The Relationship between Overweight and Wages for Women in Germany: Empirical Evidence for Discrimination

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Abstract:
This paper estimates the relationship between overweight and wages with a very large German dataset and finds that lower wages for obese women are likely to be due to discrimination. Obese women earn 2.4 percent lower wages than women having a BMI in the recommended range, while women who are in the top 10 percent of the body mass index get 4.3 percent lower wages than thinner women. The focus of this paper is on whether these differences in wages are due to reduced productivity of overweight women or due to discrimination against them. These two hypotheses are tested using three different subgroup designs: I test whether employed or self-employed women get higher wage reductions when overweight, whether young or older women face lower wages when being overweight or whether gender-composition of coworkers plays a role. Results of these subgroup estimations clearly support the discrimination hypothesis.

JEL classification:
Keywords: Overweight, obesity, wages, discrimination

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1. Introduction

Obesity seems to be one of the most severe health problems in industrialized countries in the last decades. Among countries belonging to the European Union, the 'International Association for the Study of Obesity' ranks Germany at top position with respect to having the highest share of overweight and obese people. According to self-reported data from a large German individual-level dataset, the German Micro Census, the share of overweight and obese women is 40 percent while the share of overweight or obese men is 57 percent. But as stated in Cawley and Danziger (2004), these numbers are likely to be underreported. Overweight and obese persons face significant health limitations, like cardiovascular diseases or Type 2 diabetes mellitus.[1] In Germany, around 25 percent of the adults suffer from cardiovascular diseases (e.g. high blood pressure) and this is one of the most common consequences of overweight.

But besides health limitations, overweight persons might also face discrimination in their private as well as in their business environment. Reduction of well-being, a negative body image, social exclusion, and decreased concentration ability are potential consequences of obesity and can lead to a reduced quality of life. This might also have an impact on productivity and therefore result in lower wages or less success in the labor market. For the U.S., several studies find a negative impact of obesity on labor market outcomes, especially on wages. This negative effect of a higher body weight on earnings is especially true for white women, who earn significantly less than their healthy-weight counterparts (Cawley (2004), Averett and Korenman (1996)). This result can be partly reconfirmed in European studies (for Denmark, Belgium, Ireland, Italy, Greece, Spain, Portugal, Austria and Finland) by Fahr (2006), Brunello and D`Hombres (2006) and Garcia and Quintana-Domeque (2007) based on the European Community Household Panel.

[1] See: http://www.iotf.org/cardiovascular.asp

This paper finds that these patterns are also true for Germany: overweight and obese women earn significantly less than women of healthy weight, while there seems to be no relationship between overweight and wages for men. But in contrast to most papers, the focus of this study is to uncover through which channel the negative relationship between wages and obesity can be explained. I test two hypotheses that could be possible explanations for the gap in wages between overweight women and those of healthy weight. The first hypothesis states that lower wages are due to reduced productivity of overweight women (productivity hypothesis); while the second hypothesis claims that it is due to discrimination (discrimination hypothesis). In order to test these hypotheses, I set up three different subgroup designs. At first, correlations between overweight and wages are estimated for employed vs. self-employed women. Secondly, the dataset is divided into young and older women in order to compare effects for these two groups. Thirdly, I sort women according to the gender-composition of their coworker into jobs that are 'male-dominated', 'female-dominated' or 'male-female-balanced'. Results of these subgroup estimations clearly support the discrimination hypothesis.

The remainder of this paper is organized as follows. Section 2 gives a literature review on studies that analyze the relationship between overweight and wages. Section 3 introduces the dataset and discusses the three hypotheses in detail. Results are presented in Section 4 and can be summarized as follows: obese women earn 2.4 percent less than women of healthy weight; while women belonging to the heaviest 10 percent earn 4.3 percent lower wages. The subgroup analyses reveal that only overweight and obese employed women face lower wages, while the obesity-effect on wages in non-existing in self-employment. Furthermore, young women get much higher wage reductions when overweight than older women. Lastly, when focusing on women with mainly male coworkers, the penalty for being overweight or obese is much higher than in jobs with female coworkers or in male-female- balanced jobs. Section 5 summarizes and concludes the paper.

2. Literature review

In the last 20 years, the study of obesity and labor market outcomes has come into the interest of economists. Obesity seems to be one of the most severe health problems in industrialized countries, and it has also economic consequences. In the last decades, several studies emerged, bringing together obesity and labor market outcomes like wages or employment. Most studies focus on the U.S. since the prevalence of obesity is extremely high there. But also European countries have rising obesity rates, with Germany heading the countries belonging to the European Union with respect to the share of overweight and obese persons.[2] The literature can be divided into two parts: Studies that detect the prevalence and potential reasons for rising obesity rates and those focusing on the impact of obesity on labor market outcomes such as employment and wages.

For the U.S., Chou et al. (2004) show, that prevalence of obesity has been relatively constant between 1960 and 1980, while is has doubled between 1980 and 2000. But what are the reasons for the enormous increase of obesity in the last 30 years? Chou et al. (2004) find that lower fast food prices, higher per capita number of restaurants, risings cigarette prices and anti-smoking campaigns are the most important factors for rising obesity rates. Similar results are found by Lakdawalla and Philipson (2002). They show that reduced food prices and declining physical activity from agricultural innovations and technological changes account for increase of obesity in the United States. Other studies analyzing the determinants of obesity (Conley and Glauber (2005), Costa-Font and Gil (2004), Robert and Reither (2004), Sobal and Stunkard (1989), Zhang and Wang (2004)) find, that a higher body weight is associated with a lower socioeconomic status; although Zhang and Wang (2004) show that this trend has decreased over the last 30 years.

Empirical literature has a clear focus on the impact of overweight and obesity on wages (Register and Williams (1990), Gortmaker et al. (1993), Averett and Korenman (1996), Pagán

[2] Source: International Association for the Study of Obesity.

and Dávila (1997), Behrman and Rosenzweig (2001), Cawley (2004), Baum and Ford (2004)). Most of these U.S. studies find a significant reduction in wages for overweight and obese white women. Results for men and for black and Hispanic women are not clear.

But there are also studies for European countries: Johansson et al. (2007) find evidence that waist circumference is negatively related to wages for women in Finland. Like in U.S. studies, Sargent and Blanchflower (1994) find for Great Britain a strong and negative association of overweight and wages for women, but no effect for men. Other European studies find mixed results based on the European Household Panel (for Spain, Greece, Italy, Portugal, Austria, Ireland, Denmark, Belgium and Finland): Brunello and D'Hombres (2006) find that men get a higher wage deduction when overweight or obese (except for Finland and Portugal), while Fahr (2006) shows that lower wages are associated with higher body weight for women but not necessarily for men. The only German study by Cawley et al. (2005) based on GSOEP data finds a negative correlation between overweight and wages for women, although these results do not hold in an IV estimation.

Besides finding an association between overweight and wages, many studies try to estimate a *causal* effect of overweight on wages. If there were no unobserved factors, which are correlated with weight, an OLS regression would estimate a causal effect of weight on wages. But since there could be unobserved factors (for example discipline or self-esteem) that are correlated with weight, OLS results become biased. In order to solve this endogeneity problem, recent studies use instrumental variable estimation. Pagán and Dávila (1997) use family poverty level, health limitations and self-esteem as instruments, but by using a Hausman specification test, they cannot reject the hypothesis of weight being not endogenous in a wage regression. As pointed out by Cawley (2004) this is probably due to a correlation of the instruments with the error term in the wage regression.

Most studies that use IV estimation to address the endogeneity problem use weight of a family member as an instrument for a respondent's own weight. Cawley et al. (2005), Cawley

(2000), and Brunello and D'Hombres (2006) use the weight of children or parents as instruments. IV estimates generally go into the same direction as OLS results (coefficients are mostly larger than for OLS estimates), but some become insignificant due to reduced sample sizes and much larger standard errors. Cawley (2004) uses the weight of a sibling as an instrument for a respondent's weight. His finding, that white women (in contrast to white men) receive lower wages when they have a higher BMI can be confirmed through this IV estimation, although a Hausman specification test cannot reject the hypothesis that OLS and IV results are equal. Therefore, he concludes that OLS should be preferred over IV since it has lower standard errors. Moreover, any potential endogeneity of weight does not seem to have an impact on OLS results.

Since a person shares the same genes with his or her children and siblings, the weight of children and siblings seems to be the most convincing instrument for a person's own weight in this context. But still, one cannot be sure whether the exogeneity condition is met. If a mother's weight is correlated with the child's weight through genetics, she might also pass on other characteristics that are correlated with labor market success (discipline, motivation). In this case, the weight of a child is not a valid instrument for the mother's weight. Analogously, if siblings share the same genes when it comes to weight, they might also have the same genes in other personal characteristics that affect labor market outcomes. Again, in this case, the weight of a sibling cannot be used as an instrument of a persons own weight.

In contrast to papers that concentrate on estimating the impact of weight on wages, this paper does not try to estimate a causal effect, since there is no natural experiment to evaluate in this context and no suitable instrument in this dataset. But even if there was a causal effect of weight on wages, the question of whether overweight persons are being discriminated or whether lower wages are due to reduced productivity of overweight women could not be answered. Therefore, this paper focuses on this question and results clearly favor the discrimination hypothesis over the productivity hypothesis.

3. Data and identification strategy

This study is carried out on basis of the German Micro Census (MZ). It is a large German dataset; consisting of a one-percent sample of the entire German population (the scientific community receives a 70 percent sample of that one percent). Only more recent waves contain information on weight and height. Therefore, trends in overweight and obesity over time cannot be shown. [3] For this analysis, I take a pooled sample of observations for the years 2003 and 2005. The dependent variable is the logarithm of the monthly net wage. Wages are reported in 24 categories, with the highest limit at a net of 18,000 Euros per month, which puts only 142 individuals (0.04 percent of all women and 0.13 percent of all men) into a right-censored category. To estimate the relationship between weight and wages, I use interval regressions to account for wages being reported in intervals. As in other studies on this topic, analyses will be carried out separately for men and women. But since I will not be able to find any effects for men, further analyses will be carried out for women only.

Persons who are older than 55 years of age are excluded, since many employers offer early retirement programs to their employees. In this case, an employee receives lower wages while working, retires earlier than in the age of 65 and still receives a salary until the retirement payments start at the usual retirement age of 65. Compared to other datasets that have information on weight and height, the Micro Census dataset has the advantage that it has enough observations to conduct separate analysis for subgroups, which is described in detail in the next section. The sample of employed women between 20 and 55 years of age consists of more than 63,000 observations; the sample of men is a bit larger with more than 75,000 observations since more men than women take part in the labor force. In this sample, 20 percent of all men and 26 percent of all women do not participate in the labor market. The fact that more women tend not to participate in the labor market might lead to problems of sample

[3] For more information, please see:
http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/EN/press/abisz/Mikrozensus__e,templateId=renderPrint.psml

selection. For example, if women of higher body weight are less likely to be employed, one had to determine whether these women do not want to work or whether they do not find a job (which might be due to discrimination). But in this sample, there is no significant difference in weight or BMI of women who participate in the labor market and those who do not, although age seems to matter. While the difference in BMI is virtually zero (0.2 BMI units) for women between 20 and 35 years of age, the difference in weight becomes larger (1.3 BMI units) for women older than the age of 35, although both differences are not statistically significant different from zero.

Descriptive statistics of the average height and different measures of weight for employed persons (excluding self-employed and unemployed persons) are shown in Table 1. While the average woman is 1,67m tall and weighs 66.1kg, her BMI of 23.7 is in the recommended range. The average BMI of men is 25.9 which is classified as slightly overweight (corresponding to an average height and weight of 1.80m and 83.4kg, respectively). In this paper, standard definitions of BMI (defined as (weight in kg)/(height in m)^2) and the classification into four clinical categories 'underweight' (BMI lower than 18.5), 'healthy weight' (BMI between 18.5 and 25), 'overweight' (BMI between 25 and 30), and 'obese' (BMI higher than 30) are used. Due to the fact that height and weight are self-reported, height might be overstated and weight reported lower than the true value.[4] To account for this problem, I will not only rely on OLS regressions with BMI or dummies for the clinical categories as explanatory variables, but also introduce the deciles of the distribution of BMI as explanatory dummy variables. By sorting persons into the deciles of the distribution of BMI, they are classified relatively to the other respondents. If all respondents follow the same pattern by reporting a lower weight and overstating their height, the reported measures of BMI do not matter, since only the position of a person relative to the other respondents is of

[4] Cawley and Danziger (2004) account fort his problem by using reference weight and height measures in their study. They show that female current and former welfare-recipients report 8 to 12 pounds lower body weight and about 0.7 inches taller height. Nevertheless, this procedure to account for misreporting cannot be used for German data, since we do not have reference measures of weight and height.

interest. In the tables, results for all three regression types (correlation with BMI, with clinical categories of weight and with deciles of BMI) are presented.

The main interest of this paper is to answer the question through which channel lower wages for obese women can be explained. Therefore, I introduce two hypotheses. First hypothesis: Overweight persons are less productive due their corpulence. If they are paid according to their productivity, it would be fair that they earn less (**Productivity Hypothesis**). Second hypothesis: Employers perceive overweight and obese persons to be less productive because of prejudices against them. According to Roehling (1999), the most common prejudices against overweight persons are that they are lazy, less conscientious, less competent, emotionally unstable, or have less self-discipline or self-control. If these prejudices are not true, it would be discrimination if employers pay lower wages to overweight persons (**Discrimination Hypothesis**). Moreover, there might be unobserved factors (like self-esteem) that influence both, weight and wages. But since the true (causal) effect is hard to estimate in the absence of a natural experiment or a suitable instrument for body weight, this cannot be tested. Therefore, I concentrate on the productivity hypothesis and the discrimination hypotheses, which can be tested in different subgroup designs.

First, I divide the dataset of women into employed and self-employed women. By definition, self-employed women cannot be discriminated by their employer in terms of receiving lower wages. If overweight and obese women were less productive than women of healthy weight (productivity hypothesis), one would expect similar effects of weight on wages for both groups, employed and self-employed women. But if overweight women are being discriminated by their employer and therefore face lower wages (discrimination hypothesis), one would expect to estimate a negative effect of weight on wages for employed women and no such effect for self-employed women. Of course, selection could be a problem in this case. For example, Garcia and Quintana-Domeque (2007) find that obese women have a higher probability to be self-employed in countries like Greece, Ireland, and Italy, which might be

because they do not find an employment relationship due to their obesity. On the other hand, there is no correlation between self-employment and obesity in other European countries (Austria, Belgium, Denmark, Finland, Portugal, and Spain). Also for Germany, these findings do not seem to hold: there is no difference in weight or BMI between employed and self-employed women. In contrast, self-employed women have, on average, a lower BMI (23.4 compared to 23.7), although this difference is not statistically significant different from zero. Summary statistics of employed and self-employed women can be found in Appendix A2 (first and second column).

Second, the dataset of employed women is divided into young and older women. Young women are defined to be between 20 and 39 years of age and older women between 40 and 55. Both groups have roughly the same number of observations. If one thinks of discrimination against overweight women, we would expect larger coefficients for younger women, since they could not demonstrate their competence yet, while older overweight women might already achieved a higher position and proved that possible prejudices against them are wrong. Again, if the productivity hypothesis was true, the effect of overweight on wages for young and older women should be about the same (it might also be larger for older women, since their accumulated lifetime-productivity is lower). If the effect of weight on wages is higher for young women, the discrimination hypothesis might fit better.

Third, employed women are categorized by gender-dominance in their workplace. Based on more than 340 occupations, those jobs with more than 70 percent males or females are labeled ‘male-dominated jobs’ or ‘female-dominated jobs’, respectively. The rest are called ‘male-female balanced jobs’. If we assume that overweight women are less productive, they should be less productive in all working environments. Although it might be the case that being slightly overweight could be an advantage in some male-dominated jobs such as manufacturing jobs or jobs that demand physical power, where it bit more body mass might be useful (e.g. farmer or construction worker). If the productivity hypothesis holds, one would

expect either similar effects of weight on wages in all three working environments or smaller effects in male-dominated jobs. Results would be in favor of the discrimination hypothesis, if effects were larger for male-dominated jobs, since not only most of the coworkers are male, but also the supervisor is likely to be male and empirical studies find that men are generally more likely to have prejudices against overweight women. Therefore, I expect men to be more likely to discriminate against overweight women.

4. Results

Summary statistics of all relevant variables are shown in Table 2. The descriptives already illustrate that wages are lower for overweight or obese women, while this does not hold for overweight or obese men. In general, overweight and obesity is associated with lower education, which is also found in Zhang and Wang (2004). It is a bit surprising that heavier women have a higher probability to be married, while Averett and Korenman (1996) show that for women, a higher BMI is associated with a lower probability to be married. This is probably due to the fact that overweight and obese persons are, on average, older than healthy- or underweight persons and that these summary statistics do not control for age effects.

First results test the hypothesis that a higher weight is associated with lower wages. Previous studies for different countries find that this relationship only holds for women while there is no such effect for men (Johansson et al. (2007), Cawley (2004), Averett and Korenman (1996), Sargent and Blanchflower (1994)). Germany does not seem to be an exception; results are found in Table 3 and 4. The first column in Table 3 shows the correlation between weight on wages using BMI as a measure of weight without any further control variables. The effect for women is large and negative, while there is a positive relationship between BMI and wages for men. Both effects are highly significant. If there were no other factors that had an influence on wages, women would earn 0.8 percent lower wages for each higher unit of BMI.

In order to increase the BMI by one unit, a person has to gain about 3 kilograms. This means that a woman who is 30kg heavier than the average woman earns 8 percent less. In contrast, a 30kg heavier man would earn 3.5 percent *more* than a man having an average BMI. But since there are many factors, besides BMI, that influence wages, further control variables are added stepwise. Most importantly, educational controls are included in column 2. Schooling is included in three categories (lower, intermediate and higher education – 'Hauptschule', 'Realschule', and 'Gymnasium') and further vocational education in four categories (no apprenticeship, apprenticeship, master craftsman, university degree). For women, the effect becomes much smaller, which means that heavier women tend to have a lower education. This is different for men: the effect becomes larger when education is controlled for, which shows that heavier men have, on average, a higher education. But keeping in mind that a man of average weight is already overweight, this is not very surprising. In the third column, personal characteristics are added (age and age squared, dummy for having children, marital status, nationality and state of residence). The last column shows the estimates for the full set of control variables, adding job characteristics such as dummies for temporary work contract and for fulltime employment, tenure, tenure squared, 14 industry dummies, dummies for blue- and white-collar workers, civil servants, firm size, usual hours of work per week and usual hours of work squared. The coefficient for women remains unchanged, while the effect for men becomes smaller and insignificant as personal and job characteristics are included. For men there seems to be no relationship between BMI and wages, but women with a higher BMI earn significantly less. An increase in weight of about 30kg (or 10 units of BMI) is associated with 2.6 percent lower wages for women. In the following, all results will include the full set of control variables and only the coefficients of the weight variables are shown.

Results for the effects of all other control variables on wages are shown in Appendix A1. As expected, and as reported in the literature, schooling is positively related to wages, people in the eastern part of Germany earn less, wages increase with age and tenure, white-collar

workers and civil servants earn more than blue-collar workers, and larger firms pay higher wages. Most of the other control variables also have expected signs.

Besides BMI as explanatory variable to measure a person's physical appearance, I also use dummies for the clinical categories 'underweight', healthy weight', 'overweight' and 'obese' as regressors, with healthy weight as base category. Since measures of weight and height are self-reported, the third alternative to measure 'weight' is to use dummies for the 10 deciles of the distribution of BMI as explanatory variables. By doing so, not the reported BMI of a person matters, but the BMI of one person in relation to the other persons is of interest. If all data on weight and height are biased in the same way (by reporting lower weights and overstating height), this procedure is a good indicator for whether heavier persons earn less. Table 4 shows results for the different measures of weight, separately for men and women. The table contains coefficients of three different regressions using BMI, the clinical categories of weight, or the deciles of BMI as explanatory variables of interest. Obviously, there is virtually no effect for overweight or obese men in all three regressions, but effects for women become much stronger for heavier women. This can be seen by comparing the coefficients of 'overweight' and 'obese'. While the wage reduction for overweight women is 1.3 percent, it is almost twice as much for obese women (2.4 percent). By using the deciles of the distribution of BMI as regressors, it can be seen that higher values of BMI (the highest 20 percent) are associated with much higher wage reductions (about 4 percent lower wages) than for those women between the 40^{th} and the 80^{th} percentile (about 2.5 percent lower wages).

For women, there is no relationship between underweight and wages. In contrast, underweight seems to be strongly negatively related to wages for men. Being male and underweight is associated with about 3-times the wage reduction of being female and obese. The problem with these numbers is that only 0.6 percent (or n=416) men are classified as underweight. Therefore, it might be better to compare men and women in the lowest (highest) deciles of BMI since each decile has more than 7000 and 6000 observations for men and women,

respectively. The negative effect of belonging to the thinnest 10 percent for men is as high as being in the highest decile for women (more than 4 percent lower wages in both cases). But since this paper focuses on the relationship between overweight and wages, I will rely on results for women only, since there is no such effect for men. Potential discrimination of underweight men is not part of this study.

4.1 Results: employed vs. self-employed women

To come back to find evidence for the productivity or the discrimination hypothesis, previous results for employed women are compared to results for self-employed women. Again, if overweight women receive lower wages due to lower productivity, there should be no difference in the weight-coefficients between employed and self-employed women, since in this case overweight self-employed women should also be less productive than self-employed women of healthy weight and therefore supposed to earn lower wages. If the discrimination hypothesis holds, one might expect a negative effect of weight on wages for employed women only. There should be no effect for self-employed women since there is no employer who might discriminate them because of prejudices against heavier persons.

In general, self-employed women differ from employed women when it comes to wages. The share of self-employed women with very low or very high wages is much higher, whereas there are less self-employed women with intermediate wages. Summary statistics of wages and the explanatory variables for employed and self-employed women are shown in the first two columns of Appendix A2. Self-employed women are, on average, older than employed women. Moreover, they are better educated, more likely to be married, more likely to work fulltime and have more working hours per week than employed women. Controlling for these differences, Table 5 shows clearly that heavier self-employed women do not receive lower wages than their healthy weight counterparts (2^{nd} column) as it was found for employed women (1^{st} column).

In contrast, the absolute value of the coefficient of BMI is almost as high as the one for employed women, but it is positive (and not significant since the sample size of self-employed women is much smaller). The effects for the deciles are also very different: coefficients are highest between the 40th and the 80th percentile, while they become smaller for the heaviest 20 percent. These results favor the discrimination hypothesis, since otherwise one would expect lower wages also for self-employed women. I interpret this as a first indicator for discrimination against overweight and obese women in an employment relationship, although one cannot speak of a causal effect of weight on wages.

4.2 Results: young vs. older women

In a second step, I divide the dataset of employed women into two groups: young and older women. Different results for these two groups might also be an indicator for whether the productivity or the discrimination hypothesis fits better. As stated above, one would expect larger effects of weight on wages for younger women if the discrimination hypothesis is favorable, while coefficients are supposed to be of equal size (or larger for older women) in order to support the productivity hypothesis. Summary statistics of young and older women can be found in column 3 and 4 of Appendix A2. As expected, older women are on average notably heavier than young women. Nevertheless, this does not seem to result in larger coefficients for older women. Table 6 provides the results for young and older women for all three measures of body weight.

Supporting the discrimination hypothesis, results are indeed stronger for young than for older women. In both groups, I find a significant negative association between weight and wages. The coefficient of BMI indicates that young women receive 0.29 percent lower wages for each higher unit of BMI, which is almost 50 percent larger than the effect for older women (at 0.2 percent per unit of BMI). For the clinical category ‘obese’ effects for young and older women are about equal. A reason for the insignificance of the ‘obese’-dummy for younger

women might be larger standard errors since there are only few women who are young and obese (in the sample are twice as many obese older women than obese young women). Interestingly, the clinical category 'overweight' is not associated with lower wages for older women, while there is a large and significant effect for young women (2.4 percent lower wages if overweight compared to young women of healthy weight). This could be due to the fact that older women have, on average, a higher BMI. If all older women were overweight, there would be no discrimination among them. But in this sample, the average BMI of older women is 24.5 which is classified as 'healthy weight'. The coefficients for the deciles also indicate that there are larger effects for young women. Women above the 7^{th} decile in the BMI distribution receive 3.2 to 4.8 percent lower wages when young, while results show between 0.8 and 3.2 percent lower wages for the heaviest 30 percent older women.

I interpret these results as more evidence that the discrimination hypothesis is more likely to hold, since older women should have the same (or even higher) wage reductions when overweight if the gap in wages between overweight women and women of healthy weight was due to reduced productivity.

4.3 Results by gender dominance in the workplace

As motivated above, I expect roughly the same coefficients in all three categories or lower effects for male-dominated jobs if the productivity hypothesis holds, because there should be no difference in productivity between these three working environments or, as stated above, I would expect less 'loss of productivity' due to body mass for women in male-dominated jobs, since these jobs are more likely to be placed outside (farmer, construction worker) or physically demanding. Contrary, I interpret results as supportive of the discrimination hypothesis if coefficients of male-dominated jobs are larger, because literature on discrimination reveals that men are more likely to discriminate against overweight women than women are. Summary statistics (in Appendix A3) reveal that there are no major

differences between the four clinical weight categories in male-dominated, female-dominated, or male-female-balanced jobs; which can also be seen when comparing the average values of BMI at 23.8, 23.7, and 23.5, respectively.

Table 7 shows the results by gender dominance in the workplace. For comparison, results for all employed women are repeated in the first column. The coefficient of BMI in male-dominated jobs is almost twice as large as the average effect. Moreover, it is 1.5 times and 2.5 times as large as for male-female balanced and female-dominated jobs, respectively. The same patterns are true for the clinical categories ‘overweight’ and ‘obese’ und for the deciles of BMI: Correlations are strongest for male-dominated jobs. The reason why large effects (for example for obese women in male-dominated jobs) are not statistically significant is probably due to the fact that only few women work in male-dominated jobs (by definition), so that sample size is much smaller here.

Table 8 combines the classification into young and older women with the classification into employed and self-employed women and by gender dominance in the workplace. Previous results hold, since the expected results to support the discrimination hypothesis are again more pronounced for young women than for older women in all groups: The correlation of BMI and wages for self-employed women becomes much larger and remains positive (0.011 for young and self-employed women compared to 0.002 for all self-employed women). Coefficients for young women in male-dominated job are also much larger (and negative) than for all women in male-dominated jobs (6 percent wage reduction for a 10-point increase in BMI compared to 4.8 percent). This puts young women in male-dominated jobs at a position with most discrimination against overweight and obese women.

All in all, it can be summarized that all three subgroup designs favor the discrimination hypothesis over the productivity hypothesis.

5. Conclusion

This paper analyses the relationship between weight and wages, especially for women, who seem to face higher wage reductions when they are overweight or obese. I find that obese women receive 2.4 percent lower wages than women of healthy weight, while women who are in the top 10 percent of the body mass index get 4.3 percent lower wages than thinner women. This correlation becomes stronger for young women and women with mainly male coworkers. Based on papers that find a causal effect of overweight on wages for (white) women, this paper asks the question whether observed differences in wages between overweight women and women of healthy weight are due to reduced productivity of heavier women or due to discrimination. I set up three different subgroup designs to find support for either the productivity or the discrimination hypothesis. In all three subgroup designs, estimates are in favor of the discrimination hypothesis: First, in contrast to overweight employed women, overweight self-employed women do not experience any wage reductions. Second, the association between lower wages and higher weight is stronger for young women in contrast to older women, although one would expect either the same wage reduction or even higher wage reductions if heavier women were generally less productive. Third, overweight or obese women in jobs with mainly male coworkers seem to experience higher wage reductions than overweight or obese women with mainly female coworkers or in male-female balanced jobs. To find support for the productivity hypothesis, one would expect the same coefficients in all working environments or a weaker correlation between weight and wages for overweight women in male dominated jobs.

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Table 1: Summary statistics (I)

	Women	Men
BMI	23.7	25.9
Weight in kg	66.1	83.4
Height in cm	167	180
Underweight	0.04	0.01
Healthy weight	0.67	0.45
Overweight	0.21	0.43
Obese	0.08	0.12
n	63,388	74,416

Source: Micro Census 2003 and 2005, own calculations.

Table 2: Summary statistics (II)

	Women		Men	
	healthy- or underweight	overweight or obese	healthy- or underweight	Overweight or obese
Net wage				
Wage (300-700)	0.20	0.23	0.03	0.02
Wage (700-1100)	0.26	0.26	0.12	0.11
Wage (1100-1700)	0.44	0.43	0.52	0.52
Wage (1700-2900)	0.08	0.06	0.21	0.23
Wage (2900-4000)	0.02	0.01	0.08	0.08
Wage (>4000)	0.01	0.00	0.04	0.04
Education				
Lower secondary school	0.20	0.29	0.29	0.39
Intermediate secondary school	0.46	0.49	0.35	0.35
Higher secondary school	0.33	0.22	0.36	0.26
No further education	0.01	0.01	0.01	0.01
Apprenticeship	0.81	0.87	0.76	0.83
University degree	0.18	0.11	0.23	0.16
Personal Characteristics				
Age	37.8	41.8	37.2	41.2
Married	0.56	0.65	0.52	0.69
Children	0.33	0.28	0.34	0.37
German nationality	0.95	0.96	0.93	0.94
Living in West-Germany	0.80	0.74	0.83	0.80
Living in East-Germany	0.20	0.26	0.17	0.20
Job characteristics				
White-collar worker	0.80	0.72	0.54	0.47
Blue-collar worker	0.13	0.23	0.38	0.45
Civil servant	0.07	0.05	0.07	0.07
Temporary work contract	0.08	0.07	0.08	0.05
Fulltime employed	0.62	0.61	0.96	0.97
Hours worked per week	31.9	31.7	39.1	39.5
Tenure	8.76	10.28	9.29	11.79
Firm size (1-10)	0.26	0.24	0.15	0.13
Firm size (11-49)	0.27	0.28	0.25	0.25
Firm size (> 50)	0.48	0.48	0.60	0.61
n	44,856	18,532	34,067	41,349

Source: Micro Census 2003 and 2005, own calculations.

Table 3: BMI as explanatory variable, stepwise including control variables

	Dep. Variable: net ln(wage) in intervals			
Women (n=63,388)	**1**	**2**	**3**	**4**
BMI	-0.0080***	-0.0020***	-0.0023***	-0.0026***
	(0.0008)	(0.0008)	(0.0007)	(0.0006)
controlled for education		X	X	X
controlled for personal characteristics			X	X
controlled for job characteristics				X
Men (n=75,416)	1	2	3	4
BMI	0.0035***	0.0086***	0.0016***	0.0009
	(0.0008)	(0.0007)	(0.0006)	(0.0005)
controlled for education		X	X	X
controlled for personal characteristics			X	X
controlled for job characteristics				X

Note: *, ** and *** denote significance at the 10%, 5% and 1% level, respectively. The estimates stepwise increase the set of control variables. In the first column, no control variables are included. The second column controls for education: lower, intermediate, higher education, university degree and apprenticeship. In the third column, personal characteristics are added: age and age squared, children, marital status, nationality and state, while the last column shows the estimates for the full set of control variables, adding job characteristics such as temporary work contract, fulltime working, tenure, tenure squared, industry, dummy for white-collar worker, civil servant, firm size, usual hours of work per week and usual hours of work squared.
Source: Micro Census 2003 and 2005, own calculations.

Table 4: Results for women and men

	Women	**Men**
BMI	-0.0026***	0.0009
	(0.0006)	(0.0005)
Obese – BMI higher than 30	-0.024***	0.004
	(0.008)	(0.006)
Overweight – BMI between 25 and 30	-0.013**	0.005
	(0.006)	(0.004)
Underweight – BMI lower than 18.5	0.000	-0.078***
	(0.013)	(0.026)
BMI - 10. Percentile	-0.007	-0.044***
	(0.011)	(0.009)
BMI - 20. Percentile	-0.009	-0.020**
	(0.011)	(0.008)
BMI - 40. Percentile	-0.023**	-0.011
	(0.010)	(0.008)
BMI - 50. Percentile	-0.015	-0.004
	(0.011)	(0.009)
BMI - 60. Percentile	-0.032***	-0.014*
	(0.011)	(0.008)
BMI - 70. Percentile	-0.025**	-0.008
	(0.01)	(0.009)
BMI - 80. Percentile	-0.022**	-0.013
	(0.011)	(0.008)
BMI - 90. Percentile	-0.037***	-0.016*
	(0.011)	(0.008)
BMI - 100. Percentile	-0.043***	-0.014
	(0.010)	(0.009)
n	63,388	75,416

Note: *, ** and *** denote significance at the 10%, 5% and 1% level, respectively. The estimates are based on regressions with the following set of control variables: Age and age squared, education (lower, intermediate, higher education), university degree, apprenticeship, children, marital status, nationality, state, temporary work contract, fulltime working, tenure, tenure squared, industry, dummy for white-collar worker, civil servant, firm size, usual hours of work per week and usual hours of work squared.
Source: Micro Census 2003 and 2005, own calculations.

Table 5: Results: employed vs. self-employed women

	Women (employed)	**Women (self-employed)**
BMI	-0.0026***	0.0022
	(0.0006)	(0.0050)
Obese – BMI higher than 30	-0.024***	0.042
	(0.008)	(0.079)
Overweight – BMI between 25 and 30	-0.013**	0.011
	(0.006)	(0.047)
Underweight – BMI lower than 18.5	0.000	-0.049
	(0.013)	(0.098)
BMI - 10. Percentile	-0.007	0.003
	(0.011)	(0.077)
BMI - 20. Percentile	-0.009	-0.068
	(0.011)	(0.076)
BMI - 40. Percentile	-0.023***	-0.131*
	(0.010)	(0.074)
BMI - 50. Percentile	-0.015	-0.149**
	(0.011)	(0.075)
BMI - 60. Percentile	-0.032***	-0.025
	(0.011)	(0.075)
BMI - 70. Percentile	-0.025**	-0.107
	(0.010)	(0.079)
BMI - 80. Percentile	-0.022**	-0.066
	(0.011)	(0.076)
BMI - 90. Percentile	-0.037***	-0.025
	(0.011)	(0.082)
BMI - 100. Percentile	-0.043***	-0.052
	(0.010)	(0.081)
n	63,388	5,172

Note: *, ** and *** denote significance at the 10%, 5% and 1% level, respectively. The estimates are based on regressions with the following set of control variables: Age and age squared, education (lower, intermediate, higher education), university degree, apprenticeship, children, marital status, nationality, state, temporary work contract, fulltime working, tenure, tenure squared, industry, dummy for white-collar worker, civil servant, firm size, usual hours of work per week and usual hours of work squared.
Source: Micro Census 2003 and 2005, own calculations.

Table 6: Results: young vs. older women

	Women (20-39 years of age)	**Women (40-55 years of age)**
BMI	-0.0029***	-0.0020**
	(0.0009)	(0.0008)
Obese – BMI higher than 30	-0.021	-0.022**
	(0.014)	(0.011)
Overweight – BMI between 25 and 30	-0.024***	-0.003
	(0.009)	(0.008)
Underweight – BMI lower than 18.5	-0.005	0.004
	(0.014)	(0.026)
BMI - 10. Percentile	-0.007	-0.009
	(0.013)	(0.018)
BMI - 20. Percentile	-0.016	0.007
	(0.013)	(0.017)
BMI - 40. Percentile	-0.025*	-0.021
	(0.014)	(0.016)
BMI - 50. Percentile	-0.030**	0.003
	(0.014)	(0.016)
BMI - 60. Percentile	-0.041***	-0.017
	(0.014)	(0.016)
BMI - 70. Percentile	-0.007	-0.036**
	(0.015)	(0.015)
BMI - 80. Percentile	-0.032**	-0.008
	(0.015)	(0.015)
BMI - 90. Percentile	-0.045***	-0.025*
	(0.016)	(0.015)
BMI - 100. Percentile	-0.048***	-0.032**
	(0.015)	(0.015)
n	30,670	32,718

Note: *, ** and *** denote significance at the 10%, 5% and 1% level, respectively. The estimates are based on regressions with the following set of control variables: Age and age squared, education (lower, intermediate, higher education), university degree, apprenticeship, children, marital status, nationality, state, temporary work contract, fulltime working, tenure, tenure squared, industry, dummy for white-collar worker, civil servant, firm size, usual hours of work per week and usual hours of work squared.
Source: Micro Census 2003 and 2005, own calculations.

Table 7: Results based on gender-dominance in the job

	Women (all)	Women in male-dominated jobs	Women in female-dominated jobs	Women in male-female balanced jobs
BMI	-0.0026***	-0.0048**	-0.0019**	-0.0032***
	(0.0006)	(0.0020)	(0.0007)	(0.0011)
Obese – BMI higher than 30	-0.024***	-0.033	-0.019*	-0.034**
	(0.009)	(0.029)	(0.011)	(0.016)
Overweight – BMI between 25 and 30	-0.013**	-0.045**	-0.008	-0.017
	(0.006)	(0.021)	(0.008)	(0.011)
Underweight – BMI lower than 18.5	0.000	0.038	-0.012	0.006
	(0.013)	(0.052)	(0.015)	(0.022)
BMI - 10. Percentile	-0.007	-0.017	-0.018	0.001
	(0.011)	(0.035)	(0.014)	(0.019)
BMI - 20. Percentile	-0.009	-0.017	-0.006	-0.020
	(0.011)	(0.038)	(0.013)	(0.019)
BMI - 40. Percentile	-0.023***	-0.064*	-0.013	-0.051***
	(0.010)	(0.034)	(0.014)	(0.018)
BMI - 50. Percentile	-0.015	-0.077**	-0.020	-0.002
	(0.011)	(0.035)	(0.013)	(0.019)
BMI - 60. Percentile	-0.032***	-0.058	-0.033**	-0.008
	(0.011)	(0.039)	(0.014)	(0.018)
BMI - 70. Percentile	-0.025**	-0.070*	-0.025*	-0.033*
	(0.010)	(0.036)	(0.014)	(0.019)
BMI - 80. Percentile	-0.022**	-0.097***	-0.014	-0.021
	(0.011)	(0.035)	(0.014)	(0.019)
BMI - 90. Percentile	-0.037***	-0.85**	-0.026*	-0.040**
	(0.011)	(0.040)	(0.014)	(0.018)
BMI - 100. Percentile	-0.043***	-0.080**	-0.042***	-0.052**
	(0.010)	(0.036)	(0.013)	(0.019)
n	63,388	5,631	37,152	20,605

Note: *, ** and *** denote significance at the 10%, 5% and 1% level, respectively. An allocation into male and female-dominated job is based on the proportion of men and women in the different jobs. If more than 70 percent of the employees in a job category are male or female, this job is labeled male or female-dominated, respectively. The remaining jobs are labeled male-female balanced jobs. This division is based on a job classification into 342 jobs. The estimates are based on regressions with the following set of control variables: Age and age squared, education (lower, intermediate, higher education), university degree, apprenticeship, children, marital status, nationality, state, temporary work contract, fulltime working, tenure, tenure squared, industry, dummy for white-collar worker, civil servant, firm size, usual hours of work per week and usual hours of work squared.
Source: Micro Census 2003 and 2005, own calculations.

Table 8: All results by age group

	Employed women	Self-employed women	Male-dominated jobs	Female-dominated jobs	Male-female balanced jobs
BMI	-0.0029***	0.0106	-0.0060**	-0.0021*	-0.0035**
Young women (20-39)	(0.0009)	(0.0098)	(0.0028)	(0.0011)	(0.0017)
n	30,670	1,886	2,935	17,560	10,175
BMI	-0.0020**	-0.0006	-0.0033	-0.0014	-0.0029**
Older women (40-55)	(0.0008)	(0.0058)	(0.0026)	(0.0010)	(0.0014)
n	32,718	3,286	2,696	19,592	10,430

Note: *, ** and *** denote significance at the 10%, 5% and 1% level, respectively. The estimates are based on regressions with the following set of control variables: Age and age squared, education (lower, intermediate, higher education), university degree, apprenticeship, children, marital status, nationality, state, temporary work contract, fulltime working, tenure, tenure squared, industry, dummy for white-collar worker, civil servant, firm size, usual hours of work per week and usual hours of work squared.
Source: Micro Census 2003 and 2005, own calculations.

Appendix:

A1: Results including controls

	Women	Men
BMI	-0.0026***	0.0009
	(0.0006)	(0.0005)
Education and personnel characteristics		
Lower secondary school	-0.067***	-0.051***
	(0.007)	(0.005)
Higher secondary school	0.065***	0.052***
	(0.008)	(0.007)
No apprenticeship	-0.029	-0.070***
	(0.021)	(0.017)
Master craftsman	0.084***	0.086***
	(0.008)	(0.006)
University degree	0.214***	0.262***
	(0.011)	(0.009)
Children (<3)	-0.172***	0.083***
	(0.017)	(0.007)
Children (3-5)	0.024**	0.104***
	(0.012)	(0.007)
Children (6-9)	0.033***	0.087***
	(0.010)	(0.006)
Children (10-14)	0.027***	0.075***
	(0.007)	(0.005)
Children (>14)	-0.025***	0.017***
	(0.005)	(0.005)
Married	-0.162***	0.116***
	(0.006)	(0.005)
Nationality: German	0.035*	0.089***
	(0.018)	(0.013)
Nationality: Non-German, EU	0.043	0.088***
	(0.029)	(0.021)
Age	0.039***	0.018***
	(0.002)	(0.002)
Age squared	-0.000***	-0.000***
	(0.000)	(0.000)
State - Reference: North Rhine-Westphalia		
Schleswig-Holstein	0.000	0.004
	(0.016)	(0.013)
Hamburg	0.044**	-0.059***
	(0.019)	(0.019)
Lower Saxony	-0.025**	-0.008
	(0.010)	(0.008)
Bremen	-0.004	-0.039**
	(0.020)	(0.020)
Hesse	0.014	0.005
	(0.011)	(0.008)

A1: Results including controls (continued)

	Women	Men
State - Reference: North Rhine-Westphalia		
Rhineland-Palatinate	-0.013	0.023***
	(0.012)	(0.009)
Baden-Wurttemberg	0.008	0.034***
	(0.009)	(0.007)
Bavaria	-0.011	0.017**
	(0.009)	(0.007)
Saarland	-0.050**	-0.051***
	(0.019)	(0.013)
Berlin	-0.005	-0.110***
	(0.011)	(0.012)
Brandenburg	-0.083***	-0.244***
	(0.013)	(0.011)
Mecklenburg-West Pomerania	-0.112***	-0.242***
	(0.017)	(0.016)
Saxony	-0.124***	-0.263***
	(0.010)	(0.009)
Saxony-Anhalt	-0.137***	-0.266***
	(0.011)	(0.009)
Thuringia	-0.154***	-0.294***
	(0.014)	(0.012)
Job characteristics		
White-collar worker	0.152***	0.156***
	(0.007)	(0.005)
Civil servant	0.359***	0.266***
	(0.014)	(0.010)
Firm size (1-10)	-0.067***	-0.053***
	(0.007)	(0.006)
Firm size(>50)	0.057***	0.093***
	(0.006)	(0.005)
Tenure	0.005***	0.011***
	(0.001)	(0.001)
Tenure squared	0.000	0.000***
	(0.000)	(0.000)
Temporary work contract	-0.079***	-0.131***
	(0.010)	(0.010)
Working fulltime	0.102***	0.229***
	(0.010)	(0.023)
Hours worked per week	0.037***	0.013***
	(0.001)	(0.002)
Hours worked per week squared	-0.000***	-0.000
	(0.000)	(0.000)

A1: Results including controls (continued)

	Women	Men
Industry - Reference: Manufacturing		
Agriculture, hunting and forestry	-0.127***	-0.142***
	(0.024)	(0.013)
Electricity, gas and water supply	0.094***	0.016
	(0.030)	(0.016)
Construction	0.016	-0.029***
	(0.022)	(0.006)
Wholesale & retail trade	-0.078***	-0.083***
	(0.009)	(0.007)
Hotel and restaurant industry	-0.135***	-0.223***
	(0.016)	(0.020)
Transport and communication	0.009	-0.089***
	0014)	(0.008)
Financial intermediation	0.054***	0.053***
	(0.012)	(0.012)
Real estate and business activities	-0.001	-0.010
	(0.011)	(0.010)
Public administration and defense	-0.033***	-0.102***
	(0.010)	(0.008)
Education	0.037***	-0.108***
	(0.011)	(0.012)
Health and social work	-0.044***	-0.126***
	(0.009)	(0.010)
Other social and personal service	-0.075***	-0.074***
	(0.013)	(0.012)
n	63388	75416

Source: Micro Census 2003 and 2005, own calculations.

A2: Summary statistics for subgroups (I)

	Employed women	Self-employed women	Young women (20 - 39)	Older women (40 - 55)
Net wage				
Wage (300-700)	0.21	0.30	0.20	0.23
Wage (700-1100)	0.26	0.16	0.27	0.24
Wage (1100-1700)	0.44	0.28	0.45	0.42
Wage (1700-2900)	0.07	0.12	0.06	0.09
Wage (2900-4000)	0.02	0.08	0.01	0.02
Wage (>4000)	0.01	0.06	0.00	0.01
Weight				
Underweight	0.04	0.04	0.06	0.02
Healthy weight	0.67	0.71	0.73	0.61
Overweight	0.21	0.18	0.16	0.26
Obese	0.08	0.07	0.05	0.10
Education				
Lower secondary school	0.23	0.20	0.16	0.30
Intermediate secondary school	0.47	0.37	0.50	0.45
Higher secondary school	0.30	0.43	0.34	0.26
No further education	0.01	0.01	0.01	0.01
Apprenticeship	0.83	0.68	0.83	0.82
University degree	0.16	0.30	0.16	0.16
Personal Characteristics				
Age	39.0	42.2	31.2	46.8
Married	0.59	0.70	0.45	0.73
Children	0.32	0.39	0.41	0.22
German nationality	0.95	0.94	0.94	0.97
Living in West-Germany	0.78	0.81	0.80	0.76
Living in East-Germany	0.22	0.19	0.20	0.24
Job characteristics				
White-collar worker	0.78	0	0.80	0.75
Blue-collar worker	0.16	0	0.14	0.18
Civil servant	0.06	0	0.05	0.07
Temporary work contract	0.08	0	0.11	0.05
Fulltime employed	0.62	0.68	0.67	0.56
Hours worked per week	31.8	36.5	32.7	30.9
Tenure	9.20	8.29	6.03	12.42
Firm size (1-10)	0.25	0.95	0.26	0.25
Firm size (11-49)	0.27	0.04	0.26	0.28
Firm size (> 50)	0.48	0.01	0.48	0.47
n	63,388	5,172	30,670	32,718

Source: Micro Census 2003 and 2005, own calculations.

A3: Summary statistics for subgroups (II)

	Women in male-dominated jobs	Women in female-dominated jobs	Women in male-female-balanced jobs
Net wage			
Wage (300-700)	0.12	0.26	0.15
Wage (700-1100)	0.22	0.28	0.23
Wage (1100-1700)	0.48	0.40	0.48
Wage (1700-2900)	0.14	0.05	0.11
Wage (2900-4000)	0.03	0.01	0.03
Wage (>4000)	0.02	0.00	0.01
Weight			
Underweight	0.04	0.04	0.04
Healthy weight	0.65	0.67	0.68
Overweight	0.22	0.21	0.21
Obese	0.09	0.08	0.07
Education			
Lower secondary school	0.21	0.26	0.18
Intermediate secondary school	0.40	0.52	0.40
Higher secondary school	0.39	0.22	0.41
No further education	0.02	0.01	0.01
Apprenticeship	0.73	0.90	0.73
University degree	0.25	0.09	0.26
Personal Characteristics			
Age	38.5	39.1	38.8
Married	0.53	0.61	0.56
Children	0.30	0.33	0.29
German nationality	0.96	0.95	0.95
Living in West-Germany	0.72	0.79	0.79
Living in East-Germany	0.28	0.21	0.21
Job characteristics			
White-collar worker	0.62	0.83	0.71
Blue-collar worker	0.32	0.13	0.16
Civil servant	0.06	0.03	0.12
Temporary work contract	0.09	0.07	0.09
Fulltime employed	0.79	0.56	0.68
Hours worked per week	35.8	30.4	33.3
Tenure	8.55	8.74	10.20
Firm size (1-10)	0.16	0.33	0.15
Firm size (11-49)	0.23	0.29	0.24
Firm size (> 50)	0.61	0.38	0.61
n	5,631	37,152	20,605

Source: Micro Census 2003 and 2005, own calculations.