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Less (Model's Weight) is More (Population Overweight): Fashion Models and the Overweight Epidemic

by

Amir Heiman, Oded Lowengart, Daniel Shapira

P.O. Box 12, Rehovot 76100, Israel

ת.ד. 12, רחובות 76100

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Amir Heiman[1]

Oded Lowengart[2]

Daniel Shapira[3]

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[1] Amir Heiman is an associate professor at the department of environmental economics and management, the Robert H. Smith faculty of agriculture, food and environment, the Hebrew university, Israel. Amir.heiman@mail.huji.ac.il

[2] Oded Lowengart is a professor at the Department of Business Administration, Guilford Glazer Faculty of Business and Management, Ben-Gurion University, Beer Sheva, 841205 Israel. odedl@bgu.ac.il

[3] Daniel Shapira (corresponding author) is a Senior Lecturer at the Department of Business Administration, Guilford Glazer Faculty of Business and Management, Ben-Gurion University, Beer Sheva, 841205 Israel. Shapirad@bgu.ac.il, Tel: +972-8-6479792.

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ABSTRACT

Advertisements that present the image of the slim figures of models, movie actors and celebs are often blamed in triggering anorexia. In this paper we suggest that the slim model effect on consumers' weight is substantially greater than previously estimated due to its role in the emergence of overweight spread. We develop an economic model of rational consumer food consumption showing that the growing gap between the ideal and average figure has made the former irrelevant for most individuals. Thus, consumers now refer to the median weight rather than to the ideal one, as the latter has lost its restraining ability. We show that the lower weight of the ideal beauty figure interplayed with other factors (such as the increasing level of food industrialization) exhibits a form of overweight epidemic dynamics that is dominated by a multiplier effect. Based on large-scale historical datasets, we support our theoretical assertions by analyzing US population BMI's over the past five decades vis-à-vis ideal beauty body-size proxies, while controlling for large sets of demographic variables and food industry data.

Keywords: Fashion models, the overweight epidemic, food consumption, ideal of beauty, reference points, Body Mass Index (BMI)

Fashion models, movie stars, and other celebrities take a leading role in the design of consumer perceptions and sets of values about appearance and beauty. The importance that consumers assign to fashion models' dresses, behavior, and body shape (Mills, Polivy, Herman, & Tiggemann, 2002) is attributed to the role they play in representing a glamorous lifestyle (Thompson and Haytko 1997), and serving as a reference as to how we should look (Thompson and Hirschman 1995). The effectiveness of marketing communication strategies that are based on celebrity endorsements (Erdogan 1999; Agarwal and Kamakura 1995) has been associated in the marketing literature to the endorser's physical attractiveness (Till and Busler 2000; Ohanian 1991; Kamins 1990; Petroshius and Crocker 1989; Kahle and Homer 1985; Baker and Churchill 1977) that is usually perceived in relation to "more favorable personality traits and more successful life outcomes" (i.e., what is beautiful is good) (Eagly et al. 1991). The influence of fashion models on consumers in general and, especially on young teenagers, includes adoption of their standards of body shape as a norm to which the average and one's own body is compared (Jayson, 2009; Kenrick & Gutierres, 1980).

Since the 1980s, the well-accepted norm in the fashion industry has been to hire extremely thin models. While in 1980, size 8 was normal, nowadays size 0 is the norm (Clements, 2013), giving rise to weight concerns and increased interest in dieting (Garner, Garfinkel, Schwartz, & Thompson, 1980). Around 1965, fashion models weighed on average 8% less than the average American women, while nowadays they weigh about 23% less than the average, and less than 98% of all females. Hence, as fashion models affect consumer perceptions about what is the "right" body image, and since they are becoming slimmer, we would expect to observe an increasing tendency in the proportion of underweight young females, at least compared to other population segments. But in reality, a reverse phenomenon can be observed. While fashion models have become slimmer over time, the rest of the population in both developed and undeveloped countries has gained weight, and the largest growth in overweight can be observed in young females (Williamson et al., 1990). Furthermore, the likelihood of young women (25–34), who are already overweight, to gain more weight is greatest among all other segments (Williamson et al., 1990). The increasing gap between the average body and that of fashion models and film stars is demonstrated in Figure 1. The median body mass index (BMI) values of young women aged 17 to 35 (for data specification details, see Section 4) are plotted vis-à-vis the BMI values of James Bond actresses in films (i.e., a proxy for the ideal figure) within a 10-year moving window. As can be seen, while the Bond girls have gotten thinner and become underweight (i.e., BMI values below 18.5), the rest of the population has gained weight, and most people have become overweight (i.e., BMI values above 25).

Insert Figure 1 about here

The norm of the fashion industry of designing for an ideal thin figure has been accused of negatively affecting individuals' body weight: it has been blamed for accelerating and even promoting eating disorders, especially anorexia nervosa and bulimia (Harrison & Cantor, 1997), as "young girls compare their physical attractiveness with that of advertising models" (Martin and Gentry 1997; see also Richins 1991). Consumption of media in which pictorial images of ultra-thin fashion models has been shown to deteriorate consumers' satisfaction with their self-body image (Eisend and Moller 2007; Dittmar and Howard 2004; Groesz, Levine, and Murnen 2002; Karazsia et al. 2013). Presenting the thin models in full body pictures is claimed to accelerate the pressure on women to restrain their eating, and to increase the likelihood of eating disorders (Sypeck, Gray, & Ahrens, 2004). Lower self-body image increases this likelihood particularly among young females (Furnham, Badmin, & Sneade, 2002). Hiring only extremely slim models (which is not the subject of our study) can be explained by many variables. but regardless the reason for this custom the outcome is portrayed as having a negative effect on the self-perception of body image and self-confidence, therefore, increasing the proportion of teens who are likely to have eating disorders (Thompson & Heinberg, 1999). In this paper, we suggest that the slimmer figure effect of the ideal beauty on part of the population and the heavier average weight body size represent two sides of the same coin and thus if one accepts the idea that the thin model accounts for anorexia, then it should be expected that it would also account for the growing problem of obesity.

We posit that the slim figure of fashion models no longer serves as a reference to the ideal body figure for young females and adolescents, who are exactly the target market of the fashion industry. We hypothesize, and support empirically, that the ideal beauty no longer represents a relevant reference point, and consumers now refer to the average body size, which is constantly increasing, as their reference.

Adopting the idea of the dual effect of the reference of the ideal beauty is new to the literature. While previous studies referred to size of the dish, plate, package (box), or glass as an anchoring reference to the quantity of food eaten (Just and Wansink 2014; Wansink and Cheney 2005; Wansink, Just, and Payne 2009; Wansink, Kent, and Hoch 1998; Wansink and Park, 2001; Wansink and Van Ittersum, 2003), we refer to the outcome of over eating on gaining weight trough the distance from physical appearance reference point. We depart from consumer behavior and psychological studies that have focused mostly on studying how heterogeneity in motivation systems (Higgins, 1997), efficacy (Conner and Norman 2005; Luszczynska and Schwarzer 2005), efficiency response (Bandura 1982), self-image (Dittmar, Beattie, & Friese, 1996), and goals (Campbell and Mohr 2011) affect eating disorders and weight gain. We adopt the view that consumers' body weight, health status, and physical appearance are solved endogenously, i.e., are the outcome of utility maximization (Cawley, 2004; Posner & Philipson, 2003; Schroeter, Lusk, & Tyner, 2008) and that weighting above personal ideal weight results in disutility (Ruhm, 2010). We depart from economic studies in two aspects: first, by specifying that the disutility of being overweight results from being less physical attractive and that attractiveness is measured relative to two reference points. .

In this work, we add to the "ideal image" reference another reference point—the average body weight of the population—which is a more realistic reference point. Under the assumption that the benefit of physical attractiveness is a function of distance from the two reference points, we show that the trend of slimmer fashion models not only fails to restrain weight gain, but in contrast to common wisdom, it contributes to weight gain. The modeling approach that is presented is backed up by supportive evidence based on a historical database of tens of thousands of individuals of a representative sample of the US population dating from the 1960s until today. Our model and our empirical analysis apply to young women who are more likely to assign high importance to their physical attractiveness, while assigning relatively low importance to weight as a health argument, therefore, ignoring the benefit of controlling health hazards by monitoring eating. Also, we focus on the segment of young women mainly because they are likely to be more sensitive to the "ideal beauty" body size norm that is dictated by runway models and, thus, seem to be more responsive to changes in that norm. The choice of this segment, whose members are willing to sacrifice health for the sake of appearance (Diedrichs and Lee, 2011; Low, 2011; Weeden and Sabini, 2005), resulted in our modeling choices between the satisfaction gained from the quantity of food consumed that produces enjoyment via taste, satiates , supplies nutritional values, and supplies calories that are source of energy; and the satisfaction gained from meeting the norms and standards of physical appearance, while taking into account its social effects. Modeling utility from health and food (quantity or taste) is commonly used in the literature (Cawley, 2004; Philipson and Posner, 1999). Since overweight negatively affects appearance in the short run, and its effect on health is realized much later on, similar to the case of contemporary consumption, we reduce consumer benefit from health and appearance to that of appearance only. Replacing health with appearance as sources of utility enables us to address the scenario in which the future is heavily discounted that matches the behavior of our subject of interest—the young female segment.

Our two reference point modeling approach may capture the general effect of social norms on individuals' food consumption. Social standards shape the ideal to which many consumers aspire and take as their desirable reference point. However, the ideal reference point may become an unachievable goal for many, and even for most individuals. Hence, it may turn out to be an irrelevant reference that is replaced by a more common one in accordance with the actual attainments of a representative consumer. For the sake of brevity, we only consider the standards of beauty in our specification. However, other social norms regarding the appropriate physical appearance and the "right" habits of eating can be associated with our model as well. For example, nowadays the choice of adopting a healthy lifestyle is gradually becoming a social norm, yet people in general and young consumers in particular may adopt healthy life norms not necessarily because they have internalized the bad consequences of "bad" eating on health in the far future, but more likely due to their desire to meet the social standards of today.

In the next section, we specify consumer choices in the quantity of food when considering the tradeoff between the direct benefit from food consumption and the disutility resulting from gaining weight. Then we provide supportive evidence for our theory, ending with a short discussion and final remarks.

CONSUMERS' CHOICE OF FOOD CONSUMPTION

Consumer utility is specified by the quantity of food consumed, physical appearance (attractiveness), and all other goods. Consumer physical appearance is determined by weight relative to two reference body indices (e.g., BMI): the average population and the ideal image as portrayed by the fashion and the entertainment industries. In our model, weight is included in the utility indirectly via its effect on physical attractiveness, rather than as a direct argument as in Schroeter et al. (2008) and Philipson and Posner (1999), although due to linearity, the choice quantity of food could be easily replaced by the choice of consumer weight.

Our basic argument is that, subject to any given food budget, a consumer who is a resident of a developed country (OECD for example) has the means to consume a quantity of food beyond his or her calorie requirements. Low income and low budget results under such a scenario, on average, in consumption of a high quantity of low quality food, while high income consumers are likely to face the same problem of overconsumption but of higher quality food. One can argue that high quality food is probably more enjoyable and healthy per calorie consumed, but even then our research question is still valid—what has caused the reference of appearance to lose its potency? Therefore, we do not explicitly analyze differences in income and choice between food items that posit tradeoff between better taste and higher calorie content (e.g., vice vs. virtue) and assume choice of quantity is done with regard to a specific homogenous food product.

Let *x* denote the quantity of food consumed that can be either a certain homemade meal, meal at a restaurant, or the weighted sum of calories produced by food per period of time. p_x represents either the cost of food prepared at the household per representative meal, price of a dish in a restaurant, or weighted average price of the food purchased per period of time. In addition, let *y* denote the quantity of units of other goods. For simplicity, we normalize the price of y to unity, i.e., $p_y = 1$, and let B denote consumer budget.

According to our assumption that at any given budget consumers can consume more food than needed, the optimal quantity of food does not depend directly on consumer budget, i.e., $\frac{\partial x^*}{\partial B} = 0$. This allows us to specify that utility from the two goods, food quantity x and other goods y, is a quasilinear utility in food and other goods quantities, i.e., consumers face the following problem:

$$(3.1) \quad \begin{matrix} Max_{x,y} & u(x, A(m(x) \mid R_j)) + y \\ s.t. & p_x x + y = B \end{matrix},$$

where A denotes consumer physical appearance and is a function of the individual body weight m, that by itself is a function of the quantity of food consumed x,[1] and R_j are the two physical appearance reference points (ideal and median body weights). The utility is derived from the consumption of food (that may increase body weight) or from improving physical appearance (that may be associated with reducing consumer body weight). We assume that $\frac{\partial u}{\partial A} > 0$ and $\frac{\partial u}{\partial x} > 0$.[2]

The production functions of food's benefit such as supply of nutrients, satiety, and taste are affected by the level of food industrialization and the prevalence of processed food in a consumer's diet that is represented by the parameter F.[3] Processed food products are designed to be tasty, and in some cases addictive, by creating an optimal mixture of fats, sugar, salt, and food additives (Moss, 2013), where higher content of fat and sugar per gram of food is equivalent to higher calorie density per gram of food. The tastier the food, the larger the quantity consumed (Sorensen, Moller, Flint, Martens, & Raben, 2003). In addition, processed foods have a typical low satiety index relative to the reference index, resulting in a higher quantity of food needed in order to satiate (Holt et al. 1995). Since industrialized food is less satiating, and it tastes better per unit of consumption (or per calorie) higher level of F, increases the marginal utility from food consumption. Formally, we assume that $\frac{\partial u}{\partial F} > 0$, and $\frac{\partial^2 u}{\partial F \partial x} > 0$. Moreover, as processed food calorie burning is inefficient, in general its consumption accelerates weight gain. Thus, the higher the level of food industrialization F, the stronger the marginal effect of additional calorie consumption on the likelihood of gaining weight.

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[1] As our focus is not on the apparent tradeoff between caloric intake and outtake ceteris paribus, we assume that the level of individual physical activity is determined exogenously e.g., via type of employment and lifestyle.

[2] As long as the quantity of the food eaten is not too large, the more one eats, the more the good feeling of satiety increases where the tastier the food, the larger the quantity consumed (Sorensen et al. 2003). Beyond a certain point, the individual experiences an unpleasant sensation of fullness. That is, as the marginal benefit of taste should be positive, while the marginal benefit of satiation may be negative, we assume that $u(x, A)$ exhibits an inverted-U shape, while holding a constant level of appearance A. However, as the optimal consumption point lies in the increasing part of the utility without any loss of generality, we assume that $\frac{\partial u}{\partial x} > 0$.

[3] The level of food industrialization parameter F is assumed to be exogenous rather than a decision variable. Solving for the case in which the level of process is solved endogenously adds complexity to the analyses without adding insight.

Therefore, we define an individual's body size for a given quantity of food consumption *x* and food industrialization level *F* as $m(x|F)$. We assume that $\frac{\partial m}{\partial x} > 0$, $\frac{\partial m}{\partial F} > 0$ and $\frac{\partial^2 m}{\partial F \partial x} > 0$, i.e., a "processed" calorie contributes more to weight gain than an "unprocessed" one. Note that not all individuals are influenced by food industrialization in the same manner. Since there is a supply of unprocessed food of high quality that is naturally more expensive, there is a demand for that food that comes from consumers who have the willingness and ability to afford it. Hence, it should be expected that wealthy people are less affected by food industrialization.

Consumer benefit from appearance *A* is affected indirectly by food consumption *x* via body size *m*. Since in the Western world, slenderness is considered more appealing (Furnham, et al., 2002), the higher the BMI, the lower the physical appearance, i.e., $\frac{\partial A}{\partial m} < 0$. Consumer appearance is assumed to be affected by two reference points: m_I—the upper bound below which weights are perceived by the consumer as ideal inspired by the figures of models and film stars (hereinafter ideal beauty) and the upper bound weight m_E—above which consumers' physical appearance is lower than the typical (normative) standard. That is, in our specification, the two reference points R_J are represented by m_I and m_E, so the individual physical appearance is given by $A(m(x) \mid m_I, m_E)$. The ideal of beauty reference point m_I is shaped by exogenous industry standards that will be defined as *I*, i.e., the weight of the raw beauty models depends on I, $m_I = m_I(I)$, and the higher the standard, the higher the weight of the model $\frac{\partial m_I}{\partial I} > 0$. m_E, the edge of the typical reference point, is assumed to be shaped by the population representative body size (e.g. the median) M , such that $m_E = m_E(M)$,where $\frac{\partial m_E}{\partial M} > 0$. Note that the two reference weights m_I and m_E encapsulate the individual perceptions of the ideal and the edge of the typical figures, respectively; hence, these figures differ from person to person.

However, they are strongly affected by the exogenous ideal social standards *I* and the representative weight of the population *M*, e.g., the median weight. We capture the heterogeneity in the individual perceptions by assuming that given *I* and *M*, $m_I(I)$ and $m_E(M)$ are drawn from a distribution bounded by $\overline{m}_I(I)$ and $\overline{m}_E(M)$ from above and $\underline{m}_I(I)$ and $\underline{m}_E(M)$ from below, respectively.

The ideal reference point m_I may affect the individual decision to improve her appearance by losing weight only if it is not too far from her own figure. Otherwise, the ideal figure becomes an unreachable goal, and the environment reference point m_E de-facto turns out to be the only individual reference point. It is also likely that the implications of gaining weight on the individual self-image of appearance become more significant when one's figure is close to the ideal range or typical range margins. For example, while it may be acceptable to gain several pounds if one still remains in an average figure range, it is much less desirable to gain weight when that consumer is close to the edges: either around the ideal region or when approaching the overweight zone relative to the media reference group. It should be noted that the term "overweight" that is used in this study is one's weight relative to her reference point, rather than relative to the clinical definition of overweight. In order to capture the effect of having dual theoretical reference points, consumer appearance is represented as decreasing double sigmoid function of the form:

$$(3.2)\quad A(m\,|\,m_I(I),m_E(M)) = S_I(z)\big|_{z=m-m_I(I)} + S_E(z)\big|_{z=m-m_E(M)},$$

where $S_I(z)$ and $S_E(z)$ are decreasing sigmoid functions that stand for the relative contributions of the ideal beauty and the environment reference figures, respectively. Namely, $\frac{\partial S_I}{\partial z}<0$ and $\frac{\partial S_E}{\partial z}<0$, where the existence of a pair of horizontal asymptotes on each sigmoid function implies that $\frac{\partial S_I}{\partial z}\xrightarrow[z\to\pm\infty]{}0$ and $\frac{\partial S_E}{\partial z}\xrightarrow[z\to\pm\infty]{}0$. The value of $z=0$ denotes a turning point in which the sigmoid functions change from concave to convex patterns, so that $\frac{\partial^2 S_I}{\partial z^2}<0$ and $\frac{\partial^2 S_E}{\partial z^2}<0$ for $z<0$,

$\frac{\partial^2 S_I}{\partial z^2} > 0$ and $\frac{\partial^2 S_E}{\partial z^2} > 0$ for $z>0$, and $\left.\frac{\partial^2 S_I}{\partial z^2}\right|_{z=0} = 0$ and $\left.\frac{\partial^2 S_E}{\partial z^2}\right|_{z=0} = 0$. Thus,

$\frac{\partial^2 A}{\partial I \partial m} = -\left.\frac{\partial^2 S_I}{\partial z^2}\right|_{z=m-m_I(I)} \cdot \frac{\partial m_I}{\partial I}$ and $\frac{\partial^2 A}{\partial M \partial m} = -\left.\frac{\partial^2 S_E}{\partial z^2}\right|_{z=m-m_E(M)} \cdot \frac{\partial m_E}{\partial M}$.[4]

In general, the environment reference sigmoid S_E can be viewed as the individual subjective indication for the degree of the compliance of her figure to her immediate environment accepted norms, while the ideal reference sigmoid S_I represents the "bonus" one feels the closer she gets to the ideal figure.

A schematic illustration of the individual self-image of appearance production function is displayed in Figure 2. If the ideal and the typical figures are far apart (i.e., when $m_I << m_E$), the ideal reference figure m_I and the edge of the typical weight m_E denote the edges of the ideal region and the edge of the typical region of appearance, respectively. On the other hand, if the ideal and the upper bound of typical figures are close to one another, the ideal and the typical regions tend to come together, where the ideal figure inclines to become the only reference point. Within the ideal region, the gradient of appearance deterioration becomes steeper as more weight is gained. This tendency is changed at the ideal region endpoint m_I in which the ideal figure starts to become an unachievable goal, so the more distant one's figure from the ideal region, the less is the decreasing appearance slope until it plateaus. Within the plateau, the restraining force of appearance is weak as the individual figure is about the average and gaining some extra pounds may not affect her self-image of appearance when she compares herself to her immediate environment. The effect of appearance becomes significant again when the individual figure tends to be above the typical figure, so that the

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[4] $S_I(z) = \frac{a_I}{1+e^{b_I \cdot z}}$ and $S_E(z) = \frac{a_E}{1+e^{b_E \cdot z}}$, where a_I, b_I, a_E, and b_E are positive constant parameters, are specific examples of such decreasing sigmoid functions. In that case, the appearance will take the form:

$A(m \mid m_I(I), m_E(M)) = \frac{a_I}{1+e^{b_I \cdot (m-m_I(I))}} + \frac{a_E}{1+e^{b_E \cdot (m-m_E(M))}}$ (see Equation 3.2).

larger the individual body size, the sharper the decreasing appearance gradient slope. The edge of the typical region (the point m_E) is the point above which the individual starts to feel that the "battle of staying in shape" is lost and, hence, gaining weight beyond the typical region endpoint m_E diminishes the "restraining force" of appearance on weight. Naturally, the upper edge of the typical region m_E is greater than the typical figure of most individuals; hence, by definition the body size of most individuals satisfies that $m < m_E$ and particularly the population median $M < m_E$ as well.

Insert Figure 2 about here

Integrating the industrialization index F into the representation of utility (Equation 3.1), which is assumed to be additive in consumption of food and other goods y, yields the utility specification that is maximized by setting the optimal quantity of food under budget constraint B. Thus, the consumer maximizes the following:

$$(3.3)\quad \begin{array}{ll} Max_{x,y} & U(x,A,y\,|\,F,I,M) = u(x\,|\,F, A(m(x\,|\,F)\,|\,m_I(I), m_E(M))) + y \\ s.t. & p_x x + y = B \end{array}.$$

Since the solution of the individual optimization problem introduced by Equation 3.3 is an interior solution by nature (i.e., x is positive, but not all the budget is used for this purpose), it follows that:

$$(3.4)\quad u_x(x\,|\,F, A(m(x\,|\,F)\,|\,m_I(I), m_E(M)))\big|_{x=x^*} = p_x$$

where $u_x \equiv \frac{du}{dx} = \frac{\partial u}{\partial x} + \frac{\partial u}{\partial A}\frac{\partial A}{\partial m}\frac{\partial m}{\partial x}$ (Note that the food industrialization level *F* is assumed to be exogenous and, hence, $\frac{dm}{dx} = \frac{\partial m}{\partial x}$) the consumer's optimal quantity of food is then represented by:

$$(3.5)\qquad x^* = x^*(p_x\,|\,F, I, M).$$

We further assume that the benefit derived from physical appearance does not depend directly on the enjoyment resulting from the taste of the food consumed, i.e., $\frac{\partial^2 u}{\partial x \partial A} = \frac{\partial^2 u}{\partial A \partial x} = 0$. Hence, the Marshalian approximation of the demand (Equation 3.5) under these assumptions is derived from a separable and additive utility in food consumption and appearance of the form:

(3.6) $$u(x \mid F, A(m(x \mid F) \mid m_I(I), m_E(M))) = w_0 u_0(x \mid F) + w_A A(m(x \mid F) \mid m_I(I), m_E(M)),$$

where u_0 is the utility gained by the direct satisfaction from eating, and it is the product of taste and satiation. w_0 and w_A denote the importance weights of food consumption and physical appearance, respectively. Our propositions below are derived and presented given the assumption that $\frac{\partial^2 u}{\partial A^2} = 0$, i.e., $\frac{\partial w_A}{\partial A} = 0$. In the appendix, we prove our propositions relaxing this assumption and show that relaxing it does not add much insight to the analysis. In this context, it should be noted that the direct satisfaction from eating u_0 and from appearance A exhibit an indirect tradeoff through their common factor of production—the amount of food consumption x.

Moreover, the food price p_x and the level of food industrialization F, as well as the social standards of the ideal beauty I, affect the individual demand for food products both directly and indirectly via their effect on the population median figure M, as indicated by Equation 3.5. Therefore, as the median M itself is obtained from the body size of the entire population, then on the basis of Equation 3.5, we find that $M = g(p_x, F, I, M)$. Total derivation of Equation 3.5 according to price suggests that $\frac{dx^*}{dp_x} = \frac{\partial x^*}{\partial p_x} + \frac{\partial x^*}{\partial M}\frac{dM}{dp_x}$. That is, the effect of change in price on the demand of food is the sum of the direct effect $\frac{\partial x^*}{\partial p_x}$, and the indirect effect via the effect of the population median figure on the appearance $\frac{\partial x^*}{\partial M}\frac{dM}{dp_x}$. The indirect effect of change in price on the demand is therefore given by

$\frac{dx^*}{dp_x} - \frac{\partial x^*}{\partial p_x} = \frac{\partial x^*}{\partial M}\frac{dM}{dp_x}$. The same logic applies to total derivation of this equation according to *F* and *I*. In the following propositions, we analyze these direct and indirect effects on the individual demand for food. (All proofs are provided in Appendix A.)

Proposition I: The Effect of Food Price

While the direct effect of food price p_x *affects the quantity demanded is negative, i.e.,* $\frac{\partial x^*}{\partial p_x} < 0$, *the indirect effect depends on the location of individual's weight. Specifically, if the individual's body size* $m < m_E$, *then* $\frac{dx^*}{dp_x} - \frac{\partial x^*}{\partial p_x} < 0$ *and otherwise* $\frac{dx^*}{dp_x} - \frac{\partial x^*}{\partial p_x} > 0$.

A decline in food prices results in a direct increase of the quantity of food consumed. As a result, the body size of the "average" figure increases. Hence, among most of the population, who lie in the range of $m < m_E$, the restraining force of appearance decreases because the increase of the "average" figure body size improves the image of their own appearance (the misfortune of many is some kind of consolation), resulting in a further increase in individual food consumption by a mechanism that gives rise to a multiplier effect. That is, among most of the population, the total effect of reduction in food price results in an increase in their food intake. For the group of consumers whose weight is above the typical figure edge point, i.e., $m > m_E$, the restraining force of appearance is amplified by food price reduction as the "average" figure is a more reachable goal, while mitigating the direct tendency of increasing food consumption.

The direct effect of level of industrialization *F* on the optimal food consumption is determined by the tradeoff between the direct benefit from food consumption (quantity),which is represented by

$w_0 \frac{\partial^2 u_0}{\partial F \partial x}\bigg|_{x=x^*}$ and the change in the restraining component of appearance that is represented by

$$w_A \frac{\partial^2 A}{\partial F \partial x}\bigg|_{x=x^*} \equiv w_A \left(\frac{\partial A}{\partial m} \cdot \frac{\partial^2 m}{\partial F \partial x} + \frac{\partial^2 A}{\partial m^2} \cdot \frac{\partial m}{\partial F} \cdot \frac{\partial m}{\partial x} \right)\bigg|_{x=x^*}.$$

Proposition II: The Effect of Food Industrialization Level on Food Consumption

a. *If the marginal change in benefit from food consumption as the intensity of food industrialization increase is greater than the marginal change in the restraining component of appearance, then a positive direct effect takes place. Otherwise, the direct effect is negative.* *i.e., if* $w_0 \frac{\partial^2 u_0}{\partial F \partial x}\bigg|_{x=x^*} + w_A \left(\frac{\partial A}{\partial m} \cdot \frac{\partial^2 m}{\partial F \partial x} + \frac{\partial^2 A}{\partial m^2} \cdot \frac{\partial m}{\partial F} \cdot \frac{\partial m}{\partial x} \right)\bigg|_{x=x^*} > 0$, *then* $\frac{\partial x^*}{\partial F} > 0$ *and otherwise* $\frac{\partial x^*}{\partial F} < 0$.

Assuming that for most individuals the direct benefit of food consumption is stronger than the appearance restraining adjustment, the direct effect of the increase in the intensity of food industrialization is likely to result in an increase of the population body size median $\frac{\partial M}{\partial F} > 0$.

b. *If the intensity of food industrialization results in an increase in the weight of the median individual, then the indirect effect is positive for individuals whose weight is lower than the typical region edge point* m_E *and negative for those whose weight is above the typical region edge point* m_E, *i.e., if* $\frac{\partial M}{\partial F} > 0$, *then if the individual body size* $m < m_E$, *then* $\frac{dx^*}{dF} - \frac{\partial x^*}{\partial F} > 0$ *and otherwise* $\frac{dx^*}{dF} - \frac{\partial x^*}{\partial F} < 0$.

Proposition II implies that the increasing trend of the food industrialization level over the years has two contrasting direct effects on individual food consumption. On one hand, the more processed the food, the more tasty and less satiating it is, resulting in a higher quantity of food intake consumed.

On the other hand, by accelerating body weight, industrial processed food increases the disutility from lower appearance and attractiveness, and this may counterbalance the quantity consumed. Apparently, in the long run, the direct effect of food consumption among most individuals is stronger than the restraining power of self-regulation (Linde et al. 2006); hence, the direct effect of food industrialization can be associated with an increase in food consumption and, as a result, contributes to the propagation of the overweight epidemic. Moreover, as the "average" figure body size becomes larger, the direct effect on most individuals (those who lie below the typical figure edge point m_E) is amplified by an additional positive indirect effect. Similar to the indirect effect presented in Proposition I, the restraining force of appearance is then moderated and, hence, most individuals further increase their food intake by a mechanism that gives rise to a multiplier effect.

Proposition III: The Effect of the Ideal Beauty Figure

a. *The direct effect of change in the weight of the ideal beauty reference I is negative on individuals whose weight is higher than the ideal region edge point* m_I *and positive for those whose weight is lower than the ideal region edge point* m_I *(i.e., within the ideal region), i.e., if* $m > m_I$*, then* $\frac{\partial x^*}{\partial I} < 0$ *and otherwise* $\frac{\partial x^*}{\partial I} > 0$.

At this step, it is necessary to make an assumption about the effect of changes in the BMI of the ideal beauty on the weight of the population., We analyze the effect of this change in the weight of the ideal beauty in the common scenario wherein most of the population is heavier than their upper edge of the ideal region m_I, then it is likely that the slimming tendency of the ideal beauty would lead to an increase of the median population body size, i.e., $\frac{\partial M}{\partial I} < 0$.

b. *If most of the population lies above ideal region upper edge point* m_I*, such that* $\frac{\partial M}{\partial I} < 0$ *holds, then the indirect effect is negative on individuals who lie below the typical region edge point* m_E *and positive on those who lie above the typical region edge point* m_E*. Namely, if the individual's body size* $m < m_E$*, then* $\frac{dx^*}{dI} - \frac{\partial x^*}{\partial I} < 0$ *and otherwise* $\frac{dx^*}{dI} - \frac{\partial x^*}{\partial I} > 0$.[5]

c. *If the ideal region edge point* m_I *and the typical region edge point* m_E *are very far apart, then the total effect is negative on individuals who lie within the typical region and positive on those who lie within the ideal region. Namely, if* $m_I << m_E$*, then* $\frac{dx^*}{dI} < 0$ *for individuals whose body size* $m_I < m < m_E$ *and* $\frac{dx^*}{dI} > 0$ *in cases where* $m < m_I$.

From Proposition 3 (a)–(c), it follows that the trend of hiring slimmer supermodels and movie actresses affects the body weight of the population depending upon their initial weight relative to the two reference points: the ideal weight and the range of the average individual. In recent decades, it seems that most individual body weights are above the ideal reference in a manner that the appearance restraining force has become less effective. As a result, the tendency to increase food consumption becomes stronger because it is less restrained by the ideal beauty. On the other hand, for individuals in the lowest BMI percentiles who are within the ideal region, the decline in the weight of the ideal model has an opposite direct effect, inducing them to become even slimmer.

While the latter effect (on the lowest percentiles of BMI) is well documented, the former, i.e., the inverse effect of slim models on the median individual which boosts the obesity epidemic is our contribution to the literature. Since most of the population lies above the "ideal weight" (i.e., beyond the ideal edge point m_I), a decrease in weight of the ideal figure therefore conveys a negative indirect impact on the majority of the population (not beyond typical edge point m_E) by a multiplier effect

[5] In the scenario where most of the population lies below the interval of the ideal region upper edge point, the results of proposition 3b are reversed.

mechanism. Among the majority who are in the typical BMI region, the direct and indirect effects of the slim ideal figure amount to an overall negative effect that is stronger based on how low the BMI is. On the other hand, for those individuals whose BMI falls within the ideal region, the direct and indirect effects affect opposite directions. The direct effect tends to reduce individual food intake corresponding with the decline in BMI of the ideal reference point, while the indirect effect that takes place via the effect on the median reference point may counterbalance it. If the ideal and the "average" figures are too far apart, then in the lowest BMI percentiles, the moderating indirect effect becomes negligible compared to the direct effect.

According to our theory, the food production industrialization that accounts for affordable, available, and time and labor saving processed food products combined with the trend of adopting the ultra-thin model as representing ideal feminine beauty enable a vicious cycle to take over. The ideal and the "average" figures drift apart. Most individuals are about "average" and also take the "average" figure as their reference point and, hence, sense a relatively moderated effect of appearance. Thus, in the industrial world wherein the level of food processing is increased while facing a weakened impact on appearance, young individuals increase their caloric intake and, hence, gain more weight, so the "average" and the ideal figures drift further apart and so on.

It is therefore hypothesized that:

H1: *Ceteris paribus, the BMI of most young women is* ***negatively correlated*** *with the ideal figure body size (as expressed for instance by the BMI of fashion models, film actresses, and celebrities). In contrast to the general trend, the BMI of young women in the lowest percentiles is* ***positively correlated*** *with the ideal figure body size.*

H2: *The ideal figure body size affects the BMI of young women both directly and indirectly via its effect on the "average" figure body size. Ceteris paribus, once separating the direct from the indirect effect the BMI of most young women is* ***negatively correlated*** *with the ideal figure body size and* ***positively correlated*** *with the "average" figure body size. On the other hand, the*

*BMI of young women in the lowest percentiles is relatively **strongly positively correlated** with the ideal figure body size and is relatively **weakly positively correlated** with the "average" figure body size.*

We expect therefore that individuals in the lowest BMI percentiles tend to be more affected by the social standards of the ideal beauty figure than the typical figure that is widespread in their own immediate environment. Accordingly, we also expect that the higher the individual BMI, the more a young woman is affected by her immediate environment and the less she is affected by the ideal beauty reference point.

In the next section, we provide empirical evidence to support our hypotheses.

DATA DESCRIPTION

In order to validate our hypotheses regarding the influence of the ideal of beauty on body size in the general population, we created a unique database that is based on three different historical datasets as described below.

Individual-Level Physical Measurements and Demographics

We used historical individual level data based on large-scale representative samples of the US population over the last five decades imparted by the National Health and Nutrition Examination Survey (NHANES), wherein sample weights to account for sample selection bias are provided for each individual in each survey. Unlike males who vary in their ideal body figure, with some desiring a strong massive build, and others regarding thin and slim as their model, there is a broad consensus in regard to the figure of the ideal feminine beauty, which is thin. Therefore, we focused our interest in collecting data and analyzing non-pregnant young females in the ages between 17 and 35 years old.

The data was retrieved from 12 surveys conducted in 12 different time periods: NHES 1959–1962, NHANES I 1971–1975, NHANES II 1976–1980, NHANES III Phase A 1988–1991, NHANES III Phase B 1991–1994, NHANES 1999–2000, NHANES 2001–2002, NHANES 2003–2004, NHANES 2005–2006, NHANES 2007–2008 , NHANES 2009–2010, and NHANES 2011–2012 (see http://www.cdc.gov/nchs/nhanes/about_nhanes.htm). The NHANES data include actual measurements of individual weights and heights that enable the calculation of each individual's BMI in the sample.[6] In addition, the following demographic variables were provided for each respondent: age, ethnicity (White, African-American, Hispanic/Latino-American, or other), education (high school and above or below high school), marital status, and household annual income estimates and the number of people in the household, used to calculate per-capita discounted annual income.[7] Income and income per capita are not provided in the most recent survey NHANES (2011–2012). Detailed variable definitions are given in Appendix B.

In order to conduct our analyses, we also had to associate a time tag (specification) to each individual measurement. In two surveys (NHANES I 1971–1975 and NHANES II 1976–1980), both the respondent's age at the time of screening and date of birth were provided, so we were able to retrieve time tags for each individual measurement in an annual resolution. However, in all other surveys, respondent dates of birth were omitted, so the survey mid-time periods were used to tag the individual measurements. For example, the individual measurement time tag of all participants in the NHES 1959–1962 survey was chosen to be 1960.5.

The combined sample included 18,033 individuals, of which 17,313 observations provided complete demographic data except for income and per capita estimates, with 16,033 of these (omitting the NHANES 2011–2012 survey) including a full demographic profile. Descriptive statistics for the demographic variables in our sample is given in Table 1. The evolution of young US females' BMI percentiles in 5% intervals (from the 5% percentile to the 95% percentile) over time is depicted in Figure 3. The data that are presented in this figure suggest that a clear increasing BMI trend appears in all percentiles, and that the higher the percentile, the steeper the growth of its BMI value. Moreover, in recent years, most individuals cross the overweight "red line," as the median BMI lies above 25,

[6] The BMI is defined as the ratio of weight to the square of height and is used as a measure for human mass that takes into account the height of the body. In this context, we note that the data are not based on a panel.
[7] The discounted incomes were calculated in accordance with US inflation rates based on the Consumer Price Index published by the US Bureau of Labor Statistics. The reference year is 2012.

and about 25% of individuals are considered as obese (i.e., their BMI is above 30) in contrast to the relatively moderate increase observed among the lowest BMI percentiles. The median BMI of young US females has increased by 17% in the last five decades from 21.89 in the 1960s to 25.60 in 2011–2012, where this increase has more than doubled among individuals in the highest 5% percentiles from 31.78 to 42, an increase of 32.2%, compared to moderate growth in the lowest 5% percentile from 17.80 to 18.60, an increase of just 4.5% in five decades.

Insert Table 1 about here

Insert Figure 3 about here

The Ideal Feminine Beauty Proxy

In parallel to the significant changes in consumer weight over the years, the body figure of the ideal feminine beauty has been also subject to tremendous changes. In order to capture the changes in the BMIs of the ideal beauty, we sought a quantitative measure of the ideal figure that is considered representative and was not only available currently, but also in the past. We found such a measure in the form of the BMI of female actresses (the Bond girls) in James Bond movies. The Bond phenomenon has had remarkable societal impact, and the fact that its success seems to be universal and immune to time is partially attributed to the attractiveness of the Bond girls (Nuendorf et al. 2010; Caplen 2010; Lindner 2003; d'Abo and Cork 2003). Moreover, the high regularity of Bond film productions in the last five decades, 23 films in the time period between 1962 (*Dr. No*) and 2012 (*Skyfall*) enabled the bracketing of an ideal feminine body size to each year in the individual level database (that was generated on the basis of the historical NHANES data, as described above), so we were able to associate an ideal inspiring figure for each individual in our sample. More precisely, by intensive search on a variety of online websites, we obtained the BMI of most (though not for all) of the Bond girls over the years (see Appendix B for details). Next, we used a 10-year moving window average of the BMI values of Bond girls who appeared in films during the last ten years as a proxy for the ideal feminine beauty figure in each year since 1960. The value of the proxy for the years before 1962 was taken to be the average BMI of the Bond girls who appeared in the first Bond film. Then finally, we associated an ideal reference figure to each individual in our sample in accordance with her sampling time tag.

Figure 4a demonstrates that the temporal evolution of the Bond girls-based proxy of ideal feminine beauty BMI exhibits a decreasing S-shape. While until the mid 1980s the ideal figure BMI was more or less constant ranging between 20 and 21, an abrupt decrease was observed throughout the 1990s into a range of underweight values between 17 and 18.5, that became the standard scope of the ideal feminine beauty BMI and which is still well-accepted in our time. These findings are in line with others which documented the rise of the ultra-thin ideal model during the 80s and 90s (e.g., Sypeck et al. 2004). Of particular interest is to compare the temporal evolution of the ideal feminine beauty with respect to the body size of the general population at the very same time. As shown in Figure 4b, wherein the Bond girls' proxies for the figure of ideal feminine beauty is displayed, in the 60s and the 70s the BMI values of these women ranked at about the 28th percentile of young females in the US, whereas nowadays this figure has dropped to below the 4th percentile as a representation of the current ideal figure. These percentiles were estimated using the NHANES-based representative sample of young US females ages 17 to 35, where the provided sample weights were taken into account. The BMI of percentile p is defined as the BMI of the individual i_p for whom $\sum_{i=1}^{i_p} w_i = p$, where w_i is the sample weight of the ith individual in the sample where individuals are sorted according to BMI.

As discussed above, in this paper we posit that these opposite trends are related and unveil two sides of the same coin.

Insert Figures 4a and 4b about here

Food Industrialization Level Proxy

The per-capita discounted annual sales of eating and drinking places (restaurants and eateries) were used as a proxy for ready prepared food production and the level of food industrialization. The demand for eating out of the household is assumed to be affected by variables that change the demand for processed food such as the alternative cost of time. The low price of processed food and restaurants including fast food chains and sales of food outside home can be used a proxy for the proportion of processed food over homemade food from fresh ingredients. The sales data also encapsulate the effect of price. The source of our data is the advance monthly historical data reports provided in the Retail and Trade Survey of the US Census Bureau at the US Department of Commerce. These historic releases are available from 1953 (see https://www.census.gov/retail/marts/historic_releases.html). We collected the annual sales in eating and drinking places (historical SIC code 58) or food services and drinking places (NAICS code 722).[8] Then we normalized the discounted values of the total sales in eating and drinking places on the US population in the corresponding years (based on the US Census Bureau intercensal population estimates) to obtain the discounted per-capita annual sales in eating and drinking places that we later used as a proxy of the food industrialization level.[9] These proxy values were associated afterwards to each individual in our general dataset according to their sampling time tags. The food industrialization level proxy was later used as an explanatory variable of individual BMI; therefore, the association was taken place with a lag of at least one year to avoid the effect of simultaneity. More precisely, in cases where the exact date of the individual measurements were available in annual resolution (i.e., in the surveys NHANES I 1971–1975 and NHANES II 1976–1980), the food industrialization level proxies were associated by a one year lag. For example, if the individual measurement time tag was 1974, then the associated food industrialization level proxy referred to the year 1973. On the other hand, for those surveys wherein

[8] The North American Industry Classification System (NAICS) replaced the Standard Industry Classification (SIC) in 1997. Benchmark reports of annual sales were available for both classifications between 1992 and 2000.The differences between annual sales according to these two classifications is between 1% to 2%.

[9] The discounted sales were calculated in accordance with US inflation rates based on the Consumer Price Index published by the US Bureau of Labor Statistics. The reference year is 2012.

the individual measurement year tags were not precise, the associated food industrialization level referred to the year before the first year of the survey. For example, all the respondents in the NHES 1959–1962 survey were associated to the food industrialization level proxy which refers to the year 1958.

The temporal evolution of the food industrialization level proxy is displayed in Figure 5. A respectable growth in the level of the food industrialization is observed similar to previous studies. The per-capita discounted annual sales in eating and drinking places in the US has grown from $700 US dollars in 1958 to $1,720 US dollars in 2012, an absolute increase of 145% with an average discounted increase per capita of 1.7% every year.

Insert Figure 5 about here

EMPIRICAL FINDINGS

Our main research hypotheses posit that the social standards for the figure of the ideal of beauty affect individuals' BMI both directly and indirectly via the ideal figure effect on the individual's immediate environment as expressed by her reference group median BMI. We start our analysis by examining the total effect, which sums up the direct and indirect effects, of the ideal of beauty body image on young females' BMI, testing hypothesis H1. Then we separate between the direct and indirect effects on BMI, testing hypothesis H2.

The Total Effect of the Ideal of Beauty on Individuals' BMI—Testing H1

Our baseline specification for examining the total effect of the ideal of beauty figure on the individual tendency to gain weight, while controlling for other effects, is given by the following regression model:

$$(5.1) \quad BMI_i = \beta_0 + \beta_I I_{t_i} + \beta_F F_{t_i} + \vec{\beta}_D \cdot \vec{D}_i + \varepsilon_i ,$$

where BMI_i denotes the BMI of respondent i that was sampled at time t_i, I_{t_i} is the ideal of beauty figure BMI at time t_i, F_{t_i} is the lagged level of the food industrialization, measured by per capita aggregate consumption in monetary value that corresponds to time t_i, $\vec{D}_i$ is the i^{th} respondent vector of demographic variables, and ε_i is an error term. The model coefficients were estimated using weighted least squares (WLS) regression analysis. The individual sample weights were calculated using the original NHANES individual sample weights (see section 4 above). More precisely, we defined the individual sample weight as the original NHANES sample weight normalized by the sum of all the original sample weights of those individuals who were sampled in their own survey and were also included in our data base.[10] This definition ensures that the sample weight ratio between any two respondents within the same survey is preserved as in the sample weight ratio in the complete original survey, and it also guarantees that each one of the 12 surveys is equally considered in the analysis.

Table 2 presents the WLS regression results (based on Equation 5.1) where the original and standardized BMIs of young US females between the ages 17 to 35 are the dependent variables. Since there is no available data on individuals' annual income per capita in the household in the most recent NHANES 2011–2012 survey, the results are introduced in two realizations: one in which all the NHANES samples are included, but without the individual income variables (first and third columns) and the other where the NHANES 2011–2012 sample is omitted, but all the demographics variables are included (second and fourth columns). According to our theory, it is expected that individual BMI values will change at different rates over time in different percentiles (the higher the BMI percentile, the greater the change) and, hence, that may be a source to heteroscedasticity. Therefore, in order to infer the statistical significance levels that are based on an unknown distribution of the BMI, we used the bootstrapping method. The negative coefficient of -.5 between the BMI in our samples and the Bond girls' BMI supports the first part of hypothesis H1, that suggests that the slimming figure of the

[10] Note that our database does not consist of all the NHANES respondents, as we focused on the young female segment. Data points with missing explanatory variables were omitted as well.

ideal beauty is likely to contribute to the growing tendency of young females to gain weight. A one-point decrease in the ideal beauty figure BMI is associated with a significant increase of about .5 BMI points among young US females. Our observations imply that the intermingling of the two opposite trends of consistent increase of the level of the food industrialization together with the shrinking body size of the ideal figure over the years, fuels the apparent trend of overweight and obesity (as indicated by the opposite signs of the corresponding regression coefficients: $\beta_F > 0$ and $\beta_I < 0$). While the variation in the level of the food industrialization seems to have a higher impact on the individual BMI compared to the effect of the change in the ideal figure body size, the latter appears to be of the same order of magnitude.

As both the social standards for the desirable figure of the ideal feminine beauty and the level of the food industrialization exhibit temporal trends, our results may suffer from problems of collinearity to some extent. Yet these problems appear to be tolerable since, as shown in Table 2, the variation inflation factors (VIFs) of all variables do not exceed the value of 3.1.[11]

Demographic characteristics of the population do affect individual BMI. Especially more mature, less educated, and poorer consumers are more likely to have higher BMI. The correlation between marital status of young women and their BMIs has changed over the years. Until the mid 90s, young married women's BMI values tended to be higher than that of young unmarried women, while this has gradually reversed in recent decades. This phenomenon seems to be very intriguing, but since it is out of the original scope of this study, we leave it for future research. Further insights and concerns are raised and discussed in Appendix B.

Insert Table 2 about here

While a negative correlation between the ideal of beauty and consumers' BMI was expected and observed at the aggregate level, in the second part of hypothesis H1, we predicted that in the lowest percentiles, this correlation would be reversed and become positive. In order to test this

[11] The VIF is much below the commonly used value of 10 as a base for indication of an undue influence of multi-collinearity and is even less than the value stated by the stringent rule of 5 (see O'Brien 2007 and references therein).

hypothesis, we had to define a range of BMI percentiles within which all individuals in our sample are in the ideal region. However, the temporal shrinkage trend of the body size of the ideal of beauty implies that the BMI percentile range of the ideal figure region has become narrower over the years. Therefore, we had to define a range of BMI percentiles wherein subjects lay within the ideal figure range in all periods. Hence, we focused on the BMI percentile range that is below or equal to the lowest 4th percentile as it defines an intersection of the ideal regions at all times (as demonstrated in Figure 2c above).

In Table 3, we report the WLS regression results for the BMI of young US females in the age range of 17 to 35 in the lowest 4th percentile. Our estimates are based only on data points with a complete vector of explanatory variables. In contrast to the significant negative association at the aggregate level analysis of young females, the effect of the ideal of beauty for this group of women is positive (significant) and in line with the second part of hypothesis H1. That is, we get an indication that the temporal decreasing trend of the body size of fashion models, film actresses, and other celebrities encourages thin young females to become even thinner. This finding is consistent with previous studies (Hesse-Biber, Leavy, Quinn, & Zoino, 2006; Silverstein, Perdue, Peterson, & Kelly, 1986; Stice & Shaw, 1994).

Insert Table 3 about here

Distinction between Direct and Indirect Effects: Testing Hypothesis H2

Our analytical analysis suggests that the level of food industrialization *F* and the BMI of the ideal of beauty *I* affect the individual BMI both directly and indirectly through their impact on peer BMI. As a consequence, we maintain that these direct and indirect effects have also an influence on the median BMI of the individual environment. Let M_{t_i} be the respective median BMI at time t_i in which the individual *i* was sampled. As we focus our empirical analysis on young females between 17 and 35, we define M_{t_i} for each individual *i* as the median of all young females who participated in the i^{th} individual's survey, considering the appropriate NHANES sample weights. It is suggested that:

$$(5.3)\quad BMI_i = BMI(F_{t_i}, I_{t_i}, M_{t_i}, \vec{D}_i)$$

such that $M_{t_i} = M(F_{t_i}, I_{t_i}, \text{Other Variables})$, where F_{t_i} and I_{t_i} are the levels of lagged food industrialization and the figure of the ideal of beauty that correspond to time t_i, respectively and $\vec{D}_i$ denotes the i^{th} individual vector of demographic variables. According to our previous observations, ceteris paribus, we expect that the individual BMI is positively correlated with *F* and negatively correlated with *I* as a result of the direct effects. The BMI is likely to be positively correlated with *M*, which by itself sums up the indirect effects, so that *M* is positively correlated with *F* and negatively correlated with *I*. Thus, a straightforward generalization of the specification 5.1 of the form:

$$(5.4)\quad BMI_i = \beta_0 + \beta_I I_{t_i} + \beta_F F_{t_i} + \beta_M M_{t_i} + \vec{\beta}_D \cdot \vec{D}_i + \varepsilon_i$$

may suffer from severe problems of multi-collinearity. In order to overcome this hitch, we employed a two-stage procedure. In the first stage, we conducted an auxiliary regression, wherein the respective median BMI was regressed vis-à-vis the level of food industrialization and the figure of the ideal of beauty at the time of sampling according to the specification:

$$(5.5)\quad M_{t_i} = b_0 + b_F F_{t_i} + b_I I_{t_i} + \mu_{t_i},$$

where μ_{t_i} is a noise term. We assume that μ_{t_i} captures those effects (on the median BMI) which are uncorrelated with the food industrialization level and the ideal of beauty. Then we calculated the residuals:

$$(5.6)\quad \hat{\mu}_{t_i} \equiv M_{t_i} - \hat{M}_{t_i} = M_{t_i} - \hat{b}_0 - \hat{b}_F F_{t_i} - \hat{b}_I I_{t_i},$$

where the $\hat{b}$ s stand for the WLS regression estimates of the coefficients of the specification 5.5 to give:

$$(5.7)\quad M_{t_i} = \hat{b}_0 + \hat{b}_F F_{t_i} + \hat{b}_I I_{t_i} + \hat{\mu}_{t_i}.$$

In the second stage of our procedure, we plugged the median BMI of the individual environment (given in Equation 5.7) into the main regression model (Equation 5.4) to obtain the specification:

$$(5.8) \quad BMI_i = B_0 + B_I I_{t_i} + B_F F_{t_i} + B_\mu \hat{\mu}_{t_i} + \vec{B}_D \cdot \vec{D}_i + \varepsilon_i ,$$

where $B_0 = \beta_0 + \beta_M \hat{b}_0$, $B_I = \beta_I + \beta_M \hat{b}_I$, $B_F = \beta_F + \beta_M \hat{b}_F$, $B_\mu = \beta_M$ and $\vec{B}_D = \vec{\beta}_D$. These *B*s indicate the total marginal effects from which the direct marginal effects on the individual BMI can be extracted. The model coefficients (the *B*s) were estimated using WLS regression analysis. Then we were able to elicit the direct effects and separate them from the "environmental effect" as follows: $\hat{\beta}_F = \hat{B}_F - \hat{B}_\mu \hat{b}_F$, the marginal direct effect of the food industrialization; $\hat{\beta}_I = \hat{B}_I - \hat{B}_\mu \hat{b}_I$, the marginal direct effect of the ideal of beauty; and $\hat{\beta}_M = \hat{B}_\mu$, the marginal effect of the respective population median BMI. The $\hat{b}$ s and $\hat{B}$ s denote the WLS regression coefficient estimates of the auxiliary and the main regression models (5.5) and (5.8), respectively.

Another source of concern that is worth attention is the apparent endogeneity in the model specification (5.8). Although the median BMI residuals $\hat{\mu}_{t_i}$ are aggregate level variables, and by definition (see Equation 5.6), all the individuals that are sampled at the same time share the same residual value where the contribution of an individual BMI to the median is marginal, one should still take into account that $E(\hat{\mu}_{t_i}\varepsilon_i) \neq 0$. Both the median M_{t_i} and BMI_i are drawn from the same distribution, so the individual BMI implies on the population median. Furthermore, among individuals in the median percentiles, these variables even become identical. Hence, one cannot find proper instrumental variables to resolve this potential endogeneity because any factor that shifts the median BMI should also appear as an exogenous explanatory variable in the individual BMI regression (see specification 5.8). Nevertheless, based on the positive correlation between an individual's BMI and the population median, we posit that $E(\hat{\mu}_{t_i}\varepsilon_i) > 0$ and, hence, the direction of the potential inconsistency in the regression estimates caused by the endogeneity can be retrieved.

More precisely let $y = XB + \varepsilon$ be the regression model 5.8 in a matrix form, where y is a column vector of the dependent variable observations (the individual BMI), X is the matrix of the explanatory variables and a column of ones (where the rows correspond to individual observations), B is the regression coefficients' vector, and ε is the vector of unobservable errors and noise terms. Then the vector of regression coefficients B is retrieved from the WLS estimator $\hat{B}^{WLS}$ via the relation $B = \hat{B}^{WLS} - (X'WX)^{-1}(X'W\varepsilon)$, where the second term on the right designates the regression estimation bias (due to endogeneity). W is the diagonal matrix of the individual sample weights, where the kth component of the vector $X'W\varepsilon$ is given by $(X'W\varepsilon)_k = \left(\sum_i \hat{\mu}_{t_i} w_i \varepsilon_i\right)\delta_{\hat{\mu}k}$, where δ is the Kronecker delta. As $E(\hat{\mu}_{t_i}\varepsilon_i) > 0$, we maintain that $\sum_i \hat{\mu}_{t_i} w_i \varepsilon_i > 0$ and, hence, the direction of the bias estimation of the k^{th} regression coefficient can be retrieved according to the sign of the $k\mu^{th}$ component of the matrix $-(X'WX)^{-1}$.

The explicit estimates of the auxiliary regression according to the estimation of the median (see specification 5.7) are introduced in Table 4, and the main regression results after plugging the median BMI residuals according to specification 5.8 are presented in Table 5. Next, the marginal direct effects of the food industrialization level and the ideal of beauty were separated from the marginal effect of the median BMI based on the auxiliary and the main WLS regressions for young US females ages 17 to 35 for the entire population, as well as for specific percentiles. The results are presented in Table 6. Similar results were obtained in estimations that consider an individual's income. However, including income in the estimates would require giving up the data provided by the last survey NHANES 2011–2012, for which these estimates are missing.

The first column from the left in Table 6 represents the marginal direct effects on the entire population sample. We find that on average the ideal of beauty is not directly associated with ordinary individuals' BMIs, as expected by our theoretical reasoning and in contrast to intuitive expectations. The direct regression coefficient $\hat{\beta}_I$ was found to be statistically insignificant. Yet $\hat{\beta}_I$ <0 is in accordance with the first part of our hypothesis H2. Since it is overestimated, as noted earlier, its actual value should be even more negative. In contrast, a strong positive association with the respective population median BMI was observed and suggests that the representative young females in general are much more affected by their environment, rather than by the figure of the ideal beauty (yet it should be noted that the regression coefficient $\hat{\beta}_M$ is overestimated). Based on our theory, we suspect that for most individuals the ideal of beauty has no any direct effect on their BMI, as it has become an unattainable goal; thus, it cannot be a realistic reference point. Instead, it seems that most individuals compare themselves to their own environment (median BMI). In contrast, direct association with the ideal of beauty is observed only in the low BMI percentiles, as indicated in the next two columns of Table 6. Individuals in this group exhibit positive direct association between their BMI and the figure of the ideal of beauty, while there is no significant association with the median BMI of the population. These results are in accordance with the second part of hypothesis H2. The results imply that unlike most of the young females where the reference group is the population median BMI (environment), the ideal feminine beauty is the reference figure for the thinnest female group (4 percentiles). This association with the figure of the ideal of beauty is reversed and becomes negative in the next percentile tier where the association of the median BMI becomes significant and positive (see the third column of Table 6). According to our theoretical reasoning, if the direct marginal effect of the ideal of beauty becomes more negative, (the thinner the ideal feminine model), then the greater is the individual tendency to gain weight. Acknowledging that we have overestimation between the ideal of beauty and the individual BMI, the actual negative effect we observe is even more intense for most individuals. At the same time, the overestimated association also indicates a weaker positive association between the figure of the ideal of beauty and the individual BMI in the lowest percentiles. Nonetheless, we believe that the bias caused by this overestimation is mild due to the remoteness of the median percentile from those that were analyzed.

Insert Table 4 about here

Insert Table 5 about here

Insert Table 6 about here

DISCUSSION

In this paper, we posit that the effect of media in promoting the ultra-thin body figure as the ideal of feminine beauty is even more critical than previously argued. While previous studies argued that the slim ideal beauty portrayed in the media accelerated eating disorders such as bulimia and anorexia (Stice & Shaw, 1994), in this paper, we suggest that it is also positively associated with the increase in the average BMI.

Scholars tend to agree that the greater the distance between an individual's body weight and that of the "ideal beauty," encapsulated in the figures of celebrities, the greater the feeling of body self-image dissatisfaction, which in turn increases the risk of anorexia and bulimia. We suggest that this argument holds for individuals whose weight posits them in the lowest percentiles of weight distribution (very slim consumers). In contrast to that effect, for most of the population, the growing distance between self and ideal body weights is likely to result in a loss of relevance of the ideal beauty figure. Thus, instead of referring to the ideal beauty figure, consumers now refer to the average, which continues to grow over time. That is, we maintain that the dramatic increase of the prevalence of overweight among youngsters and particularly young females exhibits a strong contagious effect. As for most people, the image of the ideal of beauty becomes an unachievable goal; individuals are then influenced by their own immediate environment and tend to become overweight.

Our empirical findings that obesity is accelerated by a constantly increasing median BMI suggest that this process exhibits a form of epidemic. These findings are consistent with Christakis and Fowler (2007). We add to their findings a theoretical reasoning for the emergence of person-to-person spread of overweight. If we observe that the median of the population serves as the relevant reference point, then we automatically accept the idea that obesity is a form of epidemic and, therefore, it can also be viewed (and modeled) as a diffusion type problem where the number of adopters is replaced with the number of overweight individuals.

Combining observations from three datasets allow us to show that for most consumers a negative correlation between body mass and the weight of the ideal beauty is observed, while a positive correlation between individuals' BMI and the average reference point is documented. Our data is also consistent with previous studies, which have suggested that underweight models and actresses promote anorexia. When we analyze the effect of the two reference points on the weights of individuals who are in the low weight percentiles of weight distribution, we find that indeed the median reference point of weight is not relevant, while the ideal beauty is the relevant reference.

When combining these effects with the index of eating outside the household, which serves as an index for food industrialization (see our explanation in Section 4), that has been related in past studies to gaining weight (Pereira, et al., 2005; Young & Nestle, 2002), we find that the effects of the ideal of beauty and the median weight reference points on the individual weight are not cancelled. (i.e. they are statistically significant). Therefore, we cannot reject that the slimming trend of models and actors provides an additional explanation other than dining out.

One obvious limitation of our study is the nature of our data that is historical and not in the form of control and manipulation groups. This leads to having correlation-based empirical support, rather than showing what is the cause and what is the result. One can always argue that choosing ultra-slim models is a response to the desire of the fashion and glamour industry to differentiate itself and its showcase models and is done by selecting a trend opposite to that of ordinary consumers. But even if this is true, we maintain that the choice of the ideal thin model by itself plays a part in the excess prevalence of overweight, as the distance between the ideal and the average individual figure becomes larger. The question of why the industry chooses to promote ultra-thin female bodies remains unsolved, and it is certainly an interesting research topic per se.

Our focus on young females allowed us to focus on physical appearance as a motive, ignoring health considerations. With older consumers, this is certainly not the case, and future research could focus on older consumers, combining health considerations with our reference point. This of course requires having datasets that include actual measurements of health, BMI, age, and medical treatments.

From a policy perspective, more individuals are exposed to health threats due to overweight-associated illnesses and risks relative to a much smaller percentage of the lower percentile of weight group (underweight individuals who are exposed to the risk of anorexia). Thus, our findings suggest that the effect of slimmer ideal beauty is much larger than previously estimated. The fashion and entertainment industries are called to consider more responsible behavior when taking into account the effect on social welfare. Given our results (and hopefully following studies), regulators may ban pictorial advertisement of slim models in the media.

Our findings do not suggest that companies should build their image exactly according to the median (how the "normal" person looks), but they certainly do suggest that the difference between the positioning of the brand via its presenters and the average customer should not be too large. The failure of the "dress normally" campaign of The Gap was associated with its positioning as "be yourself, dress normally," whereas the reason one buys a fashion item is to improve attractiveness and come closer to ideal beauty. Buying normal does not help us improve physical attractiveness unless one is already as beautiful as the presenters are in the first place.[12]

From a more general perspective, our use of ultra-slim fashion models has began to be irrelevant since it is unachievable for the majority of the population, it is just an example of a social norm that sets a reference point to be followed. According to our observations, if a social standard is set in a region that is hard to achieve, then it is likely to be used only by a small proportion of the target market. This supposition also goes in line with other research that points out that while consumers develop a strong attachment to brands, they must enhance the feeling of autonomy and relatedness in order to maintain a strong consumer–brand relationship, as well (Thomson 2006); otherwise, the use of highly attractive models in advertising may even arouse feelings of loathing among consumers towards both the models and the brand (Bower 2001). That is, building more relevant figures of the ideal of beauty may be beneficial for both firms at the microlevel, as well as for society as a whole.

[12] http://www.independent.co.uk/news/business/news/gap-dress-normal-campaign-fails-to-lift-sales-9907025.html http://www.boston.com/life/fashion/2014/11/07/gap-dress-normal-campaign-isn-working-because-normal-people-don-want-normal/QlZCmU9Q2sbYUX1Su0uUjP/story.html

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Figures:

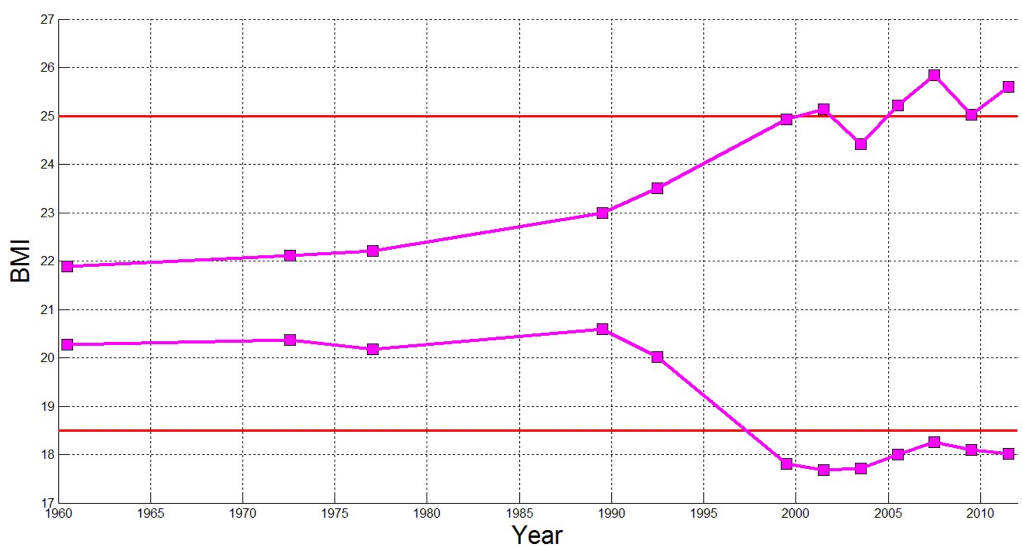

Figure 1. The median figure BMI of young US females (ages 17 to 35) over the years: The data points are in accordance with NHANES survey times. The upper solid line represents the median BMI in the population, and the lower solid line denotes the 10-year moving average of Bond girl BMIs. The

upper and the lower horizontal lines represent the clinical BMI values that denote overweight (25) and underweight (18.5), respectively.

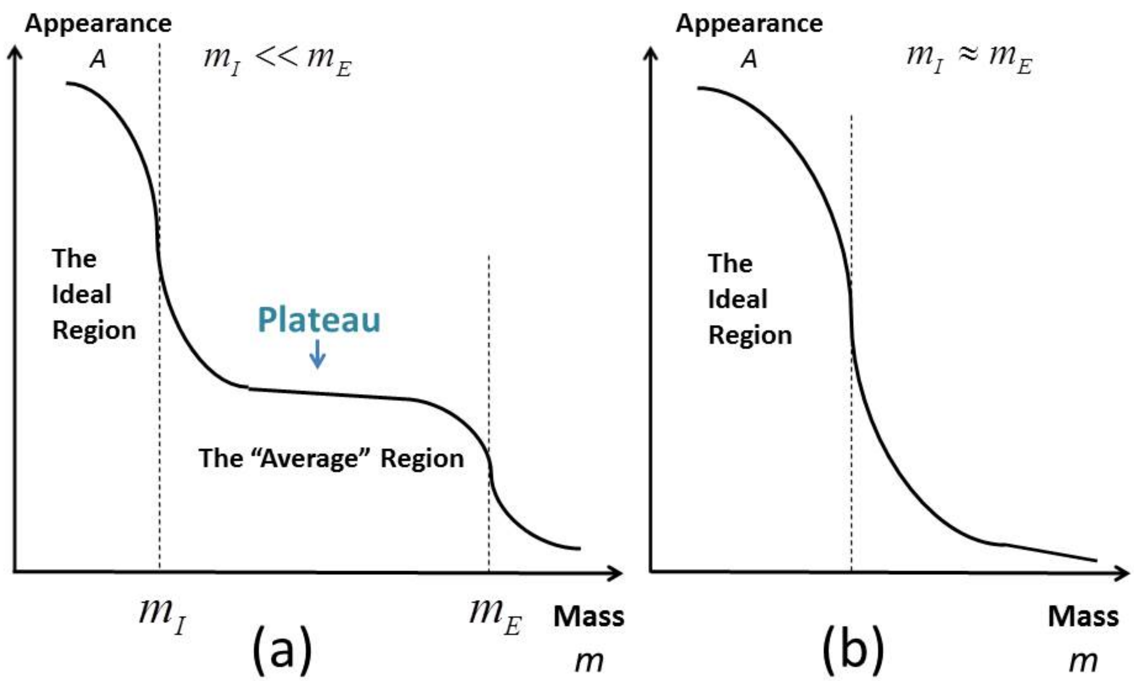

Figure 2. The individual self-image of appearance: (a) When the ideal and the average figures are far apart, the plateau is very wide. (b) When the ideal and the average figures are close, the plateau disappears, and the ideal figure is the only reference point.

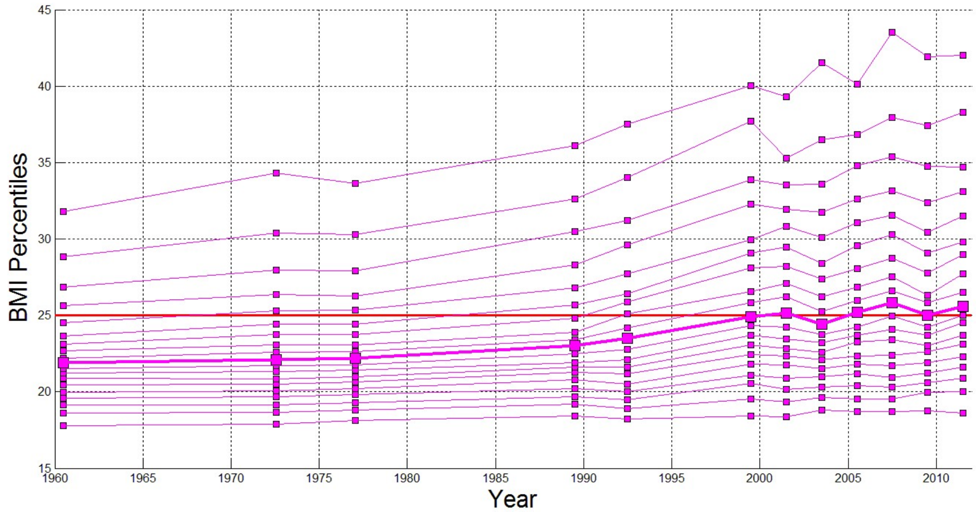

Figure 3. Descriptive statistics of the NHANES data: the BMI of young females (ages 17 to 35). The curves indicate BMI percentiles in steps of 5% from the lowest 5% to the highest 5% percentile.

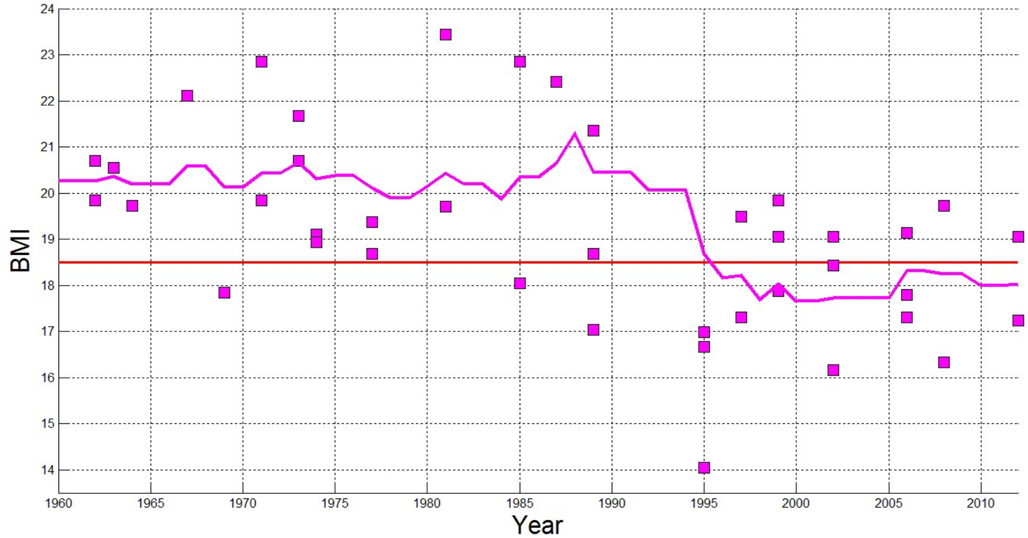

Figure 4a. The ideal figure BMI over the years where Bond girl BMIs are given as a proxy. The solid line represents 10-year moving average of Bond girl BMIs. The specific observations are marked as squares.

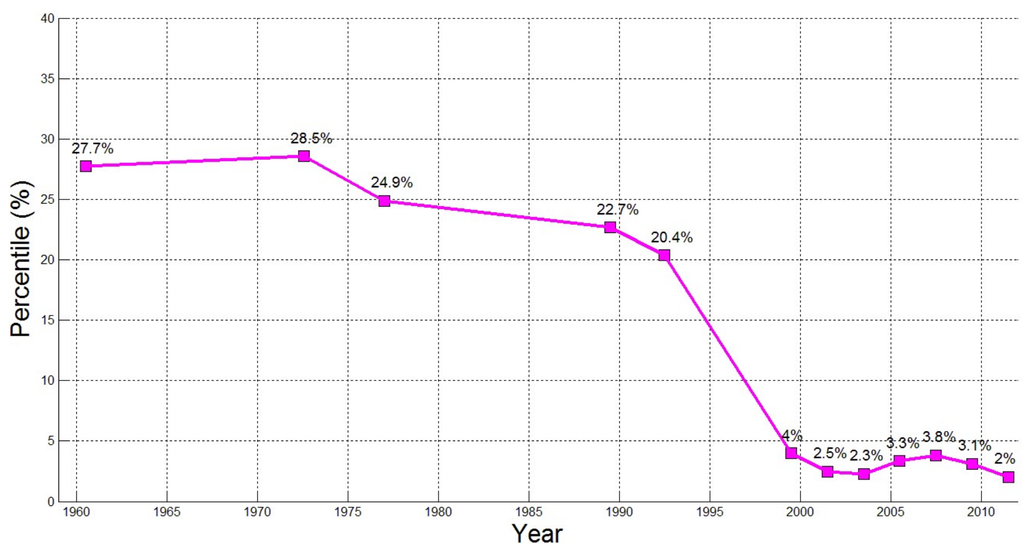

Figure 4b. The ideal figure BMI percentiles since 1960 is obtained on the basis of the Bond girl BMI proxies. The data points are in accordance with NHANES survey times.

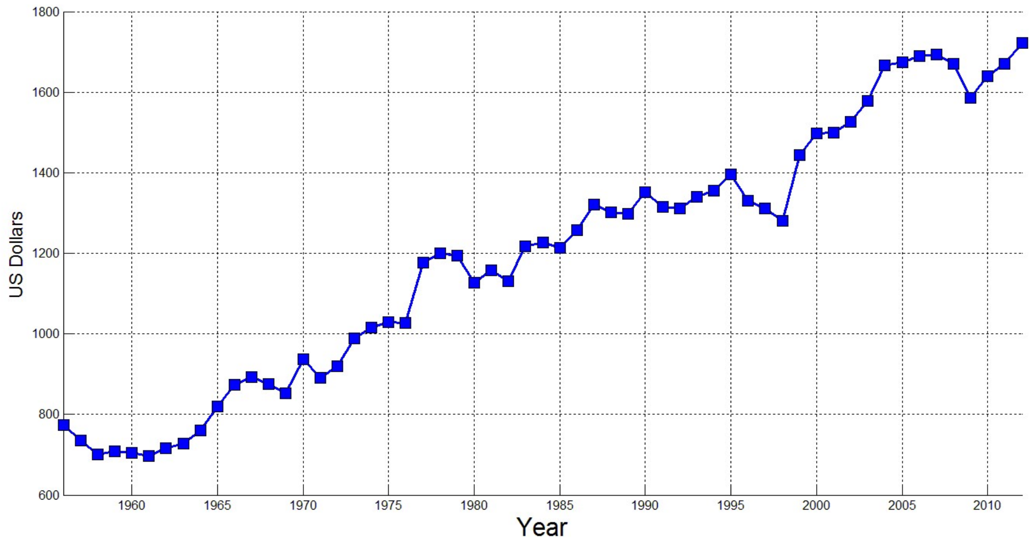

Figure 5. The per-capita discounted annual sales in eating and drinking places in the US since 1960.

Tables:

TABLE 1: DESCRIPTIVE STATISTICS OF THE NHANES DATA: YOUNG FEMALE (AGES 17 TO 35) DEMOGRAPHICS

Survey	Sample Size	Average age[(1)] (STD[(1)])	Proportion of Whites[(1)]	Proportion of African Americans[(1)]	Proportion of Hispanic Latino Americans[(1)]
NHES 1959–1962	1234	26.63 (5.31)	85.9%	11.8%	NA
NHANES I 1971–1975	4303	26.78 (5.18)	81.6%	11.3%	5.8%
NHANES II 1976–1980	2483	25.4 (5.35)	79.6%	12.1%	6%
NHANES III – Phase A 1988–1991	1661	26.25 (5.45))	72.7%	14.2%	6.3%
NHANES III –	1938	26.41 (5.35)	66.6%	14.7%	7.4%

Phase B 1991–1994					
NHANES 1999–2000	874	26.28 (5.71)	64.1%	12.4%	19.6%
NHANES 2001–2002	922	25.97 (5.51)	63.5%	13.7%	18.2%
NHANES 2003–2004	910	25.97 (5.69)	66.3%	14.1%	14.7%
NHANES 2005–2006	962	26.15 (5.65)	61.9%	15.2%	16.1%
NHANES 2007–2008	850	25.95 (5.44)	63%	14.3%	17.7%
NHANES 2009–2010	1010	25.84 (5.31)	58.4%	14.7%	18%
NHANES 2011–2012	886	25.74 (5.4)	56.2%	14.8%	19.9%
Total	18033	26.09 (5.47)	68.3%	13.6%	13.6%

TABLE 1 (CONT.): DESCRIPTIVE STATISTICS OF THE NHANES DATA: YOUNG FEMALE (AGES 17 TO 35) DEMOGRAPHICS CONT.

Survey	Proportion of individuals with above high school education(1) (N(2))	Proportion of married individuals(1) (N(2))	Average discounted annual income per capita in the household(1) (1000$'s) (STD(1), N(2))
NHES 1959–1962	20.3% (1229)	70.5% (1234)	12 (8.5,1111)

NHANES I 1971–1975	33.8% (4286)	66% (4301)	19.1 (14.6,4174)
NHANES II 1976–1980	40.8 (2467)	52.6% (2479)	19.1 (13.6,2402)
NHANES III – Phase A 1988–1991	38.9% (1650)	53.8% (1658)	17.8 (14.6,1637)
NHANES III – Phase B 1991–1994	40.3% (1931)	52.3% (1935)	16.1 (12.7,1904)
NHANES 1999–2000	50.9% (873)	44.3% (817)	14.3 (13.5,811)
NHANES 2001–2002	50.3% (921)	48.5% (922)	16.3 (15.6,890)
NHANES 2003–2004	57% (910)	46% (910)	14.5 (13.4,887)
NHANES 2005–2006	56.7% (962)	51.7% (962)	15.9 (13.3,928)
NHANES 2007–2008	56.2% (849)	52.4% (664)	17.3 (14.8,810)
NHANES 2009–2010	56.3% (1010)	50.7% (801)	15.7 (15.3,957)
NHANES 2011–2012	66.4% (886)	54.1% (684)	NA
Total	47.3% (17974)	53.6% (17367)	16.2 (14,16511)

(1) The representative sample weights, which were used by NHANES were taken into account in the calculations of Table 1.

(2) N denotes the number of available data points.

TABLE 2: WLS REGRESSION RESULTS: BMIS OF YOUNG US FEMALES AGES 17 TO 35

Independent variables:	Dependent variable: Individual BMI		Dependent variable: Individual standardized BMI	
	Partial model	Full model	Partial model	Full model
Age	.2043***/###	.2065***/###		
Standardized age			.1587***/###	.1632***/###
African-American	3.1795***/###	3.0139***/###	.4665***/###	.4460***/###
Hispanic	1.2135***/###	1.3324***/###	.1781***/###	.1971***/###
Other	-1.1930***/###	-.8182***/###	-.1751***/###	-.1211***/###
Above high school education	-1.2554***/###	-1.1742***/###	-.1842***/###	-.1737***/###
Married	-.1584/#	-.2498**/##	-.0232/#	-.0370**/##
Discounted annual income per capita in the household (10^3 $s)		-.0149*/##		
Square of the discounted annual income per capita in the household (10^3 $s)^2		.0001		
Standardized discounted annual income per capita in the household				-.0307*/##
Standardized square of the discounted annual income per capita in the household				.0142
Food industrialization level annual discounted sales per capita (10^2 $s)	.4050***/### (VIF=3.09)	.3821***/### (VIF=2.89)		
Standardized food industrialization level (discounted sales per capita)			.1822 ***/### (VIF=3.09)	.1728***/### (VIF=2.89)
Ideal figure BMI	-.5095***/### (VIF=3.00)	-.5119***/### (VIF=2.82)		
Standardized ideal figure BMI			-.0882***/### (VIF=3.00)	-.0904***/### (VIF=2.82)
R2	.1251	.1209	.1251	.1209
Number of observations	17,313	16,033	17,313	16,033

*p<0.1 **p<0.05 ***p<0.01 # Bootstrap p<0.1 ## Bootstrap p<0.05 ### Bootstrap p<0.01

TABLE 3: WLS REGRESSION RESULTS: BMI OF YOUNG US FEMALES AGES 17 TO 35 BELOW THE LOWEST 4% PERCENTILE AS DEPENDENT VARIABLE

Independent variables:	Dependent variable: Individual BMI	
	Partial model	Full model
Age	.0183***/###	.0097#
African-American	.0554	.0568
Hispanic	-.1372	-.1817
Other	-.1220#	0.1283*/#
Above high school education	.1672***/###	.1415**/##
Married	-.1859***/###	-.1227/#
Discounted annual income per capita in the household (10^3 $s)		-.0022
Square of the discounted annual income per capita in the household (10^3 $s)^2		.0002
Food industrialization level annual discounted sales per capita (10^2 $s)	.1114***/###	.0901***/###
Ideal figure BMI	.1196***/###	.0916**/##
R2	.1510	.1205
Number of observations	633	578

*p<0.1 **p<0.05 ***p<0.01 # Bootstrap p<0.1 ## Bootstrap p<0.05 ### Bootstrap p<0.01

TABLE 4: THE AUXILIARY REGRESSION RESULTS (ACCORDING TO THE SPECIFICATION 5.7): THE MEDIAN BMI OF YOUNG US FEMALES AGES 17 TO 35 AS A DEPENDENT VARIABLE

Food industrialization level annual discounted sales per capita (10^2 $s)	.2613***/###
Ideal Figure BMI	- .5088***/###
R2	.9230
Number of observations	18,033

*p<0.1 **p<0.05 ***p<0.01 # Bootstrap p<0.1 ## Bootstrap p<0.05 ### Bootstrap p<0.01

TABLE 5: ESTIMATING SPECIFICATION 5.8: THE BMI OF YOUNG US FEMALES AGES 17 TO 35 AS A DEPENDENT VARIABLE

	The entire population	The lowest percentiles below or equal to 4%	The percentile range between 4% to 25%
Age	0.2010(u)***/###	0.0178 (u)**/####	0.0057 (u)*/##
African-American	3.1636(u)***/###	0.0534 (u)	0.1148 (u)**/##
Hispanic	1.1816 (u)***/###	- 0.1379 (o)	0.0959 (u)*/#
Other	- 1.239 (u)***/###	0.1156 (u)#	- 0.0666 (u)
Above high school education	- 1.263(u)***/###	0.1690 (o)***/###	0.0646 (o)**/##
Married	- 0.1731 (u)/#	- 0.1826 (o)**/###	0.0820 (u)**/##
Food industrialization level annual discounted sales per capita (10^2 $s)	0.4060 (o)***/### (VIF=3.09)	0.1116 (o) ***/###	0.1067 (u)***/###
Ideal figure BMI	- 0.5096(u)***/### (VIF=3.00)	0.1199 (o)***/###	-0.1914 (u)***/###
Median BMI residuals	0.8821 (o)***/### (VIF=1.01)	0.0714 (o)	0.1006 (o)** /###
R2	0.1276	0.1521	0.2795
Number of observations	17,313	633	3,364

*p<0.1 **p<0.05 ***p<0.01 # Bootstrap p<0.1 ## Bootstrap p<0.05 ### Bootstrap p<0.01

(u) The regression coefficient is underestimated.

(o) The regression coefficient is overestimated.

TABLE 6: THE IDEAL OF BEAUTY VS/ THE MEDIAN BMI EFFECTS: THE BMI OF YOUNG US FEMALES AGES 17 TO 35 AS A DEPENDENT VARIABLE

	The entire population	The lowest percentiles below or equal to 4%	The percentile range between 4% to 25%
Food industrialization level annual discounted sales per capita (10^2 \$s) The direct effect: $\hat{\beta}_F = \hat{B}_F - \hat{B}_\mu \hat{b}_F$	0.1755 (u)***/###	0.0929 (u)**/##	0.0804 (u)***/###
Ideal figure BMI The direct effect: $\hat{\beta}_I = \hat{B}_I - \hat{B}_\mu \hat{b}_I$	- 0.0608 (o)	0.1562 (o)***/###	- 0.1402 (o)***/###
Median BMI The direct effect: $\hat{\beta}_M = \hat{B}_\mu$	0.8821 (o)***/###	0.0714 (o)	0.1006 (o)**/###
Number of observations	17,313	633	3,364

*p<0.1 **p<0.05 ***p<0.01 # Bootstrap p<0.1 ## Bootstrap p<0.05 ### Bootstrap p<0.01

(u) The regression coefficient is underestimated.

(o) The regression coefficient is overestimated.