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"Is your commute really making you fat?": The causal effect of commuting distance on height-adjusted weight

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“Is your commute really making you fat?”: The causal effect of commuting distance on height-adjusted weight

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Abstract: This paper explores the causal relationship between commuting distance and height-adjusted weight (BMI) in Germany, using micro-level data for the period 2004 – 2012. In contrast to previous papers, we find no evidence that longer commutes are associated with a higher BMI. The non-existence of a relationship between BMI and commuting distance prevails when physical activity and eating habits are adjusted for.

Keywords: BMI, commute, obesity, overweight, weight

JEL: D00, I12, R41

1. Introduction

Overweight and obesity are rapidly growing health problems that affect an increasing number of countries worldwide.[1] According to the World Health Organization (WHO 2014) 39% of adults (38% of men and 40% of women) were overweight and 13% (11% of men and 15% of women) were obese in 2014. Thus, more than half a billion adults were classified as obese and the worldwide occurrence of obesity nearly doubled between 1980 and 2014. The prevalence of overweight and obesity is highest in the Americas (61% overweight, 27% obese) and lowest in South-East Asia (22% overweight, 5% obese).

The worldwide growth in overweight and obesity is a serious cause for concern because weight, or more precisely, an excessive BMI is a risk factor for a number of major illnesses including cardiovascular diseases, diabetes, musculoskeletal disorders and cancer (WHO 2014). In the European Union, 8% of all deaths are attributed to excess weight, while in the United States obesity is the second leading cause of preventable diseases and of death next to smoking (Banegas et al. 2003, Flegal et al. 2004).

Besides the direct consequences in terms of health problems, excess weight also imposes a substantial financial burden. Overweight and obesity account, inter alia, for up to 21% of national health care expenditures (Cawley and Meyerhoefer 2012). In addition to these direct medical costs, obesity also entails more indirect costs. Excessive weight is, for example, shown to lower productivity. The literature in this area includes analyses of the aggregate productivity losses originating in the labour market, including sickness absence and also presenteeism (Hammond and Levine 2010). Excess weight may also have other consequences that affect economic outcomes. Overweight or obese individuals are more likely to suffer from social stigmatisation and discrimination. Such consequences have been documented in a variety of settings, including health care and labour market (WHO 2004, Zettel-Watson and Britton 2008). In the latter case, there is growing evidence that obese people receive lower wages and are less likely to be employed than non-obese people (Cawley 2004, Morris 2007, Wada and Tekin 2010, Majumder 2013, Averett 2014). This variety of detrimental effects indicates how important it is to slow the growth of overweight and obesity.

[1] Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. Overweight and obesity are normally measured in terms of body mass index (BMI), which is a simple index of weight-for-height. It is defined as a person's weight in kilograms divided by the square of his height in meters (kg/m^2). The BMI range generally considered to be healthy is 20 to 25 kg/m^2. Those with a BMI below 20 kg/m^2 are underweight, those with a BMI greater than or equal to 25 kg/m^2 are overweight and those with a BMI greater than or equal to 30 kg/m^2 are obese (WHO 2014).

The fundamental cause of excessive weight is an energy imbalance because the energy intake from food and drink surpasses energy expenditure for metabolic processes and physical activity. Usually, energy balance within the body is well regulated by a range of physiological responses. However, societal and environmental factors may influence energy intake and expenditure through effects on dietary and physical activity patterns resulting in an attenuation of the physiological control of bodyweight. Such factors include, but are not limited to, a changing food and activity environment, changing modes of transportation, increasing urbanization and a modified work environment. Especially longer working hours and living further from work and, hence longer commuting distances have led to a situation in which individuals can devote less time to planned nutrition and physical activity. Such behavioural changes may result in a higher BMI (Gill 2015).

Therefore, in recent years, the journey to work has gained attention in the study of overweight and obesity. It is generally claimed that commuters are more likely to suffer from excess weight. Most pertinent studies concentrate on means of transportation to work and specifically examine the connection between an active (such as walking, cycling or public transport) or passive (commuting by car) transport mode to work and BMI. An increasing body of evidence shows that passive commuting modes are significantly positively associated with excess weight compared to active modes (Wen et al. 2006, Lindström 2007, Bassett et al. 2008, Davison et al. 2008).[2] While these, predominantly cross-sectional, studies are informative with regard to the effects of transport mode on BMI, none specifically addresses the relationship between commuting distance and BMI, which is the topic of interest of this analysis.[3] To date, only little research has been performed to investigate the relationship between commuting distance and height-adjusted weight. One recent study (Hoehner et al. 2012) uses cross-sectional data of 4,297 adults living in Texas and finds that commuting distance is positively associated with BMI. Unfortunately, the study population consists predominantly of white, well-educated, healthier men from the Dallas-Fort Worth-Arlington Metropolitan Area.[4] Moreover, the authors have no information about e.g. occupation, income and eating habits and could only establish correlations.

[2] Researchers suggest that the physical activity generated by active commuting modes is helpful in weight control and can result in substantial amounts of energy expenditure as well as provide other physical and mental health benefits (HHS 2001, Hamer and Chida 2008).

[3] Furthermore, using a cross-sectional design to associate urban form measures with obesity among 10,878 individuals in Atlanta (Georgia, U.S.), Frank et al. (2004) find that *commuting time* (each additional hour spent in a car per day) was associated with a 6% increase in the likelihood of obesity.

[4] Since data was collected from the largest metropolitan area in Texas, the effect of commuting distance may be more serious in such a metropolitan area with worse traffic congestion.

Given this limited knowledge, the aim of this paper is to examine the causal impact of commuting distance on height-adjusted bodyweight. An understanding of this effect is important not only because commuting distances have increased in recent decades but also because commuting to the workplace is an important dimension of labour market experience as well.[5] The analysis is conducted using data from the German Socio-Economic Panel (SOEP) for the period 2004 – 2012. First, an ordinary least square model is estimated. Second a fixed effects model is used to remove time invariant unobserved heterogeneity. To take care of reverse causality, we further replace commuting distance variables with lagged values in order to avoid the influence of BMI on contemporaneous commuting distance. Finally, we exploit variation in commuting distance within an individual, when there are no changes in residence and employer. By keeping employer and residence location constant in the estimations, any change in commuting distance is than the result of employer-induced workplace relocation (so the employer moves to another location).

We add to the understanding of the effect of commuting distance on BMI on at least three frontiers: First, this relationship has not been studied in Germany before, and it is not clear whether the U.S. results are valid elsewhere. Although the prevalence of obesity is increasing in Germany, it is much less widespread than in the United States. Second, we contribute to the literature by providing a more complete analysis of the link between commuting distance and BMI. To our knowledge, this is the first paper to estimate the effect of individual-level commuting distance on height-adjusted weight using panel data to control for unobserved time-invariant heterogeneity. Third, this is the first study attempting to establish a causal link between commuting distance and BMI.

Our results cast doubt on the idea that commuting distance is positively associated with excess weight. More precisely, the results reveal that an increase in commuting distance does not affect an individual's BMI. Even after controlling for time-invariant characteristics no significant associations are observed. In addition, the non-existence of a relationship between BMI and commuting distance is consistently found across various sub-samples and prevails regardless of included control variables (e.g. physical activity and eating habits). Concentrating on the models in which we account for the potential reverse causality bias, we also obtain non-significant relationships.

Our analysis is structured as follows. The next section provides a description of the data. Section 3 presents the empirical strategy. Section 4 reports our main results from pooled

[5] In the US., for example, average commuting distances increased from 8.9 miles in 1983 to 21.1 miles in 2001 (Hu and Reuscher 2004). The average distance commuted to work in the U.K. increased from 13.4 km in 2001 to 15 km in 2011 (Office for National Statistics 2014).

and fixed effects specifications, including several robustness checks, and also discusses explanations for the findings. Section 5 contains the discussion of causality and Section 6 concludes.

2. Data and Variables

The data used in this study is from the German Socio-Economic Panel (SOEP), which is representative for the entire population of Germany, aged 17 and older. The SOEP includes rich information on labour market status, wealth, incomes and standard of living, health and life satisfaction as well as on family life and socio-economic variables.[6]

The SOEP provides information on self-reported bodyweight and height of respondents in 2002, 2004, 2006, 2008, 2010 and 2012. Given these numbers, we calculate our dependent variable labelled 'log of BMI' by dividing a respondent's weight in kilograms by the square of its height in meters (kg/m^2) before taking the logarithm.[7]

The key explanatory variable is self-reported one-way commuting distance to work, which is measured in this study, first, by the continuous variable 'commuting distance' (in km) and, second, by a categorical variable, indicating whether a respondent is a non-commuter (commuting distance $<$ 10 km or working from home), short distance commuter (commuting distance $\geq$ 10 km and $<$ 25 km), a middle distance commuter (commuting distance $\geq$ 25 km and $<$ 50 km) or a long distance commuter (commuting distance $\geq$ 50 km).[8] Commuting mode is not provided for the years we are observing.

In addition to commuting distance, a long list of variables is used as controls. In order to control for differences in personal characteristics we include variables such as sex, age and age squared, educational attainment, marital status, number of children, current health status and degree of disability, physical pain, limitations due to physical problems as well as information on migration background. It is also reasonable to argue that psychological and behavioural aspects may affect both weight and the decision to commute. Thus, we control for whether the respondent is concerned about one's own health, an indicator of how balanced a respondent feels and a measure of how energetic he/she perceives him-/herself to be. Further,

[6] Further information about the SOEP is provided by Wagner et al. (2007) and can also be found at: http://www.diw.de/english/soep/29012.html. We use the SOEP long v30 dataset.

[7] Self-reported weight and height could be problematic as people commonly underreport their weight or overreport their height. However, researchers with access to both self-reported and actual height have shown that correcting for errors in the self-reported values does not substantially alter coefficient estimates in regressions of bodyweight (i.e. Cawley 2004, Lakdawalla and Phillipson 2009).

[8] No standard definition of commuting is used internationally or in Germany. We build our categories in line with definition used by the Federal Statistical Office of Germany.

we take into account eating and smoking behaviour and whether the respondent does sports.[9] To control for employment characteristics we include variables such as working hours, working hours mismatch, employment status (full time, part time, vocational training or marginal employed), sector information, industry dummies, a dummy for white-collar jobs and income. Finally, we include information on leisure time, region of residence, as well as dummies for years and federal states. This set of control variables is common in the literature on health outcomes such as health satisfaction, sickness absence and BMI (e.g. Courtemanche 2009, Roberts et al. 2011, Hoehner et al. 2012, Abramowitz 2016).

We restrict our sample to the years 2004, 2006, 2008, 2010 and 2012 since the 2002 wave of the SOEP does not provide information about eating behaviour, which is an important influential factor for BMI. Our estimation sample consists of 18 to 65-year old individuals in paid employment.[10] Since weight may be affected by current or recent pregnancy, we exclude women who are on maternity leave at the time they report their weight and who gave birth in the year of observation. This leaves a baseline sample of 14,304 individuals and 33,034 observations.

Tables A.1 and A.2 in the Appendix A show our variables definitions and a complete list of covariates and descriptive statistics.

3. Empirical Strategy

In the present study, ordinary least squares (OLS) regressions are used to model BMI as a function of commuting distance and other covariates. Continuous commuting distance is used in one regression and commuting distance categories (short distance, middle distance and long distance commuters with non-commuters as reference category) are used in the other regression. To allow for non-linear effects of commuting distance, we additionally include its squared value in the former regression. The latter regression captures the non-linearity by virtue of the binary nature of the categorical distance variables. Thus, the two regressions take the following forms:

$$(1) \qquad log\,(bmi_i) = \alpha + \beta_1 CD_i + \beta_2 (CD_i^2) + \gamma X_i + \varepsilon_i$$

$$(2) \qquad log\,(bmi_i) = \alpha + \beta_1 SDC_i + \beta_2 MDC_i + \beta_3 LDC_i + \gamma X_i + \varepsilon_i$$

[9] Information about frequency of sport participation relates to the previous year (t – 1) since data is not available in t.

[10] As Roberts et al. (2011) we exclude self-employed, since they are more likely to have a workplace at home and have different commuting patterns compared to employees.

where $log\,(bmi_i)$ is the individual's logarithm of height-adjusted weight, CD_i is the commuting distance, SDC_i, MDC_i and LDC_i are dummies indicating whether a respondent is a short distance, middle distance or a long distance commuter. The vector X_i includes all the control variables. ε_i denotes the error term. β and γ are coefficients and our main interest lies in β. The pooled estimators identify the effect of commuting distance on BMI based on the variation in these variables between people and for each individual over time.[11]

The longitudinal characteristic of the SOEP allows estimating fixed effects OLS specification in which idiosyncratic effects that are time invariant can be controlled for. The effect of commuting distance on BMI is then identified by the variation in commuting distance within observations for the same individual. As in equations (1) and (2) continuous commuting distance is used in one regression and commuting distance categories are used in the other regression. Thus, equations (3) and (4) take the following forms:

$$(3) \qquad log\,(bmi_{it}) = \alpha_i + \beta_1 CD_{it} + \beta_2 (CD_{it}^2) + \gamma X_{it} + \varepsilon_{it}$$

$$(4) \qquad log\,(bmi_{it}) = \alpha_i + \beta_1 SDC_{it} + \beta_2 MDC_{it} + \beta_3 LDC_{it} + \gamma X_{it} + \varepsilon_{it}$$

where α_i denotes time-invariant idiosyncratic effects. The remaining notation is comparable to that of equations (1) and (2).

If commuting distance is strictly exogenous, then an OLS estimate of β can be interpreted as a consistent estimate of the true effect of commuting distance on BMI. However, the literature dealing with consequences of commuting suggests that commuting may be endogenous (e.g. Roberts et al. 2011, van Ommeren and Gutiérrez-i-Puigarnau 2011). We will explicitly address the potential endogeneity of commuting distance in Section 5.

4. Results

4.1 Estimation Results

Table 1 reports the association between commuting distance and BMI. The mean BMI for the sample is 25.66 and the mean one-way commuting distance amounts to 21.80 kilometres. This is in line with a range of other studies employing German data (Clark and Etilé 2011, OECD 2007). Figure A.1 in Appendix A plots the average one-way commuting distance and the average BMI per year. The figure shows a clear though small increase in

[11] The impact of commuting distance can be calculated as $\frac{\partial \log(bmi)}{\partial\, CD} = \hat{\beta}_1 + 2\hat{\beta}_2 CD$. The marginal effects of binary distance variable SDC can be calculated as $marginal\ effect = \exp(\hat{\beta}_1) - 1$. The marginal effects of MDC and LDC can be calculated in the same way.

both the average distance, from 20.46 km in 2004 to 23.37 in 2012, and the average BMI, from 25.24 BMI points in 2004 to 26.32 BMI points in 2012.

About 55% of individuals in our dataset are short, middle or long distance commuters. The mean BMI increases by about 0.30 BMI points, as one-way commute distance increases from under ten (non-commuters) to over 50 kilometres (long distance commuters). Those individuals who commute long distances have a BMI of 25.86 on average. In other words, with a height of e.g. 1.70 meters a long distance commuter would weight on average about 0.8 kilogrammes more than a non-commuter. Figure A.2 in Appendix A illustrates the basically positive association between average commuting distance and mean BMI, differentiated by survey year.

Table 1

Descriptive statistics for full sample and for commuter categories. Source: SOEP 2004 – 2012.

	Full sample		NC		SDC		MDC		LDC	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
BMI	25.66	4.43	25.58	4.45	25.63	4.50	25.85	4.35	25.86	4.15
BMI (log)	3.23	0.16	3.22	0.16	3.22	0.16	3.23	0.16	3.24	0.15
CD (in km)	21.80	54.11	3.82	2.50	15.19	4.04	32.27	6.66	135.99	155.25
N	33,034		14,782		10,421		5,396		2,435	
%	100%		44.75%		31.55%		16.33%		7.37%	

Notes: Summary statistics only for key variables. SD = Standard deviation. Appendix A shows the detailed descriptive statistics in Table A.2.

All in all, the descriptive statistics indicate that individuals who commute longer distances have a higher BMI. However, from distance category to distance category the increase of BMI points is relatively small.

Table 2 reports the estimation results on height-adjusted weight for pooled and fixed effects specifications. Since commuting distance and its square are included as well as the categorical distance variable, the table also reports the F-statistics and p-values of joint significance. The joint significance tests indicate whether there is indeed a non-linear relation between commuting distance and BMI. Pooled OLS results presented in Models I and II of Table 2 suggest that there are no significant effects of commuting distance or the categorical distance variable on BMI. These findings are not in accordance with the results reported by Hoehner et al. (2012) for the United States, according to which commuting distance is positively associated with BMI. In our cross-sectional analyses, a number of variables appear to impact on height-adjusted weight (see Appendix A, Table A.3). Regarding personal characteristics we find that being male, having a partner, bad health and having a migration background are associated with a significantly higher BMI. Being better educated

significantly lowers BMI. The relationship between age and BMI is significant in an inversely u-shaped manner. With regard to the variables which are reflecting psychological and behavioural aspects our results show that missing vital energy and not paying attention to health-conscious nutrition significantly increase BMI, whereas higher levels of physical activity significantly decrease BMI. Further, it is interesting that those individuals who are not concerned about health, who never feel balanced and who smoke have a significantly lower BMI, relative to their respective reference categories.

Concentrating on the models in which we account for the potential impact of time-invariant, unobservable characteristics on BMI (Table 2: Models III and IV) we may draw the same conclusion with respect to the relationship between commuting and BMI. We do not observe significant effects on BMI, neither from the continuous (Model III) nor the categorical measure (Model IV). The non-existent relationship between commuting distance and BMI prevails independent of the inclusion or exclusion of variables capturing nutritional habits and physical activities.

Table 2

Estimation results. Dependent variable: Log of BMI. Source: SOEP 2004 – 2012.

	Model I Pooled OLS	Model II Pooled OLS	Model III FE OLS	Model IV FE OLS
Commuting distance	-0.00000610		-0.0000172	
	(-0.18)		(-0.57)	
Commuting distance squared	-2.43e-08		1.47e-08	
	(-0.44)		(0.35)	
Short distance commuter		-0.00217		-0.000383
		(-1.11)		(-0.19)
Middle distance commuter		0.00317		-0.00148
		(1.31)		(-0.52)
Long distance commuter		0.00180		-0.000807
		(0.57)		(-0.25)
F-statistic for joint significance	0.95	1.65	0.23	0.10
(p-value)	0.3852	0.1758	0.7908	0.9617
N	33,034	33,034	33,034	33,034

Notes: Only the coefficients for the commuting variables are reported. Non-commuters are treated as the reference category in Models II and IV. Following control variables are included: current health status, worries about health, invalidity level, sport, physical problems, physical pain, being well-balanced, energy, healthy nutrition, smoking, women (exc. FE OLS), age, age squared, # of children, partner, education, income, regional information, working hours mismatch, leisure time, migration (exc. FE OLS), civil service, employment status, white-collar, industry, federal state dummies, year dummies. Appendix A shows the results for control variables in Table A.3. All models are estimated using robust standard errors. *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In both models the strongest effect on BMI originates from nutritional habits. Those paying little attention to healthy nutrition have a significantly higher BMI compared to individuals who are conscious about healthy eating. Surprisingly, neither concerns with one's

health nor doing sports is related to BMI in the fixed effects specification. The negative effect of smoking on BMI remains significant (see Appendix A, Table A.3). Re-running the basic fixed-effects results on different sub-samples (women, men, fulltime worker, daily commuters, smokers, non-smokers, younger and older individuals, as well as individuals living with a partner) does not reveal a relationship between commuting and BMI for any of these subgroups (see Appendix A, Table A.4).

4.2 Explanations for the (Non)-Relationship between Commuting Distance and BMI

Given the general perception that commuting increases weight and the according (cross-sectional) evidence, especially for passive commuting modes, it is striking that we do not find such association in Germany. Our findings are all the more noteworthy, because they also apply to people who travel to work more than 25 kilometres per day and way and are, hence, very unlikely to actively commute. Therefore, in this sub-section, we analyse two possible key mechanisms which could rationalise our findings.

Weight gain is *predominantly* caused by an imbalance between calories consumed and calories expended. If an individual commutes longer to work, her leisure time drops ceteris paribus, which could theoretically increase her weight through two mechanisms: First, she might exercise less and, hence, decrease calories expended (Courtemanche 2009). Second, she might devote less time to food preparation, causing a substitution from home-prepared meals to unhealthy convenience food, such as fast food and pre prepared processed food. This substitution could increase caloric intake, as a higher frequency of eating fast food results in greater consumption of calories and fat (i.e. Satia et al. 2004) and is also associated with excess weight (i.e. Jefferey et al. 2006). In contrast to this line of argumentation, individuals who commute to work might be aware of the potential adverse effect of commuting and, therefore, adjust their behaviour to their situational needs, e.g. they could use income to substitute away from time-intensive to goods-intensive health investments (Abramowitz 2016). In line with this hypothesis, Künn-Nelen (2015) finds evidence for compensating health behaviour among those with relatively long commutes, using data from the UK household longitudinal study Understanding Society. Long commutes appear to lead to changes in nutrition and physical activities that are likely to reduce weight, e.g. increased consumption of fruit and vegetables and more physical activities. Consequently, long distance commutes and the adjusted health behaviour may rather enhance health-aware nutrition and lifestyle than deteriorate it.

Even though the SOEP does not cover more detailed data on nutrition and physical activities, we perform more analyses in order to present the available information in a more meaningful way and to explore whether the mechanisms explained in the previous section could explain our findings. We first use a graph which enables us to simply identify patterns between commuting distance and eating behaviour or physical activities (see Appendix A, Figure A.3). Second, we perform two random-effects ordered logistic regressions that include commuting distance as key explanatory variable as well as several other control variables. The first regression assumes the extent to which the respondent cares about health conscious nutrition as cardinal measure and depended variable. The second regression uses the frequency of sport or exercise as dependent variable (see Appendix A, Table A.5).

Figure A.3 in Appendix A illustrates the basically negative association between commuting distance and health conscious nutrition. However, this association is not supported by the findings of the logistic regression. We do not observe jointly significant effects on nutritional habits, neither from the continuous nor the categorical commuting distance variable. Consequently and contrary to expectations, we find no evidence that commuters eat unhealthier compared to non-commuters.

Concentrating on the second potential mechanism, namely physical activity, Figure A.3 shows a small increase in the frequency of doing sports with increasing commuting distance. Our logistic regression results presented in Table A.5 also provide support for the positive relationship between commuting and physical activity since the coefficients of interest are jointly significant. So, our findings suggest that there is little evidence that those who commute compensate for it by more physical activity. Thus, commuting appears to induce changes in physical activities that are likely to reduce weight.

In summary, commuting does not encourage an unhealthy eating behaviour in general but fosters doing more exercise. These effects could therefore explain why no significant relationship is found between commuting distance and BMI. Unfortunately, we are not able to investigate to which extent employees with different commuting distances eat, for example, more vegetables or/and fruits or how much time they spend doing sports or the type of sport. This is the case since our data does not provide detailed information on nutrition and physical activities. This limitation may be worth addressing in future research.

5. Discussion of Causality

One major issue in the empirical study of the effect of commuting distance on health outcomes is reverse causation. An increased BMI may reasonably contribute to the decision to

commute, and combined with this, the commuting distance. For example, an individual with high BMI may become lethargic due to obesity-induced health barriers and myopic towards future (Majumder 2013). As a result, an overweight or obese individual is less likely to accept jobs at longer distances. Consequently, commuting habits may result from excess weight.

In order to deal with the potential endogeneity of commuting when estimating the effect of commuting distance on BMI, we employ two strategies. The first is to replace commuting distance (in equations (3) and (4)) with a one-year lagged value of commuting distance in order to avoid the influence of BMI on contemporaneous commuting distance. This strategy is based on the assumption that lagged commuting distance is uncorrelated with the current BMI residual, which assumes no serial correlation in the BMI residuals for the two periods.

The second strategy is to exploit variation in commuting distance within an individual, when there are no changes in residence and employer. The literature dealing with the consequences of commuting argues that analyses of individuals who neither change employer nor residence reveal the effect of exogenous changes in commuting distance on health outcomes. It is alleged that when keeping employer and residence location constant, any change in commuting distance is than the result of employer-induced workplace relocation (e.g. Roberts et al. 2011, van Ommeren and Gutiérrez-i-Puigarnau 2011, Künn-Nelen 2015).[12]

The findings from both strategies are depicted in Table 3. Results from fixed effects regressions depicted in Models I and II of Table 3 demonstrate that replacing contemporaneous distance measures by lagged distance measures does not change the statistical significance of the estimated coefficients of the commuting variables. In particular, coefficients of the lagged commuting distance and the lagged distance categories remain insignificant as before. Results from the regressions in which we only consider employees who do not change employer and residence reveal broadly the same conclusion. If anything, the results provide evidence that commuting measured by the categorical variable produces a decrease in BMI (Table 3: Model IV) rather than an increase. However, it is important to note that we do not observe a joint significance of the distance coefficients.

Again, we see that the strongest effect on BMI comes, inter alia, from nutritional habits. Individuals who are conscious about healthy nutrition have a significantly lower BMI

[12] Unfortunately, the SOEP does not include information on workplace relocation, so one cannot rule out that such relocations apply to this sub-sample. However, it is plausible that if a worker changes neither employer nor residence while commuting distance increases or decreases, the worker must have changed workplace location because e.g. of a firm relocation. Such changes in workplace location due to firm relocation have been shown to be quite common (Gutiérrez-i-Puigarnau and van Ommeren 2010, Gutiérrez-i-Puigarnau and van Ommeren 2013). For example, about 16.5% of firms in Germany are each year involved in relocation decisions (Federal Statistical Office of Germany 2008).

compared to those paying little attention to healthy eating. Health status or sporting activities do not seem to impact BMI. In addition, we do not observe a relationship between BMI and commuting distance in various sub-samples (not reported) and regardless of the set of control variables included.

Table 3

Results of strategies for causal inference. Dependent variable: Log of BMI. Source: SOEP 2004 – 2012.

	Strategy I Using *lagged values* of commuting distance		**Strategy II** Using *exogenous changes* in commuting distance	
	Model I FE OLS	Model II FE OLS	Model III FE OLS	Model IV FE OLS
Commuting distance	-0.0000116		-0.0000826	
	(-0.36)		(-1.16)	
Commuting distance squared	3.83e-08		3.12e-08	
	(0.83)		(0.24)	
Short distance commuter		-0.000818		-0.00231
		(0.43)		(-0.72)
Middle distance commuter		0.00130		-0.0000773
		(0.45)		(-0.02)
Long distance commuter		0.00208		-0.0110*
		(0.65)		(-1.81)
F-statistic for joint significance	0.85	0.40	1.59	1.42
(p-value)	0.4261	0.7504	0.2041	0.2335
N	29,448	29,448	21,455	21,445

Notes: Only the coefficients for the commuting variables are reported. Non-commuters are treated as the reference category in Models II and IV. Following control variables are included: current health status, worries about health, invalidity level, sport, physical problems, physical pain, being well-balanced, energy, healthy nutrition, smoking, age, age squared, # of children, partner, education, income, regional information, working hours mismatch, leisure time, civil service, employment status, white-collar, industry, federal state dummies, year dummies. Appendix A shows the results for control variables in Table A.6. All models are estimated using robust standard errors. *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6. Conclusion

This paper explores the relationship between height-adjusted weight and commuting in Germany by using individual microdata for the period 2004 – 2012. In contrast to other studies relating commuting distance to BMI, we use fixed effects analyses to control for unobserved time-invariant characteristics of individuals. In order to identify a causal link between BMI and commuting distance we, first, replace contemporaneous distance variables by their one-year lags and, second, exploit variation of commuting distance within individuals, when there are no changes in residence and employer.

We find no evidence that longer commutes are associated with a higher BMI. This non-relationship is consistently found across various sub-samples and prevails regardless of included control variables. All in all, the German evidence presented is not in accordance with

the results reported by Hoehner et al. (2012) for the United States, according to which commuting distance is positively associated with BMI. The intuition of our results is that either the effect of commuting distance on BMI found for the U.S. does not hold for Germany, since overweight and obesity are much more common in the United States than in Germany or that individuals who commute are aware of the potential adverse effect of commuting and, therefore, adjust their behaviour to their situational needs. We find some (albeit little) evidence for compensating health behaviour, such as more physical activity, among those who commute, which could explain why we do not find any effects of commuting distance on BMI. Additional research focusing on the relation between commuting distance and sporting or nutritional habits could further increase understanding of the relation between commuting distance and BMI.

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Appendix A

Table A.1

Variable definitions. Source: SOEP 2004 – 2012.

Variable	*Definition*
Dependent variable	
Log of BMI	Logarithm of bodyweight in kilograms divided by the square of height in meters (BMI = kg/m^2).
Focal variables	
Commuting distance	One-way commuting distance measured in kilometres.
Commuting distance squared	Commuting distance measured in kilometres squared.
Commuter	Dummy variables indicating whether the individual is a non-commuter (< 10 km, ref.), short distance commuter (10 – 24 km), middle distance commuter (25 – 49 km) or a long distance commuter (> 49 km).
Personal characteristics	
Women	Dummy equals 1 for women.
Age	Age in years.
Age^2	Age squared.
Married	Dummy equals 1 if the individual is living together with partner (either married or unmarried couple).
Number of Children	Number of children in household.
Education	Dummy equals 1 if individual has a school degree higher than intermediate.
Health status	A five point indicator of self-reported health status: 1 = "very good", 2 = "good", 3 = "acceptable", 4 = "less good", 5 = "bad".
Invalidity level	Statutory degree of disability in %.
Physical pain	Dummy variables indicating how often physical pain is experienced in the last 4 weeks (always (ref.), often, sometimes, almost never, never).
Physical problems	Dummy variables indicating how often limitations due to physical problems are experienced in the last 4 weeks (always (ref.), often, sometimes, almost never, never).
Migration background	Dummy equals 1 if individual has a direct or indirect migration background.
Psychological & behavioural aspects	
Concerns about health	Dummy variables indicating whether individual is concerned about own health (very concerned (ref.), somewhat concerned, not concerned at all).
Feel balanced	Dummy variables indicating how often the individual felt balanced in the last 4 weeks (always (ref.), often, sometimes, almost never, never).
Feel energetic	Dummy variables indicating how often the individual felt energetic in the last 4 weeks (always (ref.), often, sometimes, almost never, never).
Taking part in sports	Dummy variables indicating the frequency with which individual participates in sport (almost never (ref.), several times a year, at least once a month, at least once a week).
Eating behaviour	Dummy variables indicating whether individual eats health-consciously (very strong (ref.), strong, a little, not at all).
Smoking	Dummy equals 1 if individual currently smokes.
Employment characteristics	
Working hours	Contractually agreed weekly working time.
Working hours mismatch	Dummy variables indicating mismatch in working hours (no mismatch (ref.), preference for working fewer hours, preference for working more hours).
Employment status	Dummy variables indicating full time employment (ref.), part time employment, vocational training or marginal employment.
Sector	Dummy equals 1 if individual works in the public sector.
Industry	9 dummies equalling 1 for individuals working in the named industry: agriculture, energy, mining, manufacturing, construction, trade, transport, bank or insurance, services.
White-collar job	Dummy equals 1 if individual is a white-collar worker.
Log (monthly wage)	Logarithm of current gross labour income.
Other variables	
Leisure time	Time in hours spent for leisure and hobbies.
Spatial information	Dummy equals 1 if individual lives in an urban region.
Federal states	Dummy variables for the 16 federal states of Germany.
Year	Dummy variables for each year covered by the sample.

Table A.2

Descriptive statistics. Source: SOEP 2004 – 2012.

	Mean	*SD*	*Min.*	*Max.*
Log of BMI	3.23	0.16	2.59	4.59
Commuting distance	21.80	54.11	0	999
Commuter				
Non-commuter (ref.)	0.45	0.49	0	1
Short distance commuter	0.32	0.46	0	1
Middle distance commuter	0.16	0.36	0	1
Long distance commuter	0.07	0.26	0	1
Women	0.49	0.49	0	1
Age	42.53	11.13	18	65
Married	0.63	0.48	0	1
Number of Children	0.59	0.89	0	9
Education	0.30	0.46	0	1
Health status				
Very good (ref.)	0.10	0.29	0	1
Good	0.48	0.49	0	1
Acceptable	0.31	0.46	0	1
Less good	0.09	0.29	0	1
Bad	0.01	0.11	0	1
Invalidity level	2.85	12.13	0	100
Physical pain				
Always (ref.)	0.01	0.09	0	1
Often	0.07	0.26	0	1
Sometimes	0.19	0.39	0	1
Almost never	0.31	0.46	0	1
Never	0.42	0.49	0	1
Physical problems				
Always (ref.)	0.01	0.09	0	1
Often	0.04	0.20	0	1
Sometimes	0.17	0.37	0	1
Almost never	0.27	0.44	0	1
Never	0.51	0.49	0	1
Migration background	0.18	0.38	0	1
Concerns about health				
Very concerned (ref.)	0.12	0.32	0	1
Somewhat concerned	0.53	0.49	0	1
Not concerned at all	0.35	0.47	0	1
Feel balanced				
Always (ref.)	0.04	0.20	0	1
Often	0.44	0.49	0	1
Sometimes	0.37	0.48	0	1
Almost never	0.13	0.34	0	1
Never	0.02	0.12	0	1
Feel energetic				
Always (ref.)	0.03	0.18	0	1
Often	0.32	0.46	0	1
Sometimes	0.45	0.49	0	1
Almost never	0.17	0.37	0	1
Never	0.03	0.15	0	1
Taking part in sports				
Almost never or never (ref.)	0.28	0.44	0	1
Several times a year	0.21	0.40	0	1
At least once a month	0.09	0.28	0	1
At least once a week	0.42	0.49	0	1
Eating behaviour				
Very strong (ref.)	0.07	0.24	0	1
Strong	0.39	0.48	0	1
A little	0.48	0.49	0	1
Not at all	0.06	0.24	0	1
Smoking	0.35	0.47	0	1
Working hours	34.38	9.16	0.6	78
Working hours mismatch				
No mismatch (ref.)	0.26	0.43	0	1
Prefer to work fewer hours	0.58	0.49	0	1
Prefer to work more hours	0.16	0.36	0	1

Employment status				
Full time (ref.)	0.71	0.45	0	1
Part time	0.21	0.40	0	1
Vocational training	0.04	0.18	0	1
Marginal	0.04	0.20	0	1
Public sector	0.30	0.45	0	1
White-collar job	0.60	0.49	0	1
Log (monthly wage)	7.57	0.76	2.30	10.43
Leisure time	1.84	1.33	0	24
Spatial information	0.68	0.47	0	1
N		33,034		

Table A.3

Complete estimation results. Dependent variable: Log of BMI. Source: SOEP 2004 – 2012.

	Model I Pooled OLS	**Model II** Pooled OLS	**Model III** FE OLS	**Model IV** FE OLS
Commuting distance	-0.00000610		-0.0000172	
	(-0.18)		(-0.57)	
Commuting distance squared	-2.43e-08		1.47e-08	
	(-0.44)		(0.35)	
Commuter: Non-commuter (ref.)				
Short distance commuter		-0.00217		-0.000383
		(-1.11)		(-0.19)
Middle distance commuter		0.00317		-0.00148
		(1.31)		(-0.52)
Long distance commuter		0.00180		-0.000807
		(0.57)		(-0.25)
Women	-0.0649***	-0.0646***	*omitted*	*omitted*
	(-29.38)	(-29.26)		
Age	0.00795***	0.00798***	0.0120***	0.0120***
	(12.29)	(12.33)	(13.08)	(13.10)
Age^2	-0.0000652***	-0.000065***	-0.0000814***	-0.0000816***
	(-8.70)	(-8.72)	(-8.14)	(-8.15)
Married	0.0207***	0.0207***	0.0101***	0.0100***
	(9.36)	(9.35)	(4.42)	(4.42)
Number of Children	-0.00287***	-0.00281***	0.000809	0.000817
	(-2.68)	(-2.62)	(0.75)	(0.76)
Education	-0.0213***	-0.0215***	-0.00185	-0.00204
	(-10.67)	(-10.74)	(-0.17)	(-0.18)
Health status: Very good (ref.)				
Good	0.0190***	0.0190***	0.00243	0.00243
	(7.04)	(7.05)	(1.40)	(1.40)
Acceptable	0.0436***	0.0436***	0.00479**	0.00478**
	(13.11)	(13.12)	(2.26)	(2.25)
Less good	0.0497***	0.0498***	0.00273	0.00273
	(10.37)	(10.37)	(0.99)	(0.99)
Bad	0.0432***	0.0432***	0.00449	0.00445
	(4.03)	(4.03)	(0.62)	(0.62)
Invalidity level	-0.000170**	-0.000169**	0.0000710	0.0000711
	(-2.06)	(-2.05)	(0.79)	(0.79)
Physical pain: Always (ref.)				
Often	0.0103	0.0104	0.000242	0.000265
	(0.90)	(0.91)	(0.04)	(0.04)
Sometimes	-0.00206	-0.00206	-0.00137	-0.00136
	(-0.18)	(-0.18)	(-0.22)	(-0.22)
Almost never	-0.00564	-0.00558	-0.00260	-0.00257
	(-0.49)	(-0.49)	(-0.41)	(-0.41)
Never	-0.0147	-0.0146	-0.00409	-0.00407
	(-1.28)	(-1.27)	(-0.65)	(-0.65)
Physical problems: Always (ref.)				
Often	-0.00966	-0.00960	-0.00311	-0.00312
	(-0.83)	(-0.83)	(-0.52)	(-0.52)
Sometimes	-0.00931	-0.00927	-0.00327	-0.00328
	(-0.83)	(-0.83)	(-0.55)	(-0.56)
Almost never	-0.00623	-0.00619	-0.00493	-0.00496
	(-0.55)	(-0.55)	(-0.84)	(-0.84)
Never	-0.00513	-0.00512	-0.00429	-0.00429
	(-0.46)	(-0.46)	(-0.73)	(-0.73)
Migration background	0.00483**	0.00485**	*omitted*	*omitted*
	(2.13)	(2.14)		
Health concerns: Very concerned (ref.)				
Somewhat concerned	-0.00632**	-0.00627**	-0.00187	-0.00188
	(-1.98)	(-1.97)	(-0.97)	(-0.97)
Not concerned at all	-0.0201***	-0.0200***	-0.00344	-0.00345
	(-5.77)	(-5.75)	(-1.58)	(-1.59)
Feel balanced: Always (ref.)				
Often	-0.00668	-0.00671	0.00157	0.00158
	(-1.52)	(-1.53)	(0.66)	(0.66)
Sometimes	-0.0156***	-0.0157***	-0.00188	-0.00188

	(-3.37)	(-3.39)	(-0.75)	(-0.75)
Almost never	-0.0236***	-0.0237***	-0.00407	-0.00407
	(-4.60)	(-4.62)	(-1.43)	(-1.43)
Never	-0.0295***	-0.0295***	-0.00889*	-0.00886*
	(-3.45)	(-3.44)	(-1.91)	(-1.90)
Feel energetic: Always (ref.)				
Often	0.000358	0.000447	0.00107	0.00107
	(0.07)	(0.09)	(0.39)	(0.39)
Sometimes	0.00369	0.00379	0.00552*	0.00553*
	(0.75)	(0.77)	(1.90)	(1.91)
Almost never	0.0112**	0.0113**	0.00656**	0.00657**
	(2.07)	(2.10)	(2.07)	(2.07)
Never	0.0253***	0.0254***	0.00908**	0.00907**
	(3.25)	(3.27)	(2.17)	(2.16)
Taking part in sports: Almost never (ref.)				
Several times a year	-0.00353	-0.00355	0.000392	0.000382
	(-1.38)	(-1.39)	(0.27)	(0.27)
At least once a month	-0.0163***	-0.0163***	-0.00320*	-0.00322*
	(-5.13)	(-5.13)	(-1.86)	(-1.87)
At least once a week	-0.0203***	-0.0203***	-0.00259*	-0.00259*
	(-9.16)	(-9.15)	(-1.90)	(-1.90)
Eating behaviour: Very strong (ref.)				
Strong	0.0210***	0.0211***	0.0107***	0.0107***
	(6.28)	(6.32)	(5.29)	(5.29)
A little	0.0502***	0.0502***	0.0202***	0.0202***
	(14.71)	(14.74)	(8.92)	(8.93)
Not at all	0.0413***	0.0414***	0.0185***	0.0185***
	(8.43)	(8.45)	(5.61)	(5.62)
Smoking	-0.0245***	-0.0245***	-0.0185***	-0.0185***
	(-13.19)	(-13.18)	(-8.50)	(-8.51)
Working hours	0.000330	0.000329	-0.000277*	-0.000277*
	(1.62)	(1.62)	(-1.83)	(-1.83)
Working hours mismatch: No (ref.)				
Prefer to work fewer hours	-0.00446**	-0.00449**	-0.000251	-0.000244
	(-2.19)	(-2.21)	(-0.23)	(-0.22)
Prefer to work more hours	0.00790***	0.00788***	0.000575	0.000589
	(2.80)	(2.79)	(0.38)	(0.39)
Employment status: Full time (ref.)				
Part time	-0.00910**	-0.00906**	0.00182	0.00182
	(-2.35)	(-2.34)	(0.64)	(0.64)
Vocational training	-0.0143**	-0.0144 **	-0.00105	-0.00106
	(-2.45)	(-2.47)	(-0.20)	(-0.21)
Marginal	0.0166 **	0.0162 **	0.00560	0.00556
	(2.23)	(2.19)	(1.07)	(1.06)
Public sector	0.00107	0.00127	-0.00326	-0.00325
	(0.46)	(0.55)	(-1.40)	(-1.39)
White-collar job	-0.00506**	-0.00510**	0.00246	0.00246
	(-2.54)	(-2.56)	(1.03)	(1.03)
Log (monthly wage)	-0.00239	-0.00269	0.00201	0.00200
	(-1.16)	(-1.31)	(0.99)	(0.99)
Leisure time	0.000965	0.00103	-0.000359	-0.000355
	(1.45)	(1.55)	(-0.79)	(-0.78)
Spatial information	-0.00586***	-0.00567***	0.00216	0.00215
	(-2.68)	(-2.59)	(0.38)	(0.38)
Industry dummies	Included	Included	Included	Included
Federal state dummies	Included	Included	Included	Included
Year dummies	Included	Included	Included	Included
Constant	3.029***	3.030***	2.837***	2.837***
	(118.43)	(118.48)	(102.36)	(102.53)
F-statistic for joint significance	0.95	1.65	0.23	0.10
(p-value)	0.3852	0.1758	0.7908	0.9617
N	33,034	33,034	33,034	33,034

Notes: *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.4

Heterogeneous effects. Source: SOEP 2004 – 2012.

	(i) Women	(ii) Men	(iii) Full time worker	(iv) Daily commuter	(v) Smoker	(vi) Non-smoker	(vii) Age<42	(viii) Age≥42	(ix) Respondents with partner
Commuting distance	-0.00000264	-0.0000115	-0.0000294	0.0000715	-0.0000882	-0.0000213	-0.0000360	-0.00000381	0.00000733
	(-0.04)	(-0.35)	(-0.96)	(0.47)	(-1.13)	(-0.65)	(-0.86)	(-0.08)	(0.22)
Commuting distance squared	-4.52e-08	1.46e-08	5.14e-08	-0.000000755	0.000000238	-9.21e-09	2.53e-08	1.44e-08	2.59e-09
	(-0.34)	(0.34)	(1.21)	(-0.62)	(1.58)	(-0.20)	(0.44)	(0.22)	(0.06)
F-statistic for joint significance	0.35	0.06	0.83	0.20	1.73	1.14	0.70	0.05	0.22
(p-value)	0.7055	0.9391	0.4352	0.8150	0.1771	0.2431	0.4948	0.9479	0.8010
Commuter: Non-commuter (ref.)									
Short distance commuter	-0.00406	0.00413	-0.00154	0.00368	0.00508	-0.00315	0.000996	-0.00120	0.000441
	(-1.36)	(1.53)	(-0.68)	(0.94)	(1.46)	(-1.23)	(0.34)	(-0.40)	(0.17)
Middle distance commuter	-0.00513	0.00246	-0.00296	0.00289	0.00171	-0.00530	0.00307	-0.00219	-0.000627
	(-1.11)	(0.71)	(-0.96)	(0.67)	(0.31)	(-1.61)	(0.77)	(-0.57)	(-0.18)
Long distance commuter	-0.00441	0.00304	-0.00232	0.00196	0.00919	-0.00653	-0.00402	0.00446	0.000618
	(-0.78)	(0.08)	(-0.66)	(0.36)	(1.54)	(-1.72)	(-0.92)	(0.09)	(0.15)
F-statistic for joint significance	0.69	0.82	0.33	0.33	1.53	1.131	0.85	0.16	0.06
(p-value)	0.5601	0.4829	0.08065	0.8047	0.2038	0.2701	0.4639	0.9234	0.9801
N	16,265	16,769	23,500	16,740	11,690	23,344	14,564	18,470	21,134

Notes: Only the coefficients for the commuting variables are reported. Same control variables included as in the main analyses (see Table A.3). All models are estimated using robust standard errors. *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.5

Explanations for findings based on additional analyses. Source: SOEP 2004 – 2012.

	Dependent variable: Health conscious nutrition (not at all, a little, strong, very strong)	**Dependent variable:** Frequency of sport or exercise (almost never, several times a year, at least once a month, at least once a week)
Log(Commuting distance)	0.0428	0.138***
	(0.96)	(3.61)
Log(Commuting distance squared)	-0.00195	-0.0202***
	(-0.23)	(-2.64)
F-statistic for joint significance	4.04	16.64***
(p-value)	0.1329	0.0002
N	32,576	32,576
Commuter: Non-commuter (ref.)		
Short distance commuter	0.0779*	0.102***
	(1.73)	(2.60)
Middle distance commuter	0.00902	0.0625
	(0.16)	(1.28)
Long distance commuter	0.0847	0.0981
	(1.07)	(1.47)
F-statistic for joint significance	3.92	7.41**
(p-value)	0.2706	0.0598
N	33,034	33,034

Model: Random-effects ordered logistic regression.

Notes: Only the coefficients for the commuting variables are reported. The following control variables are included: age, age squared, women, current health status, number of children, marital status, education, region, year dummies. All models are estimated using robust standard errors. *t* statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.6

Complete results of causal inference strategies. Dependent variable: Log of BMI. Source: SOEP 2004 – 2012.

	Strategy I Using lagged values of commuting distance		**Strategy II** Using exogenous changes in commuting distance	
	Model I FE OLS	Model II FE OLS	Model III FE OLS	Model IV FE OLS
Lag of commuting distance	-0.0000116			
	(-0.36)			
Lag of commuting distance squared	3.83e-08			
	(0.83)			
Commuter: Lag of non-commuter (ref.)				
Lag of short distance commuter		-0.000818		
		(-0.43)		
Lag of middle distance commuter		0.00130		
		(0.45)		
Lag of long distance commuter		0.00208		
		(0.65)		
Commuting distance			-0.0000826	
			(-1.16)	
Commuting distance squared			3.12e-08	
			(0.24)	
Commuter: Non-commuter (ref.)				
Short distance commuter				-0.00231
				(-0.72)
Middle distance commuter				-0.0000773
				(-0.02)
Long distance commuter				-0.0110*
				(-1.81)
Women	*omitted*	*omitted*	*omitted*	*omitted*
Age	0.0118***	0.0118***	0.00997***	0.00997***
	(11.87)	(11.89)	(7.78)	(7.79)
Age^2	-0.0000789***	-0.0000789***	-0.0000615***	-0.0000616***
	(-7.35)	(-7.36)	(-4.58)	(-4.59)
Married	0.0103***	0.0103***	0.0125***	0.0126***
	(4.20)	(4.18)	(3.40)	(3.42)
Number of Children	0.00118	0.00117	-0.000424	-0.000421
	(1.03)	(1.02)	(-0.32)	(-0.31)
Education	-0.00947	-0.00948	0.0823***	0.0823***
	(-0.30)	(-0.30)	(10.71)	(10.74)
Health status: Very good (ref.)				
Good	0.00336*	0.00331*	0.00471**	0.00474**
	(1.72)	(1.70)	(2.00)	(2.01)
Acceptable	0.00565**	0.00560**	0.00653**	0.00656**
	(2.42)	(2.39)	(2.38)	(2.40)
Less good	0.00318	0.00314	0.00406	0.00413
	(1.07)	(1.05)	(1.19)	(1.21)
Bad	-0.00213	-0.00230	-0.00572	-0.00550
	(-0.37)	(-0.40)	(-0.84)	(-0.80)
Invalidity level	0.000124	0.000125	0.000180*	0.000176*
	(1.39)	(1.40)	(1.77)	(1.73)
Physical pain: Always (ref.)				
Often	0.00397	0.00404	0.00676	0.00670
	(0.71)	(0.72)	(0.95)	(0.94)
Sometimes	0.00183	0.00191	0.00550	0.00556
	(0.32)	(0.33)	(0.75)	(0.76)
Almost never	0.000689	0.000738	0.00487	0.00491
	(0.12)	(0.13)	(0.64)	(0.65)
Never	-0.000986	-0.000932	0.00366	0.00370
	(-0.17)	(-0.16)	(0.48)	(0.49)
Physical problems: Always (ref.)				
Often	-0.00134	-0.00141	-0.00240	-0.00253
	(-0.24)	(-0.25)	(-0.36)	(-0.37)
Sometimes	-0.00232	-0.00243	-0.000551	-0.000657
	(-0.43)	(-0.45)	(-0.08)	(-0.10)
Almost never	-0.00376	-0.00384	-0.00209	-0.00221
	(-0.69)	(-0.71)	(-0.32)	(-0.34)

Never	-0.00340	-0.00349	-0.00152	-0.00167
	(-0.63)	(-0.64)	(-0.23)	(-0.25)
Migration background	*omitted*	*omitted*	*omitted*	*omitted*
Health concerns: Very concerned (ref.)				
Somewhat concerned	-0.00185	-0.00184	-0.00111	-0.00103
	(-0.91)	(-0.91)	(-0.44)	(-0.41)
Not concerned at all	-0.00334	-0.00333	-0.00254	-0.00255
	(-1.46)	(-1.45)	(-0.91)	(-0.91)
Feel balanced: Always (ref.)				
Often	0.00121	0.00121	0.00486*	0.00486*
	(0.48)	(0.48)	(1.83)	(1.83)
Sometimes	-0.00151	-0.00152	-0.000213	0.00215
	(-0.58)	(-0.58)	(-0.76)	(0.77)
Almost never	-0.00489	-0.00490	-0.000587	-0.000544
	(-1.64)	(-1.64)	(-0.18)	(-0.17)
Never	-0.0105**	-0.0104**	-0.0114**	-0.0113**
	(-2.28)	(-2.26)	(-2.12)	(-2.12)
Feel energetic: Always (ref.)				
Often	-0.00155	-0.00152	-0.00565	-0.00572
	(-0.54)	(-0.53)	(-1.60)	(-1.61)
Sometimes	0.00287	0.00290	-0.000263	-0.000383
	(0.94)	(0.96)	(-0.07)	(-0.10)
Almost never	0.00403	0.00405	0.000450	0.000299
	(1.22)	(1.23)	(0.11)	(0.07)
Never	0.00698	0.00702*	0.00146	0.00125
	(1.64)	(1.65)	(0.29)	(0.25)
Taking part in sports: Almost never (ref.)				
Several times a year	-0.000128	-0.000124	0.000893	0.000889
	(-0.09)	(-0.08)	(0.53)	(0.52)
At least once a month	-0.00353**	-0.00352**	-0.00121	-0.00118
	(-2.01)	(-2.01)	(-0.58)	(-0.57)
At least once a week	-0.00256*	-0.00256*	-0.000653	-0.000631
	(-1.80)	(-1.80)	(-0.38)	(-0.37)
Eating behaviour: Very strong (ref.)				
Strong	0.0102***	0.0102***	0.0118***	0.0119***
	(4.33)	(4.33)	(4.65)	(4.68)
A little	0.0204***	0.0204***	0.0205***	0.0205***
	(7.85)	(7.86)	(7.12)	(7.13)
Not at all	0.0195***	0.0195***	0.0246***	0.0247***
	(5.59)	(5.59)	(6.08)	(6.10)
Smoking	-0.0220***	-0.0220***	-0.0227***	-0.0227***
	(-9.92)	(-9.90)	(-8.58)	(-8.58)
Working hours	-0.000244	-0.000245	-0.000372*	-0.000365
	(-1.46)	(-1.46)	(-1.68)	(-1.64)
Working hours mismatch: No (ref.)				
Prefer to work fewer hours	-0.00104	-0.00103	0.0000374	0.0000486
	(-0.89)	(-0.88)	(0.03)	(0.04)
Prefer to work more hours	-0.000559	-0.000574	-0.00101	-0.000946
	(-0.36)	(-0.37)	(-0.53)	(-0.50)
Employment status: Full time (ref.)				
Part time	0.00281	0.00282	0.000428	0.000488
	(0.91)	(0.91)	(0.11)	(0.13)
Vocational training	-0.00683	-0.00691	0.000566	0.00102
	(-1.14)	(-1.16)	(0.04)	(0.07)
Marginal	0.00858	0.00861	0.00127	0.00129
	(1.34)	(1.34)	(0.15)	(0.15)
Public sector	-0.00322	-0.00325	-0.00255	-0.00251
	(-1.23)	(-1.24)	(-0.75)	(-0.73)
White-collar job	0.000791	0.000787	0.00439	0.00438
	(0.31)	(0.31)	(1.27)	(1.26)
Log (monthly wage)	0.00164	0.00164	0.000530	0.000407
	(0.70)	(0.70)	(0.16)	(0.12)
Leisure time	-0.000319	-0.000311	-0.0000435	-0.0000360
	(-0.66)	(-0.64)	(-0.07)	(-0.06)
Spatial information	0.00254	0.00263	0.00246	0.00329
	(0.39)	(0.41)	(0.13)	(0.17)
Industry dummies	Included	Included	Included	Included
Federal state dummies	Included	Included	Included	Included

Year dummies	Included	Included	Included	Included
Constant	2.837***	2.838***	2.855***	2.864***
	(90.31)	(90.36)	(68.14)	(69.93)
F-statistic for joint significance	0.85	0.40	1.59	1.42
(p-value)	0.4260	0.7504	0.2041	0.2335
N	29,448	29,448	21,455	21,455

Notes: *t* statistics in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Figure A.1

Commuting distance (in km) and BMI over the years in Germany. Source: SOEP 2004 – 2012.

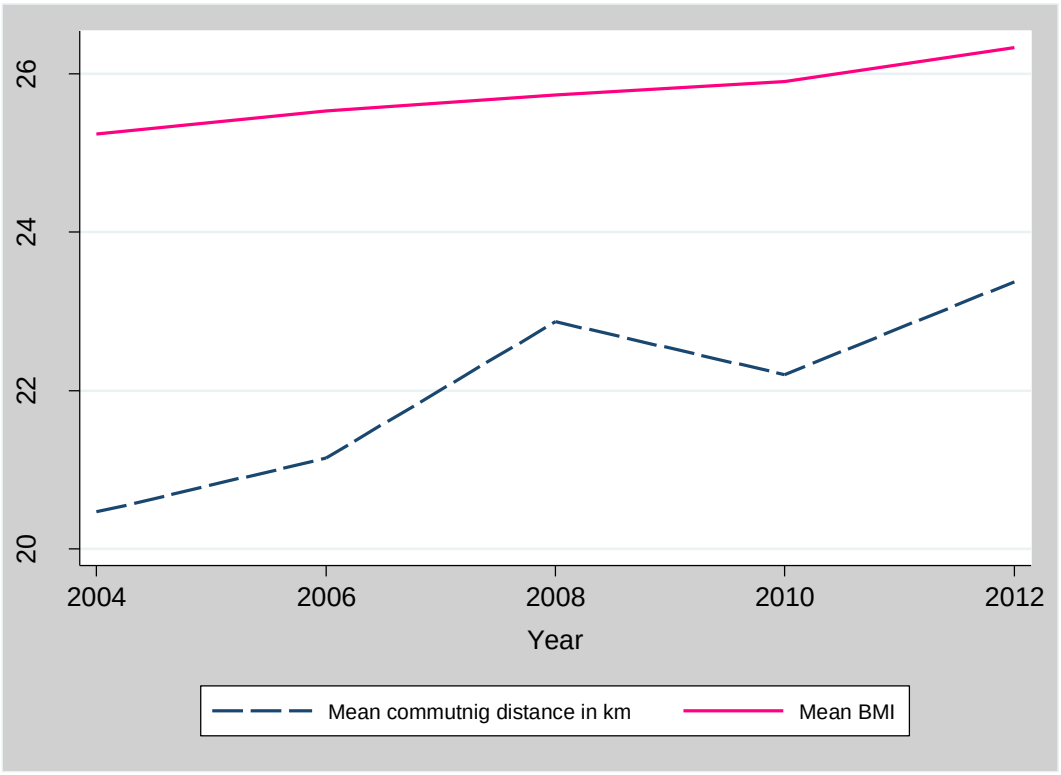


Figure A.2

BMI by type of commuter over the years in Germany. Source: SOEP 2004 – 2012.

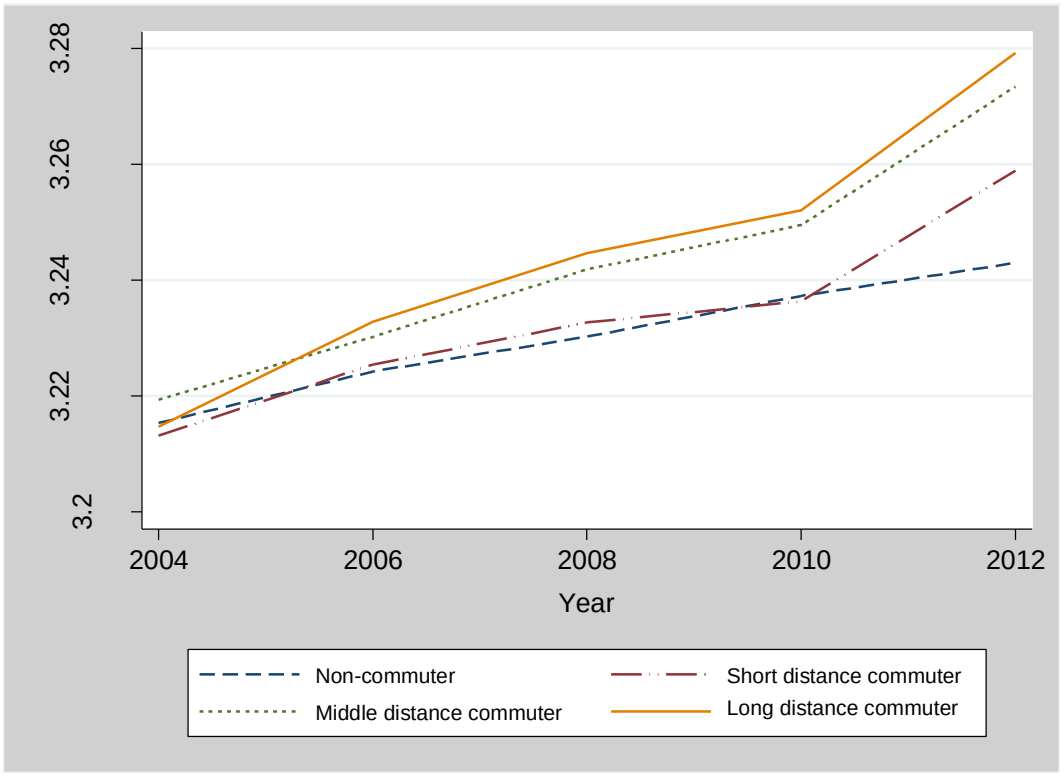
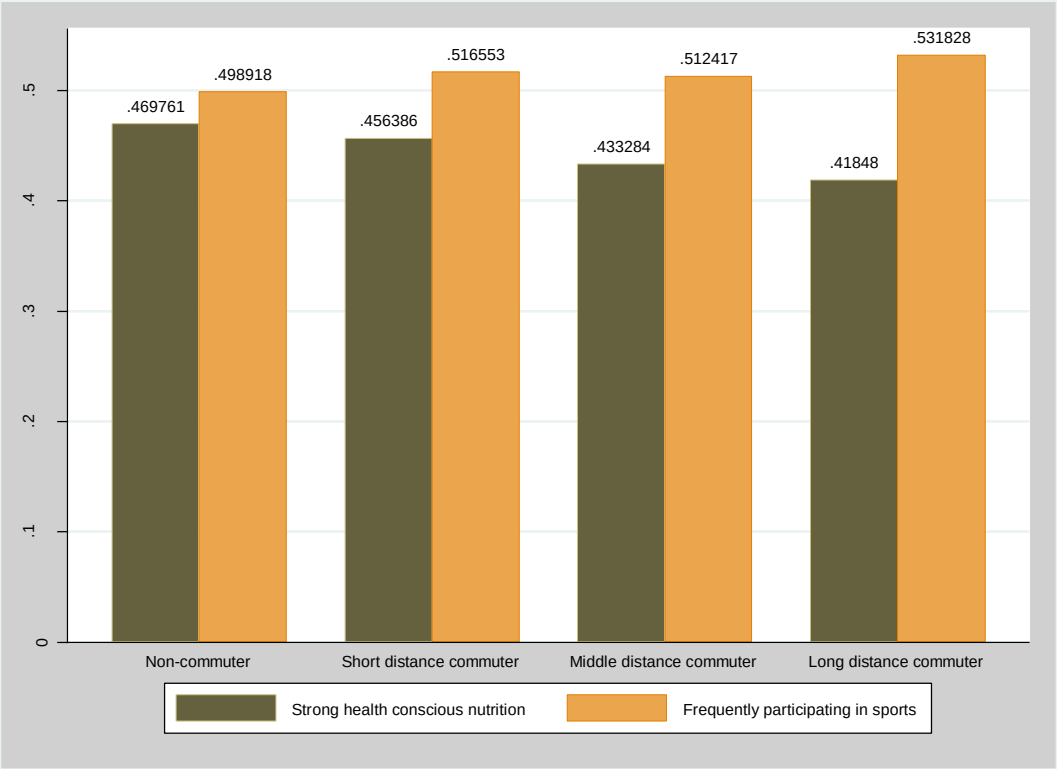


Figure A.3

Eating behaviour and frequency of sport participation by type of commuter. Source: SOEP 2004 – 2012.



Notes: The green bars denote the percentage of individuals that pay strong or very strong attention to health conscious nutrition. The yellow bars denote the percentage of those who participate in sports at least once a month or at least once a week.