extended to include current and lagged variables of the major choice variables, i.e. commuting time, labor income y and working hours h:

$$\begin{aligned} u_{it} = {} & \alpha + \beta_1 D_{it} + \beta_2 D_{it-1} + \beta_3 D_{it-2} + \beta_4 D_{it-3} + \\ & \gamma_1 \ln y_{it} + \gamma_2 \ln y_{it-1} + \gamma_3 \ln y_{it-2} + \gamma_4 \ln y_{it-3} + \\ & \delta_1 h_{it} + \delta_2 h_{it-1} + \delta_3 h_{it-2} + \delta_4 h_{it-3} + \varphi X_{it} + \lambda_i + \tau_t + \varepsilon_{it} \end{aligned} \tag{6}$$

Based on the estimated coefficients β_1 to β_4 and γ_1 to γ_4, the degree of dissipation in the impact of a change in commuting time and labor income on subjective well-being can be simply calculated by dividing the sum of the coefficients for the lagged variables by the initial

[15] If income is kept constant, commuting time is expected to enter negatively into the equation.

[16] Due to lack of data, we cannot study adaptation to luxury housing.

effect, i.e. $(\beta_2+\beta_3+\beta_4)/\beta_1$ and $(\gamma_2+\gamma_3+\gamma_4)/\gamma_1$. To test for full adaptation, the hypotheses $\sum_{l=1}^{4}\beta_l = 0$ and $\sum_{l=1}^{4}\gamma_l = 0$ are set up.

3. Data and Sample Selection

The two proposed empirical tests are performed with data from the German Socio-Economic Panel Study (GSOEP). The GSOEP is one of the most valuable data sets for studying individual well-being over time. It was started in 1984 as a longitudinal survey of private households and persons in the Federal Republic of Germany and was extended to residents in the former German Democratic Republic in 1990. Reported subjective well-being is based on the question "How satisfied are you with your life, all things considered?" Responses range on a scale from 0 "completely dissatisfied" to 10 "completely satisfied". In addition, people in the survey are asked a wide range of questions with regard to their socio-economic status and their demographic characteristics.

Information on individual commuting time was collected in eight waves between 1985 and 2003: 1985, 1990 and 1993 for the old German Laender, 1992 for the New German Laender and 1993, 1995, 1998 and 2003 for all the Laender. People were asked "How long does it normally take you to go all the way from your home to your place of work using the most direct route (one way only)?" In order to study adaptation based on the formulated strategy, information on commuting time is required annually. As there is detailed information in the GSOEP about changes in people's jobs or places of residence, values for commuting time in intermediate years can easily be imputed. We follow a simple procedure. First, we check whether a person either changes his job and/or his place of residence between the waves for which commuting time is available. For those identified as movers, imputation of commuting time is possible using information about past and future commuting time. As long as they stay in the same job and place of residence, commuting time is carried forward from the last reported year to the following year(s) where the information is missing. Accordingly, for years in the past respondents stayed in the same job and residence, commuting time is imputed backwards. If someone only moves once between years with reported information on commuting time, commuting time can be imputed throughout. For those identified as non-movers, commuting time between years with reported information is linearly interpolated.

The sample selection is based on the following criteria: First, we restrict the sample to those who either commute on a regular basis to the same workplace, or work at home, and report being either employed or self-employed. Second, we focus on people who are most likely to be equally involved in the household decision on where to live and work, i.e. the heads of households and their spouses. Third, as underemployment is a serious restriction to employees in Germany (Statistisches Bundesamt Deutschland 2006), we only include full time workers in the sample. On average, people in the selected sample commute 22 minutes one way, with a standard deviation of 18 minutes.

4. Econometric Estimations for Incomplete Compensation

The first empirical test extends previous work on commuting and life satisfaction by Stutzer and Frey (2008). The results of the earlier study are summarized and replicated for the extended data set with imputed data on commuting time. Moreover, they are integrated in the context of utility misprediction.

In table 1, equation (5), which captures the effect of commuting time on life satisfaction, is estimated in a least squares regression (column A), taking a large number of individual characteristics into account, as well as year and individual specific effects.[17] The latter exclude spurious correlations due to time-invariant unobserved characteristics of people that are systematically correlated with people's commuting time and reported subjective well-being.

[Table 1 about here]

The partial correlation reveals that commuting time has a negative effect on life satisfaction. People who spend one hour rather than 0 minutes commuting (one way) report, on average, a -0.115 points (t=-3.40) lower level of subjective well-being. For one standard deviation (i.e. 18 minutes), the effect is -0.034 (t=-3.40). The size of the commuting effect for one standard deviation is one-eighth of the effect of finding or losing a partner for those being single.

[17] Here, only ordinary least squares estimations are reported. Thus, it is implicitly assumed that the answers can be cardinally interpreted. While the ranking information in reported subjective well-being would require ordered probit or logit regressions, comparative analyses for GSOEP have shown that it makes virtually no difference whether responses are treated ordinally or cardinally (Ferrer-i-Carbonel and Frijters 2004). The 11 categories of the dependent variable seem to mitigate potential problems from assuming continuity.

Compared to the effect of becoming unemployed (=-0.671) (see Stutzer and Frey 2004, table 4), an increase in commuting time by one standard deviation (one hour) is about one twentieth (sixth) as bad for life satisfaction.

This result is at odds with the benchmark prediction of standard location theory and the implicit assumption in many economic models that people are compensated, on average, for commuting. Rather, it is consistent with the view that people who mispredict utility and opt for too long a commuting time are trapped in a situation in which they are not compensated for the burden of commuting.

A discussion of the results (not shown) for the socio-demographic and socio-economic covariates of life satisfaction in Germany can be found in Stutzer and Frey (2004) and Frijters et al. (2004).

However, there might be alternative explanations for commuters not being fully compensated[18]. First, although commuting might be a burden for those involved, other members of the family might benefit so that, overall, the households' well-being is equalized. But spouses are not reporting higher life satisfaction when their partners spend more time commuting. Moreover, the negative correlation is also found for single households where intra-household bargaining and altruism play much less of a role. Second, there are search models in urban and regional economics that build in transaction costs (e.g. Weinberg et al. 1981, van Ommeren et al. 1997). They predict lower utility for those in a disadvantaged situation with long commuting times (e.g. van Ommeren 2000) and reckon that transaction costs prevent people from adjusting to economic shocks. In particular, transaction costs might hinder people who experience a longer or more disturbing commuting time ex post than expected ex ante from re-optimizing. Therefore, people might be locked into a disadvantaged commuting situation. It is very difficult to reject an explanation based on transaction costs, especially as transaction costs can easily systematically interact with our explanation based on utility misprediction. However, an albeit smaller negative effect of commuting time on life satisfaction is also estimated for people who either change their job and/or their place of residence and so have the opportunity of re-optimizing their commuting situation. For them, there might also well be an explanation in terms of economic costs not yet found and so not yet incorporated into the analysis. This cost factor would be interesting to know, because it potentially relates to a sizeable loss in well-being and should be explicitly modeled in urban

[18] Several of them are empirically addressed in Stutzer and Frey (2008).

and public economics. Until an adequate rational choice explanation has been provided, we propose the general result to be consistent with people mispredicting utility.

5. Econometric Estimations for Differential Adaptation

The results for the second empirical test based on equation (6) are also reported in table 1. The impact of the current commuting and working situation on life satisfaction is captured in column B. In addition to the negative partial correlation for commuting time, there is a statistically significant positive correlation between real labor income and workers' well-being. An increase in labor income by 50 percent corresponds to a 0.074 points higher satisfaction with life.

Current and past levels of commuting time and labor income are taken into account in column C. The estimated coefficients for the lagged variables allude to a systematically different pattern. The levels of commuting one year back or two years back enter negatively into the estimation and thus hint at sensitization rather than adaptation to commuting. In contrast, past levels of labor income enter negatively into the equation and indicate adaptation, i.e. part of the positive impact of a higher income level is offset over time. Figure 1 shows the differential impact of past experiences graphically. For illustrative purposes, the path of reported life satisfaction is simulated for an increase in commuting time by 30 minutes and a simultaneous income increase of 50 percent in t=0.

[Figure 1 about here]

The degree of adaptation based on the estimated coefficients for labor income, i.e. $(\gamma_2+\gamma_3+\gamma_4)/\gamma_1$, amounts to -0.70 or 70 percent. The degree of sensitization when experiencing a longer commuting time, $(\beta_2+\beta_3+\beta_4)/\ \beta_1$ is estimated to be around 0.24 or 24 percent. The main asymmetry is also reflected when the hypotheses of full adaptation are tested. $\sum_{l=1}^{4}\beta_l = 0$ is rejected with prob > F = 0.033. In contrast, $\sum_{l=1}^{4}\gamma_l = 0$ cannot be rejected (prob > F = 0.333).

In sum, the observed asymmetry in the degree of adaptation to changes in the commuting/job situation is consistent with the general claim that adaptation is more pronounced for goods and activities that serve extrinsic needs rather than those that satisfy intrinsic needs. If people

have limited ability to predict adaptation, the asymmetry is carried forward to the misprediction of utility in commuting choices. The economic consequence is that people choose work/housing arrangements that involve too much commuting, for which they are not compensated, and thus experience reduced individual well-being.

VI. Conclusions

This paper argues that individuals systematically mispredict the future utility of the goods consumed and activities undertaken. Goods and activities characterized by stronger intrinsic attributes (such as spending time with family and friends and pursuing hobbies) are undervalued compared to those characterized by stronger extrinsic attributes (such as most consumer goods). Due to the complexity of having to compare various attributes, learning is slow and imperfect, so that the distorted decisions are preserved over time. As a consequence, individuals experience a lower level of utility than if they were not subject to this systematic bias of misprediction.

The result that individuals are worse off according to their own best interests distinguishes us from the more traditional "consumption critique", according to which individuals are not able to choose what is best for them – but what is "best" is evaluated according to outside preferences.

The argument synthesizes a multitude of phenomena, mainly from psychology, and related to utility (mis)prediction in a common framework. Thereby, the asymmetry in the extent of utility misprediction across goods and activities is emphasized. The proposed concept should assure the fruitful introduction of utility misprediction into economics in order to derive predictions about economic consequences in terms of individual behavior and individual welfare.

In an empirical application, individuals' commuting decisions are analyzed using data on subjective well-being. We find that people who spend more time commuting report lower life satisfaction, i.e. they are not fully compensated for the burden of commuting either by a higher salary, a better living environment or a lower rent. This is consistent with people overestimating future utility from the extrinsic attributes of job offers and housing options, and neglecting the intrinsic attributes, such as the physical burden of commuting and having less time available to spend with friends and family. In a refined analysis, the evidence for differences in the degree of adaptation is studied. It is found that full-time workers adapt, to a large extent, to a higher labor income over a period of three years. In contrast, people adapt

much less to commuting, and even seem to become increasingly sensitive toward the burden of commuting. This latter evidence adds to a consistent explanation of the commuting phenomenon in terms of utility misprediction. There is an asymmetry present in adaptation that leads to distorted choices, if adaptation is not taken into account in the evaluation of alternatives.

Research on utility misprediction in economics is only in the initial stages. Fruitful next steps could go in many possible directions. While we focus on a specific characterization of goods and activities, there might be other areas where the degree of utility misprediction systematically differs. Inspiration might come from the analysis of further trade-offs that involve choice options that are difficult to evaluate. Further promising studies could be made. In the work sphere, these studies could be based on the decision to become self-employed or to do voluntary work. In the private sphere, these studies could focus on TV viewing, which is the most time-consuming leisure time activity in the Western World, and involved in many trade-offs in time allocation. Above all, we hope reading this article was not due to utility misprediction.

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Table 1. Commuting and Life Satisfaction: Compensation and Adaptation

Full time employed or self-employed people in Germany, 1984-2005

Dependent variable: Satisfaction with life

	(A)	(B)	(C)
Commuting time t	-0.0019	-0.0020	-0.0020
	($0.56e^{-3}$)	($0.56e^{-3}$)	($1.69e^{-3}$)
t-1			$-0.49e^{-3}$
			($1.99e^{-3}$)
t-2			$-0.10e^{-3}$
			($1.84e^{-3}$)
t-3			$0.10e^{-3}$
			($1.31e^{-3}$)
Ln real labor income t	not incl.	0.1828	0.1569
		(0.015)	(0.030)
t-1			-0.0256
			(0.030)
t-2			-0.0232
			(0.029)
t-3			-0.0606
			(0.029)
Working hours	not incl.	in year t incl.	in years t-3 to t incl.
Ind. characteristics[a]	incl.	incl.	incl.
Individual fixed effects	incl.	incl.	incl.
Year fixed effects	incl.	incl.	incl.
No. of observations	85'332	85'332	37'368

Notes: Partial correlations are from least square estimations. Standard errors are in parentheses. [a] Individual control variables include age square, nine variables for marital status, three variables for the number of children in the household, the square root of the number of household members and indicators for self-employment, residence in the New German Laender, foreigners with EU nationality, other foreigners and first interview.

Data source: GSOEP.

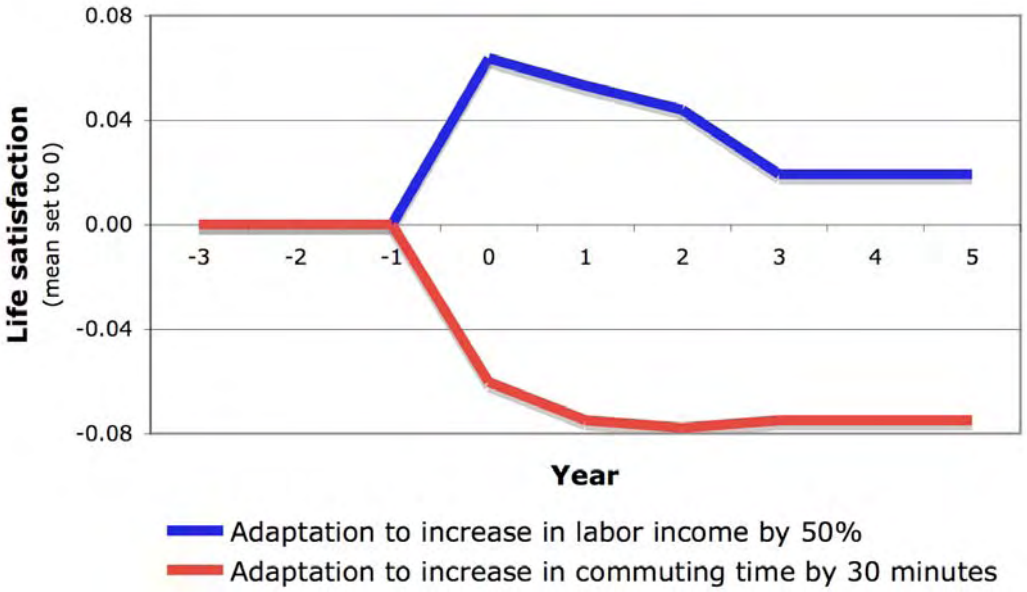

Figure 1. Adaptation to Commuting and Labor Income

Full time employed or self-employed people in Germany, 1984-2005

Note: Simulation based on the estimated coefficients in table 1, panel C.
Data source: GSOEP.