Social norms, Ideal Body Weight and Food Attitudes

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Abstract

This paper uses French data on ideal body weight and food attitudes to investigate the role of social norms in the consumer's weight control problem. A proxy measure of social norms is constructed by averaging individual perceptions of ideal body mass index (BMI) over all observations in a reference-group. Testing for different definitions of the reference-group, we find that individual representations of ideal body shape are differentiated mainly along gender and age lines. Social norms on body shape have a significant effect on perceptions of ideal BMI for those women who want to slim down, with an elasticity close to 0.5. For many women and for all men, ideal BMI is not affected by social norms, but almost exclusively determined by habitual BMI. Since ideal BMI predicts a number of attitudes toward food, perspectives on the obesity epidemic should take into consideration the habituation effect produced by habitual BMI on ideal BMI.

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1 Introduction

Trends in body mass have recently become a major health concern for France. In 2002, 37.5% of French adults aged over 15 were overweight against 29.7% in 1990 (OECD Health Data 2005). The medical cost of obesity was already 1 billion euros in 1991 (Detournay *et al.*, 2000).[1] This suggests an obvious arena for policy intervention through taxes, subsidies and information. However, calibrating public intervention requires that social interactions in the consumer's weight control problem be identified, because they induce social multiplier effects (Clark and Oswald, 1998). In this perspective, this paper investigates global interactions through social norms.

Investigating the role of social norms requires that reference-groups be appropriately defined, and that a measure of social norms in these groups be constructed. As a starting point, this paper defines the reference-groups on the basis of gender, birth cohorts and occupation groups. The economics of social interaction often posits that norms act through individual expectations of average behaviour. Here, the "behaviour" under scrutiny is an outcome measure: the Body Mass Index (BMI). The BMI is a good predictor of overweight-related morbidity. By adjusting weight for height, it gives a more precise picture of individual's body shape than body weight alone, and arguably takes into consideration both medical and aesthetic concerns with body weight. Following the traditional approach, the mean reference-group BMI could then be considered as a proxy for social norms. This paper takes another route by assuming that social norms affect subjective perceptions of ideal BMI, which in turn influence food choices and ultimately actual BMI. It uses the French survey "Enquête sur les Conditions de Vie des Ménages 2001", which covers roughly 10 000 people in 5000 households. This data set contains a detailed health interview of one person in each household with information on actual body weight and height, as well as a measure of ideal body weight. Using findings from social psychology, we argue that averaging ideal BMI over all observations in each reference-group yields a proxy measure of social norms on body shape.

The theoretical framework is a model wherein utility is a function of weight satisfaction. A key assumption is that ideal BMI maximises weight satisfaction, which is specified as a function of social norms, an idiosyncratic bliss point, and the individual's habitual weight. The latter captures the adjustment costs that individuals face when they want to slim down. The model yields two predictions that guide the empirical analysis.

[1] According to the WHO health standards, individuals are overweight when their Body Mass Index, which equals their weight in kilograms divided by their height in meters squared, is over 25. They are obese if their BMI is over 30.

First, individuals with high marginal adjustment costs around habitual weight are more likely to declare their habitual weight as ideal. Absent good measures of marginal adjustment costs, this prediction is not testable. Nevertheless, for about 40% of the sample, actual and ideal BMI are equals. As such, actual BMI should be a good proxy for habitual BMI.

Second, for individuals with low marginal adjustment costs around habitual weight, both social norms and habitual BMI affect ideal BMI. Those individuals who would like to gain weight (6% of the sample) are more likely to have specific health conditions, so that we ignore them. For the remaining 50% - those individuals who want to slim down -, we estimate a linear equation that specifies ideal BMI as a function of social norms, habitual BMI (proxied by actual BMI) and individual characteristics. As actual BMI and social norms are likely to be endogenous, we identify their effect by an instrumental variable method, using the average ideal BMI of adjacent birth cohorts, years of schooling and area-level indicators as instruments. In the estimation subsample, the elasticities of individual ideal BMI to social norms and to habitual BMI are respectively about +0.5 and +0.5 for women, and 0 and +0.8 for men. These are upper and lower bounds for the whole sample, and they are quite sensitive to the choice of the instrument set and the definition of the reference-groups. Regarding the latter, we find that individual representations of ideal body shape are differentiated mainly along gender and age lines. Occupation, education or other stratifying variables matter less.

The paper is organised as follows. Section 2 recalls some key findings and definitions from the literature on obesity and social norms. Section 3 presents the data on ideal and actual BMIs, and constructs a measure of social norms. Section 4 exposes the economic model. Section 5 proposes an econometric specification and outlines the identification issues. Our main findings are reported in Section 6. Section 7 discusses the results. Section 8 concludes.

2 Body shape and social norms.

Economic explanations of the obesity epidemic have focussed on the role of two factors: the fall in the price of calorie intakes and the rise in the price of calorie expenditures (see *inter alia* Drewnowski and Darmon, 2004; Cutler *et al.*, 2003; Philipson and Posner, 1999). Yet, considering available empirical results, a large part of the individual variance remains unexplained. Before appealing to idiosyncratic factors such as genes or personality traits, it is worth asking whether an analysis of social interactions can provide additional insights into the etiology of the epidemic. Burke and Heiland (2005) have recently argued that social norms may explain some aspects of the dynamics of the BMI distribution, in particular its increasing skewness. The key argument is that social norms act as a social multiplier if, at time t, they depend on some moment of the BMI distribution at time $t-1$ (for instance the mean or the median). Hence, a price decrease has a direct positive effect on calorie intakes, which moves the BMI distribution towards the right; if this causes an increase in the social norms, then the cost of over-eating is reduced, and individuals face fewer incentives to control their calorie intakes. The direct effect of a price increase is therefore multiplied in the presence of social norms, especially for those individuals in the right-tail of the distribution because they are more prone to lack of self-control.

One solution for identifying the effect of social norms is the observation of sanctions. For instance, Averett and Korenman (1996) and Cawley (2004) find significant differences in economic status for white obese women in America. Using French data, Paraponaris *et al.* (2005) suggest that time spent in an unemployment spell is positively correlated with the body mass index. However, this demand for standardized body shapes may arise from expectations interactions (Manski, 2000). Various experiments have shown that overweight is considered by recruiters and supervisors as a signal for unobservable predispositions, such as laziness, lack of self-control, a higher probability of illness etc. As long as these defaults are believed to be negatively correlated with productivity, an informational discrimination can arise, especially in the race for job positions that require self-control, dynamism, and leadership.[2] Expectations interactions may also explain the emergence of standards of thinness. New markets have developed upon the ideal of thinness, which has largely diffused in the western middle and upper classes after World War II. The high division of labour in the sector of entertainment renders possible for individuals from lower social classes to succeed, even if they have no other capital than their body. Last, the medicalisation of obesity has also led individuals to consider their weight as a risk factor for health. One standard prediction of the health demand model is that individuals with higher lifecycle wage profiles have higher incentives to remain healthy: sticking to the medical standards of thinness is a health investment.

These examples emphasises that, facing the same constraints, either in terms of body characteristics demanded on the labour market, or in terms of returns to health investments, individuals are likely to have similar perceptions of ideal body weight. Following Manski (1993), this is a correlated effect, which produces standards of behaviours rather than social norms. However, a number of

[2] This may explain why the obesity wage penalty is more important in high income occupations than in low ones (Carr and Friedman, 2005). However, high income positions are generally proposed with employer-sponsored insurance in the US. The obesity wage penalty may simply represent the employer's risk premium (Bhattacharya and Bundorf, 2005).

sociologists consider that, in the long run, external constraints are internalized by individuals, in the sense that they induce institutionalized role expectations that are sustained by reactions of the group's members (Horne, 2001). Using Manski's terminology, it means that norms emerge from preference interactions with 'significant' others. As such, norms produce endogenous effects, which generate a social multiplier while correlated effects do not. Disentangling endogenous effects from correlated effects is important in a public policy perspective and poses substantial identification problems.

3 Data

To explore the relationship between social norms and body shape, we employ data from the survey "Enquête Permanente sur les Conditions de Vie des Ménages" EPCV2001), which was carried out by the INSEE (the French national statistical agency) in 2001. It contains information at both the household and the individual levels, and one randomly-drawn individual in each household answered a detailed health questionnaire. The starting sample consists of 5194 individuals in the same number of households. Given the presence of missing values, 3538 individuals are kept for the analysis. All variables are presented with descriptive statistics in Table A1, Appendix A.

3.1 Ideal and actual BMIs in the data

Height and actual body weight are self-declared.[3] Our measure of ideal BMI is based on the following question *"What is the weight you would like to reach or keep?"*. The distributions of actual and ideal BMIs are represented respectively by the solid and dashed lines in Figures A1 of Appendix A.

A comparison of the two distributions with relative distribution methods reveals both a location- and a shape-shift (see Contoyannis and Wildman, 2006, for a thorough presentation of these methods). The graph in the left frame of Figure A2 compares the BMI distribution (taken as the reference) and the distribution that would have the same shape but the median of the ideal BMI's distribution. The solid line, which represents the relative distribution, is clearly downward sloping. For almost all percentile positions r of the reference distribution the proportion of observations in the comparison distribution is higher than r: there is a negative location shift. For 39% of the sample actual and ideal body weights are equal; more than 55% of the sample would like to slim down; the remaining 6% want to gain weight. Among these latter, one individ-

[3] We are not able to correct for declaration biases. Data with both self-reported and measured weights are not yet available for France. See Cawley (2004) for a correction procedure in US data.

ual is medically overweight (BMI>25) and 69.3% meet the medical standards (18.5≤BMI<25). These individuals are also more likely to have peculiar characteristics. For instance, they are more prone to mental disorders and negative affects: 19% of them take a psychiatric treatment against 14% in the whole sample, 25% feel lonely (vs. 15%), etc. We will ignore them in the empirical analysis.

The graph in the right frame compares the distribution of actual BMI adjusted for location (the reference) and the distribution of ideal BMI. There are fewer observations in the latter than in the former for all percentile positions lower than 0.2 or higher than the 0.8: both tails of the actual BMI's distribution are denser and there is less dispersion in ideal BMI than in actual BMI. Almost 50% of those individuals who meet the medical standards are satisfied with their weight. This is the case for 25.3% of the overweight (25≤BMI<30) and 12.6% of the obese (30≤BMI) individuals. Most obese (87.4%) and overweight individuals (74.6%) would like to slim down (against 42% of those in the [18.5;25] range). Almost 47% of those individuals who are under the medical threshold of thinness (BMI<18.5) would like to gain weight while 46% of them are satisfied. Hence, there is a positive concordance between the deviation from the medical standards and weight satisfaction, which is rather good news for public health policies.

3.2 Measuring social norms

Identifying the effect of social norm requires first that reference-groups be appropriately defined. Norms are enforced through social interactions, and the costs and consequences of interactions are generally lower the closer are individuals in social space (Horne, 2001; Akerlof, 1997). Parents, friends, work colleagues, and geographic neighbours may participate to the enforcement of norms on body shape. These 'significant' others should not be confounded with the reference-group, who is made of 'similar' others.[4] Norms on body shape are actually sustained by a social comparison process which necessarily takes into consideration biological constraints. As such, age and gender should obviously characterise the reference-group. Similar others may also be those who share the same occupation, have the same education or lives in the neighbourhood. At this point, following Manski (1993), it is worth having some a priori. The French sociological research suggests that occupation is the key factor that drives social differentiation in body shapes and food habits (Bourdieu, 1979; Grignon and Grignon, 1999; Regnier, 2006). As a consequence, we assume that individuals

[4] Festinger (1954) proposed the hypothesis that individuals make permanent comparisons to the behaviours and the expectations of members of a reference group, which determine feelings of satisfaction.

are similar to each other if : (i) they are of same sex; (ii) they have no more than 5 years of age difference; (iii) they belong to similar or close occupation groups. This choice is extensively discussed in Section 7.

The presence of material sanctions (*via* for instance the labour and the marriage markets) is neither a necessary nor a sufficient condition for the existence of social norms. As noted by Elster (1989), social norms are "sustained by the feelings of embarrassment, anxiety, guilt and shame that a person suffers at the prospect of violating them". Some psychological studies have found that these feelings are associated with the discrepancies between the representations of attributes individuals actually possess and the attributes they would like to possess *and* 'significant' others believe they ought to possess (see for instance Tangney *et al.*, 1998). Hence, ideal BMI is a measure of both individual aspirations and *what ought to be*. Since "the most common element [in the definitions of social norms] is oughtness - an expectation that is shared by the members of some group." (Hechter and Opp, 2001, p. 403), averaging ideal BMI in each reference-group produces a proxy measure of how the individual believe s/he ought to be, given one's group membership (see Stutzer and Lalive, 2004, for a similar approach). We use a geometric average instead of an arithmetic average for three reasons. First, a geometric average is less sensitive to extreme values as long as the variable takes values bounded away from zero. Since our measure is computed from the data, the reference-groups are small, and we do not want to put too much weight on outliers. Second, if ideal BMI were log-normal, its median could be estimated by a geometric average. From a normative point of view, as a norm should aggregate a majority of individual preferences, a median-voter argument may apply.[5] Third, in the empirical analysis we will regress the logarithm of ideal BMI on the logarithm of the social norm. Defining the latter as a geometric average makes our model resemble the traditional linear-in-means model of the social interactions literature.

4 Model

This section proposes an economic model of weight satisfaction, in order to guide our empirical analysis of the relationship between social norms, ideal BMI and food attitudes.

[5] Although a Shapiro-Francia test rejects the log-normality of ideal BMI (p-value=4 10^{-4}), diagnostic plots show that this is mainly due to the extreme values of the empirical distribution.

4.1 Weight satisfaction

The economic setting is a model, wherein individual utility $U(.)$ is separable into weight satisfaction, $WS(W)$, and satisfaction from food F and a numeraire m, $CS(F, m)$. The consumption goods affect BMI W, through a weight production equation. Given a static income constraint $\pi_F F + m = I$, where I is income, the consumer's weight control problem is:

$$Max_F U\left[CS(F, I - \pi_F F); WS(W)\right] \tag{1}$$
$$W = w(F, I - \pi_F F)$$

Weight satisfaction is specified as the sum of loss functions, which increase in the differences between W and three reference point: a social norm W^g sustained by preference interactions; habitual weight W^h, which induces costs of adjustment; an idiosyncratic bliss point W^p.

The social cost of deviation from the norm is captured by the sub-utility $v(W; W^g)$. A key assumption is that W and W^g are complementary in $v(.)$, so that utility is comparison-concave, and its concavity depends on the marginal cost of deviating from the reference point (Clark and Oswald, 1998). As in Akerlof (1997), we consider a quadratic specification:

$$v(W; W^g) = -\frac{1}{2}\gamma^g \left(W - W^g\right)^2 \tag{2}$$

where γ^g is positive and might be specific to the individual's reference-group g.

Loosing weight is not easy, mainly because body weight is produced by a set of consumption habits that condition current consumer choices (foodways and exercise essentially). Hypo-caloric slimming diets have also specific cognitive costs. During moments of high-awareness, dieters generally avoid answering to their basic caloric needs (as signalled by the sensations of hunger and satiety). In this case, the body interprets calorie restrictions as a threat, protects its fat reserves, and sends signals that induce losses of control especially during moments of low awareness. Maintaining awareness has a cost, as well as lack of self-control because it damages self-esteem (Heatherton *et al.*, 1993, Basdevant, 1998, Herman and Polivy, 2003). We introduce a quadratic adjustment cost function $\Gamma(.)$:

$$\Gamma(W, W^h) = \begin{cases} -\left[\frac{1}{2}\gamma_2^{h-}(W - W^h)^2 + \gamma_1^{h-}(W - W^h)\right] & if \quad W \leq W^h \\ -\left[\frac{1}{2}\gamma_2^{h+}(W - W^h)^2 + \gamma_1^{h+}(W - W^h)\right] & if \quad W > W^h \end{cases} \tag{3}$$

The main characteristics of adjustment costs is that their right and left first derivatives may not be continuous at the habitual weight level W^h: $\gamma_1^{h+} \geq 0 \geq$

γ_1^{h-}. For many individuals, only slimming induces adjustment costs so that $\gamma_2^{h+} = \gamma_1^{h+} = 0$, and $\gamma_1^{h-} < 0$. Individuals with chronic illnesses such as cancer or AIDS have problems for gaining weight: for them, $\gamma_1^{h+} > 0$. Adjustment costs are asymmetric and may be convex, as in the problem of smoking quits (Suranovic *et al.* 1999). Convex adjustment costs are observed when a small decrease in calorie intakes - or equivalently in actual BMI - yields a dramatic loss of utility. Hence, the sign of γ_2^{h-} is not fixed *a priori*.

A concave loss function $u(.)$ which peaks at an individual reference point W^p, captures the remaining idiosyncratic variations in ideal BMI:

$$u(W; W^p) = -\frac{1}{2}\gamma^p (W - W^p)^2 \tag{4}$$

Note that γ^p is positive.

Since $WS(W) = v(W; W^g) + \Gamma(W, W^h) + u(W; W^p)$ and given that the sub-utilities are quadratic, one may equally specify $WS(W)$ as:

$$WS(W) = -\frac{1}{2} S \left(W - \widetilde{W} \right)^2$$

with:

$$\widetilde{W} = \frac{1}{S} \left[\gamma^p W^p + \gamma^g W^g + 1_{\{W \le W^h\}} \left(\gamma_2^{h-} W^h - \gamma_1^{h-} \right) + 1_{\{W > W^h\}} \left(\gamma_2^{h+} W^h - \gamma_1^{h+} \right) \right] \tag{5}$$

$$S = \gamma^p + \gamma^g + 1_{\{W \le W^h\}} \gamma_2^{h-} + 1_{\{W > W^h\}} \gamma_2^{h+}$$

where $1_{\{W \le W^h\}}$ equals 1 if $W \le W^h$ and 0 otherwise.

4.2 Ideal body weight

Suppose now that ideal BMI W^* maximises weight satisfaction. Let $W^{ref} = \frac{\gamma^p}{\gamma^p + \gamma^g} W^p + \frac{\gamma^g}{\gamma^p + \gamma^g} W^g$. When $W^{ref} < W^h$ (the most likely case), it can be shown that:

- if $-(\gamma^p + \gamma^g)(W^h - W^{ref}) < \gamma_1^{h-}$, then the marginal cost of slimming at W^h is lower than its marginal benefit in terms of conformity to the reference BMI, W^{ref}. Ideal BMI W^* is:

  $$\begin{aligned} W^* &= \widetilde{W} = \frac{1}{S} \left[\gamma^p W^p + \gamma^g W^g + \gamma_2^{h-} W^h - \gamma_1^{h-} \right] \\ S &= \gamma^p + \gamma^g + \gamma_2^{h-} \end{aligned} \tag{6}$$

  One has necessarily $\widetilde{W} < W^h$.

- if $-(\gamma^p + \gamma^g)(W^h - W^{ref}) \ge \gamma_1^{h-}$ then the marginal cost of slimming is greater than the marginal benefit of conformity so that ideal BMI is simply habitual BMI: $W^* = W^h$

Symmetric implications are found when $W^{ref} > W^h$.

The model yields three predictions. First, ideal and habitual BMIs should be equal for those individuals with high marginal adjustment costs around habitual weight. Second, equation (5) is a measurement equation that links ideal BMI to social norms and habitual BMI for all those whose habitual and ideal BMI differ. Third, assuming without loss of generality that $U = CS + WS$, the first-order condition with respect to food consumption F is:

$$\frac{\partial CS}{\partial F} = \pi_F \frac{\partial CS}{\partial m} + S(W - \widetilde{W}) \tag{7}$$

Imagine that food consumption is measured in calories. Then, the full price of energy intakes is higher than the market price for those whose actual weight is higher than $\widetilde{W}$. Their diet should be less caloric.[6]

5 Econometric specification

5.1 A linear-in-means model

The selection condition $(-(\gamma^p + \gamma^g)(W^h - W^{ref}) < \gamma_1^{h-})$ and equation (6) form a structural model that is not identifiable without a good measure of W_t^p Nevertheless, the first prediction suggests that actual BMI is a good proxy for habitual BMI, because ideal and actual BMIs are equal for about 40% of the sample.[7] Hence, we may assume that $W^h = W$. Then $W^* < W = W^h$ implies that $W^* = \widetilde{W}$ as in equation (6). The latter provides a starting point for specifying the relationship between ideal BMI and social norms in the subsample of those individuals who would like to slim down: this will be our estimation sample, whose descriptive statistics are presented in Table A1. of Appendix A. For them:

$$W^* = \underbrace{\frac{\gamma^g}{\gamma^p + \gamma^g + \gamma_2^{h-}}}_{\alpha^g} W^g + \underbrace{\frac{\gamma_2^{h-}}{\gamma^p + \gamma^g + \gamma_2^{h-}}}_{\beta^g} W + \underbrace{\frac{\gamma^p}{\gamma^p + \gamma^g + \gamma_2^{h-}}}_{1-\alpha^g-\beta^g} W^p - \gamma_1^{h-} \tag{8}$$

The key implication of the model is that regressions will have to control for W, which proxies habitual weight, in order to estimate correctly social norms effect. Note also that, ceteris paribus, the lower is γ^p, the less likely is the selection condition $-(\gamma^p + \gamma^g)(W^h - W^{ref}) < \gamma_1^{h-}$ to hold. Hence, estimating

[6] All predictions holds under one regularity condition: adjustment costs must not be downward sloping for all $W < W^h$. Hence, γ_2^{h-} should not be too negative. This condition also implies that S is positive in equation (6).

[7] Another obvious reason is that there are measurement errors ('heaping' effects for instance) in answers about ideal body weight.

(8) in the selected subsample yields an upper bound for the social norms effect in the whole sample.

For the empirical analysis, it is supposed that the variables W, W^* and W^g are logarithms of actual BMI, ideal BMI and social norms. Let Q be the vector of variables that define group membership (age, gender and occupation), and $\Psi(Q)$ the corresponding interaction dummy. $\mathbb{E}(W^*|\Psi(Q) = g)$ is our measure of W^g for the reference-group g, since it is a logarithm of a geometric average (see Section 3). For each individual i, W^g is estimated by averaging W^* over the group of similar others R_i. To this end, we construct a $N \times N$ spatial weights matrix D, which specifies for each observation i the set of similar others. This is a matrix of 0 and 1, such that $d_{ij} = 1$ if i and j are similar and $d_{ii} = 0$. We standardize the elements of this matrix by $\sum_j d_{ij}$. Then, the $N \times 1$ vector $\hat{W}^g = DW^* = \mathbb{E}(W^*|\Psi(Q) = g)$ contains in row i a first-stage estimates of W^g for individual i. Note that even if the estimation subsample does not include individuals whose ideal and actual BMIs are equal, all available observations are used in the computation of $\hat{W}^g$.[8] Since W^g takes only one value for group g, we have to impose the restriction that $\forall g, \alpha^g = \alpha$ and $\beta^g = \beta$ in equation (8).

The idiosyncratic reference point W^p is a function of observable and unobservable individual characteristics. Let H represents individual variables that could affect perceptions of ideal body shape (such as income, area of residence, marital status etc.); $\mathbb{E}(H|\Psi(Q))$ are contextual effects, whereby individuals have similar perceptions due to average within-group observable characteristics.[9] We assume that:

$$(1 - \alpha^g - \beta^g)W^p - \gamma_1^{h-} = \overline{\delta}\mathbb{E}(H|\Psi(Q)) + \delta H + \eta$$

where H includes the constant and η_i is an error-term with mean zero that captures unobservable individual effects.

The econometric counterpart of equation (8) is :

$$W^* = \alpha DW^* + \beta W + \overline{\delta}\mathbb{E}(H|\Psi(Q)) + \delta H + \eta \tag{9}$$

When η is correlated with $\Psi(Q)$ ($\mathbb{E}(\eta|\Psi(Q)) \neq 0$), there are correlated effects, whereby agents in the same group behave similarly because they have "similar unobserved characteristics or face similar institutional environments"

[8] When the reference-groups are defined as in Section 3, social norms are computed using 4229 observations. The sample of 3538 individuals used to compute the descriptive statistics was obtained by dropping individuals with missing values to questions about food attitudes. Reference-groups with less than 15 individuals are dropped from the regressions.

[9] Imagine for instance that there is some segregation by social group on the marriage market. Then, ideal body weight in this group may depend on the average rate of singles, which determines somewhat how competitive is the group-specific marriage market.

(Manski, 1993). Common representations of ideal body shape generate correlated effects when they are produced by external economic constraints that are not internalized by individuals as preference parameters (see Section 2).

5.2 Identification issues

Specification (9) raises several identification issues (*cf.* the discussion in Manski, 1993). First, taking expectations of (9) with respect to $\Psi(Q)$ reveals that $DW^* = \mathbb{E}(W^*|\Psi(Q))$ is a function of $\mathbb{E}(H|\Psi(Q))$ (and $\mathbb{E}(\eta|\Psi(Q))$ if there are correlated effects). These variables are collinear and the effect of $\mathbb{E}(W^*|\Psi(Q))$ is not identifiable without further assumptions. As it is often the case in models of social interactions, we assume that there are no contextual effects: $\overline{\delta} = 0$. The model becomes:

$$W^* = \overline{\alpha} DW^* + \overline{\beta} W + \delta H + \eta \tag{10}$$

Second, the model is identified if $\mathbb{E}(\eta|\Psi(Q)) = 0$ (no correlated effects). As this is unlikely to be the case (at least because contextual effects are omitted), we have to instrument $\hat{W}^g = DW^* = \mathbb{E}(W^*|\Psi(Q))$. Actual weight may also be endogenous ($\mathbb{E}(\eta|W) \neq 0$), because unobservable individual characteristics such as tendencies to eating disorders can simultaneously affect ideal BMI and actual BMI.

As a consequence, equation (10) is estimated by a Generalized Method of Moments (GMM) that exploits the orthogonality conditions between the residuals and a set of instruments. The latter includes the social norms of adjacent reference-groups (following Grodner and Kniesner, 2006). More precisely, consider an individual i of age A_i. All individuals j, with age A_j such that $A_i - 5 \leq A_j < A_i$ belong to the reference-group of i, R_i. Then, same-sex and -occupation individuals k such that $A_j - 5 \leq A_k < A_i - 5$ belong to R_j, but not to R_i. Averaging social norms over these individuals k produces a variable W^{g-} that should be correlated with the ideal BMI of individuals j, and therefore with i's social norm. Conditionally on the latter, W^{g-} should not be correlated with W^*. Symmetrically, one can construct W^{g+} by using individuals k such that $A_i + 5 \leq A_k < A_j + 5$ for all js in R_i. According to (10) current actual BMI may influence future ideal BMI. Hence, we expect W^{g+} to be correlated with W.

We also use two area-based instruments in an attempt to summarise local factors (prices, quality of food supply, deprivation etc.) that may affect actual BMI. These variables are the mean prevalence of obesity ($MOBESE$) and dental problems ($MDENTS$) across individuals living in the same or adjacent department, and the same or close types of residential area.[10] The mean prevalence of obesity is estimated from the data (using all available information), while the mean prevalence of dental problems is estimated from the five yearly surveys "Enquête sur les Conditions de Vie des Ménages 1996-2000". These instruments should not be correlated with ideal BMI conditionally on actual BMI. This may also be the case for years of schooling ($YRSCHOOL$, computed using the OECD's equivalence scale for the French education levels).

For the identification to be robust, the instruments must be strongly correlated with social norms and actual BMI, conditionally on the other variables that affect ideal BMI. We test the weakness of the instruments using the Cragg-Donald statistics (CD) as suggested by Stock and Yogo (2002). Under a normality assumption, this statistics generalises the F-statistics from the first-stage regression when there are more than one endogenous variable. Conservative critical values are computed by Stock and Yogo under the null that the instruments are weak. We also use an Anderson-Rubin statistics (AR), which tests the null that the instruments are jointly not significant in a reduced form version of (10) wherein they replace the endogenous regressors. Last, we always use more than two instruments. As such, the model is over-identified and the over-identifying restrictions are tested by the Hansen test. The regressions use the instrument sets that maximise CD and AR and minimise Hansen statistics.

6 Results

Central to this paper is the idea that social norms do not affect behaviours directly, but through individual perceptions. Actually, following equation (7), we should observe a positive correlation between $(W - W^*)$ and healthy food attitudes for those individuals who want to slim down (since for them $W^* = \widetilde{W}$). The converse should be true for those who want to gain weight. Before estimating equation (10), we show that the difference between actual and ideal BMIs predicts a number of attitudes towards food.

6.1 Ideal body weight as a predictor of food attitudes

The data contains information on some consumer's attitudes and behaviours: the perception of diet quality (4 levels), the frequency of consumption of light products, the restrictions on food products motivated by concerns with their fat or sugar content, the last day consumptions of carbohydrate drinks and alcohol,

[10] France is divided in 95 departments, and there are 5 types of residential area (STRAT1-STRAT5 in Table A1 of Appendix A). We assume that STRATk and STRAT$k+1$ are close, while STRAT$k-1$ and STRAT$k+1$ are distant.

and exercise frequency (see Table A1 in Appendix A). Controlling for a number of variables (income, education, age, sex, occupation and localisation), we estimate probit and ordered probit models of the attitude variables as functions of six explanatory variables: W, the logarithm of height, social norms, $DIFFNEG$ and $DIFFPOS$. These last two variables intend to capture asymmetric effects of deviations from ideal BMI:

$$
\begin{aligned}
DIFFNEG &= 1_{\{W \leq W^*\}}(W^* - W) \\
DIFFPOS &= 1_{\{W^* < W\}}(W - W^*)
\end{aligned}
\tag{11}
$$

Table B1 in Appendix B reports the results. Given actual BMI, unsatisfaction with BMI is positively correlated with feelings of having an unhealthy diet (see the coefficient on $DIFFPOS$). Those who feel overweight are more likely to declare restrictions, consume more often light or sugar-free products. Their last day consumption of sodas and alcohol is lower. Opposite or insignificant results are found for those who are satisfied with their weight or feels underweight. Interestingly, they are no significant correlations between weight satisfaction and exercise.

These results suggest that ideal BMI captures information about individual preferences that are not captured by actual BMI. Moreover, given weight satisfaction and actual weight, there are few correlation with social norms. These are suggestive evidence that social norms may affect behaviours, but only indirectly, through individual perceptions.

6.2 The effect of social norms on ideal body weight

Table B2 in Appendix B reports the main results. The econometric method is indicated in the first row.[11] The coefficients on social norms or actual BMI are elasticities.

The first column (OLS / 1) produces OLS results from a specification, which controls only for the H variables. Men have an higher ideal BMI than women (+11%), as expected, and the age effect is increasing concave. The occupation dummies are generally not significant, but lower social classes and farmers seem to have an higher ideal BMI than executives. There is also a negative education effect, which disappears when actual BMI is introduced, as is shown by the OLS results in the second column (OLS / 2). This specification also controls for social norms. Here, the gender effect is weaker, the age effect is no more significant, and the social gradient is somewhat reversed. The elasticity of ideal

[11] All results were obtained with Stata's procedure ivreg2 (Baum *et al.*, http://fmwwc.bc.edu/repec/bocode/i).

BMI to social norms is positive, low but significant (+0.14), while the elasticity to actual BMI is rather high (+0.64)

The age trend and the sex and occupation dummies are dropped in the third specification, which is estimated by GMM using $YRSCHOOL$, $MDENTS$, W^{g-} and W^{g+} as instruments (GMM/3). As shown by the p-value of the AR statistics, the model is not underidentified in the sense that, absent controls for social norms and actual BMI, the instrument set is significantly correlated with ideal BMI. The p-value of the Hansen's over-identification test is correct, although not very high. Perhaps more worrying is the CD statistics of 4.3. According to Stock and Yogo (2002, Table 1), this corresponds to a bias of the GMM estimator relative to OLS of about 30%. GMM do better than OLS but the results are still biased. The elasticity to social norms is much higher than in OLS/2 (+0.73), while the effect of actual BMI is cut by half (+0.27).

The fourth specification drops actual BMI (GMM/4). Here, all the tests pass largely. As such, the problem of weak identification encountered in specification GMM/3 was generated by a lack of strong instruments for actual BMI. Note also that specification GMM/4 is open to the "tautological identification" criticism (Manski, 1993, section 2.4). Actual BMI being excluded, there are no individual control variables that are significantly correlated with ideal BMI. Hence, this fourth specification can be thought of as a regression of ideal BMI on its mean, and it is not surprising to find an elasticity close to 1.

The fifth specification adds to specification 3 controls for age, gender and occupation as in column 1 (GMM/5). Here we try to identify the impact of the variables Q, by relying on non-linearities between some control function $f(Q)$ for the effects of Q, and $\mathbb{E}(W^*|\Psi(Q))$. The elasticities are quite similar to those found in OLS/2, but the CD statistics clearly shows that identification is not robust.

Individual perceptions seem to be a weighted average of the social norm and the actual BMI, with respective coefficients of 0.7 and 0.3. Individual characteristics play a minor role here, because actual BMI captures most of their influence. However, we find a significant negative effect of single-parenthood: in any given social group, single-parents have a lower ideal body weight. One appealing explanation is in terms of value on the re-marriage market: thinness may compensate for the presence of children.

7 Discussion

We have found a remarkably high elasticity of ideal BMI to the social norm (about 0.7). But this is clearly an upper bound for the true elasticity in the whole population, because only the subsample of individuals for which, according to the model, social norms matter, was selected. The structural model implies that the elasticity is 0 for those with high marginal adjustment costs.

One may also wonder whether the effect of social norms varies by gender and how sensitive it is to the definition of the reference-group.

Table B3 presents estimation results of our preferred specification (GMM/3) for men and women separately. It tests various definitions of the reference-group. For each definition, the coefficients of interest are displayed in the first and second rows. The test statistics are reported in the next three rows. The number of observations and the instrument set are found in the last two rows.[12]

The benchmark results are reported in the upper part of the Table, for reference-groups that comprise same sex and same occupation individuals with less than 5 years of age difference. Perhaps the most striking result is that the elasticity to social norms is about +0.7 for women, and negative but not significant for men. For women, the results are more robust than previously, since the CD statistics show that the bias of GMM relative to OLS is about 20%. There is clearly an important problem of weak identification in the men subsample. The estimates do not change sensitively when the maximum age difference goes from 2, to 5, and eventually 10 years (see the first and second rows in the upper part of the Table). There is more variations for men, but the Hansen statistics rejects the overidentifying restrictions (p-value: $2e^{-4}$) when the maximum age difference is set to two years.

We then model the social stratification by seven education levels instead of twelve occupation groups.[13] The results reported in the middle part of Table B3 show little changes, which means that education and occupation are interchangeable indicators. Actually, does the socioeconomic stratification matter at all?

The lower part of the Table presents our most robust results. The reference-group is defined on the basis of age and gender only. As previously, the elasticity to social norms is not significant for men, but somewhat lower for women (+0.52). All test statistics are satisfying. In particular, the CD statistics for women is around 8.5, which means that the bias of GMM relative to OLS is lower than 10%. The CD statistics for men is close to 5.2, so that the relative bias is about 20%.

The sensitivity analysis has shown that the definition of the reference-group

[12] Since we only keep groups with more than 15 individuals, the number of observations varies with the definition of the reference-group.

[13] These seven education levels are : no qualification, primary school, general secondary school, vocational secondary school, Baccalaureat (≃A-level), Baccalaureat + 2years, more than 2 years after the Baccalaureat.

is a key assumption in any study that aims at quantifying the role of social norms. It also suggests that the representations of ideal body shape (for oneself) are structured mainly along gender and age lines. Socioeconomic frontiers matter less.

8 Conclusion

One of the major objectives of public health policy over recent years has been to reduce the prevalence of overweight and obesity. It has been suggested that taxes and subsidies to food products, as well as the dissemination of information and nutritional labelling may help to achieve this objective. In this perspective, assessing the role of social norms on body shape is crucial, since they act as social multipliers of public policies' effects. Our intuition was that social norms can be thought of as social interactions that are mediated by individual representations of ideal body shape.

We find that weight satisfaction is significantly correlated with a number of attitudes toward food, with the expected signs. There are few direct correlations between food attitudes and our measure of social norms. This suggests that social norms act on consumption behaviours not directly, but indirectly, by modifying individual aspirations. Social norms have a significant effect on individual representations of ideal body shapes for the women who want to slim down. The elasticity of ideal BMI to social norms is between 0.5 and 0.75. If there were some inertia in social norms, then such elasticities would be good news. However, this result is an upper bound. Men do not seem sensible to social norms. Further, the elasticity of ideal BMI to habitual BMI is at least 0.3 for women, and higher than 0.8 for men. Habituation of individual representations to the reality is important and, *in fine,* moves social norms upward. These findings have two consequences. First, the autocorrelation of ideal BMI in social groups is mainly due to correlated effects rather than to endogenous effects. Second, the social multiplier effect plays a minor role compared to the habituation effect, whereby an agent's aspirations for one's own weight adapt to one's habitual weight.

As noted by Manski (1993), working on global interactions in large reference-group hinges heavily upon a priori about the group of "similar" others. While age and gender are important stratifiers, this is not the case for the socioeconomic indicators. This suggests two directions for future research. First, individuals may base their representations on role models (pop-stars, sport players etc.). This is known for teenagers, but there are only scarce evidence for adults and ethnographic studies may be helpful. Second, studies of interactions in small groups lack. Since it has been found for smoking that interactions in small groups (peer effects) are often low, we may wonder whether it is the same for the consumer's weight control problem.

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Appendix A. Descriptive statistics

Table A.1. – Names and definitions of the variables

Name	Definition	Mean (s.d.) or %	
Sample		Whole (N=3538)	Estimation (N=1955)
WEIGHT	Self-declared actual body weight	68.91 (14.13)	72.88 (14.25)
IDEALWEIGHT	Ideal body weight	65.43 (12.04)	66.03 (11.91)
HEIGHT	Height (in m)	166.92 (8.97)	166.27 (8.75)
BMI	Self-declared body weight in kg divided by height in meters squared	24.65 (4.21)	26.26 (4.13)
IDEALBMI	Self-declared ideal body weight in kg divided by height in meters squared	23.37 (3.16)	23.76 (3.05)
SEX	=1 if male, = 0 otherwise	41.2%	34.4%
AGE	Age	50.58 (16.24)	49.85 (15.38)
INCMIN	Minimum yearly net household income adjusted by the number of consumption unit (OECD scale), in 2001 FF	138559.9 (84938.8)	144181.6 (85779.9)
EDUCATION			
YRCHOOL	Years of schooling (OECD equivalence scale)	9.04 (5.47)	9.37 (5.32)
STANDARD OCCUPATIONAL CLASSIFICATION (SOC)			
FARMERS	Farmers and farm managers	4.5%	3.4%
OWNERS	Small business owners (mainly in skilled trades occupations)	6.3%	6.4%
EXECUTIVES	Public and private sectors executives (include other business owners, managers in the public and industrial sectors, professionals in the private sector, upper categories in the teaching, culture and media sectors) (reference).	13.1%	13.6%
MIDPUB1	Teachers, professional occupations in the health and social welfare sectors (nurses, community workers, etc.)	7.9%	8.3%
MIDPUB2	Associate professional and technical occupations in the public sector (police officer etc.)	5.6%	6.5%
MIDPRIV	Associate professional and technical occupations in the private sector (technician etc.)	5.2%	4.4%
EMPPUB	Administrative, secretarial and personal service occupations in the public sector without management responsibilities (nursing assistant, policeman etc.)	11.7%	12.9%
EMPPRIV1	Administrative, secretarial and personal service occupations in the private sector without management responsibilities (company secretary etc)	9.6%	11.3%
EMPPRIV2	Sale and customer service occupations in the private sector without management responsibilities (retail cashiers etc.)	11.2%	11.9%
SKWORK1	Skilled workers	11.6%	9.9%
SKWORK2	Transport and mobile machine drivers and operatives	2.9%	2.6%
UNSKWORK	Elementary occupation	10.5%	8.8%
REGION			
REGION1	Ile-de-France (reference)	17.2%	18.8%
REGION2	Nord, Champagne-Ardennes, Lorraine, Alsace	17.0%	17.3%
REGION3	Pays de Loire, Bretagne, Centre, Limousin, Aquitaine, Poitou-Charente	24.2%	21.7%
REGION4	Bourgogne, Franche-Comté, Rhône-Alpes, Auvergne, Midi-Pyrénées, Languedoc	25.7%	26.0%
REGION5	PACA, Corse	8.0%	8.5%
REGION6	Picardie, Normandie	8.0%	7.7%
URBAN UNIT			
STRAT1	Rural area	26.4%	25.3%
STRAT2	Small towns	16.9%	18.0%

STRAT3	Middle towns	13.4%	11.9%
STRAT4	Big towns	28.6%	29.0%
STRAT5	Paris (reference)	14.7%	15.9%
MARITAL STATUS			
SINGFAM	Single parent family	6.7%	7.2%
COUPLECH2	Couple with at least two children	13.4%	13.3%
COUPLECH1	Couple with one children	18.3%	18.2%
COUPLENOCH	Couple without children	29.8%	31.2%
SINGLE	Single without children (never been in couple, separated or divorced)	23.3%	22.7%
WIDOWED	Widowed	12.8%	11.7%
ATTITUDES AND BEHAVIOURS			
EXERCISE	Frequency of exercise = Never or less than once in a month	65.2%	65.1%
	Between one and three times in a month	5.7%	6.0%
	Once a week at least	12.3%	13.0%
	Several times in a week	16.9%	15.9%
SUBJDIET	Perception of diet quality = unbalanced	4.1%	4.3%
	Not well balanced	19.5%	22.3%
	Fairly balanced	44.2%	45.2%
	Well balanced	32.3%	28.2%
LIGHTFAT	Consume products light in fat = rarely or never	48.9%	28.4%
	Sometimes	19.3%	10.1%
	At least once a week	8.5%	21.6%
	Every days	23.3%	39.9%
FREESUGAR	Consume products light in sugar = rarely or never	64.9%	24.3%
	Sometimes	11.3%	7.0%
	At least once a week	5.8%	13.1%
	Every days	18.0%	55.7%
RESTRICT	Avoid consuming some tasty food products when they are too rich in fat or sugar	44.0%	52.0%
SODA	Had drunken at least one glass of a carbo-hydrated drink in the last day	38.6%	37.3%
ALCOHOL	Had drunken at least one glass of alcohol in the last day	50.5%	49.2%

Figure A1.

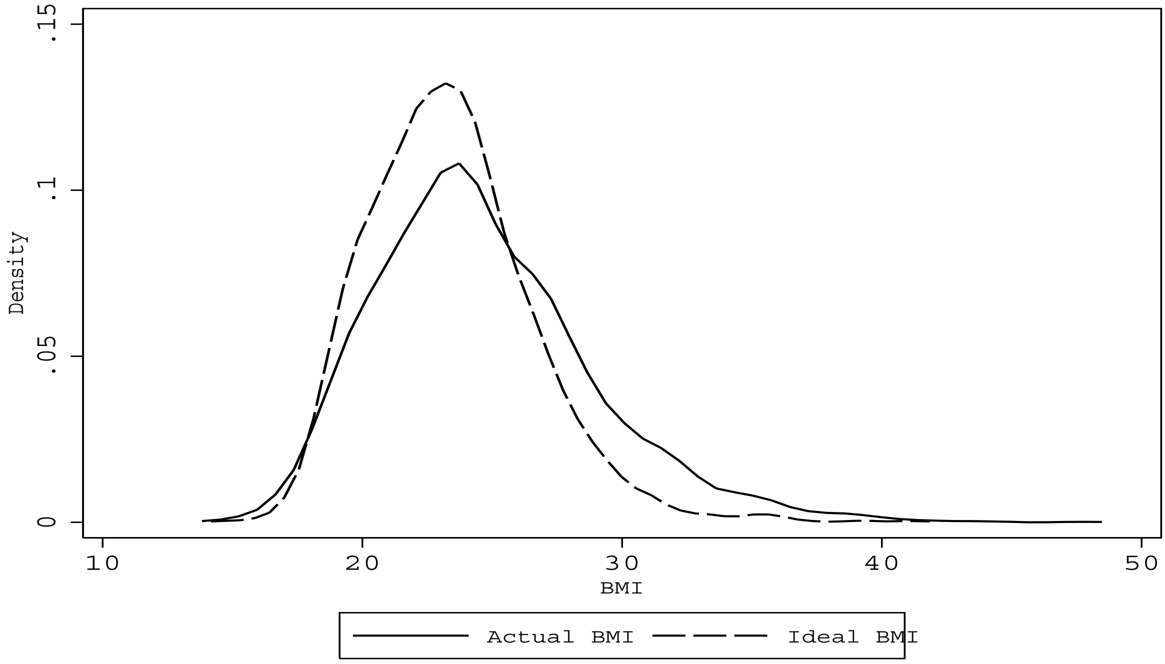
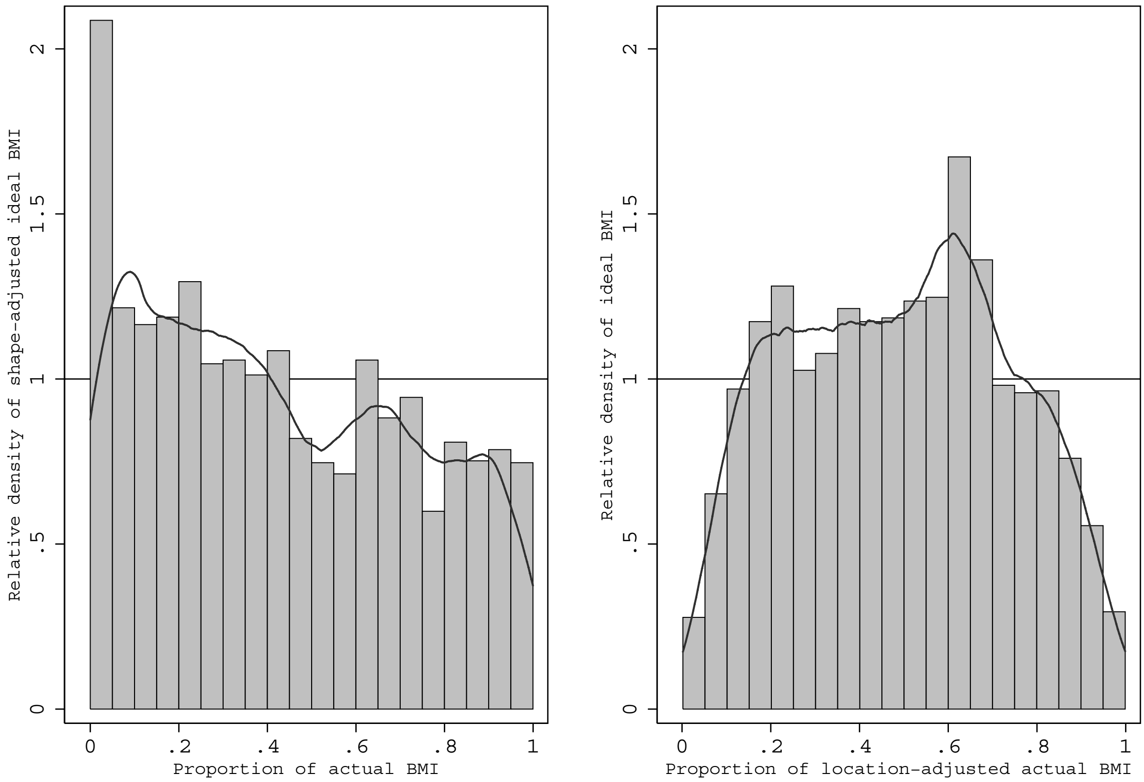


Figure A2.



Appendix B – Results

*Notes for all tables: *=significant at the 10% level, **=significant at the 5% level, ***=significant at the 1% level. Standard errors in parenthesis.*

Table B1 – Ideal Body Weight as a predictor of food attitudes

	SPORT	**SUBJDIET**	**LIGHTFAT**	**FREESUGAR**	**RESTRICT**	**SODA**	**ALCOHOL**
Model	*Ordered probit*				*Probit*		
DIFFNEG	-1.163 (0.937)	-1.726** (0.790)	-3.179*** (0.984)	-1.358 (1.053)	-2.473** (1.002)	-1.220 (1.007)	-0.497 (0.941)
DIFFPOS	-0.380 (0.441)	-2.208*** (0.360)	0.994*** (0.376)	1.754*** (0.397)	1.750*** (0.430)	-0.987** (0.464)	-0.884** (0.439)
Log(Social norm: E(W*|Q))	1.905* (1.049)	-1.366 (0.902)	0.036 (0.955)	-2.311** (1.038)	-1.012 (1.078)	-1.832* (1.106)	-1.396 (1.082)
Log(Actual BMI: W)	-0.681*** (0.211)	-0.231 (0.176)	0.593*** (0.185)	0.941*** (0.198)	0.236 (0.207)	-0.193 (0.217)	-0.167 (0.210)
Log(HEIGHT)	-0.537 (0.571)	-0.233 (0.493)	1.007* (0.515)	1.063* (0.560)	0.761 (0.581)	0.811 (0.603)	0.668 (0.587)
Controls	Log(INCMIN), SEX, AGE/10, $(AGE/10)^2$, FARMERS, OWNERS, MIDPUB1, MIDPUB2, MIDPRIV, EMPPUB, EMPPRIV1, EMPPRIV2, SKWORK1, SKWORK2, UNSKWORK,YRSCHOOL, COUPLECH1, COUPLENOCH, SINGLE, SINGFAM, WIDOWED, STRAT1-STRAT4, REGION2-REGION5						

Table B2 – The determinants of ideal BMI (Dependent variable : log (W*); N=2121).

Method / Specification	**OLS / 1**	**OLS / 2**	**GMM / 3**	**GMM / 4**	**GMM / 5**
Log(Social norm)		0.136* (0.024)	0.762** (0.000)	1.030** (0.000)	-0.179 (0.786)
Log(Actual BMI)		0.635** (0.000)	0.273* (0.038)		0.588** (0.000)
SEX	0.110** (0.000)	0.035** (0.000)			0.072 (0.289)
AGE/10	0.052** (0.000)	-0.005 (0.416)			0.017 (0.680)
$(AGE/10)^2$	-0.003** (0.008)	0.001* (0.030)			-0.000 (0.973)
FARMERS	0.041* (0.010)	0.007 (0.461)			0.029 (0.507)
OWNERS	0.005 (0.691)	-0.012 (0.075)			-0.001 (0.956)
MIDPUB1	0.002 (0.813)	-0.009 (0.124)			-0.006 (0.423)
MIDPUB2	0.006 (0.572)	-0.000 (0.986)			0.007 (0.636)
MIDPRIV	0.021 (0.104)	-0.001 (0.931)			0.009 (0.623)
EMPPUB	0.026* (0.010)	-0.006 (0.333)			0.011 (0.733)
EMPPRIV1	-0.005 (0.605)	-0.016** (0.004)			-0.011 (0.336)
EMPPRIV2	0.013 (0.256)	-0.013* (0.041)			0.001 (0.982)
SKWORK1	0.023* (0.035)	-0.010 (0.127)			0.006 (0.840)
SKWORK2	0.041* (0.013)	-0.003 (0.736)			0.024 (0.649)
UNSKWORK	0.018 (0.137)	-0.020** (0.005)			0.000 (1.000)
YRSCHOOL	-0.002** (0.005)	0.000 (0.815)			
Log(INCMIN)	-0.006 (0.265)	0.004 (0.192)	0.003 (0.570)	-0.003 (0.497)	0.003 (0.410)
COUPLECH1	0.002 (0.765)	-0.003 (0.475)	-0.004 (0.451)	-0.003 (0.747)	-0.002 (0.724)
COUPLENOCH	0.007 (0.372)	-0.005 (0.243)	-0.002 (0.693)	-0.000 (0.955)	-0.001 (0.876)
SINGLE	-0.003 (0.644)	-0.005 (0.209)	-0.007 (0.173)	-0.009 (0.220)	-0.003 (0.663)
SINGFAM	-0.031** (0.001)	-0.014** (0.005)	-0.019* (0.014)	-0.024* (0.015)	-0.017* (0.037)
WIDOWED	0.034** (0.002)	0.003 (0.570)	0.012 (0.169)	0.016 (0.148)	0.012 (0.440)
Other control variables *H* : constant, STRAT1-STRAT4, REGION2-REGION5, log(HEIGHT)					
Excluded instruments			YRSCHOOL, MDENTS, W^{g+}, W^{g-}		
Cragg-Donald statistics			4.30	613.9	3.71
Anderson-Rubin statistics			p-value: 0.0006	p-value: 0.000	p-value: 0.0018
Hansen's over-identification test			p-value: 0.196	p-value: 0.570	p-value: 0.757

Table B3 – Sensitivity analysis (specification 3, GMM estimator)

	Women			Men		
Maximum age difference	**2**	**5**	**10**	**2**	**5**	**10**
	Reference-group: same sex, same occupation, age window.					
Log(Social norm)	0.679***	0.699***	0.741***	0.108	-0.220	-0.171
Log(Actual BMI)	0.347***	0.335***	0.302***	0.735***	0.953***	0.856***
CD statistics	4.46	5.38	5.08	1.01	2.16	3.07
p-value AR statistics	$4e^{-4}$	$1e^{-4}$	$1e^{-4}$	0.239	0.031	0.006
p-value Hansen statistics	0.25	0.43	0.11	$2e^{-4}$	0.18	0.29
N	1010	1283	1246	403	672	728
Instruments	YRSCHOOL, MDENTS, W^{g+}, W^{g-}			YRSCHOOL, MOBESE, W^{g+}, W^{g-}		
	Reference-group: same sex, same education, age window= 5 years.					
Log(Social norm)	0.727***			-0.162		
Log(Actual BMI)	0.297*			0.898***		
CD statistics	3.08			2.10		
p-value AR statistics	0.009			0.040		
p-value Hansen statistics	0.17			0.34		
N	1322			736		
Instruments	MDENTS, W^{g+}, W^{g-}			MOBESE, W^{g+}, W^{g-}		
	Reference-group: same sex, age window = 5 years.					
Log(Social norm)	0.519***			-0.019		
Log(Actual BMI)	0.490***			0.785***		
CD statistics	8.47			5.18		
p-value AR statistics	$1e^{-5}$			$1e^{-4}$		
p-value Hansen statistics	0.18			0.33		
N	1342			767		
Instruments	YRSCHOOL, MDENTS, W^{g+}, W^{g-}			YRSCHOOL, MOBESE, W^{g+}, W^{g-}		