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A weighty issue revisited: the dynamic effect of body weight on earnings and satisfaction in Germany

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A weighty issue revisited: the dynamic effect of body weight on earnings and satisfaction in Germany

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Abstract

We estimate the effect of changes in the body mass index (*bmi*) on wages and satisfaction in a panel of German employees. Dynamic models indicate that there is an inverse u-shaped association between *bmi* and wages among young workers. Among men, work satisfaction is affected beyond the effect on earnings. However, the implied optimum *bmi* is relatively high (in the overweight range). Thus, the recent rise in weight may not constitute a major limitation to productivity yet.

Keywords: Obesity, earnings, System-GMM estimator, dynamic panel model, GSOEP

JEL classification: J24, J28, J31, J71

1 Introduction

The global rise in obesity has stirred a large body of research, not only on the physiological consequences of obesity but also on its psychological burden and its effects in the labor market (Cawley, 2004; Puhl and Heuer, 2009). In the US, obese persons are more likely than those with normal weight to report day-to-day interpersonal discrimination. Carr and Friedman (2005) find that this difference is larger in higher socioeconomic strata, and that perceived discrimination is an important factor in explaining lower self-acceptance among the obese. It is not so clear, though, whether the psychological burden works on top of the effect on labor market outcomes. The relationship may also be country-specific, due to cultural differences and different legal frameworks (Brunello and D'Hombres, 2007).

We analyze the association of body mass index (*bmi*) with wages and satisfaction among German workers. While *bmi* has clear limitations as a measure of central body fat (as muscle mass contributes even more to weight than fat mass), this information is now included in several surveys that also feature detailed information on income. While most previous studies have used cross-sectional models or static panel data models, the present study acknowledges that there could be earnings persistence, i.e. the full adjustment of wages could take some time. In the context of the effect of schooling on wages, Andini (2013a) has recently shown that static models might underestimate the full effect of schooling. Andini (2013b) provides a theoretical derivation of the dynamic form of a Mincer regression equation as the outcome of a wage bargaining model. The *bmi* might be of particular relevance for the wage of younger workers, inasmuch as weight gain may be regarded by employers as a signal for low future productivity (Pinkston, 2010). To be sure, weight gain may not be a problem for a slenderly built worker, so that potential non-linearity in the relationship should be accounted for by the model. Moreover, panel data allow us to filter out time-invariant hetero-

geneity across workers.

In the German case, previous work on the causal relationship from *bmi* to wages did not show a weight penalty (Cawley et al., 2005; Bozoyan and Wolbring, 2011). Apart from differences in the econometric specification, such a result may reflect the higher degree of regulation in the German labor market in comparison to, e.g., the US. In case there really was a burden from weight on worker productivity and this burden is not absorbed by wages, one could speculate that other forms of discrimination—such as bullying—play a stronger role. As a consequence, a worker who has become more chubby would experience a greater disutility of labor, at given earnings. This channel might explain the observation that happiness is a negative function of weight and that the strength of this relationship varies across countries (Katsaiti, 2012). We address this channel by using indicators of satisfaction with life and satisfaction with work as additional outcome measures, again within a dynamic panel framework.

2 Material and method

Our analysis uses data from the German Socioeconomic Panel (SOEP v28, 2012). As (self-reported) anthropometric data are only available at biennial frequency our analysis only considers every second year. While variables other than *bmi* are measured in odd years (2003,2005,2007,2009,2011), the information on *bmi* refers to the respective preceding, even year. In this setting we treat *bmi* as a pre-determined variable, i.e. a shock to the outcome variable (wage or satisfaction) is allowed to affect *bmi* only in the future. Several inclusion criteria were applied. In particular, we only consider employees aged 65 years or younger, who worked for at least 10 hours per week, and who earned a (nominal) hourly wage of at least 1 EUR. Observations with imputed anthropometric or wage data are excluded from the analysis, and we also disregard data on women who were—according to their fertility

history—pregnant at the time of the anthropometric interview or who had given birth to a child shortly before.

The dependent variable in our wage regression is the natural logarithm of the deflated gross hourly wage. The models on satisfaction use either subjective well-being with life in general or with work as dependent variable. These are measured on a Likert-type scale, ranging from 0 (dissatisfied) to 10 (satisfied). Similar to previous literature (e.g., Katsaiti (2012)) we treat these ordinal-scaled variables as if they were metrical. Our explanatory variable of interest is *bmi*, defined as weight in kilograms divided by height in meters squared. In order to reflect a non-linear relationship, we also use the square of this variable. If anything, we would expect to find an inverse u-shape association, with an implied maximum in the healthy *bmi* range.[1] The resulting effective sample is not balanced but requires that information from at least three consecutive waves is available for a particular individual.[2]

For each outcome variable, we specify a separate dynamic regression equation of the form

$$y_{it} = \alpha_i + \sum_{j=1}^{p} \gamma_j y_{i,t-j} + \beta_1 bmi_{it} + \beta_2 (bmi_{it})^2 + \boldsymbol{x}_{it}' \boldsymbol{\delta} + \varepsilon_{it},$$

where α_i is a person fixed effect and $\boldsymbol{x}_{it}$ contains control variables (including exogenous dummies for time). The error term ε_{it} needs to be uncorrelated over time. In general, we believe that *bmi* is not exogenous but might react to shocks in income or happiness, respectively. Notice that by construction of our dataset, bmi_{it} refers to the preceding year, and it should thus not be able to react to *current* shocks but only to *past* shocks. As a consequence, we treat *bmi* as a predetermined variable. This means that, within a GMM framework, the first lag ($bmi_{i,t-1}$) can serve as an instrument for Δbmi_{it} in

[1] It is often assumed that a healthy *bmi* falls into the range 18.5–25, whereas 25–30 marks overweight, and values above 30 indicate obesity.

[2] This number increases to four if the specification includes two lags of the dependent variable.

the difference equation (Cameron and Trivedi, 2005, p. 765). Estimation is carried out with the System-GMM estimator that additionally considers a levels equation (Blundell and Bond, 1998). In search of a parsimonious specification, we only consider $p \in \{1, 2\}$, depending on residual autocorrelation tests.

In the wage regression, we use years of schooling, years of actual labor market experience, and a dummy for East Germany as additional control variables, all of which are assumed to be exogenous.[3] Our models on subjective well-being incorporate earnings and the number of work hours (both in natural logarithm) as explanatory variables presumed to be predetermined. All other regressors are believed to be exogenous. All estimations are stratified by gender. We also consider sub-samples restricted to 'young' workers with a labor market experience of 15 years or less.

3 Results

Table 1 presents results for the augmented dynamic Mincer regression. All specifications pass the residual autocorrelation test and the Hansen test on instrument exogeneity. With a moderate number of (at most) 43 instruments, we believe that the Hansen tests are not biased.[4] In the male young worker model, both *bmi* and its square turn out to be statistically significant. With a positive and negative sign, respectively, they imply an inverse u-shaped relationship. However, the 'optimum bmi' is only achieved at a *bmi* of 30, i.e. at the threshold from 'overweight' to 'obesity' (Figure 1). For female workers (in general) the maximum is reached at about the same *bmi* value, whereas the respective number is 'only' 26 (overweight) for young female workers.

[3] Years of schooling is the hypothetical number of years required to receive the individual's highest degree, irrespective of actual time spent in formal education. As our sample contains only individuals with completed education, this variable is time-invariant and thus could not be used in the Arellano/Bond GMM estimator.

[4] This also applies for our models on subjective well-being with at most 70 instruments.

Table 1: Wage regression results

	Male workers		Female workers	
	all	young	all	young
	(1)	(2)	(3)	(4)
$y(t-1)$	0.1983***	0.2834***	0.1520***	0.2260***
	(0.0389)	(0.0779)	(0.0401)	(0.0681)
bmi	0.0297	0.1479**	0.0531**	0.0951***
	(0.0274)	(0.0614)	(0.0211)	(0.0367)
$(bmi)^2$	–0.0005	–0.0024**	–0.0009**	–0.0018***
	(0.0005)	(0.0011)	(0.0004)	(0.0006)
schooling	0.0676***	0.0621***	0.0754***	0.0642***
	(0.0036)	(0.0068)	(0.0041)	(0.0057)
experience	0.0229***	0.0059	0.0214***	0.0180
	(0.0028)	(0.0161)	(0.0030)	(0.0129)
$(experience)^2$	–0.0004***	0.0004	–0.0003***	–0.0004
	(0.0001)	(0.0007)	(0.0001)	(0.0006)
East Germany	–0.3265***	–0.2272***	–0.2325***	–0.2226***
	(0.0203)	(0.0322)	(0.0178)	(0.0280)
Observations	11,514	2,911	8,910	2,515
Persons	4,858	1,642	3,963	1,514
Arellano-Bond autocorrelation test (p-value)				
first order	0.0000	0.0004	0.0000	0.0000
second order	0.9815	0.2645	0.7711	0.7634
Hansen test on instrument exogeneity (p-value)				
Model	0.6656	0.6806	0.7036	0.8172
ΔJ for levels eq.	0.4109	0.7509	0.6026	0.4336
Instruments	34	43	43	43
Implied $bmi^{opt.}$	32.3	30.3	29.6	26.2

Remarks: Method of estimation: System-GMM. Models additionally include an intercept term and year dummies. Robust standard errors with Windmeijer correction in parentheses. */**/*** indicates statistical significance at the 10/5/1% level. See text for definition of subsamples.

The relationship seems to be stronger among young workers. Our estimates suggest that for a young female worker with a *bmi* of 20, a permanent increase in *bmi* would by associated with an increase in wage by c. 2.3% on impact. In the very long run, the predicted wage increase amounts to 3.0%.[5].

While the wage regressions suggest some sort of similarity between men and women, we obtain quite different results by gender in the models on subjective well-being when it comes to the *bmi* (Table 2). For men, it does not

[5] $100 \times \frac{0.0951 - 2 \cdot 0.0018 \cdot 20}{1 - 0.2260}$

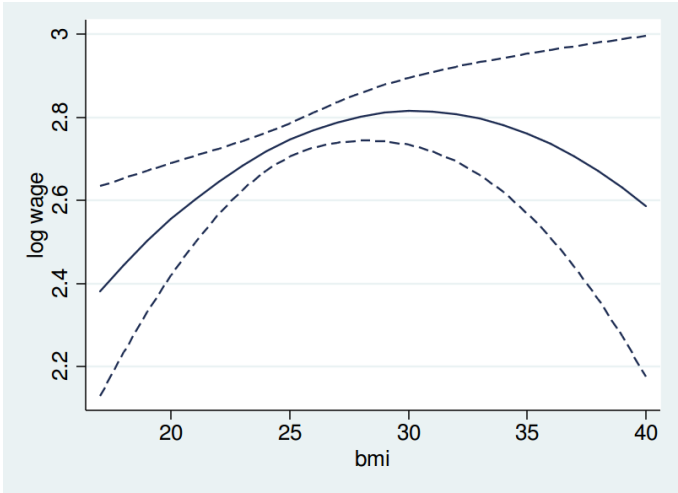

Figure 1: Estimated relationship between *bmi* of young men and their log hourly wage, with approximate 95% confidence interval (source: Table 1, col. 2).

seem to matter, whereas it is highly significant for women, with an implied optimum at 29. Notice that this is after controlling for individual earnings. The *bmi* relationship in women need not accrue from discrimination but might reflect health concerns or limitations instead. When work satisfaction is considered as outcome, we find the inverse u-shape again, but it is not statistically significant for women. For young men, in turn, it is significant, with an implied optimum at a *bmi* of 29. This is quite remarkable inasmuch as this effect works in addition to the effect on earnings. This hints at a subtle form of discrimination at the workplace. As was the case with the wage regression, the autoregressive coefficient (on $y(t-1)$) is far from 1, so the difference between the effect on impact and in the long run is modest. Nonetheless it turns out as highly significant and thus points to some mild form of persistence in subjective well-being.

Table 2: Regression results for satisfaction with life and work

	Male workers			Female workers		
	Life all (1)	Work all (2)	Work young (3)	Life all (4)	Work all (5)	Work young (6)
$y(t-1)$	0.1459***	0.2711***	0.1650***	0.1690***	0.1530***	0.1857***
	(0.0230)	(0.0295)	(0.0439)	(0.0285)	(0.0267)	(0.0586)
$y(t-2)$		0.0928***				
		(0.0266)				
bmi	0.0072	0.3349*	0.4922***	0.2251***	0.0592	0.2259
	(0.0894)	(0.1988)	(0.1833)	(0.0867)	(0.1138)	(0.2171)
$(bmi)^2$	–0.0001	–0.0052	–0.0084***	–0.0039***	–0.0011	–0.0041
	(0.0015)	(0.0033)	(0.0032)	(0.0014)	(0.0019)	(0.0037)
$\ln(earnings)$	0.5288***	0.7707***	1.1885***	0.4188***	1.1373***	1.4431***
	(0.1104)	(0.1991)	(0.2378)	(0.1324)	(0.1605)	(0.3369)
$\ln(hours)$	0.0080	–0.1808	–0.2478	–0.0125	0.2097	0.0217
	(0.1489)	(0.2737)	(0.3592)	(0.1640)	(0.2177)	(0.4013)
schooling	0.0228**	–0.0143	–0.0395	0.0188	–0.0806***	–0.1268***
	(0.0113)	(0.0195)	(0.0249)	(0.0153)	(0.0188)	(0.0359)
age	–0.1161***	–0.0982***	–0.1143**	–0.0840***	–0.0729***	–0.1397**
	(0.0147)	(0.0232)	(0.0571)	(0.0171)	(0.0215)	(0.0556)
$(age)^2$	0.0011***	0.0009***	0.0011	0.0008***	0.0007***	0.0018**
	(0.0002)	(0.0002)	(0.0008)	(0.0002)	(0.0002)	(0.0007)
East Germany	–0.1698***	0.0416	0.0157	–0.3478***	–0.0808	0.1296
	(0.0619)	(0.0935)	(0.1111)	(0.0588)	(0.0727)	(0.1497)
married	0.1891***	–0.1183**	–0.1224	0.2773***	0.4038***	0.4805***
	(0.0434)	(0.0591)	(0.0843)	(0.0561)	(0.0698)	(0.1221)
Observations	11,514	6,611	2,911	8,910	8,910	2,515
Persons	4,858	3,209	1,642	3,963	3,963	1,514
Arellano-Bond autocorrelation test (p-value)						
first order	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
second order	0.1544	n/a	0.7259	0.3969	0.6965	0.1266
Hansen test on instrument exogeneity (p-value)						
Model	0.2821	0.2544	0.3060	0.3583	0.6664	0.1640
ΔJ for levels eq.	0.2576	0.0257	0.1228	0.5375	0.5596	0.3929
Instruments	70	58	70	70	70	70
Implied $bmi^{opt.}$	n/a	32.0	29.3	28.8	26.1	27.6

Remarks: Method of estimation: System-GMM. Models additionally include an intercept term and year dummies. Robust standard errors with Windmeijer correction in parentheses. */**/*** indicates statistical significance at the 10/5/1% level. See text for definition of subsamples.

4 Discussion

That a single notch of *bmi* can make a difference of 3% in earnings in the long run is no negligible result. The relatively high *bmi*, at which the relationship

becomes negative, is puzzling, though. It suggests that the movement from normal weight into the overweight category by a considerable share of the workforce may not jeopardize productivity. These findings are somewhat at odds with earlier findings by Cawley et al. (2005). However, our study uses a different estimator and also more waves of the GSOEP data. We find that work satisfaction follows a similar function as the wage among young workers even when holding earnings constant, though the effect is not statistically significant among women.

Yet, our results do not necessarily reflect the full scope of obesity's effect on the German labor market. First, our estimator requires several observations on each individual. As we only focus on workers, this could imply a sample selection problem as, among the individuals with high *bmi*, only those with health good enough to work, enter our sample. So we disregard the possibility that high *bmi* could increase the risk of being unemployed or out of the labor force. Second, we cannot rule out that workers who were already heavier (e.g., for genetic reasons) at the time when decisions on schooling were made or when they entered the labor market found themselves on a lower wage trajectory throughout their later professional career (Chen, 2012). Hence, some of the effects of *bmi* might be obscured in our analysis and picked up as part of unobserved heterogeneity. Third, *bmi* bears the problem of not distinguishing muscle and fat mass. A better approximation of body fatness could be achieved with additional information on waist and hip circumference, which are currently not collected in social surveys that cover detailed information on wages, and imputation of fat mass based on existing variables (height, weight, age) does not seem to be a promising solution if one analyzes intrapersonal changes.

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