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THE WEIGHT OF SUCCESS: THE BODY MASS INDEX AND ECONOMIC WELL-BEING IN SOUTHERN AFRICA

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We show that body mass increases with economic resources among most Southern Africans, although not all. Among Black South Africans the relationship is non-decreasing over virtually the entire range of incomes/wealth. Furthermore in this group other measures of "success" (e.g., employment and education) are also associated with increases in body mass. This is true in both 1998 (the Demographic and Health Survey) and 2008 (National Income Dynamics Survey). A similar relationship holds among residents of Lesotho, Swaziland, Mozambique, Malawi, and Namibia. This suggests that body mass can be used as a crude measure of well-being. This allows us to examine the vexed question in South African labor economics whether there is involuntary unemployment. The fact that the unemployed are lighter than the employed, even when we control for household fixed effects, suggests that they are not choosing this state.

JEL Codes: D31, I19, I32

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1. Introduction

Obesity has been increasing across the world. In developed countries it has become one of the main public health issues. Nevertheless it has increased even in developing countries, arguably because of changes in diet and activity levels (Popkin, 1999). Many South Africans, even poor ones, have a high body mass (Puoane *et al*., 2002; Case and Deaton, 2005; Ardington and Case, 2009). This has led to an increase in the prevalence of hypertension and strokes in contexts where one might not have expected to see this (Kahn and Tollman, 1999). Indeed, it has been claimed that excess body mass is the fifth most important risk factor for chronic disease in South Africa, as measured by DALYs (Bradshaw *et al*., 2007, table 1, p. 646).

Understanding some of the correlates of high body mass is therefore useful purely from a health perspective. But the rapid increase in obesity around the world has become the focus of attention not only of health researchers. Increasing numbers of social scientists have also started to explore the economic correlates of

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the increase in body weight. In developed countries a negative relationship between income and obesity has been observed (Sobal and Stunkard, 1989; McLaren, 2007). On the other hand it seems clear that across countries obesity is positively correlated with income. Indeed in developing countries it is typically the case that high body mass is associated with more affluent individuals (Sobal and Stunkard, 1989; McLaren, 2007).

This "stylized fact" underpins an emerging literature which uses body mass index (BMI) as a direct marker of economic well-being (Araar *et al.*, 2009; Sahn and Younger, 2009; Molini *et al.*, 2010). Critical to the success of that strategy is the idea that the relationship between BMI and economic well-being is non-decreasing. This is, of course, an empirical question and South Africa provides an interesting setting for examining these effects. First, it has high levels of inequality. This means that there is a section of the population (largely the White sub-population) that has incomes and standards of living comparable to those found in developed societies, where we might expect BMI to decline with income. Furthermore this sub-group has historically identified itself with the lifestyles and norms of high income groups in OECD countries. Within the Black South African majority there is also a wide range of incomes which will give us some power to analyze these relationships. Norms and values within this group however, will be less evidently "westernised." Second, we have information from two surveys ten years apart, so that the socio-economic and cultural changes attendant on the removal of apartheid will have had a chance to work. We will be particularly interested whether there is an observable shift in the sign of the association between obesity and income, for example from positive correlation to a negative one. Finally, obesity is becoming a demonstrable problem, even in communities in which poverty seems to be widespread, so that understanding the nexus between obesity and economic factors is useful, simply from a public health perspective.

This paper has two main objectives. In the first place we seek to analyze the relationship between measures of economic well-being (such as incomes, employment, and education) and body mass. We will show that for Black South Africans this relationship is to all intents and purposes monotonic. Indeed we will show that this relationship is not unusual—it is the patttern in other Southern African countries also. Furthermore we produce evidence which suggests that, on average, Black South Africans desire a high body mass. This legitimizes the use of BMI as a marker of economic "success." It allows us to use the results of our analysis to reflect again on a longstanding debate within South African labor economics: the extent to which unemployment can be characterized as "voluntary" or not. Since employed individuals are, on average, heavier than unemployed or not economically active ones, our evidence suggests that unemployment is, indeed, involuntary.

Our results have rather troubling public health implications. To the extent to which economic success is measured by girth, we are likely to see increases in obesity, at least in the near future, with the attendant implications for disease.

2. Literature Review

A number of authors have tried to explain the increase in obesity observed internationally. Popkin (1999) has argued that urbanization has led to changes in diets and activity patterns which are implicated in the rise of body mass. Of course this does not explain why urban people should be consuming a different diet. Chou *et al*. (2004) have suggested that changes in the operative prices—and in particular the opportunity costs of time spent cooking at home—are sufficient to explain increases in the rate of consumption of take-out foods and hence obesity. Cutler *et al*. (2003) argue that it is technological changes in the way food is prepared, allowing it to be accessed within the home much more quickly, that are the causal factor. Philipson and Posner (2003) and Lakdawalla *et al*. (2005) argue that it is technological changes in the workplace which are to blame. In the past individuals had to expend considerable calories in order to obtain their food. Modern machinery has meant that the caloric costs of acquiring food have come down rapidly.

Sahn and Younger (2009) have argued that whether increases in body mass have occurred because of access to more calories, because of reduced exposure to disease or parasites, or due to reduced work loads, the outcome is a summary measure of well-being which has the virtue of being capable of direct measurement. In particular it can be measured on different people in the same household without making assumptions about how consumption or income is allocated between individuals. Furthermore, unlike income or expenditure, body mass is not subject to the same level of reporting bias. Indeed it can be measured directly by a competent observer without being unduly intrusive. Because of these measurement advantages Sahn and Younger (2009) have suggested that body mass is uniquely placed to throw light on intrahousehold allocation issues. Araar *et al*. (2009) have used this method to explore inequality in Namibia. They came to the startling conclusion that "intra-household inequality is much larger than inequality between households and represents about 57% of total inequality" (Araar *et al*., 2009, p. 37). Similarly Molini *et al*. (2010) used BMI to explore who was the primary beneficiary of Vietnam's economic growth.

One of the key assumptions made in these papers is that well-being is non-decreasing in body mass. Sahn and Younger concede that:

> This may not be the case for BMI: there is a threshold above which too much body mass is unhealthy. However, despite the negative health effects of obesity, BMI still measures, at least in one dimension, the allocation of resources within the household relative to need. A second problem is that BMI captures only a part of household consumption that relate to food and health status.
>
> Practically, for the developing countries included in our analysis, these problems are not too severe. Food consumption is a large part of overall household consumption, and obesity remains very low, afflicting less than a few per cent of each sample. (Sahn and Younger, 2009, p. S16)

The last statement is palpably false for South Africa ((Puoane *et al*., 2002; Case and Deaton, 2005; Ardington and Case, 2009). But there is an additional problem with the argument. It is not clear that heavier individuals always have superior control over resources: if that was true then poor Americans (who eat fast and fatty foods) would be assumed to have access to better resources than rich Americans (who snack on health foods and go to the gym). If body mass is thought of as the outcome of an individual "energy balance" equation (Cutler *et al*., 2003;

Chou *et al.*, 2004; Bleich *et al.*, 2008), then access to resources will affect both what type of energy is acquired (on the "input" side) and what type of active leisure can be pursued (on the "expenditure" side).

Furthermore, once individuals and households have enough resources to afford to get themselves out of the "underweight" category, there is an element of individual optimizing choice about what level of body mass they would like (for a model along these lines, see Lakdawalla *et al.*, 2005). In contexts where the availability of calories is no longer a binding constraint, it is therefore not clear that differences in body mass between individuals are a reliable reflection of differences in access to resources. Ignoring issues such as differences in the metabolic rate, they are this only if individuals *desire* (on average) to be heavier. This is, at least in principle, an issue that can also be empirically explored.

In the case of South Africa, there are several studies which provide evidence that in fact a higher body mass is preferred to a lighter one. Puoane *et al.* (2005) did detailed interviews with 44 community health workers in Khayelitsha, Cape Town. The majority of these workers were obese (BMI > 30) or extremely obese (BMI > 40). Most did not perceive themselves to be overweight and preferred to be heavy. Thinness was thought to be a mark of disease or neglect. A companion study (Chopra and Puoane, 2003, pp. 25–6) found that healthier styles of cooking (e.g., boiling) were perceived as markers of "backwardness." Another study reported that

> few overweight and obese women view themselves as overweight, and that moderately overweight women are perceived by the community as attractive, and that this is associated with respect, dignity and affluence. (Kruger *et al.*, 2005, p. 493)

Case and Menendez (2009) conducted a survey of over 1000 adults in approximately 500 households, also in Khayelitsha, in which they explored *inter alia* desired body shapes. Stylized shapes with varying degrees of heft could be compared to the actual body mass collected in the survey. The authors suggested that:

> Finally (and more speculatively), women's perceptions of an ideal female body are larger than men's perceptions of the ideal male body, and individuals with higher ideal body images are significantly more likely to be obese. On average, South African Black women report that their body size accords with their ideal at a body mass index (BMI) of 30, the lower bound of the World Health Organizations definition of obesity. (Case and Menendez, 2009, p. 3)

Mciza *et al.* (2005) also investigated body images in a sample of women. They found that Black women's idea of "normal" was centered on a heavier shape than was the case for either White or Colored women. On the whole Black women were less dissatisfied with their weight than White women. White women were thinner, but desired to be yet lighter.

The last study should alert one to the fact that the relationship between resources and actual weight is unlikely to be the same across the entire South African population. White women (who on the whole will be much more affluent than Black ones) are likely to take much stronger action to curtail their weight. Indeed this pattern will be confirmed in our empirical data.

3. Research Questions and Methods

The primary question of our research is to what extent it is permissible to use BMI as a marker for economic well-being. BMI is defined as weight (in kg) divided by the square of height (in meters). BMI is typically divided into ranges, with values under 18.5 categorised as underweight, 18.5 to 25 as normal, between 25 and 30 as overweight, and above 30 as obese (see, for instance, Sahn and Younger, 2009). More particularly, we will be concerned to analyze whether the relationship between BMI and economic resources is (on average) non-decreasing, or whether there is a turning-point. We will also analyze whether this relationship is congruent with choice, i.e. does it appear that given additional resources people would choose to be heavier?

A secondary question is whether the nature of this relationship has changed over the ten-year period between 1998 (using the data of the Demographic and Health Survey, DHS 1998) and 2008 (using the National Income Dynamic Survey, NIDS 2008). Given the many economic and social changes over the post-apartheid period, it might be supposed that the relationship between body mass and economic well-being might have changed.

Third, we consider whether the patterns that we observe in the South African data are likely to be a product of South Africa's peculiar history. To that end we rerun our core analyses on the Demographic and Health Surveys from a range of other Southern African countries. We chose all of South Africa's neighbors, with the exception of Botswana, whose DHS was last conducted in 1988 and whose data is not readily available, and Zimbabwe. The latter country was excluded because Pimhidzai (2011) has argued that the economic crisis after 1999 had marked effects on anthropometric measures.

A final question is how the well-being of unemployed individuals compares to that of employed ones, when using body mass as metric of well-being. Clearly this question is premised on the idea that BMI can usefully proxy for economic resources. The answer to this question has a bearing on whether the unemployed should be construed to be "voluntarily" unemployed.

In order to begin to analyze the first question we need to deal with the fact that the Demographic and Health Survey does not have any income information. There is, however, information about assets in the household questionnaire. This allows us to construct an "asset index" as advocated by Filmer and Pritchett (2001). In separate work, we have compared the performance of such asset indices to the results that would be obtained using household expenditure and concluded that the asset indices perform remarkably well (Wittenberg, 2009, 2011a).

Our first set of analyses comprise non-parametric regressions of BMI on the asset index (in the Demographic and Health Surveys) or log household income (in NIDS 2008). Given the indications in the literature that the relationship may be different in different subpopulations, these relationships are analyzed separately by gender. In many of the other countries' DHSs we only have body mass for women in any case. In our main South African regressions we also disaggregate by race, since "White" and "Black" South Africans were historically segregated and had very different incomes and cultural reference-points. Only the "Black" and "White" subsamples are used, because there are too few "Colored" or

"Indian" respondents in these surveys. The purpose of this analysis is to determine whether the bivariate relationship looks monotonic or not. The estimator used is a local linear regression estimator with the plug-in bandwidth and Epanechnikov kernel. Due to instabilities of the estimator in regions where the density of x values is low, the relationship is graphed from the 1st to the 99th percentile of the distribution of the x variables.

The relationship is then analyzed parametrically, by estimating a regression of BMI on the asset index (DHS 1998) or log household income (NIDS 2008). To make these regressions less subject to outliers, we "winsorize" the variables at the 1st and 99th percentile. Other variables included are a quadratic in age, education completed (in years), an indicator of whether the person is employed, number of children and number of adults in the household, an indicator of whether the person is a smoker, and indicators for province. The specification is broadly comparable to regressions estimated by other authors (Chou *et al.*, 2004; Lakdawalla *et al.*, 2005; Ardington and Case, 2009). We also examine whether or not the inclusion of quadratic terms in the asset index or log household income change the basic picture. Unlike some of these authors we do not maintain that the relationships are the same in all subgroups. Consequently we also estimate separate regressions by gender and race. It should be noted that in at least one study (Cawley, 2004) BMI was on the right-hand side of the regression with certain economic outcome variables on the left-hand side, notably employment and hourly wage. The underlying intuition is that a high body weight may impact on productivity; alternatively, in a society where obesity is stigmatized, it may be more difficult for overweight women to gain employment or to demand appropriate remuneration. Given the fact that we find a positive relationship between BMI and employment, this particular "reverse" relationship is unlikely to be operating, or if it is, it is likely to be a second order effect. Could it be that employers actively discriminate *in favour* of overweight individuals? Given that most employers in South Africa are White, and that in this community high body mass is not valued, this is unlikely.

In our regressions we will be particularly concerned to analyze the relevance of assets/income in terms of both size (economic significance) and statistical significance. In the regressions including the quadratic terms we will estimate the "turning point" in the relationship and calculate what fraction of our sample would fall into the range where BMI rises with resources.

Besides these cross-sectional regressions we also run household fixed effects and random effects regressions. These are designed to investigate whether the observed relationship between employment status and weight is merely an artefact of the way in which employed and unemployed/not economically active people are sorted into different households, or whether this relationship holds up within households. In order to estimate these we restrict our sample to Black South Africans only. Furthermore we pool men and women, but allow separate age-profiles for these two groups. Empirically the age profiles look quite different by gender (Ardington and Case, 2009, fig 1, p. 5). The fixed effects specification makes least assumptions, but it sacrifices the ability to look at the relationship with economic resources. The random effects specification assumes that the household level effects are normally distributed and independent of the other explanatory variables. This set of stringent assumptions may be problematic. The results are qualitatively not that different, although a bit sharper in the random effects version. The fixed effects estimates will be more conservative but probably more robust.

We rerun the fixed effects regressions and the standard linear cross-sectional regressions on nine Demographic and Health Surveys from other Southern African countries to check whether the results that we achieved in South Africa are due to its peculiar history or are an artefact of the transition from apartheid.

In order to make the case that BMI is a reasonable marker for economic "success" we would like to show that, on the whole, a heavier body mass is valued, or at least, not stigmatized. To that end we use a variable in the DHS that records whether the respondent thought that they were "underweight," "normal," or "overweight." We run non-parametric (local linear) regressions of dummy variables for the first and third category on actual BMI. We then investigate this relationship parametrically by means of ordered probits with BMI as explanatory variable as well as education (in years), a quadratic in age, employment status, assets/income, and the number of children in the household. We run separate regressions by race and gender.

4. Data

4.1. *DHS 1998*

The Demographic and Health Survey is a nationally representative sample of approximately 12,000 households. In the selected households every woman between the ages of 15 and 49 was interviewed about childbearing, contraception, and attitudes to family planning. In every second household an "Adult health questionnaire" was administered which has information on health seeking behavior, clinical conditions, occupational health, health-related habits as well as anthropometrics. For this all adults aged 15 and over were interviewed. The survey was designed to collect information on about 12,000 women aged 15–49 and 13,500 adults (SADHS98, 2001, pp. 4–5). The sample was stratified by province and urban–rural. Because of the complex nature of the sample, the sample weights released with the Adult Health Questionnaire will be used in the analyses. For our analyses we restrict the age range to be above 20, given that heights change little after that time. We therefore do not need to adjust the BMI values for age.

While the health information in the survey is very rich, the socio-economic information is rudimentary to say the least. In particular there is no information about incomes or expenditures. As noted above we create an asset index to proxy for household wealth and/or income.

The other variable that is poorly measured is labor market status. The household roster contains one question on whether the individual worked for pay in the last seven days. The adult health module has a question (in the occupational health section) asking "In the last 12 months, have you worked for payment?" There is no additional information that might enable one to determine whether an individual is unemployed or not economically active, or indeed whether an individual might be employed informally or seasonally. We have chosen to work with the looser (i.e., 12 month) definition of employment, to capture any casual or seasonal workers.

TABLE 1
Summary Statistics from DHS 1998

Variable	All Mean	All Min	All Max	BW Mean	BM Mean	WW Mean	WM Mean
bmi	26.2	10.0	108.5	28.1	23.5	27.2	27.0
obese	0.239	0	1	0.346	0.092	0.281	0.232
overweight	0.257	0	1	0.271	0.205	0.291	0.408
height (cm)	162.6	78	198.4	157.9	167.5	163.3	177.4
age	41.2	20	95	40.3	39.9	48.6	47.2
hhsize	4.84	1	27	5.29	4.86	3.20	3.11
educ	7.76	0	15	6.98	7.24	11.61	12.02
asset1	0.140	−1.608	2.853	−0.211	−0.205	1.777	1.722
employed	0.410	0	1	0.275	0.464	0.496	0.721
numadults	3.08	1	13	3.05	3.19	2.63	2.59
children	1.75	0	16	2.24	1.67	0.57	0.52
smoker	0.283	0	1	0.068	0.482	0.254	0.401
female	0.579	0	1				
black	0.741	0	1				
coloured	0.114	0	1				
asianind	0.039	0	1				
n		10,299		4,342	3,215	497	418

Notes: Statistics calculated for estimation sample (weighted to population).
BW, black women; BM, black men; WW, white women; WM, white men.

Table 1 provides an initial look at the information contained in the survey. It is striking how heavy the South African population is. Around 50 percent has a weight problem (overweight or obese) and around a quarter is obese. It is clearly not the case that the majority of South Africans require additional food resources. If there is a link between resources and weight it must be driven by norms or preferences and not by physiological need. The values of the asset index indicate that Black South Africans are, on the whole, much poorer than their White compatriots. Similarly the "employed" indicator variable shows that Whites have a much stronger attachment to the labor force than Black South Africans. The fact that the "population" represented by the sample is around 60 percent female is a reflection of the fact that the survey was more successful in getting anthropometric measurements from women.

4.2. *NIDS 2008*

The National Income Dynamics Study is a national panel survey designed to investigate questions around wealth creation, demographic dynamics, education and employment, and cash transfers (Leibbrandt *et al.*, 2009, p. 3). The first wave of the panel was conducted in 2008 and included an anthropometric module. The survey was designed to be nationally representative and to gather information on around 8000 households. The members of these households would then form the basis of the panel.

In line with the socio-economic focus of NIDS, the information about incomes and employment is much richer than in the DHS. Consequently we can use household income as a variable rather than use asset proxies. We chose to use

TABLE 2
Summary Statistics from NIDS 2008

	All			BW	BM	WW	WM
Variable	Mean	Min	Max	Mean	Mean	Mean	Mean
bmi	27.1	6.8	293.3	29.1	23.8	28.3	27.5
obese	0.270	0	1	0.371	0.106	0.400	0.259
overweight	0.255	0	1	0.269	0.203	0.278	0.386
height (cm)	162.6	52.65	207.4	157.7	168.3	163.5	176.0
age	39.5	20	101	39.2	37.2	46.5	47.6
hhsizer	4.59	1	25	5.26	4.16	3.07	2.84
educ	8.62	0	18	7.97	8.35	12.02	12.65
loghhincome empstat	7.990	3.401	11.775	7.691	7.779	9.532	9.632
1	0.055	0	1	0.072	0.036	0.034	0.026
2	0.157	0	1	0.199	0.143	0.093	0.043
3	0.492	0	1	0.374	0.601	0.458	0.731
numadults	2.81	1	16	2.96	2.72	2.28	2.17
children	1.78	0	12	2.31	1.44	0.78	0.66
smoker	0.226	0	1	0.039	0.381	0.313	0.452
female	0.579	0	1				
black	0.794	0	1				
coloured	0.083	0	1				
asianind	0.026	0	1				
n		11,205		5,528	3,321	337	268

Notes: Statistics calculated for estimation sample (weighted to population).
BW, black women; BM, black men; WW, white women; WM, white men.
empstat codes: 1 = discouraged 2 = searching 3 = employed.

the total income as calculated by the NIDS team. The employment status variable is also much more reliable, being based on a set of detailed activity questions. Rather than using only an "employed" dummy, it is possible to classify individuals into four labor market states: not economically active, discouraged unemployed, searching unemployed, and employed.

The summary statistics from the NIDS survey are contained in Table 2. The levels of obesity have gone up in the ten-year period. This is entirely due to changes in weight, since the average height has stayed constant. Household size has decreased somewhat while average education levels have increased. The levels of employment are somewhat higher, but given the low quality of the DHS question, that conclusion has to be treated with considerable caution. The contrast in wealth is still quite stark.

4.3. *DHSs in Other Southern African Countries*

The summary statistics from nine DHSs are given in Table 3. Swaziland and Lesotho show levels of obesity and overweight that are comparable to South Africa. The levels in other countries are lower, but the proportion of individuals with high BMI (above 25) is never lower than 10 percent (Mozambican women in 1997). Two trends stand out in the table. First, obesity seems to be increasing over time in every country where this can be assessed. Second, in those cases where we have information on both men and women, there is a clear gender gap with women around 4 BMI points heavier on average.

TABLE 3

Summary Statistics from DHSs from Other Southern African Countries

	Les 04	Les 09		Swazi 06		Moz 97	Moz 03	Mal 00	Mal 10	Nam 92	Nam 06
	Women	Women	Men	Women	Men	Women	Women	Women	Women	Women	Women
bmi	25.9	26.0	21.8	27.5	23.3	21.6	22.3	22.2	22.8	22.8	24.0
obese	0.201	0.210	0.033	0.294	0.054	0.018	0.042	0.025	0.046	0.074	0.146
overweight	0.284	0.274	0.109	0.303	0.192	0.084	0.106	0.112	0.151	0.149	0.196
age	32.3	31.9	33.7	31.8	30.6	28.8	32.1	31.4	31.4	30.1	31.9
educ	7.4	8.1	6.2	8.3	8.5	2.1	2.1	3.7	5.0	5.6	8.3
asset index	0.281	0.373	0.207	–0.036	0.027	–0.096	–0.050	0.031	0.241	0.044	0.146
employed	0.525	0.547	0.794	0.552	0.727	0.687	0.807	0.659	0.767	0.343	0.610
smoker	0.209	0.133	0.407	0.027	0.232		0.095	0.033	0.015		0.097
n	2401	2789	2395	3232	2743	2813	8323	8922	5184	2303	6819

Notes: Statistics calculated for estimation samples (weighted to population).
Les, Lesotho; Moz, Mozambique; Mal, Malawi; Nam, Namibia.

5. Results

5.1. *Non-Parametric Regressions of BMI on Economic Resources*

The first analysis that we conducted was a set of non-parametric regressions of body mass on economic resources. The results are shown in Figure 1. The results for Black South Africans are fairly clear: body mass increases with economic resources in both periods for most of the distribution. In the case of White women the relationship is clearly negative in both periods. The relationship for White men does not look robust. In the DHS it looks non-monotonic, while in NIDS it looks as though it increases. These results clearly indicate that BMI would not be useful as a marker of economic well-being for the White subsample (particularly not for White women), but that it may be so for Black South Africans.

The corresponding regressions for Lesotho (2009) and Swaziland (2006) are given in Figure 2. Similar regressions for the other seven surveys listed in Table 3 (available on request) show a similar increasing trend across the distribution.

5.2. *Multivariate Regressions*

Further confirmation of these relationships for South Africans is contained in the regressions reported in Tables 4 and 5. In Table 4 the first column reports a regression pooling all population groups and men and women. The results show that the impact of the asset index is large and statistically highly significant. The

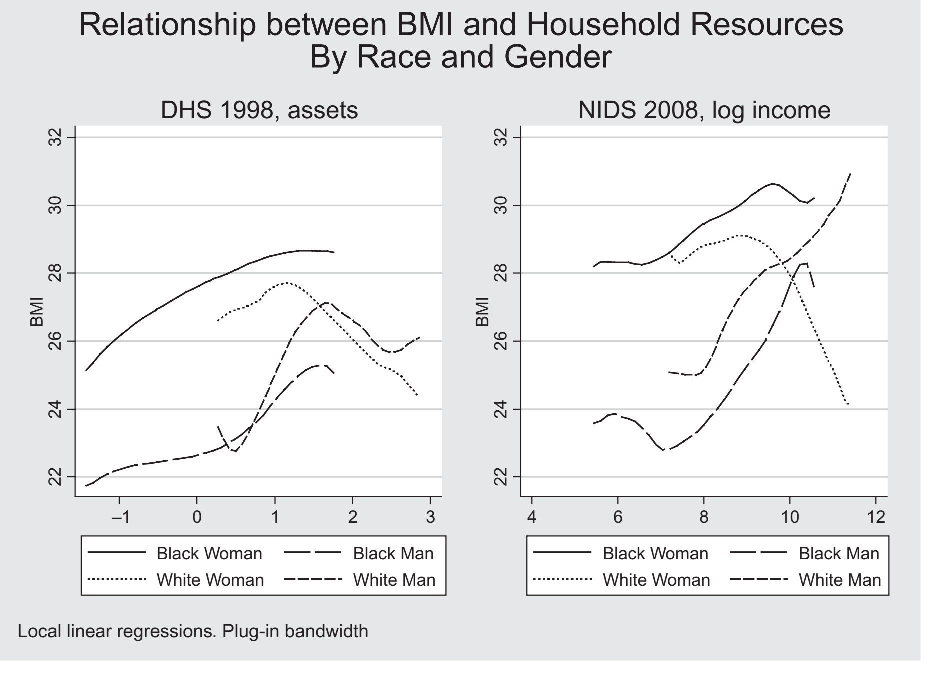

Figure 1. The Relationship Between (Average) Body Mass and Economic Resources is Mainly Increasing for Black South Africans, but Decreasing for White Women

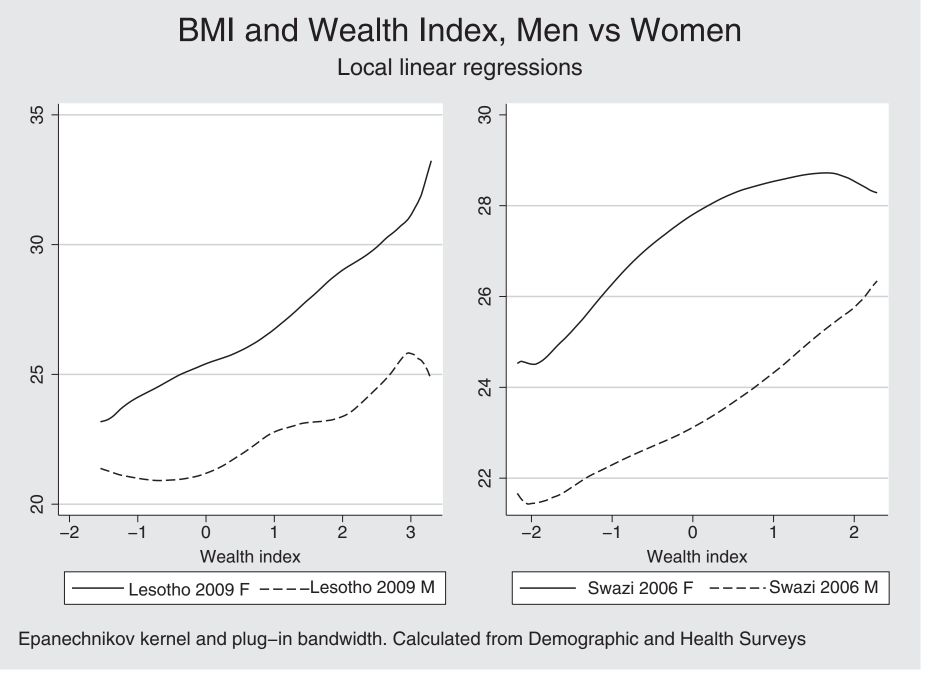

Figure 2. Local Linear Regressions of BMI on Asset Index for Lesotho and Swaziland

point estimate of 0.985 implies that a one unit increase in the index (i.e., a one standard deviation increase) translates into an extra 2.6 kg (5.7 lb) for a person of average height in our dataset. In this column we also observe that employed South Africans seem heavier, on average, than individuals who are not employed or not economically active. The point estimate of 0.288 would amount to an extra 0.76 kg (around 1.7 lb) in weight for a person of average height. It is also evident that women and Black South Africans (the base category) are considerably heavier than other individuals.

In the next four columns it becomes clear, however, that the relationships are not the same across different subsamples. We note that the asset index is highly significant (economically and statistically) in the Black subsamples (columns 2 and 3) but not so in the two White subsamples. Indeed the point estimate is negative among White women. The point estimates on the "employed" indicator also show interesting reversals—while being employed seems to increase the weight among Black South Africans, it seems to decrease it among Whites. These estimates are, however, very noisy and are statistically significant only for the Black male subsample.

The final two columns estimate regressions with household fixed effects and random effects respectively on the "Black" subsample. The point estimate on the "employed" coefficient in the fixed effects regression is similar to that in the "pooled" regression, although much less precisely estimated. In the random effects specification it is highly significant and larger in magnitude (by 44 percent). Interestingly (when compared to the fixed effects regression), the education

TABLE 4

Correlates of Body Mass in the 1998 DHS

Dep var: BMI	(1) pooled	(2) BW	(3) BM	(4) WW	(5) WM	(6) FE (B)	(7) RE (B)
female	3.074***						
	(0.152)						
coloured	−0.998***						
	(0.317)						
indian	−3.567***						
	(0.396)						
white	−1.870***						
	(0.323)						
employed	0.288*	0.199	0.600***	−0.779	−1.278	0.293	0.422***
	(0.157)	(0.272)	(0.203)	(0.780)	(1.070)	(0.219)	(0.151)
age	0.438***	0.605***	0.280***	0.254**	0.386***		
	(0.0253)	(0.0452)	(0.0357)	(0.101)	(0.0915)		
age^2	−0.00392***	−0.00550***	−0.00239***	−0.00252**	−0.00407***		
	(0.000275)	(0.000485)	(0.000382)	(0.000970)	(0.00108)		
education	0.0294	0.0575	0.0490	−0.510***	0.0313	−0.0118	0.0718***
	(0.0221)	(0.0367)	(0.0306)	(0.181)	(0.138)	(0.0346)	(0.0215)
assets	0.985***	0.996***	0.803***	−0.189	0.664		1.099***
	(0.115)	(0.181)	(0.168)	(0.703)	(0.498)		(0.112)
children	0.0903*	0.0878	0.101	−0.194	−0.0871		0.0907**
	(0.0475)	(0.0697)	(0.0628)	(0.353)	(0.308)		(0.0433)
no. of adults	−0.0378	−0.109	−0.00846	0.486*	−0.130		−0.0654
	(0.0494)	(0.0796)	(0.0661)	(0.294)	(0.286)		(0.0473)
smoker	−1.964***	−1.955***	−1.902***	−0.310	−1.658***	−1.971***	−1.880***
	(0.155)	(0.479)	(0.191)	(0.765)	(0.597)	(0.251)	(0.162)
age*male						0.326***	0.327***
						(0.0345)	(0.0247)
age^2*male						−0.00283***	−0.00280***
						(0.000376)	(0.000267)
age*female						0.488***	0.494***
						(0.0342)	(0.0258)
age^2*female						−0.00438***	−0.00445***
						(0.000377)	(0.000289)
province dummies	Y	Y	Y	Y	Y		Y
constant	15.23***	15.41***	18.88***	27.50***	19.07***	16.34***	17.61***
	(0.692)	(1.219)	(1.036)	(3.664)	(1.957)	(0.822)	(0.743)
Observations	10,299	4,342	3,215	497	418	7,557	7,557
R-squared	0.207	0.156	0.147	0.084	0.098	0.270	
No. of households						4,196	4,196

Notes: Standard errors corrected for clustering. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
BW, black women; BM, black men; WW, white women; WM, white men.
FE (B)—Fixed Effects Regression on Black subpopulation; RE (B)—Random Effects Regression on Black subpopulation.
Estimates in columns 1–5 weighted, using sample weights. It doesn't make sense to weight Random Effects regressions.

TABLE 5

Correlates of Body Mass in the 2008 NIDS

Dep var: BMI	(1) pooled	(2) BW	(3) BM	(4) WW	(5) WM	(6) FE (B)	(7) RE (B)
female	3.876***						
	(0.241)						
coloured	−0.450						
	(0.437)						
indian	−1.696**						
	(0.765)						
white	−0.913						
	(0.619)						
1.empstat	−0.136	0.0184	0.207	1.562	−9.376***	0.328	0.116
	(0.352)	(0.437)	(0.526)	(1.684)	(1.739)	(0.406)	(0.310)
2.empstat	0.212	0.0630	0.425	1.988	2.683	0.0665	0.113
	(0.324)	(0.402)	(0.450)	(1.677)	(2.569)	(0.309)	(0.239)
3.empstat	0.183	0.0141	0.546	1.843	−2.589	0.778***	0.569***
	(0.283)	(0.386)	(0.383)	(1.175)	(1.983)	(0.245)	(0.202)
age	0.445***	0.609***	0.231***	0.492***	0.462**		
	(0.0312)	(0.0484)	(0.0485)	(0.122)	(0.178)		
age^2	−0.00378***	−0.00513***	−0.00156***	−0.00436***	−0.00480**		
	(0.000344)	(0.000503)	(0.000568)	(0.00131)	(0.00200)		
education	0.113***	0.186***	0.157***	−0.432**	−0.0269	0.0589*	0.124***
	(0.0288)	(0.0411)	(0.0373)	(0.190)	(0.310)	(0.0344)	(0.0231)
log hh income	0.443***	0.509***	0.556***	−1.195**	1.521**		0.743***
	(0.132)	(0.179)	(0.155)	(0.489)	(0.705)		(0.0945)
children	−0.0475	−0.0456	−0.0461	0.746	0.0728		−0.0582
	(0.0566)	(0.0782)	(0.0772)	(0.619)	(0.404)		(0.0493)
no. of adults	−0.0131	0.0593	−0.182**	0.668	0.465		−0.0958
	(0.0715)	(0.112)	(0.0907)	(0.530)	(0.471)		(0.0612)
smoker	−1.946***	−2.190***	−1.321***	−2.641**	−1.886**	−1.353***	−1.719***
	(0.236)	(0.787)	(0.256)	(1.023)	(0.755)	(0.287)	(0.201)
age*male						0.271***	0.295***
						(0.0340)	(0.0245)
age^{2}male						−0.00217***	−0.00234***
						(0.000373)	(0.000266)
age*female						0.495***	0.511***
						(0.0332)	(0.0244)
age^2*female						−0.00425***	−0.00442***
						(0.000353)	(0.000258)
province dummies	Y	Y	Y	Y	Y		Y
constant	10.94***	10.01***	13.70***	29.18***	5.036	16.16***	10.97***
	(1.233)	(2.101)	(1.932)	(3.542)	(4.688)	(0.826)	(1.169)
Observations	11,038	5,400	3,321	330	268	8,858	8,849
R-squared	0.193	0.120	0.120	0.215	0.257	0.310	
No. of households						5,082	5,073

Notes: Standard errors corrected for clustering. ***p < 0.01, **p < 0.05, *p < 0.1.
BW, black women; BM, black men; WW, white women; WM, white men.
empstat codes: 1 = discouraged 2 = searching 3 = employed. Omitted: not economically active.
FE (B)—Fixed Effects Regression on Black subpopulation; RE (B)—Random Effects Regression on Black subpopulation.
Estimates in columns 1–5 weighted, using calibrated weights. It doesn't make sense to weight RE regressions.

coefficient in the random effects regression is significant and positive. The point estimate of 0.07 suggests that five years, extra schooling (i.e., the difference between Grade 7 and Grade 12, which is the end of secondary schooling) would imply a gain in weight of around 0.92 kg or around 2 lb for a person of average height.

The results from the NIDS sample, given in Table 5, echo many of the results from the DHS. The log of household income is strongly statistically significant (in this case also for the White subsamples). The sign on the log of household income is again negative for White women. The magnitude of the effect is difficult to compare, given the different underlying measures, even though a unit increase of log household income also corresponds to a standard deviation. A unit increase in log household income will raise weights by 1.17 kg (2.6 lb) for an individual of average height.

The "education" coefficient is highly significant in virtually all subsamples. It is positive for the Black subsamples but negative for Whites (significantly so in the case of women). The point estimates in the case of the Black subsamples of more than 0.12 are big. They suggest that a four-year increase in education (from the mean of 8 for Black women to 12, the end of secondary school) would be associated with a 1.3 kg (2.86 lb) increase in weight for a person of average height. In contrast with the DHS results, the "employed" indicator variable (category 3 of the "empstat" variable) is significant only in the fixed effects and random effects models. The point estimates are substantial. An increase of 0.57 would imply a difference in weight of 1.5 kg (3.3 lb) for a person of average height. Interestingly, the point estimate for the Black male subsample is of this order of magnitude, though not significant. The reason for the non-significance is probably due to the fact that there is a lot of residual "noise" in all these regressions. The R^2 statistics are all on the low side, suggesting that there is a lot of individual idiosyncracy associated with body mass. This is hardly surprising given that we are not adequately controlling for state of health, active leisure, or personal tastes for body weight and/or food consumption. The R^2 improves markedly once household fixed effects are included, suggesting that these regressions manage to reduce the noise somewhat.

Of course the fixed effects regressions effectively exclude households in which there is only one adult (or only one adult with anthropometric measurements). To the extent to which these individuals have different characteristics, that will also be reflected in the point estimates.

In these regressions we have imposed linearity. In Table 6 we show the coefficient results if we estimate the regressions with a quadratic in assets or log household income. This does not materially affect any of the other results. For our purposes the results show an increasing relationship for the Black subsamples over virtually the entire observed range of assets or incomes. The relevant rows are labeled "proportion where slope is positive." This is calculated as the proportion of the sample that falls below (or above) the turning point of the quadratic, as the case may be. In most cases the turning point is near the end of the range of the data. The quadratic term therefore captures a flattening or steepening of the relationship and not a real reversal of the direction of correlation. The only case where there is strong evidence of a non-monotonic relationship is that of White males in the DHS—a result that mirrors the non-parametric regressions in Figure 1.

The results for South Africa's neighbors are given in Table 7. In the simple cross-sectional regressions reported in the top panel we see that the asset index

TABLE 6
Regressions with Quadratics in Assets or Income

Dep var: BMI	(1) pooled	(2) BW	(3) BM	(4) WW	(5) WM	(6) FE (B)	(7) RE (B)
1998 DHS							
asset	1.158***	1.078***	0.799***	3.121	3.244**		1.086***
	(0.116)	(0.176)	(0.166)	(2.381)	(1.406)		(0.114)
asset^2	–0.362***	–0.643***	0.0981	–1.006	–0.824*		–0.394***
	(0.0807)	(0.175)	(0.180)	(0.661)	(0.437)		(0.115)
joint test (p value)	0.0000	0.0000	0.0000	0.2849	0.0565		0.0000
Turning pt	1.601	0.838	–4.073	1.551	1.968	N.A.	1.380
	(0.357)	(0.258)	(7.272)	(0.374)	(0.394)		(0.437)
prop where slope is +	0.91	0.88	1.00	0.44	0.66		0.96
2008 NIDS							
loghhincome	1.462	–0.0610	–3.026***	3.095	7.736		–0.379
	(0.986)	(1.383)	(1.090)	(5.844)	(7.509)		(0.796)
loghhinc2	–0.0639	0.0371	0.232***	–0.229	–0.329		0.0742
	(0.0642)	(0.0902)	(0.0717)	(0.310)	(0.415)		(0.0513)
joint test (p value)	0.0002	0.0180	0.0001	0.0479	0.0077		0.0000
Turning pt	11.43	0.82	6.51	6.75	11.77	N.A.	2.553
	(3.945)	(16.64)	(0.450)	(3.722)	(3.588)		(3.615)
prop where slope is +	0.996	1.000	0.906	0.001	1.000		1.0000

Notes: Other covariates included in the regressions are the same as in Tables 4 and 5. Please note that the fixed effects regression in column 6 cannot be estimated as assets and incomes do not differ within households. The column is still shown to facilitate comparisons across tables.

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

The full results are contained in the conference paper version of this article (Wittenberg, 2011b).

BW, black women; BM, black men; WW, white women; WM, white men.

FE (B)—Fixed Effects Regression on Black subpopulation; RE (B)—Random Effects Regression on Black subpopulation.

is strongly significant, with a coefficient comparable to that in the "pooled" regression in Table 4. We also observe that the indicator for being employed is significant in six out of the nine DHSs but has the "wrong" sign in the case of Mozambique in 1997 and Malawi in 2000. However, in every one of the fixed effects specifications this coefficient is positive and it is significant in two of the years. The years of education coefficient is more mixed. In the cross-sectional regressions it is uniformly positive, but in the fixed effects regression it is negative in four of the surveys, significantly so in the case of Mozambique in 2003. This suggests that there may be some regional differences in the correlates of BMI after all. Of course the education coefficient is not strong in the South African DHS either. Taken as a whole these results suggest that the pattern observed among Black South Africans is actually typical of the entire sub-region.

5.3. *Non-Parametric Regressions: Perceived Body Weight*

In order to assess whether the increase in weight associated with economic "success" is on the whole desired by the individuals concerned, we ran non-parametric (local linear) regressions of dummy variables corresponding to whether individuals thought they were "underweight" (or not) or whether they were "overweight" (or not). The results are given in Figure 3. The graphs show an

TABLE 7

Key Regression Results for South Africa's Neighbors

Dep var: BMI	(1) Les 04	(2) Les 09	(3) Swazi 06	(4) Moz 97	(5) Moz 03	(6) Mal 00	(7) Mal 10	(8) Nam 92	(9) Nam 06
Cross sectional									
female		3.655***	3.603***						
		(0.174)	(0.151)						
age	0.634***	0.490***	0.500***	0.0212	0.275***	0.228***	0.240***	0.486***	0.539***
	(0.137)	(0.0573)	(0.0591)	(0.0891)	(0.0558)	(0.0377)	(0.0755)	(0.124)	(0.0816)
age2	−0.00675***	−0.00538***	−0.00458***	0.000681	−0.00326***	−0.00275***	−0.00283**	−0.00634***	−0.00530***
	(0.00207)	(0.000775)	(0.000908)	(0.00136)	(0.000828)	(0.000565)	(0.00113)	(0.00196)	(0.00122)
employed	0.399*	0.161	0.404***	−0.106	0.358***	−0.0108	0.331**	1.027***	0.532***
	(0.232)	(0.168)	(0.151)	(0.227)	(0.130)	(0.0821)	(0.149)	(0.213)	(0.153)
smoker	−1.307***	−1.173***	−1.880***						
	(0.345)	(0.146)	(0.193)						
asset index	1.213***	1.083***	1.000***	0.869***	1.341***	0.573***	0.865***	1.349***	1.610***
	(0.152)	(0.0946)	(0.0902)	(0.153)	(0.0978)	(0.0520)	(0.106)	(0.127)	(0.111)
educ	0.0332	0.0471*	0.0229	0.213***	0.0310	0.0776***	0.00540	0.0357	0.0560**
	(0.0544)	(0.0254)	(0.0189)	(0.0514)	(0.0259)	(0.0125)	(0.0221)	(0.0263)	(0.0269)
Observations	2401	5184	5975	2813	8326	8923	5185	2303	6822
R-squared	0.153	0.261	0.284	0.155	0.161	0.079	0.088	0.156	0.177
Household fixed effects									
employed	0.308	0.169	0.330	0.492	0.0744	0.873***	0.638	1.429***	0.323
	(0.632)	(0.299)	(0.202)	(0.613)	(0.381)	(0.331)	(0.722)	(0.517)	(0.381)
educ	−0.000981	0.0797*	0.0479	−0.0567	−0.152***	−0.00902	0.205**	0.0685	0.123**
	(0.135)	(0.0443)	(0.0313)	(0.142)	(0.0535)	(0.0491)	(0.103)	(0.0590)	(0.0554)
Observations	2401	5184	5975	2813	8326	8923	5185	2303	6822
R-squared	0.273	0.284	0.369	0.027	0.086	0.060	0.078	0.132	0.171
Number of hid	2121	3483	3744	2651	7255	8266	4879	1823	5335

Notes: Other regressors: a quadratic in age (gender specific in the FE case), dummy for smokers, numbers of children/adults.
Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

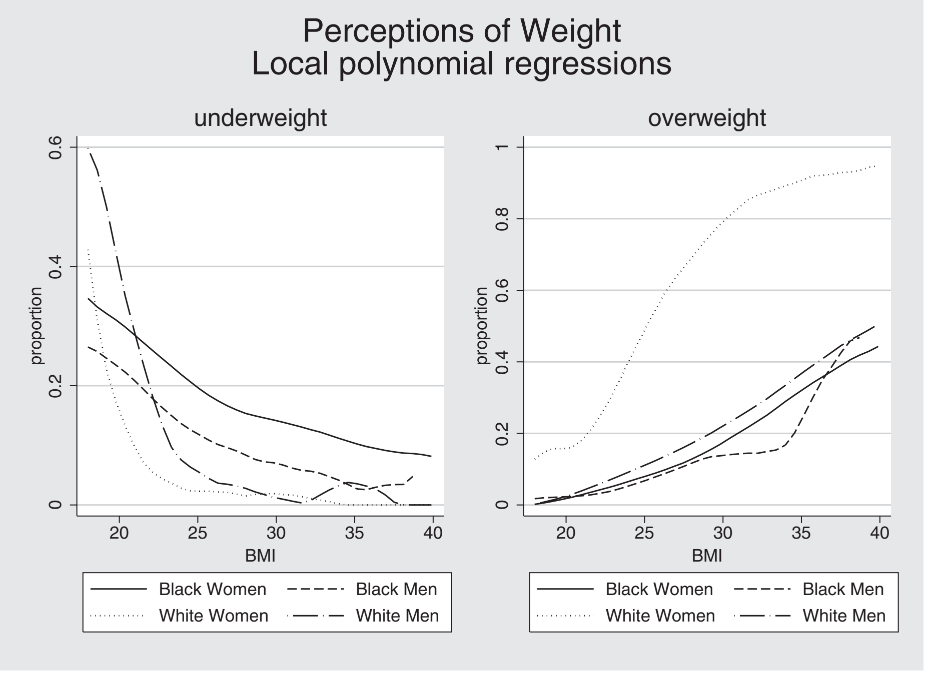

Figure 3. The Probability of Reporting Oneself as "Underweight" (Left Panel) or "Overweight" (Right Panel) in the 1998 DHS as a Function of Measured BMI. The local regressions for Black Men, White Women, and White Men are plotted up to the 99th percentile of their respective BMI distributions

interesting contrast between White women and Black women in particular. Black women with a BMI of 25 (the cut-off for overweight) still have a 20 percent probability of reporting themselves as "underweight," while less than 10 percent of such women will classify themselves as "overweight." White women, by contrast at a BMI of 25 will have a very low probability of classifying themselves as underweight and around 50 percent will perceive themselves as overweight. Black men and women have very similar rates of classifying themselves as "overweight" as a function of BMI, but these men are much less likely to see themselves as "underweight" at any level of BMI than the women. The left-hand panel of Figure 3 suggests that there are non-negligible fractions of Black men and women who actively desire to put on weight, even in regions where they would be medically classified as "overweight." The right-hand panel suggests that there are very few individuals even among the obese who see their weight as a problem.

5.4. *Ordered Probit Analysis of Perceived Body Weight*

The results of the ordered probit of perceived body weight are shown in Table 8. The equation underpinning this model is given by

$$y_i^* = \mathbf{x}_i \boldsymbol{\beta} + \varepsilon_i$$

TABLE 8

Ordered Probit of Perceived Body Weight

Dep. var: perceived weight	(1) BF	(2) BM	(3) WF	(4) WM
BMI	0.0763***	0.0691***	0.177***	0.232***
	(0.00399)	(0.00731)	(0.0221)	(0.0229)
education	0.0197***	0.0339***	0.00772	–0.0518
	(0.00512)	(0.00664)	(0.0302)	(0.0329)
employed	0.102**	0.0380	0.156	–0.0916
	(0.0425)	(0.0537)	(0.121)	(0.171)
age	–0.0234***	–0.0170**	0.00113	0.00720
	(0.00507)	(0.00724)	(0.0153)	(0.0185)
age^2	0.000117**	9.39e-05	–0.000148	–0.000193
	(5.48e-05)	(8.04e-05)	(0.000179)	(0.000199)
assets	0.204***	0.159***	0.147	0.157
	(0.0245)	(0.0331)	(0.139)	(0.120)
children	–0.0231**	0.00653	–0.0636	0.119*
	(0.00997)	(0.0127)	(0.0755)	(0.0639)
no. of adults	–0.00725	–0.000515	0.00705	0.00855
	(0.0119)	(0.0147)	(0.0608)	(0.0625)
Cut 1	0.412***	0.347*	2.585***	3.868***
	(0.129)	(0.204)	(0.603)	(0.713)
Cut 2	2.664***	3.126***	4.672***	6.315***
	(0.139)	(0.217)	(0.647)	(0.794)
Observations	5534	3863	563	469

Notes: Standard errors corrected for clustering. ***p < 0.01, **p < 0.05, *p < 0.1.
BW, black women; BM, black men; WW, white women; WM, white men.

where y_i^* is a latent variable equal to 1 (“underweight”) if $y_i^* < cut_1$, equal to 2 (“normal”) if $cut_1 < y_i^* < cut_2$, and equal to 3 (“overweight”) if $y_i^* > cut_2$. The error term is assumed to be normal with a variance of one. Provided that the distance between the “cut-points” is similar for the different subsamples (which it is, to first approximation), this common normalization implies that the relative impact of the covariates can be compared.

One of the most striking features of that table is that BMI is relatively weak in predicting how individuals would classify themselves, particularly in the Black subsamples. A ten unit increase on the BMI scale increases y^* among Black women by less than 0.8 units, which is tiny when considering the distance of 2.2 units between the two cut-points. In the case of the White subsamples the BMI score has a bigger impact on perceived weight and is the only individually statistically significant contributor to y^*.

Interestingly the “economic” variables are statistically significant in the Black subsample and all work in the direction of increasing y^*, i.e. they increase the perceived body weight—even while keeping BMI constant! Although the BMI score should contain all the information needed to classify one’s weight, individuals who have more assets, are employed, or are more educated will feel heavier.

6. Discussion

The first question that we sought to address is whether or not it is legitimate to use BMI as a marker for well-being. It is quite clear that many Southern

Africans have body mass in a range where it is no longer conducive to health. Furthermore there are also several problems with using BMI as an indicator of control over food resources. The first of these is that there are certain groups (in this case White women) where body mass decreases with control over resources, probably due to the ability to afford gym memberships and healthier produce. Second, the systematic component of the regressions explained at best around 30 percent of the individual variation in BMI. It is hard to believe that the remainder is entirely due to differential ability to control food resources within the household. That, however, is the implication of studies using BMI to explore intra-household inequality.

Nevertheless the fact that BMI is almost monotonically related to economic resources within the Black subpopulation of the Southern African region suggests that differences in *means* between groups is an accurate reflection of differences in access to resources. This is reinforced by the literature reviewed earlier which suggests that heaviness is actively desired. Furthermore as Sobal and Stunkard (1989) note, there are probably good evolutionary reasons why plumpness may be desired in traditional societies. Indeed even in Western culture many colloquial expressions associate heaviness with success—no politician or businessman would like to be referred to as a "lightweight"; people who "throw their weight around" are probably more successful doing so if they have some solid mass behind them.

Our non-parametric regressions suggest that a non-negligible fraction of overweight people desire to be even heavier. Our ordered probits suggest that insufficient "success" in the economic terrain may leave people feeling "underweight" in other respects.

It is against this background that it makes sense to interpret the difference in mean BMI between employed and the non-employed as a signal of different access to resources. The regressions with household level fixed or random effects suggest that on average within households individuals that are employed are somewhere between 0.3 and 0.7 BMI units heavier. The mid-point of this interval would translate to a 1.3 kg (2.9 lb) difference in weight for an average sized individual.

If the unemployed desire (on average) to be heavier, then this would be an indication that the unemployed are worse off than the employed people that they are living with. This, of course, does not establish conclusively that they are involuntarily unemployed, since it may be hypothetically true that they might qualify only for jobs that are materially worse than those currently occupied by the employed, so that their weight under this counterfactual scenario would not increase. *A priori* we would expect some selection into employment, so that perhaps some of the differential can be explained in terms of different unobserved characteristics of the two groups. Nevertheless it is hard to believe that the entire gap is due to selection. A plausible interpretation of the finding is that at least some of the unemployed would qualify for and want to take on jobs that would gain them the benefits currently enjoyed by the employed.

7. Conclusion

Direct markers of well-being can short-circuit many debates within economics. Our discussion suggests, however, that BMI is not such a simple marker.

In this paper we have pointed out some of the limitations of the measure. Nevertheless we have also suggested that in more limited domains it *can* function as an indicator. In particular we have argued that among Black South Africans, and indeed among residents in adjoining countries, economic "success" is associated with increases in body weight. This legitimizes using it to explore differences between subgroups. Our results suggest that within Black households, non-employed individuals are lighter than the employed. This suggests that there is some involuntary unemployment in South Africa.

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