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Abstract: People spend a lot of time commuting and often find it a burden. According to economics, the burden of commuting is chosen when compensated either on the labor or on the housing market so that individuals' utility is equalized. However, in a direct test of this strong notion of equilibrium, we find that people with longer commuting time report systematically lower subjective well-being. Additional empirical analyses do not find institutional explanations of the empirical results that commuters systematically incur losses. We discuss several possibilities of an extended model of human behavior able to explain this 'commuting paradox'.

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Stress That Doesn't Pay: The Commuting Paradox

1 Introduction

Commuting is an important aspect of our lives that demands a lot of our valuable time. There are conflicting ideas on the subject. For most people, commuting is a mental and physical burden, giving cause for various complaints. From an economic perspective, commuting is just one of numerous decisions rational individuals make. If commuting has extra psychological costs, then traveling longer distances to and from work is only going to be chosen if it is either compensated by an intrinsically or financially rewarding job or by additional welfare gained from a pleasant living environment. Accordingly, commuting is determined by an equilibrium state of the housing and labor market, in which individuals' well-being or utility is equalized over all actual combinations of alternatives in these two markets. Thus, any disagreement between the two perspectives is due to the strong belief in economics that market forces lead to an equilibrium in which rents and discrimination are prevented.

The strong notion of equilibrium in urban and regional economic theory, as well as in public economic theory, has only been partially tested so far. Studies have not been carried out as to 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.[1] However, these findings do not require an equilibrium situation, but can also be explained by the law of marginal substitution.

In order to assess the power of the equilibrium framework, a direct test is necessary. Here we analyze data on subjective well-being as proxy measures for people's utility in order to directly test the strong notion of equilibrium in location theory. High quality data are available for Germany, collected by the German Socio-Economic Panel. In a data set spanning 14 years, we study whether commuters are indeed compensated for the stress incurred, as suggested in economic models. If this is the case, we should not find any systematic correlation between people's commuting time and their reported satisfaction with life.

[1] See the research cited in section 2.2.

Our main result indicates, however, that people with long journeys to and from work are systematically worse off and report significantly lower subjective well-being. For economists, this result on commuting is paradoxical.

The empirical finding is further analyzed in four ways:

First, we study the robustness of the empirical finding to different econometric specifications. In particular, a large number of background variables and time invariant personality traits are taken into account in the estimation approach.

Second, as we apply an (as yet) unorthodox approach, taking reported subjective well-being as a proxy measure for utility, we direct our attention to two explanations that the "poor" data quality might be responsible for the empirical finding: (i) Measurement errors in commuting time and reported life satisfaction might generate spurious correlation. We address possible measurement errors due to omitted variables by taking advantage of the panel structure of our data set. (ii) Biases in judgment due to the effects of the order in which questions are asked, or differences in salience, might cover up actual compensation in reported life satisfaction. Therefore, domain satisfaction is studied in order to capture possible compensation on the labor and the housing market at a disaggregate level, rather than in an overall measure.

Third, we discuss and empirically analyze three possible explanations within the traditional economic framework that would account for the commuting paradox: (i) While commuting might be a burden for those involved, those people's partners might benefit, so that, overall, the households' well-being is equalized. (ii) Transaction costs prevent people from adjusting to economic shocks and the observed correlation might simply reflect equilibrium in a "real" world with frictions. People are studied who change either their job or their place of residence, and thus have the possibility of reoptimizing their lives. The question is asked whether they also suffer lower subjective well-being when they increase their commuting time. (iii) We study the commuting effect on life satisfaction for groups of people who face different institutional restrictions in their commuting decision or are confronted by critical life events.

Finally, we suggest several possibilities of an extended model of human behavior that could bring us closer to understanding the "commuting paradox".

The paper proceeds as follows. Section 2 summarizes the costs and benefits of commuting as discussed in economics and psychology. In section 3, the data set is described and the empirical analyses are conducted. Several explanations of the commuting phenomenon are

empirically tested in section 4. Section 5 briefly discusses the results in the light of behavioral economics. Concluding remarks are offered in section 6.

2 The costs and benefits of commuting

2.1 The physical and mental burden of commuting

Commuting involves much more than just covering the distance between home and work. Commuting not only takes time, but also generates out of pocket costs, causes stress and intervenes in the relationship between work and family. In fact, it seems that commuting is *the* daily activity that generates the lowest level of positive affect, as well as a relatively high level of negative affect (Kahneman et al. 2003). Moreover, commuting is salient in the every-day routines of many people's lives. Figure 1 gives a brief overview about commuting in European countries and the United States. It clearly shows that commuting is a widespread phenomenon. Workers in these countries commute between 29.2 minutes in Portugal and 51.2 minutes a day in Hungary. The average daily commuting time in the former EU15 is 37.5 minutes. In the United States, traveling to work takes, on average, 48.8 minutes.

[Figure 1 about here]

Engineers and social scientists have studied a wide range of the private and social costs of commuting (for a review see Koslowsky et al. 1995). For example, it has been calculated for the United States that a "typical household spends nearly 20 percent of its income on driving costs – more than it spends on food" (EPA 2001). Besides these private costs, there are the social costs of commuting, due to congestion and pollution of the environment (e.g. Marzotto et al. 2000). The calculation of the costs of congestion focuses on the value of time when delays occur whilst traveling. In an extensive survey, Small (1992) concludes that "a reasonable average value of time for the journey to work is 50 percent of the gross wage rate, while recognizing that it varies among different industrialized cities from perhaps 20 to 100 percent of the gross wage rate, and among population subgroups by even more" (p. 44).
Psychologists have focused on the non-pecuniary costs of commuting and emphasize that it is an unpleasant experience that often has delayed effects on health and family life (for surveys, see e.g. Haefner et al. 2001, Koslowsky 1998, Koslowsky et al. 1995, Novaco et al. 1990). Commuting is associated with many environmental stressors like noise, crowds, pollution and thermal conditions that cause negative emotional and physical reactions. Reactions depend, of

course, not only on the time and distance involved in commuting, but also on other factors that interact with the stressors mentioned above. Commuting is more stressful when people are not in control of certain factors that can crop up during the drive to work, e.g. due to traffic congestion or when they are under considerable time pressure. The strain of commuting is associated with raised blood pressure, musculoskeletal disorders, lowered frustration tolerance and increased anxiety and hostility, being in a bad mood when arriving at 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). The commuters studied in the empirical analysis below also confirm that commuting is stressful over and above the monetary costs involved. In the sample of people who commute more than 30 minutes, 19% indicate that commuting is a big mental and physical burden, 50% indicate that it is a small burden and only 31% indicate that it is not mentally and physically stressful.

2.2 The benefits connected with commuting

An effective transportation system increases factor productivity, because it facilitates the allocation of factors to their most valuable use. This benefit is studied at the macro level. At the individual level, people benefit when they commute to an office or a factory to supply their work, or when they can find reasonable housing further away from their job. Individuals take these benefits, as well as the pecuniary and non-pecuniary commuting costs mentioned above, into consideration when they make decisions on where to live, where to work and how to commute. Accordingly, houses that are further away from the location of work opportunities are less attractive to people, and thus have a lower market value, ceteris paribus. Jobs that involve a longer commute have to pay employees more in order to attract them and keep them. If all the participants in a perfect housing and labor market optimize, all the commuters are fully compensated for their traveling costs from home to work, either by higher wages or by lower rents. Individuals' utility is then equalized over all possible locations within space.[2] These insights have been established in classical urban location theory (see Alonso 1964, Mills 1972, Moses 1962, Muth 1969 and Huriot and Thisse 2000 for

[2] This prediction is expected to hold in equilibrium. In the short run, people may not have found their optimal portfolio. There are individuals who gain rents from commuting, while others suffer from costs related to commuting that are not compensated. On average, however, it is expected that people be compensated for costs incurred from commuting. It is thus predicted that there is no systematic relationship between commuting time and people's utility level.

recent developments) and public economic theory based on Tiebout's (1956) model of fiscal competition between jurisdictions (e.g. Conley and Konishi 2002). They reflect the strong belief in economics that market forces lead to an equilibrium in which rents and discrimination are prevented.

The strong notion of equilibrium in location theory 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 distance from job locations and other amenities in housing prices (e.g. McMillen and Singell 1992, Roback 1982, So et al. 2001), as well as for compensating wage differentials due to commuting distance (e.g. Timothy and Wheaton 2001, van Ommeren et al. 2000, Zax 1991).[3]

However, these approaches do not allow us to assess whether the compensation of commuters is complete and, if it is not, to calculate the amount that would be needed. The extent of compensation would provide evidence to judge the relevance of conclusions that are based on equilibrium theories. In the next section, we propose a new approach of directly measuring the degree to which commuters are compensated for the burden of commuting.

3 Empirical analysis of the effects of commuting on subjective well-being

3.1 Data and descriptive statistics

Individuals' compensation for commuting has so far been studied in terms of higher earnings and lower rents for housing. Here we apply a novel approach and directly analyze commuters' level of utility. Thereby, reported subjective well-being is used as a proxy measure for utility.[4] Although this is not (yet) standard practice in economics, indicators of happiness or subjective well-being have increasingly been studied and successfully applied (e.g. Clark and Oswald

[3] There have also been findings that do not fit the equilibrium view in a traditional model without discrimination. For example, there is evidence for gender and race differentials in the compensation of commuting (e.g. Carlson and Persky 1999).

[4] Subjective well-being is the scientific term in psychology for an individual's evaluation of his or her experienced positive and negative affect, happiness or satisfaction with life. With the help of a single question or several questions on global self-reports, it is possible to get indications of individuals' evaluation of their life satisfaction or happiness (Diener et al. 1999, Kahneman et al. 1999). Behind the score indicated by a person lies a cognitive assessment as to the extent their overall quality of life is judged in a favorable way (Veenhoven 1993).

1994, Di Tella et al. 2001, Easterlin 2001, Frey and Stutzer 2000, Kahneman et al. 1997, and for surveys see Frey and Stutzer 2002a,b and Oswald 1997).

Measures of reported subjective well-being passed a series of validation tests, revealing that people reporting high subjective well-being are more often smiling during social interactions and are less likely to commit suicide. Changes in brain activity and heart rate account for substantial variance in reported negative affects. Reliability studies found that reported subjective well-being is fairly stable and sensitive to changing life circumstances (see Frey and Stutzer 2002b for references). However, in order to conduct welfare comparisons on the basis of reported subjective well-being, further conditions have to be met. Well-being must be cardinal and interpersonally comparable. Economists are likely to be skeptical about both claims. However, evidence has been gathered that both of them may be less of a problem on a practical level than on a theoretical level (e.g. Kahneman 1999). Happy people, for example, are rated as happy by friends and family members (e.g. Lepper 1998), as well as by spouses. Furthermore, ordinal and cardinal treatments of satisfaction scores generate quantitatively very similar results in micro-econometric happiness functions (see, e.g., Frey and Stutzer 2000, Ferrer-i-Carbonell and Frijters 2004, and the empirical analysis below).[5] The existing state of research suggests that, for many purposes, happiness or reported subjective well-being is a satisfactory empirical approximation to individual utility.

The current study is based on data on subjective well-being from the German Socio-Economic Panel Study (GSOEP).[6] 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 include residents in the former German Democratic Republic in 1990. From this survey, we use the seven waves between 1985 and 1998 that contain information about individual commuting time. Observations for the seven waves are from all the samples available (samples A to F). People in the survey are asked a wide range of questions with regard to their socio-economic status and their demographic characteristics. Moreover, they report their

[5] This is consistent with validation results of the income evaluation approach, which focuses on the translation of verbal evaluations into numerical figures in a context-free setting (van Praag 1991). It is shown that the meaning of a sequence of verbal labels is approximately the same for all the people in the sample, and that the verbal scale is efficiently used as the underlying intervals are of about equal length.

[6] For a detailed description of the GSOEP, see Burkhauser et al. (2001) and Haisken-DeNew and Frick (2001).

actual commuting time and their subjective well-being. Commuting time is captured by the question "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)?" 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 order to study the effect of commuting on individual well-being, we restrict the sample to those who are actually commuting and who either report being employed or self-employed. Descriptive statistics for the dependent variable life satisfaction, as well as all the covariates used in the empirical analysis, are provided in table A.1 in the appendix.

Figure 2 presents the distribution of reported commuting time in Germany between 1985 and 1998. On average, people in the sample commute 23 minutes one way (a total of 46 minutes a day) with a standard deviation of 19 minutes. Median commuting time is 20 minutes. Commuters, who report travelling to work taking an hour or more, comprise 5.4 percent of the sample.

[Figure 2 about here]

Additional information about commuting distance in the year 2000 is provided by the German Federal Statistical Office. Figure 3 shows that the high fraction of commutes that take 20 minutes or less is reflected in a sizeable percentage of people (53%) who commute less than 10 kilometers. There are, however, 16% of respondents in the Microcensus 2000 reporting a commuting distance of 25 kilometers or more for one way.

[Figure 3 about here]

3.2 Commuting and reported satisfaction with life

The concept of equilibrium in economics predicts that pecuniary, as well as mental, costs of commuting are compensated for on the labor and housing market. Thus, individuals' utility level is equalized over all actual combinations of alternatives in these two markets. This, of course, only holds for homogeneous people. We start with this assumption to introduce our empirical testing strategy. We will, however, extend our argument to include people with heterogeneous preferences. Empirical estimations will be only for the latter case. In the

underlying model, commuters' utility is increasing in consumption c of goods, services and housing, and decreasing in the disamenity D for commuting time, $U=u(c,D)$.

Utility U is 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

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

Totally differentiating this equilibrium condition, we get

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

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 commuting time is zero. A decomposition of the total change is provided on the right hand side of equation (3). There are three effects of 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 tested directly. We take commuters' reported satisfaction with life as a proxy measure for individual utility. 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 by either higher salaries or lower rents for housing. The alternative hypothesis $\beta<0$ states that commuting time is not fully compensated on the labor and housing market.

Figure 4 provides a first visual test to see whether there are indications of any kind of a correlation between commuting time and people's life satisfaction. Average life satisfaction is reported for the four quartiles of commuting time. Contrary to the prediction of $\beta=0$ in

equilibrium, results indicate that there is a sizeable negative correlation between commuting time and individuals' well-being. For each subsequent quartile of longer commuting time, we find, on average, a lower reported satisfaction with life. While life satisfaction is 7.24 points, on average, for people who commute 10 minutes or less (1st quartile), average satisfaction scores for the top 4th quartile (commuting time more than 30 minutes) is 7.00 points, i.e. 0.24 points lower.

[Figure 4 about here]

The raw correlation between commuting time and life satisfaction does not take into consideration that we compare people with heterogeneous preferences facing different restrictions. In other words, the optimal commuting time is probably systematically different for different groups of people. Thus the observed lower subjective well-being of people who spend more time traveling from home to work might just reflect that these are people with different socio-demographic and socio-economic characteristics. In order to apply the test for compensation, groups of people who are very similar have to be empirically constructed. Technically, a multiple regression approach is applied to control for individual characteristics.

Equation (4) is extended in order to include a set of individual covariates X_i

$$u_i = \alpha + \beta D_i + \gamma X_i + \varepsilon_i \qquad (5)$$

It is important to note that X_i neither includes respondents' labor income nor their household income. This is crucial, because income is one of the variables through which people are compensated for the distance they cover to and from work. Equation (5) only makes a sharp prediction of $\beta=0$ if all channels for compensation remain uncontrolled. If income is controlled, people who spend more time commuting are, of course, worse off, ceteris paribus.

Heterogeneous preferences for commuting also imply sorting. It is the quintessence of spatial economics that people reside where their preferences are best met. It is this process of sorting and arbitrage that leads to the prediction on compensation. How do heterogeneous tastes for commuting and sorting affect any observed partial correlation between commuting time and life satisfaction in a cross-section estimation?

Imagine that people have homogenous tastes in all respects but commuting. There are some people who strongly dislike commuting. For a given income generating potential, they are worse off than people who do not mind commuting and they therefore experience lower

utility. Where do people live who dislike commuting? They have a high willingness to pay for a short commute. Other things equal, they thus live closer to where they work and are willing to pay more for housing. From the two arguments, the following picture emerges: People who dislike commuting have a disadvantage in our spatial economy. While they choose a combination of job and housing that involves relatively short commuting, they experience lower utility than people whose disutility from commuting is small. Accordingly, all other things being equal, a *positive* correlation between commuting time and a proxy measure for utility is expected. The effect of heterogeneous preferences for commuting and sorting thus runs counter to the correlation observed in our sample. With regard to the sorting argument, we estimate a lower bound in the following cross-section equation.

In table 1, equation (5) for the effect of commuting time on life satisfaction is estimated in a pooled least squares regression, taking a large number of individual characteristics into account, as well as year dummies.[7]

[Table 1 about here]

The results in table 1 show that people who spend more time commuting report lower satisfaction with life, ceteris paribus.[8] The effect is statistically highly significant and corroborates the findings in figure 4. An increase of an individual's commuting time by one standard deviation (i.e. 19 minutes) refers, on average, to a 0.12 point lower subjective well-being (according to the first estimation in table 1). This finding is again at odds with the prediction of location theory and the implicit assumption in many economic models that, on average, people are compensated for commuting. The size of the commuting effect is half the difference in the subjective well-being of singles with and without a partner, or equal to the effect of finding or losing a partner for those being single (fixed effect estimation). Compared to the effect of becoming unemployed (=-0.671) (see Stutzer and Frey 2004, table 4), an

[7] A discussion of the results for the socio-demographic and socio-economic factors in Germany can be found in Stutzer and Frey (2004). In another specification, six dummy variables for the distance to the nearest metropolitan area are included. No difference in the estimated effect of commuting is found.

[8] A quadratic specification of the effect of commuting time on life satisfaction is chosen because we hypothesize that the marginal burden of commuting is falling. At least in the pooled estimation of table 1, this hypothesis is not rejected. The marginal burden of commuting is estimated to reach zero at a commuting time of 117 minutes.

increase in commuting time by one standard deviation is about one fifth as bad for life satisfaction.

In table 1, ordinary least squares estimations are reported. Thus, it is implicitly assumed that the answers on the ordinal scale can be cardinally interpreted. While the ranking information in reported subjective well-being would require ordered probit or logit regressions, a comparative analysis shows that it makes virtually no difference whether responses are treated ordinally or cardinally in a microeconometric happiness function. In table A.2 in the appendix, results of an ordered logit estimation are presented. Coefficients and average marginal effects are directly comparable in their relative size with the estimated partial correlation in the OLS estimations. For example, the ratio between the partial correlation of commuting time and education is 1:64 in the OLS model, while it is 1:71 in the ordered logit model. The eleven categories of the dependent variable indeed seem to mitigate potential problems from assuming continuity.[9]

The pooled estimation in table 1 identifies the effect of commuting on reported well-being, based on the variation in these two variables between people and for each individual over time. It is assumed that any measurement errors, as well as unobserved characteristics, are captured in the error term of the estimation. Indeed, many mistakes in people's answers are random and thus do not bias the estimation results. This holds true, e.g., for the order of questions, the wording of questions, actual mood, etc. However, non-sampling errors are not always uncorrelated with the variables of interest. A measurement error perspective (e.g. Bertrand and Mullainathan 2001, Ravallion and Lokshin 2001) suggests that the inferences can be clouded by unobserved personality traits that, in our case, influence individuals' commuting behavior, as well as how they respond to subjective well-being questions. For instance, restless people who have difficulties settling down somewhere may, on average, choose longer commutes and may also report lower satisfaction with life. As a result, the observed correlation is biased. However, idiosyncratic effects that are time-invariant can be controlled for if the same individuals are re-surveyed over time. This is the case for our longitudinal data set, in which it is possible to consider a specific baseline well-being for each individual. The statistical relationship between commuting and reported subjective well-being

[9] Given that we find very similar results when applying the OLS technique rather than some more sophisticated technique, and that the OLS results are easy to interpret and easier to handle in the compensation exercise, we prefer to use the OLS in the remainder of our analysis.

is then identified by the variation in commuting time within observations for the same person. In our sample, the mean standard deviation of individual commuting experiences is 8.5 minutes.

The second estimation in table 1 reports the result for an estimation with individual fixed effects that excludes spurious correlation due to time-invariant unobserved characteristics of people. Partial correlations again show a negative effect of commuting time on life satisfaction. People who spend 19 minutes (i.e. one standard deviation) more time commuting (one way) report, on average, a –0.064 point lower utility level. Thus, the results of the raw correlation and the pooled estimation are confirmed.

The two estimation approaches in table 1 lead to somewhat different results for the effect of commuting on subjective well-being. The partial correlation is larger in the pooled regression, which also includes information on variation between people. Potentially, this allows us to estimate the correlation between commuting time and subjective well-being more efficiently. In order to test whether the individual fixed effects are correlated with the explanatory variables, a Hausman test is performed. The hypothesis that there are no systematic differences in the coefficients between the fully efficient model in the first two columns and the less efficient fixed effect estimate in table 1, however, is clearly rejected. The negative effect of commuting in the fixed effect model is thus more accurately measuring the incompleteness in compensation.[10]

To our knowledge, the empirical analysis in table 1 is, for the first time, directly testing the strong notion of equilibrium in location theory. This is made possible by applying individual reported subjective well-being as a proxy measure for utility. Contrary to the common understanding in economics, there seems to be a systematically incomplete compensation of people who choose to spend more time commuting between home and work.

[10] So far, there is no standard econometric procedure for fixed effect estimations with categorical data. In order to address the issue of interpersonal comparison, or individual specific anchors and ordinality simultaneously, we transform our dependent variable into a dichotomous variable (equal to 1 if life satisfaction is higher than 6, otherwise 0) and estimate a conditional (fixed-effects) logistic regression. The results for this robustness test are shown in table A.2 in the appendix. We find, again, a statistically significant negative effect of commuting time on reported life satisfaction.

4 Is there a simple explanation for the commuting phenomenon?

The finding that people who spend more time commuting are systematically worse off stands in sharp contrast to the equilibrium view in economics. There are two completely different ways of reacting to this challenge: First, the empirical finding may be misleading. In fact, equilibrium is maintained when households are considered as units that are compensated, or when utility from jobs and housing are studied directly. Second, equilibrium may not be attained because of frictions. Transaction costs restrict residential and job mobility and prevent commuters from being fully compensated.

4.1 Is full compensation attained at the household level?

While commuting might be a burden for those involved, the members of the family of those persons might benefit so that, overall, the households' well-being is equalized (Becker 1981). The empirical finding can thus be explained by a too limited selection of the decision making unit. At a household level, the equilibrium may still be attained.

This possible explanation of the commuting paradox is empirically studied in table 2. We analyze whether an individual's subjective well-being is increasing in relation to his or her partner's commuting time. A positive partial correlation could balance out the compensation missing for the people who are actually commuting. However, results show exactly the opposite: the more time respondents' partners spend commuting, the less satisfied the respondents are. The negative effect in the pooled analysis is more than half the size (61%) of the effect that is measured for people's own commuting (first estimation in table 1). This result indicates that commuting might even result in negative externalities for other family members (consistent with previous research on commuting and family tensions mentioned in section 2.1). Very similar effects are estimated if the respondent's own commuting time is included (second estimation in table 2), as well as if the sample is restricted to two person households (third estimation in table 2). In the latter case, there are no children who can potentially benefit from certain family members' commuting. There is thus no evidence that people systematically benefit from the commuting of other household members.

[Table 2 about here]

The issue of intra-household bargaining can be excluded if only single households are studied. The sample is, however, substantially reduced and individuals are observed, on average, only 1.7 times. In the pooled estimation, we find a slightly smaller effect than in table 1, but one that is still statistically significant (coefficient for commuting: -0.0045 (t-value: -2.31), coefficient for commuting^2: 0.016e-3 (1.11)). In the fixed effect estimation, the negative effect is no longer statistically significant.

4.2 Are there indications for compensation in satisfaction with particular life domains?

There is a second reason why equilibrium could actually be attained, though not be reflected accordingly in reported subjective well-being. When people make a judgment about their well-being, particular life domains and experiences might be more salient than others (Schwarz and Strack 1999). In our case, commuting might be over-represented in people's evaluation calculus at the time of the interview.

In order to detect possible compensation on the labor and the housing market that might not be accurately measured in overall life satisfaction, we additionally study domain satisfaction. The results are presented in table 3. According to the initial notion of equilibrium, it is hypothesized that people spending more time commuting are compensated by a more attractive job or home and, accordingly, report higher satisfaction with these two aspects. However, results for domain satisfaction contradict these predictions. People with a lengthy distance to and from work do not report increased satisfaction with their dwelling and report even lower satisfaction with their job. Employed and self-employed people who spend an hour commuting (one way) report, on average, a 0.15 points lower satisfaction with their job. Both findings are inconsistent with the idea of compensation in location theory and sustain the commuting paradox. Results in table 3 further indicate that commuting time is significantly negatively correlated with health satisfaction and satisfaction with the environment (another potential domain for compensation) and it has a large negative effect on people's satisfaction with their spare time.[11]

[11] The finding that there are significant differences in the negative effect of commuting on domain satisfaction indicates that the results cannot simply be interpreted as response biases. Response biases, in the sense that less happy people paint an overall gloomier picture in every dimension, i.e. longer commuting time, lower domain satisfaction and so on.

[Table 3 about here]

4.3 Is equilibrium not attained as a result of frictions?

The concept of equilibrium is fundamental to economics (e.g. Becker 1976). It the context of mobility, an equilibrium view is underlying modern neoclassical urban location theory, as well as public economic theory.[12] Economists may, however, be inventive enough to find reasons why an equilibrium is not attained. But if this path is followed, the equilibrium loses its power to explain empirically observed phenomena.

It might be countered that there are disequilibrium models (or search models) in urban and regional economics that complement Alonso-Muth type residential location models (for a survey see e.g. Clark and van Lierop 1986, Crampton 1999). These models take transaction costs explicitly into account (e.g. Weinberg et al. 1981, van Ommeren et al. 1997). While they generate similar predictions for individual behavior on the urban labor and housing market to the former ones, they predict lower utility for those in a disadvantaged situation with long commuting times (e.g. van Ommeren 2000).

Can the commuting phenomenon observed be explained by transaction costs? If that were the case, the paradox would vanish. Transaction costs prevent people from adjusting to economic shocks. In particular, transaction costs might hinder people experiencing a longer or more disturbing commuting time ex post than expected ex ante from reoptimizing. Therefore people might be locked into a disadvantaged commuting situation.

We follow two approaches to address the issue of frictions. In a first test, we focus on persons who changed their job or their place of residence between those survey waves for which we have information on commuting time. These people have the possibility of reoptimizing. Thus, it is not expected that any changes in commuting time will be systematically linked to reported life satisfaction. In contrast, if individuals for some reason accept commuting, despite not being compensated (the paradoxical case), a negative effect of increased commuting time on utility would again be observed.

[12] In public economics, the efficient allocation of resources is studied, based on the conviction that "migratory flows will arbitrage away any utility differentials among jurisdictions. Therefore, it is appropriate to impose equal utilities as a constraint at the outset, and to ask what allocation of resources will maximize the common level of utility for all households" (Wildasin 1987, p. 1136f).

The second approach looks at institutional conditions and particular groups of people who are forced to spend more time commuting, for which they are not compensated. There is, e.g., an extensive literature on the consequences of residential race segregation in cities for earnings and employment differences according to race (e.g. Crampton 1999, Gobillon et al. 2003). We study three such institutional explanations for the commuting paradox.

How much additional income would be necessary for full compensation?

Before we discuss the potential explanations, we want to calculate how high the hurdle is. How far short of full compensation does the equilibrium prediction fall for people in the data set? In other words, how much additional income would a commuter have to earn in order to be as well off as somebody who does not commute? For this analysis, a utility function is estimated which, in addition to the variables included in table 1, also includes the respondent's labor and household income, as well as working hours (see appendix for a detailed description of the calculation).[13] Full compensation for commuting 23 minutes (one way), i.e. the sample mean, compared with no commuting at all, is estimated to require an additional monthly income of approximately 242 Euros or 18.86 percent of the average monthly wage.[14] This is a sizeable amount to be explained by institutional restrictions, or transaction costs for reoptimizing the commuting situation.

Reoptimization of movers and compensation.

If uncompensated commuting is a reflection of the cost of reoptimizing, individuals who change either their residence or their job might overcome the inferior situation and choose optimal commuting time. This is tested based on observations for which consecutive information on commuting time is available, i.e. for the years 1985/90, 1990/93 for the Old German Laender; 1992/93 for the New German Laender; and 1993/95 and 1995/98 for both. Pairs of observations are grouped according to whether individuals either changed their job or their residence in the meantime (movers sample) or whether their job and housing situation remained unchanged (non-movers sample). For each group, the changes in life satisfaction of

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[13] The results for this estimation can be obtained from the authors on request.

[14] Full compensation for commuting one hour (one way), compared with no commuting, is estimated to require an additional monthly income of approximately 515 Euro or 40 percent of the average monthly wage. This valuation implies that the time spent commuting is worth 1.6 times the hourly wage or the average compensation for working. This is not implausible, given the satisfaction we obtain from work. The comparison to previous findings in the literature is hampered, because we

those people increasing their commuting time is compared to the changes of those people decreasing their commuting time (or keeping it constant).

Results are presented in table 4. In both sub-samples, the movers and the non-movers sample, people who increase their commuting time report lower life satisfaction, on average, compared to those who do not increase or decrease their commuting time. Strictly speaking, there is a larger negative change (or a smaller positive change), on average, for those who increase their commuting time compared to those who keep their commuting time constant or decrease it. However, both differences are measured with a large standard error. Only two other changes in circumstances are controlled for: changes in terms of living with a partner and being self-employed. The results do not indicate that the basic negative effect of commuting on life satisfaction is restricted to those who - for whatever reason - do not move and are exposed to exogenous changes in commuting time.

[Table 4 about here]

The results for movers and non-movers should, however, not be attributed too much importance. In order to identify the voluntary movers and the exogenous changes in commuting time, one would need to know the reasons why people move or, in the case of non-movers, one would need to know whether changes in commuting time are, for example, due to a voluntary change of the means of transportation. Ideally, we would like to study year to year changes in order to limit other disturbing influences.

Table 4 also indicates that people successfully improve their situation when they decide to relocate or change their job. On average, changes in life satisfaction between waves are 0.14 units higher for those who move compared to those who do not.

Institutional and social preconditions and compensation.

Another approach to identifying frictions studies the degree of compensation for groups of people optimizing under different institutional and social conditions. Three alternative hypotheses are put forward. They address the issue of segregation according to income

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calculate the effect of commuting on people's utility that is *not* compensated, while all previous approaches calculate the fraction of disutility that *is* compensated.

classes, transaction costs for owners of houses and the role of specific life events on commuting.

The first institutional explanation refers to differences in social class. It is hypothesized that discrimination and segregation in Germany leads to the negative correlation between commuting time and people's well-being. This hypothesis captures the notion that poor people have less chance of optimizing, due to powerful actors on the housing and labor market, so that they end up spending more time commuting that is not compensated. The correlation between income and commuting time is empirically studied, and it turns out that the hypothesis is not supported. There are only small differences in the commuting time of people from rich and poor households, but richer people tend to commute more. A household with an equivalence income that is 1,500 Euro above the mean commutes about 1 minute longer from home to work on average than a household with mean income. The full set of results for the covariates of commuting is presented in table A.3 in the appendix. The test for differential effects of commuting on subjective well-being is conducted in table 5. Estimation A and B shows the effect of commuting time on satisfaction with life for people who live in a household with below and above median equivalence income. Contrary to the first institutional explanation, there is no statistically significant difference in the effects (Prob>F=0.305).

[Table 5 about here]

The second explanation is based on institutional restrictions on the housing market. It can be argued that people's choice between renting and owning property is partly determined by inheritance and other reasons for path dependence. Given the high transaction costs for the transfer of property rights, owners might then be locked in a suboptimal commuting situation. This line of reasoning is tested in estimations C and D. While a smaller negative effect of commuting on the well-being of renters is estimated than of house owners, the former effect is not statistically significantly smaller.

A third explanation refers to specific events in people's lives that could explain the commuting paradox. People are restricted in their choice and possibilities of optimizing commuting time when they experience drastic life changes, like getting divorced or becoming unemployed. People who get re-employed after a period of unemployment may start with a

less attractive job, including a long journey from home to work. Couples who split up may leave one or both partners in housing conditions with increased commuting time. In these scenarios, 'third' variables like re-employment, or couples separating, affect commuting time and life satisfaction simultaneously and cause spurious correlation. However, in table 1, many individual characteristics are controlled for, e.g. people's marital status, and exclude many explanations based on omitted variables that capture to what extent people commute voluntarily. Nevertheless, estimation F in table 5 separately studies the effect of commuting on subjective well-being for a sample that includes people who have experienced drastic life changes (either they were made redundant or got divorced during the time span in the sample). The effect is compared to people who have not experienced such changes (estimation E). According to this argument, it is hypothesized that negative effects of commuting are mainly observed for people leading turbulent lives, and that other people only choose to commute when they are compensated. However, the hypothesis is not supported. There is not only a large negative effect for people who either experienced divorce or unemployment, or both, but also for people who did not make these experiences (and the difference is not statistically significant: prob>F=0.807).

All three potential explanations for the empirical phenomenon that study some sort of restrictions to optimization, and thus specify possible transaction costs, fail to explain the commuting paradox.

5 Towards behavioral explanations

There is yet another reaction to the general result of this study: Individuals' decisions concerning commuting cannot be fully understood within the traditional economic framework. It is an issue "[w]here economics stops short" (Economist 1998, special issue on commuting). Inspiration from other social sciences has to complement an economic analysis of commuting behavior. Most prominent are insights from psychology that have been successfully integrated into what is called behavioral economics (e.g. Camerer et al. 2003, Frey and Stutzer 2001, Rabin 1998).

There are at least two lines of reasoning that could contribute to a better understanding of people's commuting behavior.

First, people might not be capable of correctly assessing the true costs of commuting for their well-being. They might rely on inadequate intuitive theories when they predict how they are affected by commuting. In particular, they may make mistakes when they predict their

adaptation to daily commuting stress.[15] It has, for example, been found that people do not get used to random noise (Weinstein 1982). In contrast, people adapt to a large extent to higher income (e.g. Stutzer 2004). In the case of overestimated adaptation, people systematically choose too long commuting times. A similar reasoning is followed in Simonsohn (2003). 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 thus either commute too much or too little.

Second, people's weak will-power might be another reason why long commutes are not compensated.[16] People have limited self-control and insufficient energy, inducing some people to not even try to improve their lot. This view corresponds to what some lay people seem to think. The decision to start searching for a job closer to home or an apartment that reduces commuting time is again and again postponed to the following week. Thus, some people might not only smoke more and save less than they would actually like, but also commute more than what they consider to be optimal.

6 Concluding remarks

Commuting is for many people a time consuming experience five days a week. The journey from home to work and back is therefore an important aspect of modern life, affecting people's well-being, and it demands difficult decisions about mobility on the labor and housing market.

Commuting is also interesting for economic research conceptually. The decision to commute is hardly regulated. People are expected to freely optimize. This environment allows for testing basic assumptions of the economic approach, like market equilibrium. Positive and normative theories in urban and regional economics, as well as in public economics, rely on a

[15] Excellent overviews about people's difficulties in predicting future utility, as well as about adaptation, are provided in Loewenstein and Schkade (1999) and Frederick and Loewenstein (1999).

[16] The consequences of (economic) agents with self-control problems are, e.g., discussed in O'Donoghue and Rabin (1999) and Brocas and Carrillo (2003).

strong notion of equilibrium. It is assumed that people who can move freely and change jobs arbitrage away any utility differentials between people, whether they are due to residential characteristics or due to covering distance, ceteris paribus.

This paper directly tests to what extent equilibrium is attained by current job choices and residential location. We analyze whether people are compensated for the burden of commuting and experience equal utility, ceteris paribus. As a proxy measure for individual utility, we study data on subjective well-being from a large panel survey conducted in Germany.

Contrary to the prediction of equilibrium location theory, we find a large negative effect of commuting time on people's satisfaction with life. People who commute 23 minutes (one way), which is the average commuting time in Germany, would have to earn 19 percent more per month on average in order to be fully compensated. This phenomenon is robust to a wide range of possible response biases, and it is not explained by compensation at the level of households. The effect also seems to hold for people who either change their job or their place of residence and so have the opportunity of reoptimizing their commuting situation. Moreover, three alternative hypotheses based on institutional restrictions and critical life events find no support in the data. There might 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 and public economics. Until an adequate rational choice explanation has been provided, we propose the general result to be a 'commuting paradox'.

Further research along the lines studied in behavioral economics and psychology promises to provide a better understanding of people's decisions about where to live and work and how long the commuting time may be. We favor an explanation based on wrongly predicted adaptation. Decisions about commuting involve a difficult trade-off between socially positively sanctioned income and some loss of spare time that is difficult to assess. Other behavioral anomalies may also play an important role in commuting decisions. Limited will-power and loss aversion, however, may better explain why people remain in an inferior status quo rather than why people spending more time commuting suffer lower well-being. It will be a major challenge for future research to discriminate between alternative 'behavioral' explanations of the phenomenon.

For many people, commuting seems to be a stress that doesn't pay off. A better understanding of this phenomenon should provide valuable insights on the institutional and behavioral

restrictions to compensation. Moreover, it could help a lot of commuters to increase their individual well-being.

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Appendix

Calculation of the amount that is lacking in a full compensation for commuters

How much additional income would the average commuter (spending 23 minutes one way) have to earn in order to be as well off as somebody who does not commute? We proceed in three steps to calculate the uncompensated costs of commuting in monetary terms. First, the loss in utility is calculated due to incomplete compensation based on equation (5). Second, marginal utility of additional income is estimated. Third, the ratio between the loss in utility due to commuting and the marginal utility of income is built to calculate the missing compensation in monetary terms.

In detail, the loss in utility for a discrete change in commuting time is calculated based on equation (5) and the coefficients estimated in table 1 (second estimation)

$$\begin{aligned}\Delta U &= u(D=23) - u(D=0) \\ &= -3.65e-3*23 + 16.2e-6*23^2 - 0 \\ &= -0.075\end{aligned}$$

The marginal utility of income is estimated in an extended microeconometric happiness function. In order to estimate a coefficient for the gross marginal effect of additional income, a full specification is necessary that keeps important determinants of income constant. Here, commuting time and working time are controlled for, in addition to the covariates mentioned in table 1. Income is measured in terms of the monthly net salary (w) and annual household income in 1,000 German Marks (h) (consisting of respondent's income as well as other household members' income k).[17] Two German Marks translate into one Euro.

$$U = \alpha + \beta_1 D + \beta_2 D^2 + \gamma X + \delta_1 w + \delta_2 w^2 + \delta_3 \log y \quad \textit{and} \quad y = 12(w+k)/1000$$

The marginal utility of additional labor income at the sample mean ($\overline{w} = 2569$, $\overline{h} = 64.103$) is

$$\begin{aligned}\frac{\partial u}{\partial w} &= \delta_1 + 2\delta_2 w + \delta_3 \frac{1}{y}\frac{12}{1000} \\ &= 0.14e-3 + 2*-3.54e-9*2569 + 0.201*1/64.103*12/1000 \\ &= 0.16e-3\end{aligned}$$

From the two previous results, the missing compensation can be calculated. Here, it is calculated for a commuter spending 23 minutes each way commuting between home and work

$$\frac{\Delta U}{\partial u / \partial w} = \frac{-0.075}{0.16e-3} = -484.40$$

The additional compensation necessary for full compensation of a 23 minutes commute thus amounts to 18.86 percent of labor income at the sample mean.

[17] Without the inclusion of household income, a smaller coefficient for the marginal utility of the monthly net salary is estimated.

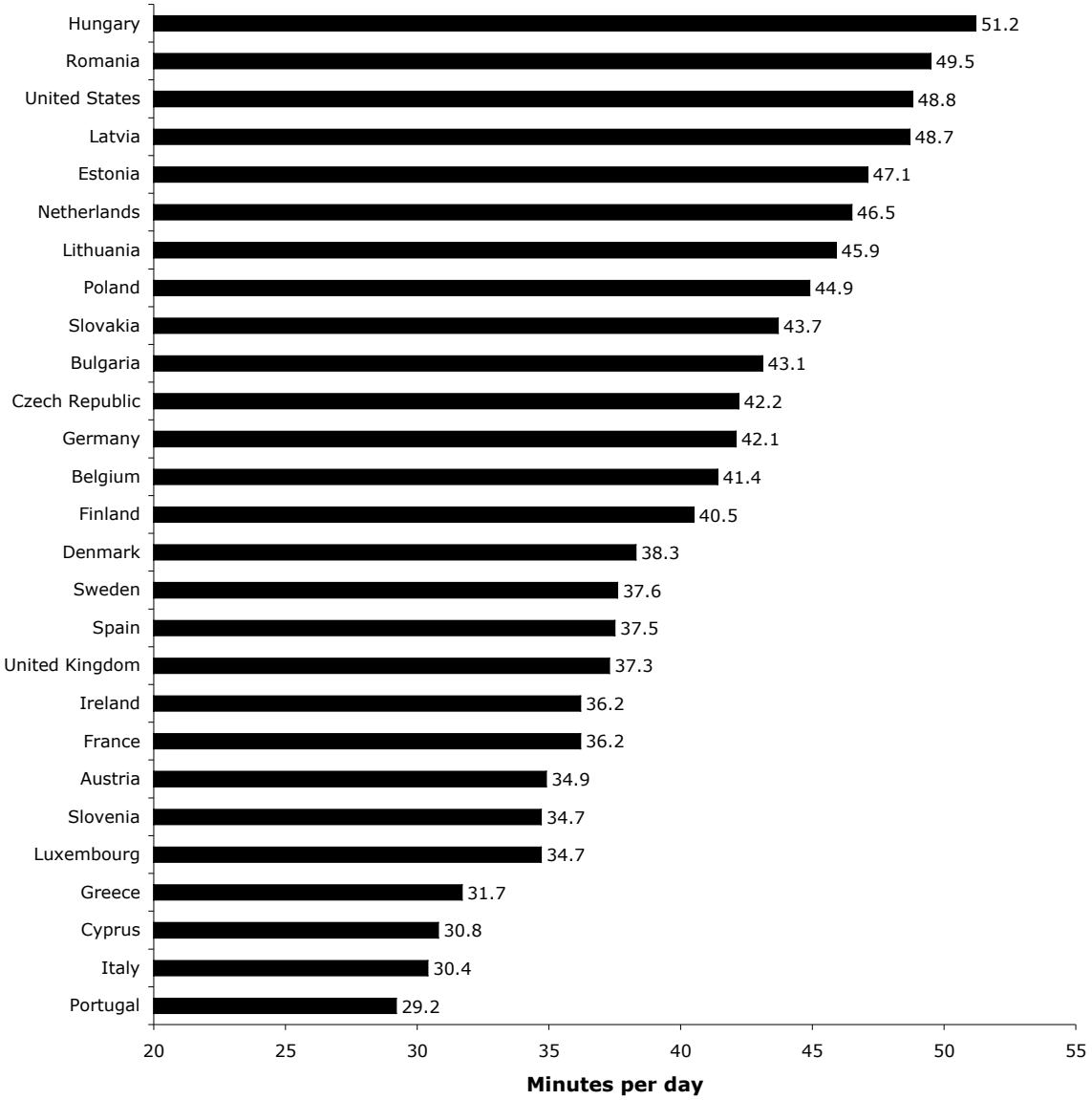

Fig. 1. **Average daily commuting time in Europe and the U.S.**

Data sources: Data for European countries is from the European Survey on working conditions, conducted by the European Foundation for the Improvement of Living and Working Conditions in 2000 for member countries and in 2001/02 for acceding and candidate countries. Data for the U.S. is from U.S. Census Bureau: 2002 American Community Survey.

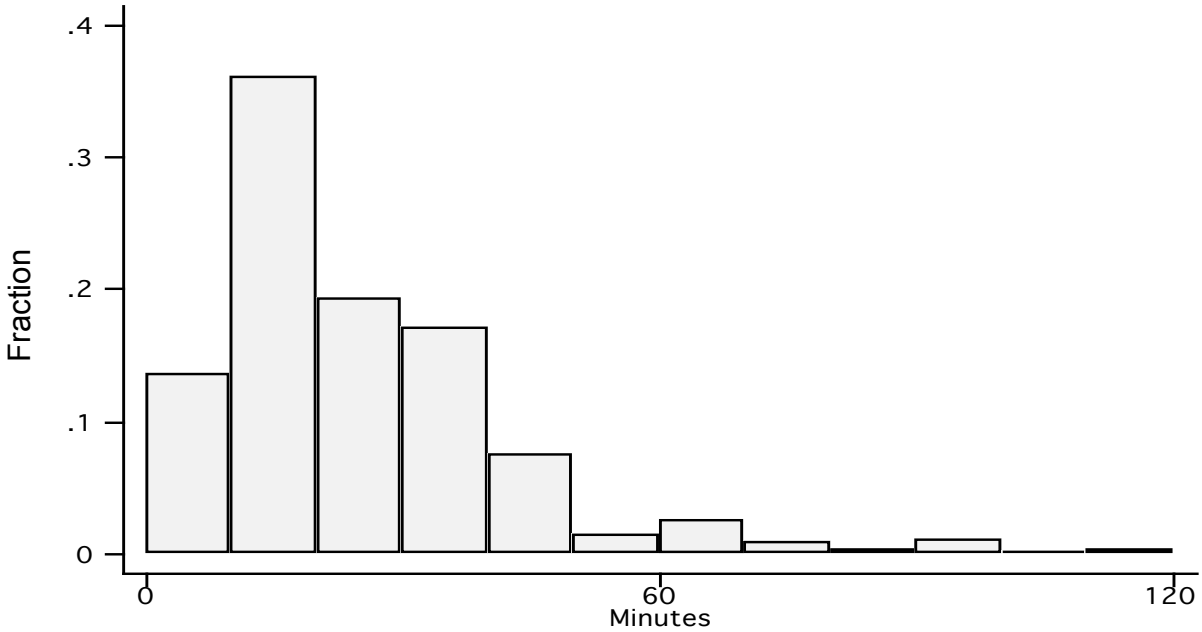

Fig. 2. **Average daily commuting time (one way)**

Data source: GSOEP.

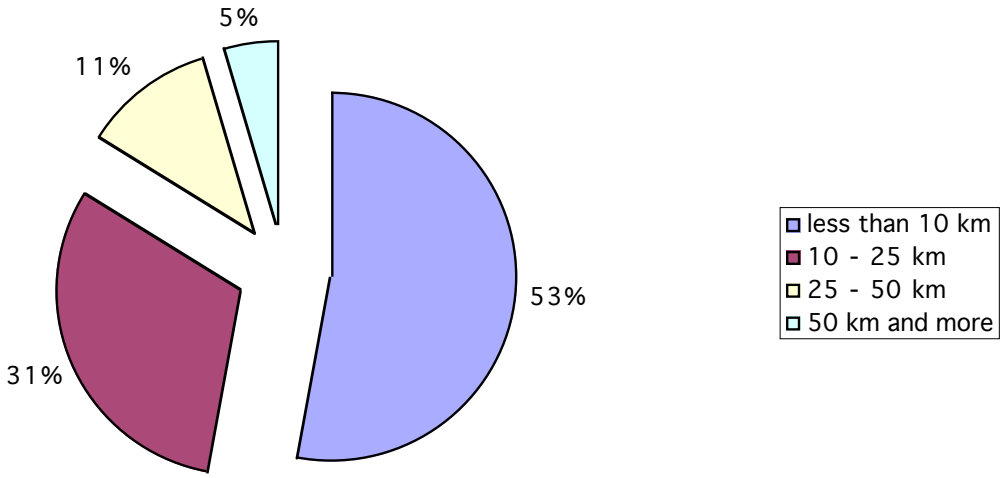

Fig. 3. **Distance from home to work, distribution for Germany in 2000**

Data source: Federal Statistical Office Germany: Microcensus 2000.

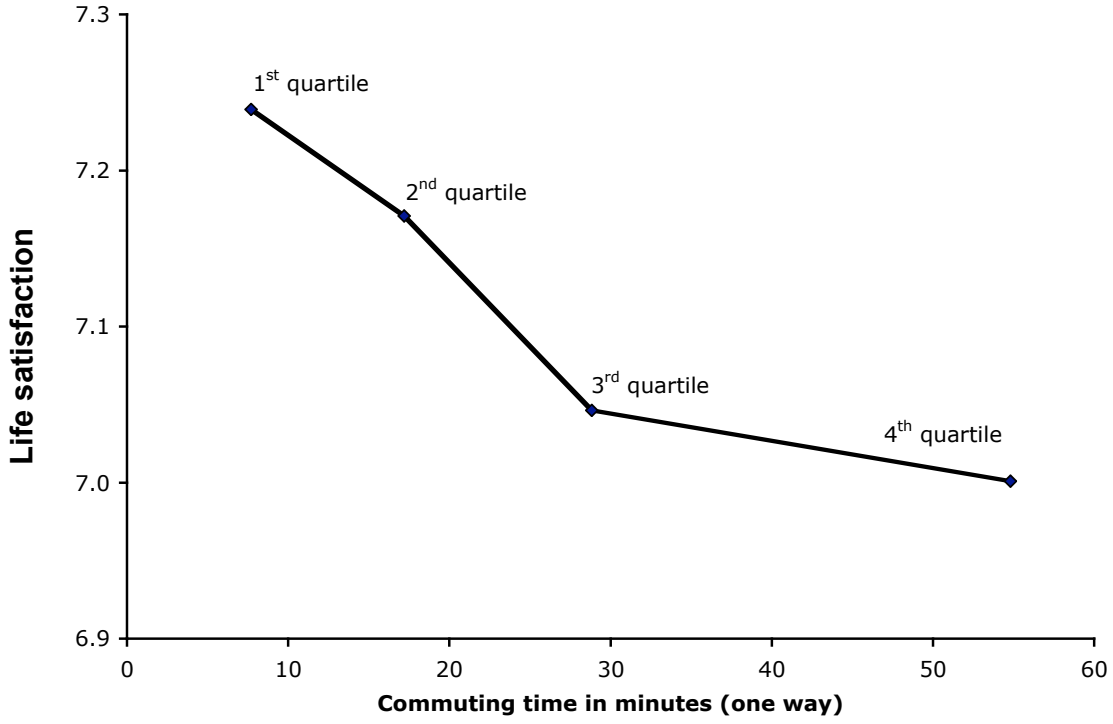

Fig. 4. **Commuting time and average reported satisfaction with life, Germany 1985-1998**

Data source: GSOEP.

Table 1
Commuting and satisfaction with life, Germany 1985-1998
Dependent variable: satisfaction with life

	OLS pooled estimation		OLS with individual fixed effects	
	Coefficient	t-value	Coefficient	t-value
Commuting time (in minutes)	-0.0070	-7.27	-0.0037	-2.55
Commuting time^2	0.030e-3	4.11	0.016e-3	1.67
Age	-0.052	-7.10		
Age^2	0.560e-3	6.32	-0.053e-3	-0.33
Male	Reference group			
Female	-0.040	-1.93		
Years of education, ln	0.446	8.32	-0.206	-0.59
No children	Reference group			
Children	-0.054	-1.72	-0.028	-0.68
Head of household or spouse	Reference group			
Child of head of household	0.297	4.73	0.076	0.77
Not child of head of household	0.019	0.18	0.026	0.12
Single, no partner	Reference group			
Single, with partner	0.252	4.49	0.130	1.64
Married	0.373	7.94	0.197	2.49
Separated, with partner	0.259	1.36	0.247	1.05
Separated, no partner	-0.388	-4.03	-0.292	-2.39
Divorced, with partner	0.332	3.97	0.542	4.17
Divorced, no partner	-0.286	-4.22	0.015	0.13
Widowed, with partner	0.409	2.22	0.296	0.91
Widowed, no partner	-0.206	-1.99	-0.347	-1.95
Spouse living abroad	-0.842	-4.48	-0.043	-0.15
No. of household members$^{1/2}$	-0.030	-0.69	-0.048	-0.67
Employed	Reference group			
Self-employed	-0.235	-3.44	-0.020	-0.18
Western Germany	Reference group			
Eastern Germany	-0.715	-25.35	-0.403	-2.15
National	Reference group			
EU foreigner	0.196	5.17		
Other foreigner	-0.212	-6.11		
Year dummies	Yes		Yes	
Constant	7.278	129.82	7.392	55.57
Number of observations	27015		27015	

Data source: GSOEP.

Table 2
Satisfaction with life and partners' commuting time
Dependent variable: satisfaction with life

	All households				Two person households	
	Coef.	t-value	Coef.	t-value	Coef.	t-value
Partner's commuting time (in minutes)	-0.0043	-3.82	-0.0039	-3.51	-0.0045	-2.08
Partner's commuting time^2	0.020e-3	2.32	0.018e-3	2.05	0.021e-3	1.20
Commuting time			-0.0046	-3.41	-0.0048	-1.92
Commuting time^2			0.015e-3	1.18	0.025e-3	1.01
Individual characteristics	Yes		Yes		Yes	
Year dummies	Yes		Yes		Yes	
Number of observations	21431		21431		6288	

Note: Partial correlation coefficients are from least squares estimations that include the same control variables as applied in Table 1.
Data source: GSOEP.

Table 3
Commuting and domain satisfaction

	Satisfaction with ...				
	health	job	dwelling	spare time	environment
Mean satisfaction	7.079	7.150	7.309	6.467	5.836
[std. dev.]	[2.06]	[2.04]	[2.22]	[2.34]	[2.10]
Estimation coefficients					
Commuting time	-4.60e-3	-4.09e-3	-1.23e-3	-0.012	-1.25e-3
	(-2.67)	(-2.18)	(-0.62)	(-3.81)	(-0.56)
Commuting time^2	0.03e-3	0.03e-3	0.01e-3	0.05e-3	-0.03e-3
	(2.93)	(2.08)	(0.44)	(2.21)	(-1.81)
Effect of one hour of commuting	-0.15	-0.15	-0.05	-0.55	-0.17
	(p=0.03)	(p=0.06)	(p=0.53)	(p=0.00)	(p=0.08)
No. of observations	26960	26510	26859	16361	18558

Notes: Partial correlation coefficients are from least squares estimations with individual fixed effects that include the control variables applied in the second estimation of Table 1. T-values are in parentheses.
Source: GSOEP.

Table 4
Compensation of people who relocate or change jobs
Dependent variable: change in satisfaction with life

	Sample			
	Movers	Non-movers	All obs.	All obs.
Increase in commuting time	-0.046	-0.049	-0.050	-0.051
	(-0.95)	(-1.47)	(-1.80)	(-1.48)
Relocation and/or job change			0.140	0.138
(=mover)			(4.89)	(3.64)
Mover x increase in commuting time				4.51e-3
				(0.08)
Number of observations	5768	10445	16213	16213

Notes: Partial correlation coefficients are from least squares estimations. T-values are in parentheses. Included in the reference group are people with commuting time remaining constant or decreasing. Additional control variables (not shown) are living with a partner now (in contrast to living without a partner in the past), living without a partner (in contrast to living with a partner in the past), being self-employed (in contrast to being employed in the past) and being employed (in contrast to being self-employed in the past).
Data source: GSOEP.

Table 5

The effect of commuting on subjective well-being for different groups

Dependent variable: satisfaction with life

Sub-sample	Est.	Commuting time	Commuting time^2	Effect of one hour of commuting	No. of obs.
Income situation					
Below median equivalence household income	A	-3.23e-3 (-1.48)	3.65e-6 (0.23)	-0.18 (p=0.04)	13506
Above median equivalence household income	B	-3.97e-3 (-2.10)	0.02e-3 (1.97)	-0.15 (p=0.06)	13509
Renter versus owner					
Renter	C	-2.89e-3 (-1.43)	0.02e-3 (1.01)	-0.12 (p=0.15)	16647
Owner	D	-3.57e-3 (-1.53)	0.01e-3 (0.78)	-0.18 (p=0.08)	10359
Negative life events					
Has never been divorced or unemployed	E	-3.57e-3 (-2.12)	0.02e-3 (1.58)	-0.15 (p=0.03)	18779
Has been divorced or unemployed	F	-3.78e-3 (-1.40)	0.01e-3 (0.70)	-0.18 (p=0.11)	8236

Notes: Partial correlation coefficients are from least squares estimations with individual fixed effects that include the control variables applied in the second estimation of Table 1. T-values are in parentheses.
Source: GSOEP.

Table A.1
Descriptive statistics

	Mean	Std. dev.		Fraction
Satisfaction with life	7.141	1.68	Male	57.6%
Commuting time (in minutes)	22.584	19.18	Female	42.4%
			No children	58.2%
Working time (hours per week)	39.244	10.86	Children	41.8%
			Head of household or spouse	84.6%
Real monthly net wage in 1999 Mark at ppp	2568.946	1571.69		
			Child of head of household	14.2%
Age	37.885	11.61		
Years of education	11.452	2.53	Not child of head of household	1.1%
Years of education, lg	2.416	0.21		
No. of household members	3.176	1.36	Single, no partner	19.8%
			Single, with partner	6.4%
No. of household members$^{1/2}$	1.741	0.38	Married	65.3%
			Separated, with partner	0.3%
			Separated, no partner	1.3%
			Divorced, with partner	1.9%
			Divorced, no partner	3.2%
			Widowed, with partner	0.3%
			Widowed, no partner	1.1%
			Spouse living abroad	0.3%
			Employed	97.8%
			Self-employed	2.2%
			Western Germany	79.1%
			Eastern Germany	20.9%
			National	80.2%
			EU foreigner	8.7%
			Other foreigner	11.1%

Data source: GSOEP.

Table A.2

Commuting and satisfaction with life: ordinal regression analyses

Dependent variable: satisfaction with life/high satisfaction with life (score>6)

	Ordinal logit regression			Conditional (fixed-effects) logistic regression	
	Coef.	t-value	Marginal effect	Coef.	t-value
Commuting time (in minutes)	-0.0071	-6.82	-1.336e-3	-0.0096	-2.86
Commuting time^2	0.030e-3	3.88	5.640e-6	0.063e-3	2.36
Age	-0.066	-8.16	-0.012		
Age^2	0.702e-3	7.17	0.132e-3	-0.375e-3	-1.05
Male			Reference group		
Female	-0.022	-0.99	-5.478e-3		
Years of education, ln	0.507	8.71	0.095	0.551	0.75
No children			Reference group		
Children	-0.082	-2.36	-0.019	-0.055	-0.60
Head of household or spouse			Reference group		
Child of head of household	0.322	4.67	0.100	-0.072	-0.33
Not child of head of household	0.297e-3	0.00	0.073e-3	-0.115	-0.27
Single, no partner			Reference group		
Single, with partner	0.240	3.95	0.067	0.249	1.42
Married	0.425	8.26	0.111	0.257	1.45
Separated, with partner	0.339	1.61	0.098	0.100	0.20
Separated, no partner	-0.408	-3.82	-0.072	-0.478	-1.92
Divorced, with partner	0.418	4.57	0.122	0.937	3.29
Divorced, no partner	-0.265	-3.56	-0.052	0.171	0.70
Widowed, with partner	0.493	2.53	0.152	1.182	1.49
Widowed, no partner	-0.174	-1.50	-0.037	-0.543	-1.42
Spouse living abroad	-1.023	-5.00	-0.086	-0.901	-1.58
No. of household members$^{1/2}$	-0.017	-0.35	-3.172e-3	0.105	0.68
Employed			Reference group		
Self-employed	-0.260	-3.50	-0.053	0.010	0.04
Western Germany			Reference group		
Eastern Germany	-0.812	-26.71	-0.096	-1.370	-2.64
National			Reference group		
EU foreigner	0.263	6.19	0.073		
Other foreigner	-0.231	-5.97	-0.048		
Year dummies	Yes			Yes	
Number of observations	27015			9062	

Note: Marginal effects are calculated for reporting a life satisfaction score of 8 or higher.
Data source: GSOEP.

Table A.3

Covariates of commuting, Germany 1985-98

Dependent variable: commuting time (in minutes, one way)

	Coefficient	T-value
Age	-0.163	-2.12
Age^2	0.002	1.82
Male	Reference group	
Female	-2.410	-10.30
Years of education	0.583	11.85
No children	Reference group	
Children	-1.338	-4.58
No couple	Reference group	
Couple	-0.988	-3.06
Equivalence income (1000 Marks per month)	0.294	3.22
Employed	Reference group	
Self-employed	-7.940	-10.07
Western Germany	Reference group	
Eastern Germany	3.176	9.90
Year dummies	Yes	
Constant	19.851	14.42
Number of observations	27015	

Note: Pooled ordinary least squares estimation.
Data source: GSOEP.