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# ABSTRACT

## The Role of Body Weight for Health, Earnings and Life Satisfaction

Based on the German Socio-Economic Panel, the influence of the body mass index on health, earnings and satisfaction is analysed by gender. Basic results are: health worsens, income declines and satisfaction is poorer with higher body mass index. If control variables are added, estimates are split by gender and different effects of over- and underweight people are determined, the health estimates show nonlinear effects but the direction of action is unchanged. Effects on earnings differ. Underweight women earn more and overweight less than others. For normal-weight men the income is on average higher than for over- and underweight men. This is also confirmed for self-employed persons. The pattern for employees is equal to the total sample. No effects on life satisfaction can be found except for underweight men. They reveal less satisfaction. Only in the public sector the sign of the coefficient changes. The results for eastern Germany are different with respect to satisfaction. Overweight women are less satisfied than others while this is not confirmed for underweight men from eastern Germany. When interdependencies are taken into account and matching procedures are applied, the outcome matches to that of independent and unmatched estimates. However, no clear-cut disadvantage in income of underweight men can be found. Stable coefficients result for the health estimates while satisfaction results fluctuate. Underweight women and especially underweight men tend to less happiness. For overweight men the influence is ambiguous but more speaks in favour of a less level of satisfaction. Overweight women seem to be happier.

**JEL Classification:** I15, I31, J16, J31

**Keywords:** over- and underweight, health, income, satisfaction, gender, self-confidence, wage earners vs. self-employed, private vs. public sector, Eastern vs. Western Germany, interdependencies, matching

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# 1 Introduction

The body mass index (BMI) is a relative weight measure and an indicator that shows marked changes over time, strong differences across ethnicity (Komlos/Brabec 2011) and varies with important outcome variables in different fields. From a statistical viewpoint we observe correlations between BMI and health, income, promotions, employment and happiness. No clear substantial explanations are given. In the literature we find medical, epidemiological, biological, demographical, psychological and economic reasons. Tendency to humour, good mood, depression and suicide, friendship with other humans, leadership and beauty are mentioned. Appearance, personality traits, behaviour patterns, inherited and environmental differences are the joint kernel why some people are healthier, more successful and happier than others. Contrary characteristics are guessed between under- and overweight people. If it is so, we can use the BMI as a unidimensional proxy of all these attributes. Relationships between health, income, satisfaction on the one hand and BMI on the other hand are assumed and empirically documented as the following brief discussion of related literature shows but if at all interdependencies between only one outcome variable and weight are taken into account and nonlinear effects are usually neglected. It is unclear whether there are interdependencies or whether there exists a hierarchy of dependencies or only seemingly unrelated connections.

We make three contributions to the literature. First, we investigate whether under- or overweight people earn more split by gender. Which group is the happier and which is healthier. Estimates are conducted that allow the identification of specific effects of under- and overweight people that reveal nonlinearities. Second, we run estimates for subgroups – for self-confident and self-employed people, for the public sector and eastern Germany. The intention is to show whether the general results are robust or whether heterogeneity is evident. Third, we analyse in which way the results are affected by interdependencies between the three major variables health, income and satisfaction and by the application of matching procedures. Therefore, investigations are carried out under single equations and interdependent estimates including matching procedures. In Section 2, related literature is summarized. Section 3 is focussed on empirical modelling, where in contrast to previous investigations interdependencies between health, income and life satisfaction are explained and estimated by different methods. In section 4 the data set is briefly outlined. Section 5 presents the econometric results. Section 6 concludes.

# 2 Related literature

The relationship between weight and health is conventionally discussed under a medical perspective. Obesity is understood as an epidemic disease that threatens to inundate health care resources by increasing the incidence of diabetes, heart disease, hypertension, and cancer (Bray 2004). Disadvantages of obesity can be produced by the mass of fat or by the metabolic effects of fat cells. In the former category are the social disabilities resulting from the stigma associated with obesity and sleep apnea. The latter category includes the metabolic factors associated with distant effects of products released from enlarged fat cells. Empirical investigations show that the relationship between BMI and the risk of various diseases is different (Hübler 2017). Oswald and Powdthavee (2007) following Offer (2006) argue that economic prosperity undermines well-being. Mental health is worse among fatter people. However, Nuttall (2015) emphasizes that a wide range of BMIs exists over which mortality risk is modest. Many combinations of weight and height lead also to the same health status (Hübler 2017).

Different studies have analysed the influence of obesity on wages (Averett/Korenman 1996, Brunello/d'Hombres 2007, Conley/Glauber 2007, Fahr 2006, Johansson et al. 2009, Luo/Zhang 2012) but also the reverse causality is considered (Villar/Quintana-Domeque 2009). Wage penalties increase with upward deviations of BMI from the social norm. Increasing BMI reduces the real earnings of males and females. Luo and Zhang find a non-linear influence of BMI on wages, especially for women, measured by BMI and $BMI^2$. A more differentiated analysis of nonlinear relationships is presented by Caliendo and Gehrsitz (2016) based on semiparametric regression in combination with stratication techniques. The largest wage is reached at a body weight far below the clinical threshold of obesity.

Kropfhäußer and Sunder (2015) use GMM estimates of wages with respect to the BMI. From this study it follows that BMI is not exogenous. Cawley (2004) uses instrumental variables and his results indicate that the hypothesis that weight does not lower wages can be rejected only for white females. One curious finding of this paper is that results for black males differ from those for all other groups. Heavier black males tend to earn more, although this appears to be due to underweight black men earning less than normal weight black men. Cook and Fletcher (2015) show that a not negligible proportion of the population is more adaptable to early exposure to environmental influences in regards to cognitive outcomes and the basis of this resiliency stems from genetics and biology in the developmental process.

The empirical results of the BMI-wage relationship between countries are different. De Miranda and Barros (2008) do not detect any statistically significant effects of obesity on wages in Portugal, both for males and females. Mahler (2008) comes to the result that obesity does not carry a wage penalty for male but does so for female workers. These findings are interpreted as evidence of discrimination against female workers who are obese or in a broader sense because of their physical appearance. Heineck (2007) emphasizes a possible reverse causality. He finds that women with low income and low skills have a higher BMI on average (Heineck 2006). For Germany and the U.S. Cawley et al. (2005) account for endogeneity of body weight and find that only heavier U.S. women tend to earn less than others. However, the estimates yield no effects for German women and for men in both countries.

Altogether, the results are mixed but we note a tendency of negative BMI effects on wages. The explanations are different. Four reasons are mentioned: Obese workers are less motivated, are more costly for employers to insure, are discriminated against by customers and are limited in their job choices due to their obesity. The results of Baum and Ford (2004) do not support the hypothesis of customer discrimination. The second reason seems plausible because obesity is associated with increased risk for a range of chronical conditions.

In general, the happiness literature has paid little attention to the relationship between weight and well-being or satisfaction. Exemptions are e. g. Herman et al. (2013), Lee and Zhao (2015), Linna et al. (2013) and Kuk et al. (2009).

Among American women about half of the women were satisfied or very satisfied with their body size. Satisfaction was associated with lower BMI, greater age, lower educational level, and better self-rated health. Under a dynamic perspective it was found for a given BMI, higher ideal body weights were associated with greater weight satisfaction but lower intentions to lose weight. Although weight satisfaction is associated with healthier current lifestyle behaviours, it also is associated with less intention to change physical activity/stamina, diet, or body weight. Ideal weight is higher in more recent years among overweight and obese individuals, particularly younger individuals. Results show that

participants with mild, moderate, or marked concern with their body satisfaction had lower healthy eating attitude scores than those with no body concern. A positive relationship was found between diet quality and healthy eating attitude.

No significant correlations were identified between BMI and healthy eating attitude. Based on Finnish data Linna et al. (2013) investigate the relationship of young female adults between BMI and subjective well-being. They find that higher BMI is related to lower well-being but the relationship is U-shaped. Katsaita (2012) estimates the influence of obesity on happiness by an instrumental variables approach. First lags of the BMI are used as instruments. Results based on microeconomic data sets indicate that in three countries, namely in Germany, UK and Australia, obesity has a negative effect on the subjective well-being of individuals.

Stutzer (2009), Stutzer and Meier (2016) discuss the relationship of BMI and well-being from another perspective. The central hypothesis states obesity makes people worse off in terms of reported subjective well-being if the increased body mass is due to a self-control problem. However, if people are not lacking willpower, a high BMI does not enter negatively into the evaluation of people's well-being. According to the basic hypothesis, obesity is expected to negatively affect the subjective well-being of those with limited willpower. For them, obesity is not meant to be the outcome of rational food consumption but rather of time inconsistent behaviour. A very high BMI is hypothesized to negatively affect well-being if it is the result of limited self-control, but not otherwise. Therefore, the authors estimate the partial correlation between obesity and subjective well-being separately for people with full and limited self-control. Consistent with this basic hypothesis, obesity is related with lower subjective well-being when people have limited self-control but no statistically significant effect is found for the sample of people classified as having full self-control.

All in all, the empirical literature to date is focussed on the relationship between the weight and health, between weight and wage or between weight and satisfaction. The estimates show usually negative effects of obesity on health and wages. The effects on satisfaction are mixed. The gender dimension is important. The estimates differ between men and women but the results are not always consistent. This may be due to the fact that interdependencies are usually neglected that nonlinearities are insufficiently considered, especially with respect to the weight, that the number and the measurement of control variables are different and that the period taken into account is not the same. We present a joint approach of BMI, health, wage and satisfaction based on a uniform panel data set.

## 3 Empirical modelling

The influence of weight, measured by BMI (=weight in kilograms divided by height in meters squared), on health, earnings and life satisfaction is usually analysed separately in different fields based on linear models so that interdependencies are overlooked. Very few existing investigations account for interdependencies and unobserved heterogeneity. Some of them were briefly addressed in Section 2. Furthermore, Sabia and Rees (2012) have run 2SLS estimates of wages with respect to BMI and compared with OLS and fixed effects estimates. Mother's obesity and sibling's BMI are used as instruments. Lagged weight is also incorporated as a determinant of earnings.

Here, we develop a three-equation model: health, earnings and life satisfaction functions. The starting point is the health equation

$$(1) \qquad \text{health} = \alpha_0 + \alpha_1 \text{BMI} + \alpha_2' x_h + u_h,$$

where $u_h$ is the error term and $x_h$ are control variables of the health equation. This vector includes age, nationality, social status, religion, self-confidence, employment patterns, regional characteristics, and year dummies. The selection is based on former investigations or significant simple correlations with health. We expect that health deteriorate with increasing BMI. Obese people eat too much and are inactive. They are prone to illness and less robust. No monotone relationship seems plausible. Not all obese people have a bad health status (Hübler 2017). This results from unobserved inherited characteristics and environmental influences. Instead of using BMI as a continuous variable, the estimation of a model with different levels of weight can lead to new insights on nonlinearities.

The basic earnings equation is modelled as

$$(2) \qquad \text{earnings} = \beta_0 + \beta_1 \text{BMI} + \beta_2 \text{health} + \beta_3' x_e + u_e,$$

where $u_e$ is the error term of the income equation. Control variables in $x_e$ are schooling, experience, experience$^2$, tenure, regional dummy (=1, if eastern Germany), nationality dummy (=1, if German), height, father's Treiman scale, religion dummy (=1, if Christian), self-confidence, and year dummies. Health determines absences and the performance at work and therefore the individual earnings level. Reverse causality between earnings and health is possible as high income allows higher expenditures for good nutrition and in consequence for health. We incorporate BMI as an independent income component in the sense that BMI is an appearance indicator and that obese people are discriminated against. Atella et al. (2008) interpret their empirical results on the relationship between obesity and wages in line with the pure discriminatory effect hypothesis. Substituting for health in (2) by (1) gives a reduced form

$$(2a) \quad \text{earnings} = \kappa_0 + \kappa_1 \text{BMI} + \kappa_2 x_h + \kappa_3 x_e + \varepsilon,$$

where $\kappa_0 = \beta_0 + \beta_2\alpha_0$, $\kappa_1 = \beta_1 + \beta_2\alpha_1$ $\kappa_2' = \beta_3\alpha_2'$, $\kappa_3' = \beta_3'$ and $\varepsilon = \beta_2 u_h + u_e$.

Life satisfaction may depend on earnings and health so that we can formulate

$$(3) \text{ satisfaction} = \gamma_0 + \gamma_1 \text{earnings} + \gamma_2 \text{health} + \gamma_3 \text{BMI} + \gamma_4' x_s + u_s.$$

The earnings hypothesis is not obvious. The Easterlin paradox that happiness does not increase with income in the long run (Easterlin 2010, 2014) mitigates the supposed relationship. A reverse causality is not excluded. Possibly, satisfied workers generate a higher performance than others. Good health improves the life satisfaction but influences also income and from there effects on satisfaction may occur. The BMI effect on satisfaction is not unique. On the one hand, overweight people are stigmatised and therefore they are less happy. On the other hand, people who are less disciplined and more easy-going have a tendency to overweight and are happier than others because they see less problems with their everyday life. Further observed determinants of satisfaction like age, height, a German citizenship, self-confidence, and year dummies are captured in $x_s$ and unobserved influences are bundled in $u_s$. The three equation model (1)-(3) shows that BMI is indirectly linked with happiness. A negatively direct effect of BMI on satisfaction, independent of health or discrimination, results if high BMI means via self-assessment a negative appearance combined with dissatisfaction. Substituting for health in (2) and (3) is substituted by (1) gives a reduced form

$$(3a) \text{ satisfaction} = \lambda_0 + \lambda_1 \text{BMI} + \lambda_2' x_h + \lambda_3' x_e + \lambda_4' x_s + \varepsilon^*,$$

where $\lambda_0=\gamma_0+\gamma_1\beta_0+(\gamma_1\beta_2+\gamma_2)\alpha_0$, $\lambda_1=\gamma_1\beta_1+\gamma_1\beta_2\alpha_1+\gamma_2\alpha_1+\gamma_3$, $\lambda_2=\gamma_1\beta_2\alpha_2+\gamma_2\alpha_2$, $\lambda_3=\gamma_1\beta_3$ and $\lambda_4=\gamma_4$. The combined error term $\varepsilon^*$ is $(\gamma_1\beta_2+\gamma_2)\, u_h+\gamma_1 u_e+u_s$.

Equations (1) - (3) describe a triangular system where interdependencies are possible via the disturbance terms. An unrelated or a seemingly unrelated system is given by equations (1), (2a) and (3a). In the latter case unobserved influences induce such links. For example, work motivation is usually unobserved but correlates with health, earnings and satisfaction. Tisch (2015) argues that low work motivation and low self-perceived work ability can partly explain the relationship between impaired health and labour market withdrawal. Furthermore, well information about healthy diet and cognitive ability (A) can contribute to a good health status and high wages. The relationship to satisfaction is not so apparent. Under the assumptions that corr(satisfaction, A)>0 and A is unobserved, $u_s$ tends to a positive relationship. One can also argue that corr(BMI, A)<0 because well informed people know that obesity hinders good health, high wages and satisfaction. In this case in combination with a linear link between BMI and A, namely $BMI=\delta_0+\delta_1 A+u_{BMI}$, the following reduced form is produced

$$\text{(3b) satisfaction} = \lambda_0^* + \lambda_1^* A + \lambda_2' x_h + \lambda_3' x_e + \lambda_4' x_s + \varepsilon^* = \lambda_0^* + \lambda_2' x_h + \lambda_3' x_e + \lambda_4' x_s + \varepsilon^{**},$$

where $\lambda_0^*= \lambda_0+ \lambda_1\delta_0$, $\lambda_1^*= \lambda_1\delta_1$. The new error term is $\varepsilon^{**}=\lambda_1\delta_1 A+\lambda_1 u_{BMI} +\varepsilon^*$. Some components of $x_h$, $x_e$ and $x_s$ may be the same. An extension to (1*) follows when earnings and satisfaction are added in (1) as further regressors. The higher the income the more resources are available for health care. High life satisfaction contributes to good health, to resist disease. Such people are more resilient. Analogously, satisfaction can be incorporated in (2). People who are happy are better motivated to work with high productivity and the consequence may be higher wages. The new equation is called (2*). Then we have an interdependent system ((1*), (2*) and (3)) and an instrumental variables estimator should be applied. Matching procedures make sense, as endogenous regressors can be viewed as treatment indicators (Cameron/Trivedi 2009, p. 187).

## 4 Data, graphs and descriptive statistics

The empirical analysis is based on the German Socio-Economic Panel (SOEP). This is a representative annual household survey started in 1984 covering western Germany at the time that was extended to eastern Germany in 1990 (Wagner et al. 2007, Goebel et al. 2018). Currently, more than 12,000 households and more than 23,000 individuals are interviewed each year. Our sample covers the years 2004, 2006, 2008, 2010, 2012, 2014 and 2016 where individuals report their weight and height. The analysis is restricted to employed people aged 25 to 55 because the investigation wants to detect effects on labour market outcome. This is best realised using prime-age workers. We should stress that the sample size used in the different estimation procedures varies because the applied information is not the same and the number of missing values fluctuates.

Different health indicators are suggested in the literature. Most commonly used variable measures subjective responses evaluated on a five-stage rating scale. Health= 1 means that the current health is very good, while = 5 expresses that the individual current health is bad. This is a quasi-continuous variable so that OLS can be applied. Self-reported measures may contain systematic measurement error that may cause bias in the estimates. Personality traits may be substantially correlated with individual-specific styles to report health. Nevertheless,

these subjective accounts are strongly correlated with other subjective and objective categorical or binary health measures (Hübler 2017, p. 98).

Weight is usually measured by the BMI. Gender-specific weight classes are defined, because systematic differences between men and women are observed. Figures 1a-1c based on fractional-polynomial predictions demonstrate clear nonlinear relationships between our outcome variables health, earnings, satisfaction on the one hand and BMI on the other hand. This means, the identification of effects of over-, normal and underweight people seems helpful. We focus on the first and the third range. Based on the SOEP-BMI distribution, BMI quartiles are constructed: lower quartile (22.1 women; 24.2 men) and upper quartile (28.4 women, 29.3 men). Income is measured by the natural logarithm of gross income per month and life satisfaction by an overall rating, on a scale from 0 to 10 (0 – completely dissatisfied, …, 10 – completely satisfied).We are interested whether gender is influential and whether nonlinear effects are effective under the control of further variables, discussed in Section 3. Descriptive statistics for these possible characteristics are presented in Table 1.

## 5 Econometric findings

### 5.1 Benchmark estimates of BMI effects on health, earnings and satisfaction as independent phenomena

Simple independent regressions of health, log of earnings and satisfaction on BMI are presented in Table 2. We find gender-specific and BMI influences of all three approaches. This is accord with other studies. We find that a BMI decrease of one unit improves the health status by roughly 0.044 units. This means, for example, if a woman with a fair, but not so good health status (health=3.5), a height of 170 cm and a weight of 100 kg has lost 30 kg, her current health status is roughly fair (health=3). The weight loss of the same woman means a pay raise of 7.8 percent. If the degree of satisfaction was 5 within the possible range between 0 and 10, the degree of satisfaction has improved, namely from 5 to 5.35. Nonlinear effects of BMI seem to be effective on health and satisfaction. However, the nonlinearity reveals only in an irrelevant BMI range.

These results are not fully confirmed when we use two German gender-specific weight classes (smaller than the lower BMI quartile, and larger than the upper BMI quartile - see Section 4) and when further control variables are considered – see Table 3 and notes. The positive health effect of low-weight women is equal to that of men. For overweight people we observe the following gender-specific differences. Women are stronger negatively affected by obesity. The complete estimates of health for women are illustrated in the Appendix, Table A1, columns (1) and (2). OLS and ordered probit estimates have the same pattern. The BMI effect on health under cluster robust estimates is any longer negatively significant as in Table 3. Compared with under- and normal-weight women an overweight has a worse health status of roughly 0.18 units within a total range between 1 and 5. The health status of underweight women compared with other women is better, namely, by 0.14 units. The absolute effect of a weight loss is somewhat weaker than that of a weight increase. Overweight women have lower incomes of 8. 3 percent while underweight women have higher incomes of roughly 8.6 percent. If a woman leaves the normal-underweight class, satisfaction improves by 0.029 units, and vice versa those who belong to the normal-overweight class are now less satisfied by 0.058 units. The absolute weight loss effect on satisfaction is stronger than the weight increase effect. Estimates of control variables show that women's health is worse if they live in western instead of eastern Germany, if they are older, dissatisfied and not self-confident, if

they have a low social status. High satisfaction contributes to better health but no significant effects of income can be seen.

Earnings effects for women are twice to that of men in the weight class above the upper quartile. In both cases they earn significantly less than others. Interestingly, underweight women have significantly higher and underweight men lower income than other workers. The reverse sign of men and women leads to an insignificant outcome when the estimates are not split by gender (not in the Tables). As for the satisfaction function, there are two points of note. No significant differences between overweight and others could be found for men as well as for women. Underweight men seem to be less satisfied than others. The effect is insignificant among women. The complete estimates of satisfaction for men are presented in the Appendix, Table A1, columns (3) and (4). In contrast to Table 3, where robust standard errors are used, the negative BMI effect with clustered standard errors is insignificant. The OLS estimates do not differ from ordered probit estimates with respect to the sign of the coefficients and significance. It is important to note that health and income have positive effects on satisfaction. These are first hints to interdependencies between health, income and satisfaction. Furthermore, we can see that short height, low age, low self-confidence, and German nationality go hand in hand with low life satisfaction. The remaining 10 complete estimates are not presented but can be sent on request.

### 5.2 Subgroup analysis - robustness or heterogeneity?

We analyze whether clear differences exist between some subgroups, again broken down by gender and our three main areas of interest. First, we distinguish employees with and without self-confidence. The hypothesis is that people with high self-confidence show stronger positive effects of low BMI on health, income and satisfaction and less negative effects of high BMI. However, the estimates in Table 4 do not reveal such simple relationships. For women the results are not in accord with this conjecture. For men we find a degree of confirmation. Self-confident men are a little bit healthier and earn more. Especially, we are interested in the question, whether self-confidence has similar effects as self-control on satisfaction, as Stutzer and Maier (2016) have found for the latter problem. The idea is that low confidence in contrast to high confidence contributes to dissatisfaction. Table A1 has given a hint. The results in Panel B, D_BMI-lq and column “satisfaction” for men of Table 4 confirm and strengthen this outcome in a more general sense. Through different channels and not only via a direct effect we find a substantial negative influence on satisfaction of underweight men. For men with high self-confidence – see Panel A, D_BMI-lq and column “satisfaction” - no analogous outcome is revealed. The coefficient is very small and completely insignificant.

In our next step we distinguish between self-employed and wage earners following Biddle and Hamermesh (1998) who test whether the latter are discriminated but not the former. In our case we guess that self-employed persons are less healthy, are happier and earn more. Again, our differentiated analysis demonstrates that the effects are not so straightforward. A problem is our small self-employed sample size. This means we have to expect less significant results than for employees. If only the size of the coefficients is considered we can say that female employees are healthier than female self-employed if they have a low BMI but a significant difference in the degree of happiness cannot be observed – see Table 5. A puzzle seems to be the resulting income effects. Underweight self-employed women and men have a smaller income than other self-employed while that of obese self-employed men is even smaller. This may be explained by the facts that income effects of weight are driven by the low percentiles and that self-employed in the low-income segment are often unskilled people

who were unemployed in the past and have not found a job as employee. For wage earners we find a result that is in accord with that of other studies. Underweight women are rewarded by higher income.

A split between the private and the public sector follows. This was also recommended by Biddle and Hamermesh (1998) in the context of beauty, productivity and discrimination and applied to the relationship between height and wages (Hübler 2009). As hypotheses we formulate: in the public sector health and satisfaction are better due to less stress and shorter working time but income is lower. Obese people suffer less discrimination in the public sector. Again, the results of our disaggregated analysis are not so straightforward. The major differences with respect to the hypotheses in Table 6 are: the health status of men as well as for women is similar in the two sectors. Male's overweight is linked to smaller income but more in the private sector. For women we observe a stronger wage cut in the public sector but the differences are not remarkable. More important is the fact that a low BMI is rewarded by higher income for women, especially in the private sector. For men we do not find such a result. On the contrary, underweight men are sanctioned in the public sector, while in the private sector we do not find a statistically significant effect. Normal weight men seem to receive the highest income on average. By the way, the pattern is similar to that in the entire sample in Table 3. One exemption should only be mentioned. In the public sector men with a low BMI are not more dissatisfied than others. We find that the degree of satisfaction of underweight men in the public sector is higher by 0.04 units than that of men in the normal-overweight class of the public sector.

The final subgroup investigation is focused on eastern and western Germany. We want to know whether employees who work in western part achieve better results than those who work in the other part. Some first results were shown at the presentation of Table A1 results in section 5.1. We had mentioned that based on these estimates overweight women are healthier in eastern than in western Germany, an unexpected result. This is not confirmed in Table 7. Now we can say in more detail that overweight leads to significantly worse health for men and women in eastern and western Germany but the effect is more pronounced in the former part for women and in the latter part for men. We should emphasize that in eastern Germany overweight women are less satisfied than others. The difference to other women in the eastern part of the country amounts to 0.17 units. In the older and larger part the same group reveals more satisfaction. For overweight men we do not find significant differences in the east and in the west. The effects of low BMI on satisfaction is similar for men and women.

Overall, we can say that the results of Table 3 are robust for the subgroups of people with strong and less self-confidence, for the private and public sector. More heterogeneity is established between self-employed persons and wage earners, between eastern and western Germany with respect to satisfaction.

### 5.3 Instrumental variables and matching estimates of BMI effects on health, earnings and satisfaction

The next steps deal with interdependent approaches because weight has not only causal effects on health, earnings and happiness. A reverse causality induced by observed and unobserved characteristics and dependencies among each other seem possible. We distinguish different methods and alternative matching variables as robustness checks. The major problem with instrumental variables approaches is to find external instruments that break the correlation between endogenous explanatory variables and unobserved variables affecting the response variable.

First, we follow Lewbel (2012) who suggests generated instruments. Identification comes from a heteroskedastic covariance restriction and is achieved by having regressors that are uncorrelated with the product of heteroskedastic errors. Instruments can be generated by the product of the residuals from the reduced form and the mean centered values. The weighting with the residuals reduces the risk of a correlation between instruments and the error term. Estimates are presented in Panel A of Table 8. Compared with other applied methods in Table 8, the sign of the BMI coefficient and the significance match. Only one exception exists: the BMI influence of overweight men on income is insignificant.

Second, we use matching procedures. An extensive simulation study of Huber et al. (2013) finds some superior large and small sample properties of a radius matching estimator. Results of this approach are presented in Panel B of Table 8. The radius varies with the distances of matched treated and controls in one-to-one matching. The quantile at a particular rank in the distribution of distances is multiplied by a constant term, which is called the radius multiplier, to define the radius. We use 0.25 as caliber. The propensity score of the BMI is determined by means of logit estimates. Covariates are father's Treiman score, the number of siblings and two dummies, namely whether the person is a German citizen and whether he/she lives in the eastern part of Germany. Compared with OLS estimates we find similar results.

The Mahalanobis matching on the propensity score supplemented by important covariates is preferred to matching on the propensity score only (Huber et al. 2015, p.24). As additional covariates mother's schooling, number of siblings, dummies whether the person has an identical twin, whether he/she has played music or done sport as an adolescent, whether he/she had conflicts with his/her father, whether parents have taken care for the person in his/her youth and whether his/her father is a Muslim. These are characteristics that were fixed before the BMI as an adult is determined and are strongly correlated with the BMI with one or two exceptions – see Appendix, Table A2. The Mahalanobis distance is defined by (u-v)'S-1(u-v), where u (v) is a vector that incorporates the values of matching variables of participants (non-participants) and S is the empirical covariance matrix from the full set of non-treated participants. Estimates to this approach can be found in Panel C of Table 8. Wage estimates tend to insignificant effects of overweight women and underweight men. For overweight employees we find in contrast to OLS estimates significant effects on satisfaction.

King et al. (2011) and King/Nielsen (2016) criticize propensity score matching suggestions. Therefore, we present also estimates based on entropy balancing suggested by Hainmueller (2012). This means reweighting of the untreated observations. The weights are chosen by minimizing the entropy distance metric. The advantage is that information about the known sample moments are directly incorporated in the reweighting scheme and no distribution assumption is necessary. Estimates can be found in Panel D of Table 8, where the same matching variables are used as under Panel C. Other than in OLS estimates we do not find significant weight effects of females on wages, while for overweight workers the influence on life satisfaction is significant, positively for women and negatively for men.

Third, we combine Lewbel's method with Mahalanobis matching. The Lewbel procedure with generated instruments only should be applied if no entirely convincing external instruments are available but this is less suitable under heterogeneity. Due to the latter argument we match in each case the two groups of BMI dummies by the same matching variables as in Panel C before starting Lewbel's approach with generated instruments. The results of this combined approach are in Panel E of Table 8. Again as in Panel D, we find a tendency to less significant effects on wages and to more significant effects on satisfaction,

especially for women. From an econometric point of view of causal models, estimates in Panel E should be preferred, although the estimates are partially imprecise due to the smaller sample size compared with Panel A in Table 8 but the signs match with two exceptions. Following Abadie (2018) we should be aware that failure to reject the null hypothesis is often highly informative while rejection carries very little information in empirical contexts of large data sets. No matter, which procedure is applied, endogeneity and matching remain huge problems. Omitted and unobserved factors, e. g. work motivation, self-control or inherited traits, may be the driving forces of the results that are not explicitly incorporated in the estimates.

By and large the results in Table 8 are similar. In most cases sign and significance correspond over all methods. Especially, BMI coefficients on health show only small variations. Health of overweight women and men is worse than that of others, while the effect is reverse of underweight people. The estimated absolute BMI effect of underweight people is larger than that of overweight people except in Panel A and B and that of independent estimates in Table 3 for women. This is a clear hint of a nonlinear influence of BMI on health. A further striking result is that underweight women earn more than other women. For underweight men we observe a contrary effect that is statistically significant, except in Panel C and E. BMI effects on life satisfaction provide the least precise estimates. No clear-cut differences in the degree of satisfaction can be shown between under-, over- and normal-weight women except in Panel E. In tendency overweight women are happier than underweight women. For underweight men we find the same but more precisely than for women. Except in Panel A the estimates demonstrate that overweight men are less satisfied than other men or no statistical difference is revealed. Among the five methods applied in Panels A-E we prefer estimates in Panel D and E, because there two relevant approaches are combined.

The comparison between the estimates in Table 3 and 8 shows a close match, in particular for the health effects. In no case a negatively significant coefficient in Table 3 switches to a positively significant coefficient in Table 8. Independent estimates and those of Table 8, except in Panel E, suggest that overweight women are discriminated against or receive lower wages because they are less productive. The estimates in Table 8 confirm the result of Table 3 that over- and underweight men are less satisfied than normal weight men and is in accord with Figure 1c for men. For women the analogous outcome is mixed. However, more speaks in favour of lower satisfaction of underweight women in line with Figure 1c for women. The major differences between the results of instrumental and matching methods compared with independent, non-causal estimates are the less clear-cut wage effects of weight and the more obvious weight effects on satisfaction of the former.

## 6 Concluding remarks

Basic estimates in accord with the results of other studies show that health worsens and income declines when the body mass index increases. Negative effects on satisfaction seem to be effective. If nonlinearities, interdependence, matching procedures and gender differences are taken into account, strong differences between men and women are manifest. Women benefit from underweight by higher earnings while for men no clear BMI influence can be found. The most stable coefficients for men and women over all applied econometric methods are those for the health estimates. The happiness results fluctuate and are not systematically significant.

The subgroup analysis shows similar results of people with strong and less self-confidence, on the one hand, and for the private and public sector, on the other hand. Nevertheless, the

absolute differences between under- and overweight effects on all three analysed areas are larger for people with low than those with high self-confidence, except for women's earnings. Female and male employees with low self-confidence feel worst when they are underweight. More heterogeneity is established between self-employed persons and wage earners, and between eastern and western Germany with respect to satisfaction. Underweight wage earners are less happy than underweight self-employed persons. In eastern Germany overweight women are less satisfied than others, while in western Germany the same group reveals more satisfaction.

If we want to look for the weight that fulfils all three objectives – good health, high income and life satisfaction – we do not find an ideal weight. Normal or slightly underweight seems to be best for women. Being underweight is advantageous for women with respect to health and income but BMI and satisfaction are negatively correlated. It is difficult to make a clear statement on whether men are happier when they are over- or underweight. If health and social policy contribute to less overweight among the population positive health effects may result. Company bonus payments in combination with fitness programmes and psychological support can be an instrument to generate a negative correlation between weight and income on the one hand and between weight and happiness on the other hand.

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Table 1: Descriptive statistics

| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| Year | 2010 | 3.663 | 2004 | 2016 |
| Health | 2.382 | 0.846 | 1 | 5 |
| Gross monthly income | 2887 | 2616 | 10 | 57000 |
| Satisfaction | 7.458 | 1.418 | 0 | 10 |
| Male | 0.486 | 0.499 | 0 | 1 |
| Height | 173.149 | 9.167 | 150 | 205 |
| Weight | 78.022 | 16.991 | 42 | 225 |
| BMI | 26 | 4.7 | 16 | 61 |
| Schooling | 4.915 | 1.603 | 1 | 7 |
| Tenure | 11.115 | 9.322 | 0 | 40 |
| Experience | 17.467 | 8.980 | 0 | 40 |
| Age | 43.660 | 7.991 | 25 | 55 |
| Self-employed | 0.097 | 0.296 | 0 | 1 |
| Eastern Germany | 0.198 | 0.398 | 0 | 1 |
| German | 0.910 | 0.286 | 0 | 1 |
| Christian | 0.776 | 0.417 | 0 | 1 |
| Treiman score, father | 42.390 | 12.759 | 13 | 78 |
| Self-confident | 2.196 | 0.680 | 1 | 3 |

Notes: N= 18,343, all missing values are excluded; health=1 if very good, …, =5 if bad; gross income per month in Euro, where capital income is excluded; life satisfaction=0 if very low, …, =10 if very high; height in cm; weight in kg; schooling in years; tenure in years, experience in years and age in years; schooling=1, if no schooling, …, =7, if Abitur; self-confident=1, if no self-confidence,=2, if some self-confidence,=3, if strong self-confidence. For fathers, the SOEP group has generated the prestige score (Treiman score – Standard International Occupational Prestige Scale) based on three steps (Ganzeboom and Treiman 1996). This means an operational procedure is provided for coding internationally comparable measures of occupational status from the International Standard Classification of Occupation (ISCO) of the International Labor Office. The higher the score, the higher is the prestige.

Source: SOEP 2004, 2006, 2008, 2010, 2012, 2014 and 2016, version 33, SOEP, 2017, doi:10.5684/soep.v33.

Table 2: Effects of BMI and gender on health, earnings and satisfaction – OLS estimates

| Dependent variable | Health | Earnings | Satisfaction |
|---|---|---|---|
| A. | | | |
| BMI | 0.0438*** | -0.0078*** | -0.0346*** |
| Male | -0.1396*** | 0.6943*** | 0.0869*** |
| N | 65,649 | 30,401 | 65,611 |
| B. | | | |
| BMI | 0.0647*** | 0.0037 | 0.0321*** |
| $BMI^2$ | -0.0004*** | -0.0002 | -0.0011*** |
| Male | -0.1445*** | 0.6915*** | 0.0715*** |
| N | 65,649 | 30,401 | 65,611 |

Notes: * p<0.10, ** p<0.05, *** p<0.01 based on robust standard errors. Earnings are measured in natural logarithm of gross income per month in Euro.

Source: SOEP 2004, 2006, 2008, 2010, 2012, 2014 and 2016, version 33, SOEP, 2017, doi:10.5684/soep.v33, author's calculations.

Table 3: Effects of over- and underweight on health, earnings and satisfaction, split by gender – OLS estimates

| Gender | Women | | | Men | | |
|---|---|---|---|---|---|---|
| Dependent variable | Health | Earnings | Satisfaction | Health | Earnings | Satisfaction |
| D_BMI-uq | 0.1761*** | -0.0830*** | 0.0291 | 0.1270*** | -0.0403*** | -0.0287 |
| Adj. $R^2$ | 0.201 | 0.224 | 0.233 | 0.216 | 0.269 | 0.249 |
| N | 17,350 | 13,373 | 15,695 | 16,650 | 12,803 | 15,058 |
| D_BMI-lq | -0.1424*** | 0.0855*** | -0.0538 | -0.1482*** | -0.0450*** | -0.0567** |
| Adj. $R^2$ | 0.203 | 0.225 | 0.238 | 0.218 | 0.269 | 0.249 |
| N | 13,198 | 13,057 | 15,320 | 12,883 | 12,776 | 15,024 |

Notes: * p<0.10, ** p<0.05, * * * p<0.01 based on robust standard errors; BMI dummies: D_BMI_uq=1 if individual BMI>aggregated upper BMI quartile and D_BMI_lq=1 if individual BMI<aggregated lower BMI quartile; control variables: health=f(BMI, log(earnings), satisfaction, age, tenure, eastern Germany, German, father's Treiman scale, Christian, self-confidence, year dummies), log(earnings)=f(BMI, health, satisfaction, schooling, experience, experience2, tenure, eastern Germany, German, height, father's Treiman scale, Christian, self-confidence, year dummies), satisfaction=f(BMI, health, log(earnings), age, height, German, self-confidence, year dummies), where log(earnings)=log(gross monthly income), capital income is excluded.

Source: SOEP 2004, 2006, 2008, 2010, 2012, 2014 and 2016, version 33, SOEP, 2017, doi:10.5684/soep.v33, author's calculation.

Table 4: Effects of over- and underweight on health, income and satisfaction, split by gender and self-confidence – OLS estimates

| Gender | | Women | | | Men | |
|---|---|---|---|---|---|---|
| Dependent variable | Health | Earnings | Satisfaction | Health | Earnings | Satisfaction |
| A. High self-confidence | | | | | | |
| D_BMI-uq | 0.1643*** | -0.1166*** | 0.0205 | 0.1096*** | -0.0151 | 0.0302 |
| Adj. $R^2$ | 0.175 | 0.187 | 0.112 | 0.174 | 0.210 | 0.132 |
| N | 6,035 | 4,812 | 5,526 | 6,420 | 5,009 | 5,847 |
| D_BMI-lq | -0.1475*** | 0.1037*** | -0.0051 | -0.1171*** | -0.0468* | -0.0023 |
| Adj. $R^2$ | 0.168 | 0.203 | 0.114 | 0.181 | 0.210 | 0.132 |
| N | 4,726 | 4,704 | 5,397 | 5,046 | 5,002 | 5,840 |
| B. Low self-confidence | | | | | | |
| D_BMI-uq | 0.1677*** | -0.0769* | 0.1386* | 0.2839*** | -0.0591 | 0.0575 |
| Adj. $R^2$ | 0.168 | 0.153 | 0.134 | 0.245 | 0.203 | 0.168 |
| N | 2,650 | 2,015 | 2,417 | 2,312 | 1,757 | 2,102 |
| D_BMI-lq | -0.1570*** | 0.0354 | -0.2004 | -0.2677*** | -0.0804* | -0.3564*** |
| Adj. $R^2$ | 0.173 | 0.150 | 0.135 | 0.239 | 0.204 | 0.175 |
| N | 2,011 | 1,982 | 2,377 | 1,765 | 1,754 | 2,094 |

Notes: * p<0.10, ** p<0.05, *** p<0.01; control variables see Table 3.

Source: SOEP 2004, 2006, 2008, 2010, 2012, 2014 and 2016 version 33, SOEP, 2017, doi:10.5684/soep.v33, author's calculation.

Table 5: Effects of over- and underweight on health, earnings and satisfaction, split by gender, self-employed/wage earners – OLS estimates

| Gender | | Women | | | Men | |
|---|---|---|---|---|---|---|
| Dependent variable | Health | Earnings | Satisfaction | Health | Earnings | Satisfaction |
| A. Self-employed | | | | | | |
| D_BMI-uq | 0.2148*** | -0.0363 | -0.1011 | 0.0719** | -0.0844* | -0.1747*** |
| Adj. $R^2$ | 0.208 | 0.167 | 0.236 | 0.194 | 0.306 | 0.265 |
| N | 3,452 | 2,695 | 3,104 | 2,670 | 2,086 | 2,417 |
| D_BMI-lq | -0.0963*** | -0.0741* | 0.0697 | -0.1787*** | -0.0328 | -0.2642*** |
| Adj. $R^2$ | 0.205 | 0.174 | 0.244 | 0.200 | 0.305 | 0.267 |
| N | 2,638 | 2,625 | 3,026 | 2,096 | 2,081 | 2,412 |
| B. Wage earners | | | | | | |
| D_BMI-uq | 0.1645*** | -0.0879*** | 0.0683** | 0.1366*** | -0.0218 | -0.0172 |
| Adj. $R^2$ | 0.202 | 0.242 | 0.236 | 0.220 | 0.263 | 0.244 |
| N | 13,534 | 10,402 | 12,125 | 13,698 | 10,511 | 12,218 |
| D_BMI-lq | -0.1558*** | 0.1101*** | -0.0729 | -0.1428*** | -0.0486*** | -0.0220 |
| Adj. $R^2$ | 0.206 | 0.244 | 0.244 | 0.221 | 0.264 | 0.244 |
| N | 10,267 | 10,160 | 11,835 | 10,564 | 10,489 | 12,190 |

Notes: * p<0.10, ** p<0.05, *** p<0.01; control variables see Table 3.

Source: SOEP 2004, 2006, 2008, 2010, 2012, 2014 and 2016, version 33, SOEP, 2017, doi:10.5684/soep.v33, author's calculation.

Table 6: Effects of over- and underweight on health, earnings and satisfaction, split by gender, private/public sector – OLS estimates

| Gender | | Women | | | Men | |
|---|---|---|---|---|---|---|
| Dependent variable | Health | Earnings | Satisfaction | Health | Earnings | Satisfaction |
| A. Private sector | | | | | | |
| D_BMI-uq | 0.1812** | -0.0674*** | 0.0083 | 0.1292** | -0.0568*** | -0.0230 |
| Adj. $R^2$ | 0.199 | 0.181 | 0.235 | 0.211 | 0.288 | 0.239 |
| N | 10,338 | 7,900 | 9,225 | 11,146 | 8,469 | 9,901 |
| D_BMI-lq | -0.1596*** | 0.1112*** | -0.0692** | -0.1561*** | -0.0251 | -0.0915*** |
| Adj. $R^2$ | 0.201 | 0.186 | 0.240 | 0.216 | 0.287 | 0.240 |
| N | 7,746 | 7,691 | 8,978 | 8,503 | 8,451 | 9,882 |
| B. Public sector | | | | | | |
| D_BMI-uq | 0.1771*** | -0.0712*** | 0.0741* | 0.1272*** | -0.0414* | -0.0110 |
| Adj. $R^2$ | 0.221 | 0.304 | 0.240 | 0.235 | 0.264 | 0.268 |
| N | 6,140 | 4,815 | 5,574 | 4,433 | 3,559 | 4,114 |
| D_BMI-lq | -0.1341*** | 0.0491** | -0.0266 | -0.1386*** | -0.0647*** | 0.0418 |
| Adj. $R^2$ | 0.217 | 0.304 | 0.242 | 0.234 | 0.266 | 0.267 |
| N | 4,764 | 4,716 | 5,456 | 3,583 | 3,551 | 4,100 |

Notes: * p<0.10, ** p<0.05, *** p<0.01; control variables see Table 3.

Source: SOEP 2004, 2006, 2008, 2010, 2012, 2014 and 2016, version 33, SOEP, 2017, doi:10.5684/soep.v33, author's calculation.

Table 7: Effects of over- and underweight on health, earnings and satisfaction, split by gender and eastern/western Germany – OLS estimates

| Gender | | Women | | | Men | |
|---|---|---|---|---|---|---|
| Dependent variable | Health | Earnings | Satisfaction | Health | Earnings | Satisfaction |
| A. Eastern Germany | | | | | | |
| D_BMI-uq | 0.1807*** | -0.1406*** | -0.1663*** | 0.0913*** | -0.0689** | -0.0565 |
| Adj. $R^2$ | 0.200 | 0.257 | 0.269 | 0.215 | 0.311 | 0.256 |
| N | 3,508 | 2,830 | 3,299 | 2,964 | 2,405 | 2,813 |
| D_BMI-lq | -0.1381*** | 0.0952** | 0.0054 | -0.1247*** | -0.0680** | 0.0083 |
| Adj. $R^2$ | 0.198 | 0.256 | 0.266 | 0.208 | 0.312 | 0.257 |
| N | 2,821 | 2,807 | 3,268 | 2,413 | 2,402 | 2,809 |
| B. Western Germany | | | | | | |
| D_BMI-uq | 0.1767*** | -0.0539*** | 0.0973*** | 0.1345*** | -0.0319** | -0.0151 |
| Adj. $R^2$ | 0.202 | 0.220 | 0.227 | 0.217 | 0.240 | 0.248 |
| N | 13,842 | 10,543 | 12,396 | 13,686 | 10,398 | 12,245 |
| D_BMI-lq | -0.1432*** | 0.0785*** | -0.0796*** | -0.1526*** | -0.0398** | 0.0737*** |
| Adj. $R^2$ | 0.203 | 0.223 | 0.232 | 0.219 | 0.240 | 0.248 |
| N | 10,377 | 10,250 | 12,052 | 10,470 | 10,374 | 12,215 |

Notes: * p<0.10, ** p<0.05, *** p<0.01; control variables see Table 3.

Source: SOEP 2004, 2006, 2008, 2010, 2012, 2014 and 2016, version 33, SOEP, 2017, doi:10.5684/soep.v33, author's calculation.

Table 8: Effects of over- and underweight on health, earnings and satisfaction, split by gender – alternative estimators

| Gender | | Women | | | Men | |
|---|---|---|---|---|---|---|
| Dependent variable | Health | Earnings | Satisfaction | Health | Earnings | Satisfaction |
| A. Lewbel's simultaneous equations estimates with generated instruments only | | | | | | |
| D_BMI-uq | 0.1960*** | -0.1022*** | 0.2509*** | 0.1555*** | -0.0214 | 0.1047** |
| Centered $R^2$ | 0.159 | 0.214 | 0.109 | 0.177 | 0.256 | 0.125 |
| N | 17,350 | 13,373 | 15,695 | 16,650 | 12,803 | 15,058 |
| D_BMI-lq | -0.1796*** | 0.0971*** | -0.1580*** | -0.2036*** | -0.0620*** | -0.1779*** |
| Centered $R^2$ | 0.173 | 0.216 | 0.120 | 0.182 | 0.255 | 0.089 |
| N | 13,198 | 13,057 | 15,320 | 12,883 | 12,776 | 15,024 |
| B. OLS estimates based on radius matching | | | | | | |
| D_BMI-uq | 0.2043*** | -0.1382*** | -0.0056 | 0.1322*** | -0.0726*** | -0.1065*** |
| Adj. $R^2$ | 0.201 | 0.241 | 0.224 | 0.203 | 0.274 | 0.236 |
| N | 8,281 | 8,747 | 5,960 | 7,611 | 8,919 | 5,443 |
| D_BMI-lq | -0.1690*** | 0.0528*** | -0.0600 | -0.1415*** | -0.0755*** | -0.1868*** |
| Adj. $R^2$ | 0.203 | 0.232 | 0.230 | 0.201 | 0.280 | 0.237 |
| N | 5,769 | 9,529 | 5,820 | 5,379 | 8,368 | 5,431 |
| C. OLS under Mahalanobis matching | | | | | | |
| D_BMI-uq | 0.1609*** | -0.0335 | 0.1226** | 0.1278*** | -0.0907*** | -0.0832* |
| Adj. $R^2$ | 0.188 | 0.213 | 0.221 | 0.201 | 0.273 | 0.234 |
| N | 7,699 | 5,482 | 6,274 | 6,886 | 4,890 | 5,593 |
| D_BMI-lq | -0.2076*** | 0.0713*** | -0.0279 | -0.1517*** | 0.0093 | -0.1486*** |
| Adj. $R^2$ | 0.205 | 0.216 | 0.230 | 0.203 | 0.271 | 0.238 |
| N | 5,446 | 5,381 | 6,194 | 5,200 | 5,176 | 5,965 |
| D. OLS estimates under entropy balancing matching | | | | | | |
| D_BMI-uq | 0.1754*** | 0.0376 | 0.0977* | 0.1409*** | -0.0570* | -0.0875* |
| $R^2$ | 0.191 | 0.223 | 0.222 | 0.210 | 0.274 | 0.247 |
| N | 8,034 | 5,671 | 6,518 | 7,379 | 5,187 | 5,992 |
| D_BMI-lq | -0.2059*** | 0.0380 | -0.0474 | -0.1619*** | -0.0229 | -0.1711*** |
| $R^2$ | 0.207 | 0.243 | 0.229 | 0.201 | 0.268 | 0.232 |
| N | 5,598 | 5,533 | 6,360 | 5,210 | 5,175 | 5,978 |
| E. Lewbel's simultaneous equations estimates under Mahalanobis matching with generated instruments | | | | | | |
| D_BMI-uq | 0.1710*** | 0.0310 | 0.2979*** | 0.1385*** | -0.1267*** | -0.0569 |
| Centered $R^2$ | 0.172 | 0.176 | 0.152 | 0.195 | 0.263 | 0.222 |
| N | 7,699 | 5,482 | 6,274 | 6,886 | 4,890 | 5,593 |
| D_BMI-lq | -0.2143*** | 0.0498* | -0.1062** | -0.1455*** | 0.0159 | -0.1815*** |
| Centered $R^2$ | 0.198 | 0.193 | 0.188 | 0.194 | 0.261 | 0.218 |
| N | 5,446 | 5,381 | 6,194 | 5,200 | 5,165 | 5,965 |

Notes: * p<0.10, ** p<0.05, * * * p<0.01; control variables see Table 3.

Source: SOEP 2004, 2006, 2008, 2010, 2012, 2014 and 2016, version 33, SOEP, 2017, doi:10.5684/soep.v33, author's calculation.

Appendix:

Table A1: Complete estimates of health for women and satisfaction for men

| Regressand | Health | | Satisfaction | |
|---|---|---|---|---|
| Method | OLS | Ordered probit | OLS | Ordered probit |
| D_BMI_uq | 0.176*** | 0.244*** | | |
| | (0.02) | (0.03) | | |
| D_BMI_lq | | | -0.057 | -0.036 |
| | | | (0.04) | (0.04) |
| Health | | | -0.590*** | -0.500*** |
| | | | (0.02) | (0.02) |
| Log(earnings) | -0.016 | -0.023 | 0.112*** | 0.086*** |
| | (0.02) | (0.02) | (0.03) | (0.02) |
| Satisfaction | -0.205*** | -0.280*** | | |
| | (0.01) | (0.01) | | |
| Age | 0.012*** | 0.018*** | 0.005** | 0.006** |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| Height | | | 0.009** | 0.008** |
| | | | (0.00) | (0.00) |
| Tenure | 0.002 | 0.003 | | |
| | (0.00) | (0.00) | | |
| Eastern Germany | -0.132*** | -0.184*** | | |
| | (0.04) | (0.05) | | |
| German | -0.022 | -0.031 | -0.078 | -0.077 |
| | (0.04) | (0.06) | (0.06) | (0.06) |
| Treiman score_father | -0.004*** | -0.005*** | | |
| | (0.00) | (0.00) | | |
| Christian | 0.006 | 0.011 | | |
| | (0.04) | (0.05) | | |
| Self-confidence | -0.094*** | -0.133*** | 0.566*** | 0.472*** |
| | (0.02) | (0.02) | (0.03) | (0.02) |
| Year dummies D2004-2016 | Yes | Yes | Yes | Yes |
| cut1- cut4 | No | Yes | No | Yes |
| Constant | 3.811*** | | 5.022*** | |
| | (0.15) | | (0.57) | |
| $R^2$ | 0.201 | | 0.250 | |
| N | 17,350 | 17,350 | 15,024 | 15,024 |

Notes: * p<0.05, ** p<0.01, *** p<0.001 based on clustered standard errors at the individual level; further explanations see Table 3.

Table A2: Logit estimates of a dummy that a women has a BMI larger than the upper BMI quartile of all women in the entire sample on personal characteristics

| | | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|---|
| Identical twin | | 0.4309 | 0.2084 | 2.07 | 0.039 | 0.0224 | 0.8394 |
| Father is a Muslim | | -0.3885 | 0.1661 | -2.34 | 0.019 | -0.7143 | -0.0628 |
| Parents have taken care for children | | 0.0147 | 0.0164 | 0.90 | 0.369 | -0.0174 | 0.0469 |
| Conflicts with father | | 0.0227 | 0.0113 | 2.01 | 0.044 | 0.0005 | 0.0449 |
| Mother's schooling | | -0.0184 | 0.0105 | -1.75 | 0.081 | -0.0391 | 0.0022 |
| Number of siblings | | -0.0569 | 0.0074 | -7.67 | 0.000 | -0.0714 | -0.0423 |
| Played music as an adolescent | | 0.1387 | 0.0308 | 4.50 | 0.000 | 0.0782 | 0.1992 |
| Done sport as an adolescent | | 0.0474 | 0.0291 | 1.63 | 0.104 | -0.0097 | 0.1046 |
| Constant | | -0.6574 | 0.0840 | -7.82 | 0.000 | -0.8222 | -0.4927 |
| LR $chi^2(8)$ | 100.62 | | | | | | |
| Prob>$chi^2$ | 0.0000 | | | | | | |
| N | 21,331 | | | | | | |