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Incentives, time use and BMI: The roles of eating, grazing and goods

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ABSTRACT

In the 2006–2007 American Time Use Survey and its Eating and Health Module over half of adults report grazing (secondary eating/drinking) on a typical day, with grazing time almost equaling primary eating/drinking time. An economic model predicts that higher wage rates (price of time) will lead to substitution of grazing for primary eating/drinking, especially by raising the number of grazing intervals relative to meals. This prediction is confirmed in these data. Eating meals more frequently is associated with lower BMI and better self-reported health, as is grazing more frequently. Food purchases are positively related to time spent eating—substitution of goods for time is difficult—but are lower when eating time is spread over more meals.

1. Introduction

The problem of obesity has been in the press increasingly in the past 20 years; and economists have poured substantial amounts of ink over the problem, as evidenced by summaries and discussions (Cutler et al., 2003; Lakdawalla and Philipson, 2009) and comparisons of the U.S. and Europe in (Komlos and Baur, 2004). While numerous studies have examined the demographic correlates of obesity, using cross-section (Barnes, 2008) and even short longitudinal data (Halliday and Kwak, 2009), no study using representative data has examined obesity in the context of a production-function approach that includes what one would think are the major inputs into producing weight—time spent eating and purchased or home-produced food. The reason for this absence is clear: No representative data have allowed such an analysis.

I take a newly created nationally representative data set and generate a model of eating that allows me to answer several questions related to obesity and health. The focus throughout is on the production of the central human activity "eating", with a particular focus on the distinction between primary eating/drinking (which I usually abbreviate as "eating") and eating/drinking while engaged in another activity that one views as primary ("grazing"). Examples of grazing are munching on a muffin while drafting an economics paper on one's computer, eating popcorn while watching television, and quaffing a beer while sitting on a riding lawnmower. The primary activities here are market work, leisure and home production respectively, and along with each primary activity grazing is occurring. In each case the individual can be viewed as "multi-tasking."

I answer four specific questions: (1) How much eating and grazing goes on in the U.S., and what is its division across a typical day? (2) What does an economic model predict about the determinants of eating and grazing, and what are the empirical determinants of these activities? (3) How do eating and grazing relate to weight and to health? (4) How are eating and grazing time combined with purchased food, and how do these combinations relate to weight and health? The general economic question throughout is how the value of time and time use relate to the process of eating and health outcomes. The result is a glimpse into how the timing and amount of eating are partly determined by economic considerations, and thus

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how those choices about time spent eating and when and how to eat relate to health. The next section of this study discusses the data and summarizes new evidence on the average amounts of eating and grazing time. Section 3 presents a theory of grazing, while the subsequent three sections answer the last three questions outlined above.

2. Data—and some evidence on eating and grazing

In 2003 the U.S. Bureau of Labor Statistics initiated the American Time Use Survey (ATUS), based on the Current Population Survey (CPS), which provides the only set of time diaries collected anywhere on a regular and frequent basis.[1] In 2006 and 2007 each ATUS respondent was also asked to answer a set of additional questions and to fill out a supplemental diary that specifically inquired about his/her eating and drinking activities while engaged in other activities. With this Eating and Health Module, the 2006 and 2007 ATUS thus contains information on primary eating/drinking—when people respond that eating/drinking is the main activity at a point in time; and on secondary eating/drinking—grazing, which occurs while occupied primarily in another activity.

The distinction between primary and secondary activity in eating is purely a matter of how the respondent views activities when s/he completes the diary (retrospectively the next day). One person might view consuming food as primary under circumstances where another would view it as secondary (or, indeed, even tertiary, on which the ATUS collects no information). The accuracy of the distinction between eating and grazing cannot be validated; but its usefulness can be shown if: (1) Different predictions about how they are determined are verified in empirical work; and (2) They relate differently to important outcomes.

The information on eating and grazing is acquired with a timing dimension—we know when each episode starts and finishes—thus allowing the computation of both the total amounts of eating and grazing and their temporal distributions. This dimension allows us to consider eating and grazing in terms of their multiplicative components—their duration and incidence. That distinction has proven fruitful in analyzing a variety of aspects of labor-market activity, such as unemployment, labor-force participation, and workplace injuries (Adams, 1985; Hyslop, 1999; Hamermesh and Wolfe, 1990).

The ATUS provides 12,943 observations in 2006 and 12,248 in 2007. Some of each year's ATUS observations can be linked to the relevant December Food Security Supplement to the CPS, which provides information on weekly spending on food/drink for entire CPS households. From the 2006 (2007) ATUS we can match 2970 (2730) individuals to the December 2005 (2006) Food Security Module.

Define total time spent eating as:

$$T^P \equiv t^P n^P, \tag{1a}$$

and total time spent grazing as:

$$T^S \equiv t^S n^S, \tag{1b}$$

where t is the average duration of an interval of the activity, n is the number of intervals (the incidence of the activity), and the P and S denote eating and grazing activities. Fig. 1a and b graphs the distributions of the T^i, i = P, S. Fig. 1a excludes the 4% of respondents who listed $T^P = 0$ and top-codes the 0.3% who listed at least 400 min per day. Fig. 1b excludes the 46% of respondents who listed no grazing and top-codes the 5.2% of respondents who grazed at least 400 min.

Conditional upon any grazing occurring, its distribution is much more dispersed, and much more skewed, than that of eating. Most people do not graze or graze very little, but a few are grazing for a large fraction of the day. Regarding the conditional means (based on all respondents with positive eating, or with positive grazing), $E(T^P|T^P > 0) = 77.4$, while $E(T^S|T^S > 0) = 128.3$, with unconditional means of 74.1 and 69.3.[2] Thus the average person is spending 2–1/4 h per day eating/drinking, either primarily or secondarily, about 1/7 of his/her waking hours.

Fig. 1c presents information on the amounts of secondary eating, T^{SF}, excluding time spent in secondary drinking that occurs without simultaneous eating, since a substantial fraction of respondents claimed to be grazing at least 400 min per day. (Primary eating and drinking cannot be separated in the ATUS.) Those who reported no secondary eating are excluded. The degree of skewness is much less than for total grazing, and the conditional mean is lower, $E(T^{SF}|T^{SF} > 0) = 39.1$, with an unconditional mean of 20.7.

Fig. 2 presents the distributions of n^P, n^S and n^{SF}, the numbers of intervals of primary eating/drinking, grazing and secondary eating, conditional on positive values of the relevant T^i. In each a tiny fraction, less than 0.1% of respondents, are top-coded at 6 intervals per day. As with the distributions of the T^i, the distributions of n^P and n^{SF} exhibit much less dispersion or skewness than the distribution of n^S. The means of n^P, n^S and n^{SF}, conditional on positive responses, are 2.02, 1.77 and 1.34 respectively. The unconditional means are 1.92, 0.96 and 0.71 respectively: The average respondent says s/he is eating/drinking almost exactly three times per day, although one of these is a period of grazing. Of the spells of grazing, three-fourths involve some eating activity.

Of all the minutes reported as grazing, T^S, almost exactly half occur during activities that are classified as leisure; and almost exactly half (not entirely the same half) take place at home. The same divisions between

[1] See Hamermesh et al. (2005) for a description of the features of these data, and http://www.bls.gov/tus/#data to obtain the data. Numerous time-diary surveys have been completed throughout the world over the past 75 years, with many of the early ones discussed in (Szalai, 1973). It is impossible to validate time-diary data generally—to know whether the self-reports are accurate. Nonetheless, the ATUS data do match fairly closely to CPS information on demographics and labor-force behavior (Abraham et al., 2006).

[2] All the statistics and estimates presented in this study weight the observations by the Eating and Health Module final weights.

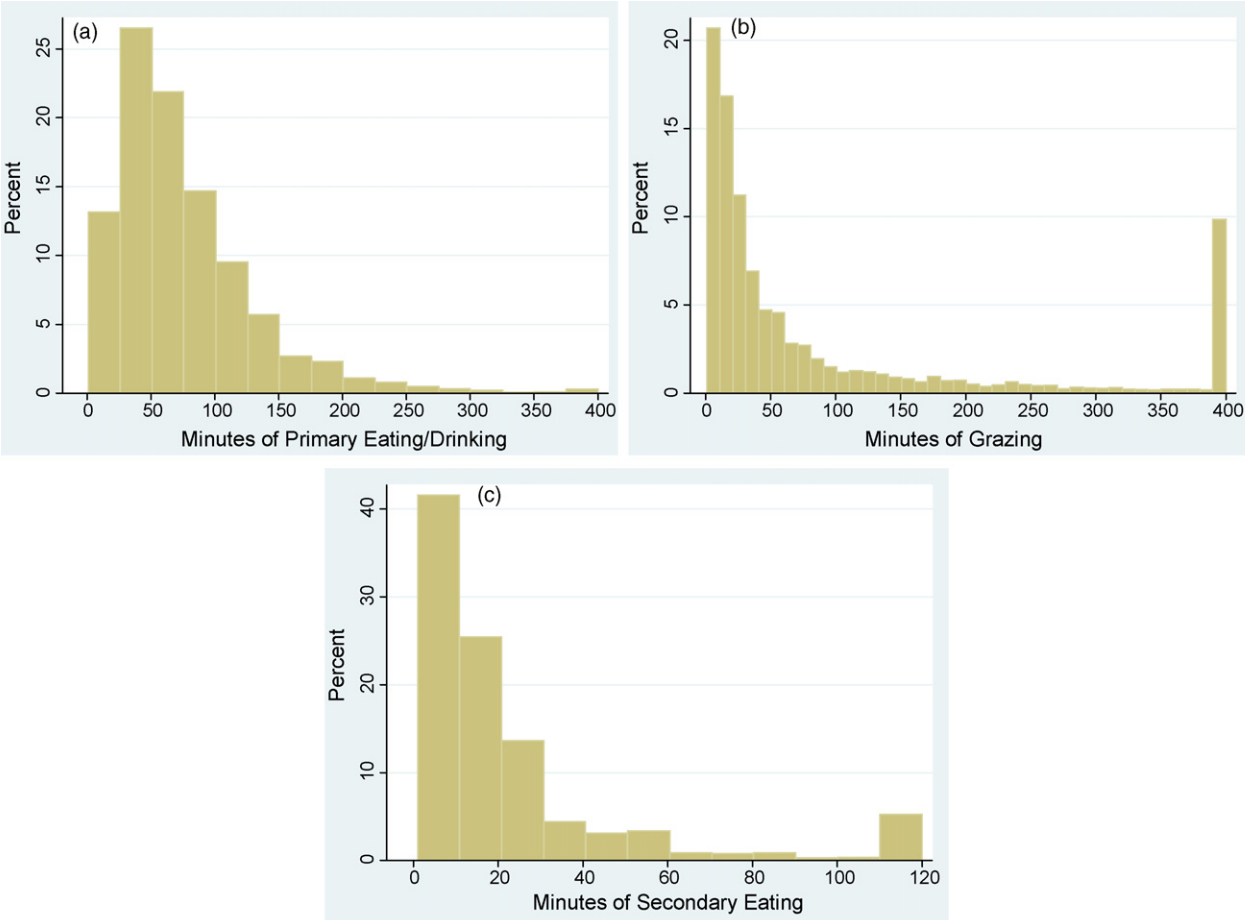

Fig. 1. (a) Histogram of primary eating/drinking time, $T^P > 0$. (b) Histogram of grazing time, $T^S > 0$. (c) Histogram of secondary eating time, $T^{SF} > 0$.

leisure and all other activities, and home and all other locations, exist for secondary eating alone, T^{SF}. Thus half of what we are discussing is eating and/or drinking that complements leisure time and that occurs in close proximity to one's kitchen.

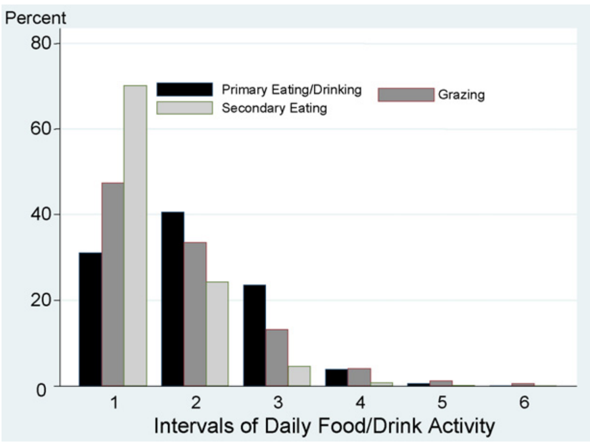

Fig. 2. Histogram of intervals of primary eating/drinking, n^P, grazing, n^S, and secondary eating, n^{SF}.

3. A theory of grazing

The purpose here is to outline a model to predict the impacts of changes in prices, particularly that of time, on the crucial variables t^P, n^P, t^S and n^S. Part of the determinants of these duration and incidence measures depends on unobservable heterogeneity in preferences. Part too depends on the technology of eating/drinking: As the example of *escargots* illustrates, it is difficult to eat some foods while engaged in other activities—some foods are not suited for grazing, while others are (clearly endogenously) exquisitely suited for providing an accompaniment to some primary non-eating activity, typically a leisure-time activity. Also, eating often has a social aspect—conversation with friends and family is one reason why not all eating is secondary to other activities—the conversation is secondary. Here I ignore these issues, which essentially deal with technology, assume that all consumers face the same technology, and concentrate instead on the role of economic factors in affecting these outcomes.

Assume that the typical consumer seeks to maximize:

$$U = U(Z, F) - WE(n^P), \tag{2}$$

where Z is a composite commodity consisting of all non-food/drink items, F is the commodity food/drink, W is the individual's wage rate, $E' > 0$, and we assume these decisions are separable from decisions about labor supply. The only non-standard part of Eq. (2) is the final term: I assume that primary eating/drinking entails set-up costs, so that each incident of primary eating/drinking generates fixed costs that effectively reduce the time available for other things (Gronau and Hamermesh, 2008). This is not true for grazing. Indeed, foods designed for grazing activities presumably have arisen because they do not entail set-up costs, or at least smaller set-up costs than food typically eaten at mealtimes.

The consumer produces Z and F in the household using the technologies:

$$Z = Z(X^Z, T^Z(T^S)), \quad Z_i > 0; \quad Z_{ii} < 0; \quad T^{Z'} < 0; \tag{3a}$$

and

$$F = F(X^F, T^P, n^P, T^S), \quad F_i > 0, \quad F_{ii} < 0, \tag{3b}$$

where the X are purchased goods inputs into home production, and I abstract from the food at home/food away distinction. The crucial assumption here is the specification of T^Z in Eq. (3a) as a decreasing function of T^S. The more an individual grazes, the lower is the productivity of time in the primary activity that the grazing accompanies. Grazing is not a free good—my eating a muffin while trying to write a paper to some extent reduces my efficiency in getting my ideas together and onto the page in a coherent form. (The specification of n^P in Eq. (3b) is necessary to ensure that the consumer could maximize at $n^P > 1$—could possibly consume more than one meal a day.) The individual faces the standard goods and time constraints (Becker, 1965):

$$WT^{\mathrm{H}} + I = p_X X^{\mathrm{Z}} + p_F X^{\mathrm{F}}; \tag{4a}$$

$$T^{\mathrm{H}} + T^{\mathrm{Z}} + T^{\mathrm{P}} = 24, \tag{4b}$$

where T^H is daily hours of market work, I is unearned income per day, and the prices of grazed and eaten food/drink are the same. Secondary eating/drinking, the only possible secondary activity, is assumed impossible during primary eating/drinking (to match the data); and the assumption that $T^{Z'} < 0$ keeps the solution for T^S interior.

As is standard in household production models, working time is the residual, determined by choices about the other endogenous variables, in this case: X^Z, X^F, T^Z, T^S, t^P and n^P. As I have specified the maximization problem and the technology of household production, t^S and n^S are not treated separately. Nonetheless, because n^P enters the maximand separately from t^P, we can draw some inferences about the effects of the forcing variables, W and I, on the duration/incidence mix of eating.[3] The power of the model comes from the assumptions that eating has larger set-up costs each time it is undertaken, while grazing reduces the efficiency of time spent in producing the other (non-eating) commodity.

The consumer solves for these six outcomes. As is standard in household production models, increases in I produce a pure income effect, shifting all production to greater goods intensity; and part of the impact of an increase in W is also a pure income effect, which also produces the same rise in goods intensity. The question is how changes in these variables alter the optimizing outcomes T^{S*}, t^{P*} and n^{P*}. We cannot sign the effects of an increase in I.[4] An increase in W, however, while it may increase or decrease the total amount of time devoted to the production of Z^F, will, by raising the set-up costs of primary eating/drinking, cause a shift within T^P toward t^P and away from n^P. We should thus expect the relative incidence of eating compared to grazing to fall, since the rise in W produces no clear effect on n^S.

Since I have assumed that duration and incidence are multiplicative in Eq. (3b), it may also be that T^P falls relative to T^S. Regardless of the narrow specification of the household technology of producing the commodity eating/drinking, a higher wage will be associated with more spells of grazing relative to spells of eating, because the former create lower set-up costs. Moreover, it is likely that a higher wage will generate an increase in the amount of time spent grazing relative to the amount of primary eating/drinking, unless the marginal effects in Eq. (3b) differ hugely between eating and grazing. If the model were expanded to include the T^i and n^i separately in Eq. (3b), with sufficient restrictions one could, depending on the nature of substitution between t^S and n^S, obtain predictions about the duration/incidence mix of grazing. We do not, however, know enough to impose those restrictions.

4. The determinants of grazing

The predictions of the model can be examined easily by comparing eating and grazing in relation to market work—between workers and non-workers. In this section I define workers as anyone who reports both positive usual weekly hours and positive usual weekly earnings; non-workers are other respondents. The crucial comparisons are in the left-hand panel of Table 1. Workers spend significantly less time eating than non-workers, and intervals of eating are also significantly lower among workers. This may be a confirmation of our theory, but it also may result from an adding-up problem: Part of the representative day of the average worker is spent in market work, so that there are fewer minutes available for all other activities, including eating.

More clear-cut confirmation of the model's predictions comes when we compare the patterns of T^P and T^S, and n^P and n^S, across the two groups. The amount of grazing is much greater among workers than among non-workers. This is especially so if we include secondary drinking, but even secondary eating alone, T^{SF}, is more prevalent among workers. Moreover, almost all of the difference in the averages of the T^S across the two groups results from differences in the n^S rather than the t^S.

[3] We could specify T^P and T^S in Eq. (3b) even more generally as functions of the t^i and n^i, but, since we know nothing about the nature of this aspect of producing F, this generalization would not add to our ability to predict the impacts of changing W and I.

[4] In any case, since we do not observe unearned income in our data, this inability is irrelevant for what is in the end an empirical exercise.

Table 1
Distributions of eating/drinking and other variables, workers and non-workers, ATUS 2006–2007.

Variable	Workers	Non-workers	Variable	Workers	Non-workers
T^P (eating)	71.90	76.63	Age	39.94	48.90
	(0.51)	(0.57)		(0.12)	(0.20)
n^P (eating intervals)	1.89	1.95	Male	0.53	0.43
	(0.009)	(0.009)		(0.004)	(0.005)
T^S (grazing)	77.57	59.62	White	0.83	0.82
	(1.62)	(1.52)		(0.003)	(0.003)
n^S (grazing intervals)	1.03	0.88	Hispanic	0.14	0.13
	(0.010)	(0.01)		(0.003)	(0.003)
T^{SF} (grazing no drink)	22.68	19.29	Married	0.57	0.52
	(0.75)	(0.72)		(0.004)	(0.005)
n^{SF} (grazing intervals, no drink)	0.76	0.66	ED12	0.29	0.31
	(0.007)	(0.007)		(0.004)	(0.004)
Weekly earnings	824.18		ED1315	0.28	0.22
	(6.30)			(0.004)	(0.003)
$7T^H$ (weekly work hours)	41.14		ED16	0.20	0.12
	(0.11)			(0.003)	(0.003)
			ED16+	0.11	0.07
				(0.003)	(0.002)
			No. of children	0.61	0.34
				(0.009)	(0.009)
N=	13,268	11,856			

Note: Standard errors of means in parentheses. All statistics here and in the following tables are weighted by the ATUS Eating and Health Module sampling weights, so that the results are for a representative individual and day of the week.

Because of the small number of integer outcomes that we observe for the n^i, I generate the estimates of their determinants using Poisson regressions. Because nearly half the ATUS respondents report no grazing, the estimates of the determinants of T^S and T^{SF} are based on tobit estimation. In Table 2 I present the effects of the demographic variables on the six outcomes, T^P, T^S, T^{SF}, n^P, n^S and n^{SF}. For each variable in the specifications here and elsewhere the standard error of the coefficient is listed in parentheses below the estimate.

For a substantial number of demographic factors the effects on eating, both its total and the number of intervals, are opposite those on grazing. Thus there is a U-shaped pattern with age of eating; but the relationship of grazing and its incidence to age is inverse-U-shaped or continuously decreasing. Indeed, the trough in eating occurs at roughly the same age as the peak in grazing. The relation to gender is also opposite along these two dimensions: Men are more likely to report eating (and to engage in more intervals of it) but less likely to graze or eat secondarily (and they engage in fewer intervals of grazing). Being married, however, is positively correlated with more "regular" eating, but also with more grazing. Race too has the same correlations with eating and grazing (with non-Hispanic whites eating/drinking and grazing more than respondents of other races/ethnicities).

Moving up the education ladder, each extra level of educational attainment is associated with more total time spent eating, more intervals of eating, more total time spent grazing and more intervals of grazing (although the relationship is weaker for total time spent in secondary eating). People with post-graduate degrees engage in primary eating/drinking for 25 min more per day than high-school drop-outs (especially surprising since the latter have more non-market time available for eating), and do so more often per day. The gradient in educational attainment, which is positively correlated with the price of time, is steeper in n^S than in n^P. As predicted, along this single dimension related to time price, intervals of grazing rise relative to those of eating.

To test the hypotheses generated from the model in Section 3 formally, I restrict the sample to those individuals for whom I can calculate an hourly wage rate (usual weekly earnings divided by usual weekly hours). To avoid errors induced by division bias, I exclude the 633 respondents whose hourly wage, derived from reported weekly earnings and hours, was below the 2006–2007 minimum wage of \$5.15 or above \$100 per hour.[5] The results are presented in Table 3. Each coefficient estimate shows the impact of the wage rate on the particular outcome. The estimates in Column (1) include the entire vector of control variables listed in Table 2; those in Column (2) exclude the vector of education indicators, while Column (3) excludes all controls.

The results strongly support the theory. In the complete model in Column (1) the estimates imply that an increase in the wage rate leads to significantly more time spent eating (with a two-standard-deviation wage increase raising T^P by 7.4%). This result is consistent with evidence of a low elasticity of substitution of goods for time in producing the commodity eating (Hamermesh, 2008). Nonetheless, workers do not increase their intervals of eating as their wage rate increases. In other words, higher

[5] I do not impute an hourly wage rate for those individuals for whom none is available (because they were out of the labor force). Table 2 shows that the usual identifier of female labor-force participation, presence of children, partly determines eating time; it is thus unclear how to identify the selection mechanism in this context. The extent of feedback from eating time or frequency to wage determination would seem minor, and that from grazing trivial, suggesting that selection bias is unlikely to be a major issue here.

Table 2
Estimates of the determinants of primary and secondary eating/drinking time and intervals, $N = 25{,}124$.

Ind. var.	Estimation method					
	OLS	Poisson	Tobit	Poisson	Tobit	Poisson
	T^P	n^P	T^S	n^S	T^{SF}	n^{SF}
	(1)	(2)	(3)	(4)	(5)	(6)
Age	−1.14	−0.0071	1.506	0.0042	−0.733	−0.0044
	(0.12)	(0.0014)	(0.601)	(0.0035)	(0.283)	(0.0034)
Age 2/100	1.50	0.00011	−0.042	−0.00014	−0.0037	−0.00005
	(0.13)	(0.00001)	(0.006)	(0.00004)	(0.003)	(0.00004)
Male	3.53	0.0292	−16.922	−0.2081	−4.340	−0.2101
	(0.75)	(0.0086)	(3.665)	(0.0202)	(1.727)	(0.0198)
White	13.24	0.1336	50.595	0.2623	8.031	0.1573
	(1.01)	(0.0130)	(4.982)	(0.0274)	(2.333)	(0.0269)
Hispanic	0.66	0.0433	−104.501	−0.4985	−36.970	−0.3928
	(1.18)	(0.0132)	(6.034)	(0.0370)	(2.833)	(0.0392)
Married	6.81	0.0882	24.759	−0.0083	11.292	0.0099
	(0.91)	(0.0101)	(4.434)	(0.0228)	(2.092)	(0.0231)
ED12	7.02	−0.0043	55.218	0.1307	20.275	0.0891
	(1.19)	(0.0144)	(6.017)	(0.0388)	(2.835)	(0.0374)
ED1315	14.68	0.0426	52.434	0.2328	17.937	0.2047
	(1.24)	(0.0150)	(6.162)	(0.0376)	(2.902)	(0.0367)
ED16	20.57	0.0986	56.568	0.3809	22.440	0.3581
	(1.38)	(0.0158)	(6.835)	(0.0394)	(3.218)	(0.0378)
ED16+	24.58	0.1027	78.723	0.4667	31.747	0.4359
	(1.65)	(0.0176)	(8.018)	(0.0434)	(3.772)	(0.0406)
No. of children	−1.22	−0.0022	−19.181	0.0078	−7.312	−0.0019
	(0.41)	(0.006)	(2.032)	(0.010)	(0.956)	(0.0093)
Adj. R^2, chi-square or pseudo-R^2	0.041	768.91	0.005	983.77	0.004	822.41

Note: Standard errors of parameter estimates here and in Tables 3, 6–8 and 10–12. Dep. var. are T^P, n^P, T^S, n^S, T^{SF}, and n^{SF}.

wages lengthen the time spent per primary eating/drinking interval, as predicted. Total grazing also rises with wages, both through a significant increase in the number of grazing intervals and an increase in the duration per interval. The second implication of the model—that intervals of grazing rise with wages relative to those of eating/drinking—is strongly supported in the data, whether we focus on all grazing or exclude secondary drinking. All of the general conclusions are strengthened as we move to equations with fewer covariates. Even though Column (3) shows that all the wage terms are statistically significant, we still find that most of the rise in primary eating/drinking with the wage rate occurs through lengthening periods of eating; and we still observe the

Table 3
Estimated effects of the price of time on primary eating/drinking, grazing and secondary eating time and intervals, $N = 12{,}825$ workers.

Dep. var.	All controls	Demographic controls only	No controls
T^P (eating)	0.1955	0.3481	0.3974
	(0.0438)	(0.0400)	(0.0378)
n^P (eating intervals)	−0.00023	0.0007	0.0019
	(0.00047)	(0.0004)	(0.0004)
T^S (grazing)	0.5740	0.8341	0.8698
	(0.2148)	(0.1956)	(0.1854)
n^S (grazing intervals)	0.0028	0.0060	0.0060
	(0.0009)	(0.0008)	(0.0008)
T^{SF} (grazing no drink)	0.1587	0.3168	0.2202
	(0.0990)	(0.0909)	(0.0858)
n^{SF} (grazing intervals, no drink)	0.0033	0.0064	0.0056
	(0.0009)	(0.0008)	(0.0008)

Note: Includes all observations with computed hourly earnings $\geq$\$5.15 and $\leq$\$100. Column (2) excludes the vector of education indicators, while Column (3) includes only the wage rate.

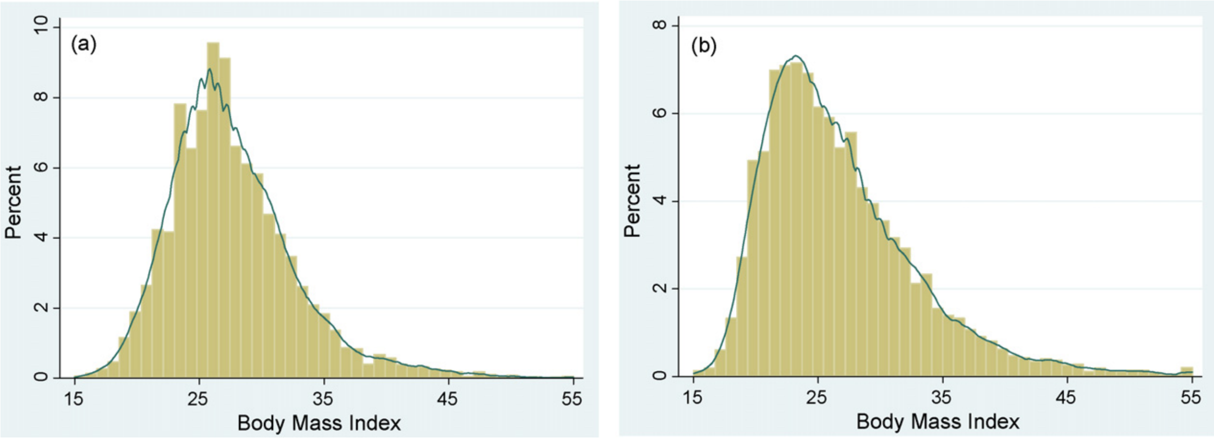

Fig. 3. (a) Histogram and kernel density of men's BMI. (b) Histogram and kernel density of women's BMI.

same relative increase in intervals of grazing, either in total or in secondary eating alone.[6]

5. The relation between eating and grazing time, and weight and health

BMI is calculated from the respondent's reported weight and height. BMI clearly has problems as a measure of weight. These arise partly because of possible errors in self-reported height and weight, partly for the substantive reason that it may not reflect body fat well (Burkhauser and Cawley, 2008; Johansson et al., 2009). It is, however, the only such measure of weight available in this, the only data set that also provides information for a large sample on eating times. The subjective health status measure is the standard five-point Likert scale: excellent, very good, good, fair and poor. While this measure too has difficulties, it is not clear for purposes of comparing it to the correlates of health that its deficiencies are particularly severe (Lindeboom and van Doorslaer, 2004; Hennessy et al., 1994).

5.1. Descriptive statistics

Fig. 3a and b graphs the BMI of the Eating and Health Module respondents for men and women (with 0.04% of men, 0.19% of women, having BMI < 15 or BMI > 55 included in the endpoints, and excluding those 1500 respondents whose BMI was not obtained).[7] Also included in each graph is a kernel estimate of the density function of BMI. Both distributions are skewed to the right, as is standard in other data sets, with the density for women being more strongly skewed than that for men. 1.0% of men are underweight (BMI less than 18.5); 42.6% are overweight (BMI at least 25 and less than 30), and 27.1% are obese (BMI at least 30). The comparable figures for women are 2.4%, 28.9% and 25.0%.

The distributions of these series of reported BMI are shown in Columns (1) and (3) of Table 4 for respondents ages 20 or over. Taking the same age, gender and racial/ethnic weights as in the NLSY, the ATUS data yield a substantially higher average BMI than found in the NLSY, perhaps due to biased reporting, or perhaps to an upward trend in true BMI (Cawley, 2004). Columns (2) and (4) show the NHANES data for 2003–2006. For men the distribution of BMI is strikingly similar to that in the ATUS data. Among women, however, the NHANES shows increasingly higher BMI as compared to the ATUS moving up the distributions. The differences may stem from greater underreporting by women than men, especially if women's true BMI continued to trend up between 2003–2005 and 2006–2007, or from this sample's higher incomes.

The distributions of the responses about subjective health are shown for men and women separately in Table 5, as are T^P, T^S and T^{SF} by health status and gender. As is common with this measure, most people view their health as at least good, and the majority considers it at least very

Table 4
BMI in the ATUS 2006–2007 and the NHANES 2003–2006.

Percentile	Men 20+		Women 20+	
	ATUS	NHANES	ATUS	NHANES
5	21.4	20.8	19.5	19.4
10	22.5	22.1	20.5	20.7
25	24.4	24.6	22.6	23.1
50	27.2	27.7	25.7	26.9
75	30.5	31.2	30.1	32.2
90	34.3	35.3	35.3	38.1
95	37.3	38.6	39.1	41.6
Mean	28.0	28.4	26.9	28.4

Note: NHANES data are from NCHS (2008), Tables 14 and 15.

[6] One might view hourly paid workers as having less flexibility to graze while on the job. There are, however, no significant differences by hourly pay status in the amount of grazing, defined broadly or narrowly, that occurs in the workplace; but conditional on reporting any grazing, it is less likely to occur at work if the person is paid hourly.

[7] Item non-response in the BMI measure is unfortunately not independent of the observables: an equation predicting non-response that includes all of the measures in Table 2 has a pseudo-R^2 of 0.065, with the most important determinant of non-response being gender (women are more likely not to report BMI data than men). BMI is only missing for 6% of the respondents, of whom 1 percentage point were pregnant women whose weight was not collected. Since the overwhelming majority of the variance in the probability of non-response is not accounted for by the observables, it is unlikely that item non-response is having an important effect on our estimates. Regardless, there is little that we can do empirically about this difficulty.

Table 5
Percent distributions of subjective health status and eating/drinking times by gender, ATUS Eating and Health Module, 2006–2007.

Health status		Men	Women
Excellent	%	19.1	18.1
	T^P	82.4	80.4
	T^S	65.0	67.6
	T^{SF}	22.4	22.2
Very good	%	34.0	34.0
	T^P	81.7	75.3
	T^S	70.4	79.4
	T^{SF}	21.0	22.0
Good	%	29.9	30.1
	T^P	76.1	71.6
	T^S	66.6	68.3
	T^{SF}	21.7	21.0
Fair	%	12.6	13.1
	T^P	71.4	68.9
	T^S	60.6	64.6
	T^{SF}	16.6	18.4
Poor	%	4.4	4.7
	T^P	66.1	60.1
	T^S	67.8	53.4
	T^{SF}	19.4	15.7
N=		10,674	14,157
Chi-square (4)		29.95	

good. Moreover, the distributions are significantly different by gender, with fewer women than men viewing their health as excellent, and more viewing it as fair or poor.[8] While there is no clear relationship between health status and grazing, there is a steady decrease in time spent at meals and in secondary eating alone with lower self-reported health.

5.2. Determinants of BMI

In Column (1) of Table 6 I present the results of OLS estimates of an equation describing BMI that excludes the time-use measures. Most of the results accord with the substantial previous work on the relation between BMI and demographic characteristics. Thus there is an inverse-U-shaped relationship with age, with the peak at 54; and non-Hispanic whites' BMI is about 1 less than that of Hispanics and blacks. These demographic effects are quite similar to those found using the NHANES (Baum, 2007). There are only small differences in BMI by educational attainment among those who have not graduated from college; but college graduates' BMI is about 1.4 less than that of individuals with lower educational attainment, and people with post-graduate degrees have BMI's that are nearly 2 below those of individuals who did not graduate from college.[9]

Each of Columns (2)–(7) presents results for various combinations of the primary eating/drinking and grazing measures, and each also includes all the demographic variables from Column (1).[10] Consider first time spent in primary eating/drinking. As the estimate in Column (2) shows, spending more time eating reduces BMI, other things equal. A two-standard-deviation (121-min) increase in time spent eating, other things equal, is related to a BMI that is 0.2 less.[11] When we break T^P into its components by adding n^P, as in Column (3), it becomes clear that the negative relation of time spent eating to BMI arises almost entirely through the frequency of eating, not the duration per interval.[12]

Expanding the estimating equations to include T^S in Column (4), or both T^S and n^S in Column (5), the implications about the effects of T^P and n^P from Columns (2) and (3) on BMI remain almost completely unchanged. The same is true in Columns (6) and (7), where we define grazing narrowly to exclude time spent in drinking as a secondary activity. If we estimate the equations in Columns (6) and (7) separately for men and women, the results are essentially unchanged: Relationships in the separate equations for gender go in the same directions as the pooled equations shown in Table 6, and the same variables are statistically significant.

Additional time spent grazing broadly defined has an insignificant negative relationship with BMI. The results in Column (5) suggest that decomposing T^S into its two components does not alter this conclusion. More grazing or more frequent grazing is not significantly related to BMI. These negative results may arise from the inclusion of long spells of (perhaps over-reported) secondary drinking in T^S. Narrowing the definition of grazing to exclude drinking, as in the final two columns, changes the conclusion about its impact: Additional time in secondary eating functions exactly like additional primary eating/drinking time in lowering BMI; but less of the effect is due to spreading the same amount of time over more intervals.

While the estimates in Table 6 summarize the average relationships between BMI and total eating time or intervals of eating, they do not get at the possible relationship between eating/grazing and weight at the main locus of policy concern, the upper part of the distribution of weight, and obesity in particular. Accordingly, in Table 7 I present a variety of estimates of the effects of the time-use variables at two points in the upper tail of that distribution, the 90th and the 95th

[8] This difference by gender is standard even for other health measures in a variety of countries (Strauss et al., 1993).

[9] Work using the Eating and Health Module relating BMI to time spent in various activities has recently been undertaken (Pinkston and Stewart, 2009).

[10] Looking at the means of T^P and T^S by weight category, "normal" weight adults spend 75.0 min on average eating/drinking, overweight adults spend 75.1 min, and the obese spend 71.2 min. The last average is significantly less than the other two. The respective times spent grazing are 70.3, 79.3 and 71.9, none statistically different from any other.

[11] Nutritionists have considered the relationship between eating frequency (intervals in our terminology) and weight for smaller samples, focusing on how eating frequency is related to energy expenditure and weight (Barba et al., 2006; Duval et al., 2008).

[12] Replacing n^P by an indicator for three meals per day yields a significant negative effect on BMI.

Table 6
OLS estimates of the relation of eating/drinking time to BMI, $N = 23{,}691$.

Ind. var.	(1)	Ind. var.	(2)	(3)	(4)	(5)	(6)	(7)
Age	0.352	T^P	−0.00174	−0.00003	−0.00167	−0.00002	−0.00186	−0.00007
	(0.012)		(0.00060)	(0.00069)	(0.00060)	(0.00069)	(0.00060)	(0.00069)
Age 2/100	−0.326	n^P		−0.2224		−0.2270		−0.2466
	(0.012)			(0.0438)		(0.0445)		(0.0447)
Male	1.053	T^S			0.00019	0.00015		
	(0.072)				(0.00020)	(0.00022)		
White	−1.015	n^S				−0.0411		
	(0.096)					(0.0352)		
Hispanic	0.902	T^{SF}					−0.00140	−0.00144
	(0.114)						(0.00043)	(0.00045)
Married	−0.128	n^{SF}						−0.0674
	(0.087)							(0.0487)
ED12	0.401							
	(0.114)							
ED1315	0.146							
	(0.118)							
ED16	−1.358							
	(0.132)							
ED16+	−1.726							
	(0.157)							
No. of children	0.087							
	(0.040)							
Adj. R^2	0.082		0.082	0.083	0.082	0.083	0.082	0.084

Note: The equations shown in Columns (2)–(7) include all the controls that make up the estimates in Column (1).

Table 7
Quantile estimates of the relation of eating/drinking time and BMI, $N = 23{,}691$.

Quantile	Ind. var.	(1)	(2)	(3)	(4)	(5)
95th (BMI = 38)	T^P (eating)	−0.00191	−0.00025	−0.00140	−0.00036	−0.00007
		(0.00360)	(0.00425)	(0.00359)	(0.00433)	(0.00404)
	n^P (eating intervals)		−0.2626		−0.2649	−0.2970
			(0.1950)		(0.2002)	(0.1889)
	T^S (grazing)			−0.00060	−0.00042	
				(0.00091)	(0.00108)	
	n^S (grazing intervals)				−0.0637	
					(0.1768)	
	T^{SF} (grazing no drink)					−0.00221
						(0.00171)
	n^{SF} (grazing intervals, no drink)					−0.1287
						(0.2319)
90th (BMI = 34)	T^P (eating)	−0.00240	0.00037	−0.00228	0.00045	0.00027
		(0.00203)	(0.00245)	(0.00202)	(0.00232)	(0.00204)
	n^P (eating intervals)		−0.3390		−0.36431	−0.41219
			(0.1367)		(0.1346)	(0.1170)
	T^S (grazing)			0.00078	0.00064	
				(0.00202)	(0.00070)	
	n^S (grazing intervals)				−0.0756	
					(0.1195)	
	T^{SF} (grazing no drink)					−0.00104
						(0.00161)
	n^{SF} (grazing intervals, no drink)					−0.1275
						(0.1344)

percentiles of BMI. Each equation for which the coefficients on the time input measures are shown in Table 7 also includes the entire vector of demographic variables shown in Table 6.[13]

At the upper extremes of the distribution of BMI the results are in the same direction as at the mean (and median) and are even roughly the same size. As at the mean of BMI, additional time spent grazing has no significant relation to BMI, although here when we examine secondary eating alone the relationships to BMI are in the same directions as in the OLS estimates but no longer statistically significant. The general conclusions from this table are that the relation of time use in eating/drinking to BMI do not vary greatly moving up the distribution of BMI from the mean.

[13] The estimates at the median of the distribution, approximately the border between normal weight and overweight, are qualitatively very similar to those from the OLS regressions summarized in Table 6, so to save space I do not present them here.

Table 8
Ordered probit estimates of the relation of eating/drinking time to subjective health, $N = 24{,}831$.

Ind. var.	(1)	Ind. var.	(2)	(3)	(4)	(5)	(6)	(7)
Age	−0.023	T^P	0.00078	0.00039	0.00074	0.00043	0.00079	0.00045
	(0.002)		(0.00011)	(0.00013)	(0.00011)	(0.00013)	(0.00011)	(0.00013)
Age 2/100	0.007	n^P		0.04861		0.0513		0.0592
	(0.002)			(0.00831)		(0.0084)		(0.0085)
Male	0.030	T^S			−0.00012	−0.00015		
	(0.014)				(0.00004)	(0.00004)		
White	0.248	n^S				0.03239		
	(0.018)					(0.00665)		
Hispanic	−0.313	T^{SF}					0.00013	0.00004
	(0.021)						(0.00008)	(0.00008)
Married	0.142	n^{SF}						0.0558
	(0.016)							(0.0092)
ED12	0.193							
	(0.021)							
ED1315	0.437							
	(0.022)							
ED16	0.743							
	(0.025)							
ED16+	0.939							
	(0.030)							
No. of children	−0.018							
	(0.007)							
Pseudo-R^2	0.052	0.052	0.053	0.052	0.053	0.052	0.053	

Note: Columns (2)–(7) also include all the controls in Column (1).

5.3. Determinants of self-reported health

The relationship between self-reported health and BMI is negative, with a pseudo-R^2 in the ordered probit of the health measure on BMI of 0.027. Moreover, the results in Column (1) of Table 8 show that the coefficients on the demographic variables are almost always the opposite sign of those in Column (1) of Table 6 (with the only exceptions being those of gender and the lower categories of educational attainment). Each additional level of educational attainment significantly increases the ordered probit index. These results are consistent with other studies (Strauss et al., 1993).

Columns (2)–(7) in Table 8 are constructed identically to their counterparts in Table 6. The results for eating are very similar to those in Table 6. As with BMI, so too with self-reported general health, more time spent eating is associated with a more desirable outcome. Here, however, more time per incident of eating and additional intervals both have significant positive relationships with self-reported health. Overall better health is associated with more time spent eating, but especially with spreading that time over more meals per day.[14]

The conclusions about the roles of time spent in primary eating/drinking and its components are unaffected by the addition (in Columns (4)–(7)) of measures of grazing. The components of grazing have mixed relationships with self-reported health, depending on whether we define grazing broadly or narrowly. Regardless, more frequent grazing is significantly associated with better health status.[15]

6. A household production approach to BMI

The general issue in this section is how combinations of purchased food and time spent eating and grazing, including the duration and incidence dimensions of time, relate to weight and health. Only a few studies examine the interaction between X^F and T^P formally for random samples of respondents (Hamermesh, 2008; Lim and Rodriguez Zamora, 2009), although another considered a small non-random sample and concentrated on time use and caloric intake in a non-formal examination (Bertrand and Schanzenbach, 2009).

The data are a small subset of those used above. From the linkage of the ATUS to the CPS December Food Security Supplements, I obtained for each respondent household the previous week's food spending and usual weekly food spending. The difficulty is that food spending is by the entire household, while the time-use data describe only one household member. While imputing time use for other household members is possible (Hamermesh, 2007), to avoid concerns about its validity I begin the analysis with one-person households—unmarried adults with no children. This generates a restricted sub-sample of only 2262 individuals. To expand the sample I use equivalence scales to deflate household food spending for married-couple

[14] Note that this is not explicable by differences in income, at least those attributable to the usual explanatory factors of age, education and demographics, as all of these are included as controls in these estimates. As with the results for BMI in Table 6, re-estimating the equations in Columns (6) and (7) separately by gender has no qualitative effect on the conclusions stemming from the pooled data on which the tabled results are based.

[15] A number of doctors recommend frequent daily meals and snacks (consistent with limited caloric intake) to control weight, and a Dutch television personality, Sonja Bakker, has proselytized for this approach.

Table 9
Descriptive statistics, unmarried childless respondents, $N = 2262$, and expanded sub-sample, $N = 4582$.

Variable	Sub-sample		Variable	Sub-sample	
	Restricted	Expanded		Restricted	Expanded
Food last week ($)	92.85 (1.52)	89.85 (0.94)	Age	51.96 (0.40)	50.10 (0.25)
Usual weekly food expenditures ($)	81.24 (1.25)	78.55 (0.78)	Male	0.44 (0.01)	0.43 (0.01)
T^P (eating)	76.04 (1.34)	76.14 (0.89)	White	0.79 (0.01)	0.84 (0.01)
n^P (eating intervals)	1.89 (0.02)	1.96 (0.01)	Hispanic	0.07 (0.01)	0.09 (0.004)
T^S (grazing)	62.79 (3.42)	68.46 (2.56)	ED12 0.32	0.32 (0.01)	 (0.01)
n^S (grazing intervals)	0.92 (0.02)	0.96 (0.02)	ED1315 0.27	0.27 (0.01)	 (0.01)
T^{SF} (grazing no drink)	21.06 (1.61)	17.78 (0.93)	ED16	0.17 (0.01)	0.18 (0.01)
n^{SF} (grazing intervals, no drink)	0.72 (0.02)	0.72 (0.01)	ED16+	0.11 (0.01)	0.12 (0.01)
Fraction working	0.48 (0.01)	0.53 (0.01)			

Note: Standard errors of means in parentheses.

households with zero, one or two children under age 18 (the overwhelming majority of married couples).[16] Adding these expands the sub-sample to 4582 respondents.

6.1. Combining goods and time

Table 9 presents the means of the food-time measures for the restricted and expanded sub-samples and the descriptive characteristics of the respondents' demographics. Several differences stand out in comparison to the overall sample. The crucial differences arise from the fact that the restricted sub-sample is much older, and also contains relatively more women, than the entire sample, which results from the presence of substantial numbers of unmarried older women (many widows). The respondents in this older sub-sample are much less likely to be Hispanics or workers than are members of the entire sample.

The allocation of time to eating differs very little from the average of workers and non-workers displayed in Table 1, especially for the expanded sub-sample. Multiplying the food expenditure measures by 52 weeks, especially for reported spending last week in the restricted sub-sample they are substantially higher than the annual average of $3328 by one-person households reported in the Consumer Expenditure Survey for 2007.[17] The difference is smaller for usual weekly food spending; and comparing spending in the expanded sub-sample to what is implied by the CES, the excess of usual weekly spending in the CPS data is only 5%.

In Table 10 I present estimates that relate food purchases (previous week in Columns (1)–(4), usual week in Columns (5)–(8)) to eating time and the number of eating intervals. Total eating time is positively related to total food spending. It takes time to eat the food that one has purchased. Implicitly, F_{12} in Eq. (3b) is positive. Given the amount of time spent eating, however, breaking it up into more intervals is associated with a substantial reduction in food spending (F_{13} in Eq. (3b) is implicitly negative). Those people who eat more, but more hurried meals, combine that time with fewer purchased goods. The effect is not small: Going from two to three meals per day reduces last week's (usual weekly) food spending by between 3% and 6% in these sub-samples. This may or not be causative—perhaps those who lead more a regular existence are better able to buy nutrition more cheaply.

The odd-numbered columns include grazing defined broadly, while the even-numbered columns include secondary eating only. These estimates suggest that, while additional time spent grazing is associated with more food spending, there is generally no statistically significant relationship between the two (although the coefficients on the broad measure of grazing approach statistical significance). Perhaps this is because spending on grazing goods is a small fraction of total food spending.

6.2. Joint relation with BMI and health

Table 11 presents estimates of the relationships of the household production of eating to BMI, with the first four columns using previous week's spending to represent X^F and the second four based on usual weekly food spending.

[16] I use the OECD modified scale, which assigns weights of 1.5 to an adult couple with no children, 1.8 to a couple with one child, and 2.1 to a couple with two children.

[17] http://www.bls.gov/cex/2007/Standard/cusize.pdf. Whether this difference is the result of an intercept shift, or instead reflects reporting errors correlated with the other characteristics, cannot be known without a proper validation study.

Table 10
Estimates of the relation between eating/drinking time and food spending, restricted sub-sample of unmarried childless respondents, $N = 2262$, and expanded sub-sample, $N = 4582$.

Sub-sample	Last week's spending				Usual weekly spending			
	Restricted		Expanded		Restricted		Expanded	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Time input								
T^P (eating)	0.0631	0.0618	0.1191	0.1201	0.0458	0.0461	0.0920	0.0938
	(0.0276)	(0.0275)	(0.0178)	(0.0178)	(0.0230)	(0.0230)	(0.0148)	(0.0148)
n^P (eating intervals)	−6.599	−6.668	−5.825	−5.546	−3.293	−3.026	−3.802	−3.454
	(1.849)	(1.858)	(1.141)	(1.144)	(1.544)	(1.550)	(0.948)	(0.950)
T^S (grazing)	−0.0097		−0.0118		−0.0019		−0.0040	
	(0.0097)		(0.0057)		(0.0081)		(0.0047)	
n^S (grazing intervals)	1.993		1.372		2.384		0.827	
	(1.479)		(0.881)		(2.592)		(0.732)	
T^{SF} (grazing no drink)		0.0075		0.0075		0.0172		0.0148
		(0.0203)		(0.0153)		(0.0170)		(0.0127)
n^{SF} (grazing intervals, no drink)		0.6731		1.085		3.333		1.733
		(1.9130)		(1.218)		(1.596)		(1.011)
Adj. R^2	0.070	0.069	0.070	0.069	0.046	0.047	0.064	0.065

Note: The estimates also include a quadratic in age, indicators of race, ethnicity and gender, and a vector of indicators for educational attainment, here and in Tables 11 and 12.

Table 11
Estimates of the relation of goods and time inputs into eating/drinking to BMI, restricted sub-sample of unmarried childless respondents, $N = 2187$, and expanded sub-sample, $N = 4351$.

Sub-sample	Last week's spending				Usual weekly spending			
	Restricted		Expanded		Restricted		Expanded	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ind. var.								
X^F	0.0051	0.0052	0.0.0029	0.0030	0.0034	0.0036	0.0022	0.0022
	(0.0017)	(0.0017)	(0.0014)	(0.0014)	(0.0021)	(0.0021)	(0.0016)	(0.0016)
Time input								
T^P (eating)	−0.0007	−0.0009	0.0001	0.0002	−0.0005	−0.0007	0.0003	0.0004
	(0.0023)	(0.0023)	(0.0016)	(0.0016)	(0.0023)	(0.0023)	(0.0016)	(0.0016)
n^P (eating intervals)	0.0827	0.0674	−0.2064	−0.2026	0.0607	0.0439	−0.2136	−0.2095
	(0.1528)	(0.0153)	(0.1049)	(0.1051)	(0.1527)	(0.1530)	(0.1049)	(0.1051)
T^S (grazing)	−0.0009		−0.0004		−0.0010		−0.0004	
	(0.0008)		(0.0005)		(0.0008)		(0.0005)	
n^S (grazing intervals)	0.2490		0.0393		0.2501		0.0407	
	(0.1220)		(0.0815)		(0.1222)		(0.0815)	
T^{SF} (grazing no drink)		−0.0060		−0.0038		−0.0060		−0.0038
		(0.0017)		(0.0014)		(0.0017)		(0.0014)
n^{SF} (grazing intervals, no drink)		0.3123		0.1639		0.3038		0.1644
		(0.1570)		(0.1128)		(0.1574)		(0.1128)
Adj. R^2	0.052	0.055	0.057	0.058	0.049	0.053	0.056	0.058

Because some of the respondents failed to provide health and/or BMI data, the sub-samples are further reduced in size. The food spending terms have a positive relation to BMI that is statistically significant for last week's spending. BMI does not rise with income over most of its range in the contemporary U.S., making this finding hard to rationalize for the superior good, food (Baum and Ruhm, 2009).

These regressions are an extension of some of those presented in Table 6, with the addition of X^F but limited to fewer than 20% of that sample's respondents. I therefore discuss the results in comparison to their counterparts in Columns (5) and (7) of that table. Considering only the estimates for the restricted sub-sample (of childless single-person households), they look very different, especially the coefficients on total time and intervals of primary eating/

Table 12
Ordered probit estimates of the relation of goods and time inputs into eating/drinking to subjective health, restricted sub-sample of unmarried childless respondents, $N = 2237$, and expanded sub-sample, $N = 4538$.

Sub-sample	Last week's spending				Usual weekly spending			
	Restricted		Expanded		Restricted		Expanded	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ind. var.								
X^F	0.0005 (0.0003)	0.0006 (0.0003)	0.0005 (0.0003)	0.0005 (0.0003)	0.0003 (0.0004)	0.0003 (0.0004)	0.0006 (0.0003)	0.0006 (0.0003)
Time input								
T^P (eating)	0.0004 (0.0004)	0.0004 (0.0004)	0.0006 (0.0003)	0.0006 (0.0003)	0.0004 (0.0004)	0.0004 (0.0004)	0.0006 (0.0003)	0.0006 (0.0003)
n^P (eating intervals)	−0.0006 (0.0285)	−0.0019 (0.0286)	0.0194 (0.0198)	0.0209 (0.0199)	−0.0030 (0.0284)	−0.0045 (0.0286)	0.0189 (0.0198)	0.0203 (0.0199)
T^S (grazing)	−0.0003 (0.0001)		−0.0003 (0.0002)		−0.0003 (0.0001)		−0.0002 (0.0001)	
n^S (grazing intervals)	0.0387 (0.0001)		0.0383 (0.0153)		0.0391 (0.0227)		0.0385 (0.0153)	
T^{SF} (grazing no drink)		0.0002 (0.00007)		−0.0001 (0.0003)		0.0002 (0.0003)		−0.0001 (0.0003)
n^{SF} (grazing intervals, no drink)		0.0015 (0.0294)		0.0339 (0.0211)		0.0009 (0.0294)		0.0335 (0.0211)
Pseudo-R^2	0.083	0.082	0.062	0.062	0.082	0.081	0.062	0.062

drinking. In the expanded sub-sample, however, whose demographic characteristics approximate more closely those of a random sample of the adult population, the estimated relations of eating time and BMI are very much like those shown in equations that exclude food spending. Additional time spent in primary eating/drinking has no relation to BMI, but spreading it over more meals is associated with lower BMI. Additional time spent grazing is associated with lower BMI, but, given the amount of grazing time, more intervals have no relation to BMI.

In Table 12 I present estimates analogous to those presented in Table 11, but here they are ordered-probit parameters describing the determinants of subjective health. While the estimates for the restricted sub-sample are different from those for the entire sample in Table 8, those for the expanded sub-sample look fairly similar and merit no comment. The novelty here, however, is that additional food spending is associated with better subjective health. Since I have held constant a vector of variables that are the usual predictors of earnings and income, this result can be interpreted as arising independent of income effects on health—given income, more spending on food is related to better health. I do not claim that the relationship is causal, since those who are in better health may choose to spend more on food, given their incomes.

7. Conclusions, completions and implications

Using the first available data set that links time use to weight and health outcomes for a large random sample, I have examined how time spent eating, both at and between meals, relates to these objective and subjective outcomes. The focus has been on both the amount of time eating and grazing and on their distributions across the day—the duration and incidence of eating time. The most interesting association is between the frequency of eating and weight and health outcomes. Conditional on total eating time, those who eat more meals, particularly regular meals, weigh less and report better health than do their demographically identical counterparts. Grazing time, however, is only weakly negatively related to BMI.

The distribution of time between eating and grazing depends on the price of time. Because meals entail greater set-up costs, people with higher wage rates graze relatively more and spend less time at meals; and they show more intervals of grazing relative to the number of meals they enjoy. When time becomes more valuable (as proxied by the hourly wage), people substitute grazing for eating, essentially switching to multi-tasking food consumption and a primary activity.

We cannot view most of the results as reflecting causation. It is reasonable to argue that the wage rate is exogenous with respect to total time spent eating and grazing and its distribution between them, so that the examination of the price of time and relative time spent in meals and grazing provides evidence on the effect of the former on the latter. But the results on BMI and health in relation to eating and grazing only show a relationship—one cannot argue that the latter cause the former. That is of special concern because I have no data on the relative caloric intake of the average and marginal minutes spent in eating and grazing.

There are a number of different substantive extensions to this study that one could undertake, especially with more extensive data. Even using the ATUS data and these supplements, a formal model of goods–time substitution could be estimated (to infer the elasticity of substitution between goods and time in the production of the commodity food); and that model could be expanded to allow for two kinds of time inputs—eating and grazing—and even for the duration and incidence components of each of these. Indeed, the same exercise could be undertaken more generally. One could also use these same data to examine how Food Stamps alter the allocation of time between eating and grazing, and how that affects time–goods substitution.

More difficult would be serious formal modeling of the economic determinants of the relation of eating and grazing time to weight and health. I have treated the determination of BMI in a static model, but it can be thought of more broadly as the outcome of dynamic maximization by a consumer acting under uncertainty about both resources and the impact of food spending and time use in the production of BMI. Given the statistical significance of some of the relationships here, particularly between intervals of primary eating/drinking (meals) and BMI and health, it would be worthwhile using longitudinal data to examine how these are affected by the price of time through both income and substitution effects and how those change over the life cycle.

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