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Factors Affecting School Students' Consumption of Peanut Butter Sandwiches

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Nine out of ten Americans, rich and poor, male and female, old and young, eat peanut butter. Peanut butter is delicious, nutritious, and energy dense. This is undoubtedly a major reason for its popularity. Several recent studies show that regular consumption of peanut butter can reduce the risk of some chronic diseases, including type II diabetes and heart disease (Jiang et al. 2002) Contrary to popular belief, regular consumption of peanut butter is also helpful in losing and keeping off weight and in lowering cholesterol (McManus, Antinoro, and Sacks 2001). With the newly discovered beneficial effects getting publicized, it is likely that consumption of peanut butter may increase.

Peanut butter is convenient to use. Open the can and eat a few spoonfuls of peanut butter, and it will keep your hunger at bay for several hours. Mix half a cup of peanut butter with some vegetables or fruits and you get a plate of delicious salad. Apply a spoonful of peanut butter to a piece of bread and you get a peanut butter sandwich, good for breakfast and lunch. Among all the alternative consumption forms, the peanut butter sandwich is the most popular.

The peanut butter sandwich has enjoyed great popularity in the United States for a long time. A recent nationwide survey commissioned by the J.M. Smucker Company in Orville, Ohio shows that the peanut butter sandwich has become a gastronomic icon in the United States (*Prepared Foods* 2002). It is particularly a favorite food for young consumers. On average, an American consumes 1500 peanut butter sandwiches before graduating from high school.

This study investigates factors influencing school students' consumption of peanut butter in the most popular consumption form, the peanut butter sandwich, taking both consumption participation and consumption frequency into consideration. Insights about consumption behavior provide valuable information for the promotion of this food item because school students are the main consumers of the product. Furthermore since the peanut butter sandwich is the dominant consumption form of peanut butter, the study may indirectly provide useful information for better understanding and more effectively exploiting the market for peanut butter.

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Econometric Model

Filter design is used in the survey to obtain information on participation and consumption. First, all the students are asked whether or not they eat peanut butter sandwiches. If a student eats peanut butter sandwiches, he is then asked how often he eats them. It is implicitly assumed that some students just have a binary choice decision to make while others have two joint decisions to make. If a student decides that he should not eat peanut butter sandwiches, his decision is over. If he decides that he should eat peanut butter sandwiches, he then has to decide how frequently to eat them. The two-stage decision nature implies that participation and consumption should be modeled jointly, partly to gain estimation efficiency. The double-hurdle model introduced in 1971 by Cragg has been frequently used to model two-stage decision processes.

An advantage of the double-hurdle model compared with the standard univariate tobit model is that it provides a more flexible framework to model the observed consumer's behavior as a joint choice of two decisions instead of a single decision. As a result, it allows for the investigation of whether participation and consumption have the same set of determinants. Previous studies have reported that participation and consumption are determined by different sets of factors (Moon et al. 2002; Huang, Kan, and Fu 1999 ; Lin and Milon 1993). For peanut butter sandwiches, a typical example is that allergy to peanut butter affects the participation decision but not consumption. If a person is allergic to peanut butter, then he may not eat peanut butter

sandwiches at all, so whether a person is allergic to peanut butter plays a decisive role in participation. On the contrary, if a person consumes peanut butter sandwiches, it is unlikely that he is allergic to peanut butter. Thus whether a person is allergic to peanut butter does not affect consumption frequency.

The data on consumption in this study are not actual consumption quantity or frequency, but consumption frequency falling in specific categories or time intervals as described in the data section. The conventional double-hurdle model, however, may not be applicable when the data on consumption are categorical. Efforts have been made to modify and to extend the standard double-hurdle model to accommodate different types of data. Huang, Kan, and Fu (1999), for example, modified and extended the bivariate probit model discussed by Meng and Schmidt (1985) to include a probit and an ordered probit model for the analysis of consumer demand for food safety. Moon et al. (2002) modified the approach used by Huang, Kan, and Fu (1999) and that used by Blend and van Ravenswaay to establish an ordered probit model with sample selection to analyze willingness to pay for environmental practices. We follow the approaches used by Moon et al. (2002) and Huang, Kan and Fu (1999) in our econometric analysis of participation and consumption. The approach is appropriate for our data because the categorical and ordinal nature of the data on consumption warrants the use of a multi-ordered response model (Maddala 1983).

Let D be a binary variable which is assigned a value of 1 when a student decides to eat peanut butter sandwiches and 0 otherwise. The probability that D = 1 can be analyzed with a binary-choice model. Conditional on D = 1, a student decides how frequently he should include peanut butter sandwiches in his meals. Let Q* be the latent utility-maximizing consumption frequency of peanut butter sandwiches, defined in intervals such as once a month or once a week, and Q be the observed interval in which the student's consumption frequency falls. Then, following Moon et al. (2002), a sample-selection model characterizing the two-stage decision process can be represented by a set of equations as

$$(1)\quad D = X\alpha + \varepsilon_d,$$
$$Q^* = Z\beta + \varepsilon_q,$$
$$Q = Q^* \text{ if } D = 1,$$
$$Q = 0 \text{ if } D = 0,$$

where X is a vector of variables affecting the decision to participate and Z is a vector of variables affecting consumption frequency; α and β are two vectors of parameters to be estimated; and ε_d and ε_q are the disturbance terms, each with a zero mean, and jointly distributed as normal standard bivariate with a correlation coefficient ρ. The first equation in (1) models participation and the second equation models consumption.

The participation equation and consumption equations in (1) are to be estimated jointly using the maximum-likelihood procedure to gain estimation efficiency and to avoid sample-selection bias. For notational convenience, assuming the data are arranged in such a manner that D = 0 for the first M observations and D = 1 for the last N − M observations, then the likelihood function can be expressed as

$$(2)\quad L = \prod_{i=1}^{4} \Pr(D_i = 0) \prod_{j=M+1}^{N} \Pr(D_j = 1, Q_j = k)$$

where k = 1, 2, 3, 4 denotes the category in which a consumption frequency falls, where 1 stands for less than once a month and 4 for more than once a week, etc.

Taking into consideration the ordered categorical nature of the data on consumption (Greene 1997; Huang, Kan, and Fu 1999; Moon et al. 2002), the log likelihood function can be expressed as:

$$(3)\quad L = \sum_{i=1}^{M} \ln\Phi(-\alpha X) + \sum_{j=M+1}^{N} \ln\{F[\alpha X, \mu_k - \beta Z, \rho]\},$$

where μ_j is the categorical thresholds for the underlying response variable Q*, where j = 0, 1, 2, 3 and $0 < \mu_1 < \mu_2 < \mu_3$; ρ is the correlation coefficient between ε_d and ε_q; Φ(.) is the standard normal CDF; and F[.] is the bivariate standard normal CDF.

Data and Empirical Model

The data are from a letter survey of school students on consumption of peanut butter sandwiches, conducted by the University of Georgia in 2002. A sample of 1259 students was randomly drawn from 40,790 students of 46 elementary schools, 18 middle schools, and 11 high schools located in Spalding County, Hart County, Clayton County, and Fayette County in Georgia. The four counties are ranked in this order from low to high in Georgia in terms of annual per-capita income.

The sample is rather evenly distributed among the four counties: more than 24% of the sample are

students from Spalding County, about 25% are from Hart County, 22% from Clayton County, and 29% are from Fayette County. The sample is not, however, evenly distributed across elementary, middle, and high schools. More than 33% of the sample is elementary school students, middle school students account for 40% of the sample, and high school students account only for a little more than 26%.

Consumption participation rates differ somewhat across elementary, middle, and high schools. Around 77% of the elementary school students eat peanut butter sandwiches. Middle school students have the highest consumption participation rate, 81%. The participation rate of high school students is 70%, the lowest. The survey results show that consumption frequencies across elementary school students, middle school students, and high school students are fairly close, with elementary school students eating peanut butter sandwiches most frequently and high school students eating them least frequently. On a measurement scale where 1 stands for eating the product less than once a month, 2 for once in a month, 3 for once a week, and 4 for more than once a week, the mean value of consumption frequency is 2.41 for elementary school students, 2.32 for middle school students, and 2.13 for high school students.

Information was obtained on the use of other ingredients—including jelly, syrup, honey, and banana—with peanut butter to make sandwiches. About 88% of the students use one kind or another with peanut butter to make sandwiches. The favorite is jelly: 76% of the students use jelly with peanut butter.

Taste is an important factor affecting consumption of food products. Those who eat school lunches were asked whether or not they like the taste of the peanut butter sandwiches served at their schools. Only 41% of the students gave a positive answer.

Table 1 presents summary statistics and detailed descriptions of the variables used in the estimation. Three variables that represent eating lunch at home, liking the taste of peanut butter sandwiches served at school, and using jelly with peanut butter to make sandwiches, are included as explanatory variables in the consumption model but not in the participation model. This is because the only information available about those who do not eat peanut butter sandwiches is school level and location of their school.

Table 1. Variable Definition and Sample Statistics.

Variable	Definition	Mean
D	= 1 if eats peanut butter sandwiches; 0 otherwise.	0.769.....
Q	= 1 if eats peanut butter sandwiches less than once a month;	2.277
	= 2 if eats peanut butter sandwiches once a month;	
	= 3 if eats peanut butter sandwiches once a week;	
	= 4 if eats peanut butter sandwiches more than once a week.	
Midschool	= 1 if respondent is a middle school student; 0 otherwise.	0.401
Highschool	= 1 if respondent is a high school student; 0 otherwise.	0.261
Fayette	= 1 if respondent lives in Fayette county; 0 otherwise.	0.290
Clayton	= 1 if respondent lives in Clayton county; 0 otherwise.	0.221
Hart	= 1 if respondent lives in Hart county; 0 otherwise.	0.251
Schoolunch	= 1 if eats school lunch; 0 otherwise.	0.825

Results

Participation and consumption, modeled by a probit model and an ordered probit model respectively, were estimated jointly using the maximum-likelihood method. The estimation results are presented in Table 2. The estimate of ρ that maximizes the likelihood function is 0.899 and is different from zero at the 0.001 significance level. Such a large ρ value implies that the residuals from the probit and ordered probit models are highly correlated. This means that the joint-estimation approach is appropriate for the data and efficiency is gained by the use of the joint estimation approach.

Two sets of factors, school level and residence place, are included in both the participation and consumption models as explanatory variables. Two types of effects on participation and consumption, the age and educational effects, are embodied in school level. Generally, middle school students are older than elementary school students, and high school students are older than middle school students. Similarly, middle school students are more educated than elementary school students, and high school students are more educated than middle school students. Given the limited information contained in the data, it is difficult to distinguish the two types of effects embodied in one variable.

Table 2. Results of Joint Estimation of Participation ane Consumption.

Variable	Participation	Consumption
Constant	0.901***	0.921***
	(9.59)	(10.01)
Midschool	0.202**	0.194**
	(2.11)	(2.10)
Highschool	-0.166*	-0.163
	(-1.65)	(-1.62)
Fayette	-0.329***	-0.358***
	(2.99)	(-3.39)
Clayton	-0.234*	-0.214*
	(-1.93)	(-1.87)
Hart	-0.179	-0.241**
	(-1.54)	(-2.11)
Schoolunch		-0.208***
		(-2.62)
Tasty		0.135**
		(2.08)
Jelly		0.006**
		(2.12)

* significant at 0.1 level.
** denotes significant at 0.05 level.
*** denotes significant at 0.01 level.
t-values are in parentheses.

To capture the effects of school level, a dummy is assigned to both middle school students and high school students. The results show that, compared with elementary school students, middle school students are more likely to participate in the consumption of peanut butter sandwiches. On the other hand, high school students are less likely to do so. Middle school students also tend to consume the product more frequently. The coefficient on the dummy for high school students bears a negative sign but is not significant at commonly accepted significance levels. Adults generally eat peanut butter sandwiches less frequently than do non-adults. Some people even think that peanut butter is mostly for children. It could be that high school students, in a transition period from teenagers to adults, begin to adopt the dietary style of adults, and so begin to reduce consumption of such food products as candies and peanut butter.

Information on income is not available because students usually do not know their household income. However, residence place may partly capture the effect of household income on participation and consumption. As stated in the data section, the four counties included in this study are arranged from low to high in Georgia in terms of per-capita income, in the order of Spalding, Hart, Clayton, and Fayette. Apart from the possible per-capita income effect, residence place may also affect participation and consumption through its impact on the quality of school lunch. A school in a high-income county may be richer than a school in a low-income county, and this may result in a quality difference of meals served at these schools, such as difference in choice varieties. Given that more than 82% of the students eat school lunches and that peanut butter sandwiches are usually eaten for breakfast or lunch, this effect could be substantial. We use Spalding County as a benchmark while assigning each of the other counties a dummy.

The results show that residence place affects both participation and consumption. Students from counties of high per-capita income—that is, Fayette and Clayton counties are less likely to participate in the consumption of peanut butter sandwiches. Furthermore, students from Fayette, Clayton, and Hart Counties tend to eat peanut butter sandwiches less frequently. Besides the possible per-capita income effect embodied in residence place, one plausible explanation is that schools in high-income counties offers more varieties to choose from for lunch. With more choices, the probability to choose peanut butter sandwiches for lunch may decrease.

Taste preference was found to have a statistically significant effect on consumption frequency. Those who like the taste of peanut butter sandwiches served at school tend to eat peanut butter sandwiches more frequently. This implies, along with the facts that 82% of the students eat school lunch and only 41% like the taste of the peanut butter sandwiches served at their schools, that consumption of peanut butter sandwiches can be increased substantially by taste improvement.

Jelly is usually considered to be a good companion for peanut butter in making a sandwich, but whether the use of jelly with peanut butter affects the consumption of peanut butter sandwiches remains unknown; to the authors' knowledge, no previous study has investigated this. The results show that those who use jelly with peanut butter to make sandwiches tend to eat peanut butter sandwiches more frequently than do their counterparts.

Those who eat school lunches tend to eat peanut butter sandwiches less frequently than do those who do not eat school lunches. Those who do not eat school lunches usually eat home-prepared lunches. School lunches usually offer more choices than do home-prepared lunches. More choices imply a ower probability to choose peanut butter sandwiches for lunch; hence, these students eat peanut butter sandwiches less frequently.

Conclusion

This study investigates school students' consumption of peanut butter sandwiches. A probit model and an ordered probit model were estimated jointly to identify factors affecting consumption participation and consumption frequency. We found that school level and residence place affect both consumption participation and consumption frequency. Improving the taste of peanut butter sandwiches served at schools may substantially increase consumption. Using jelly with peanut butter to make sandwiches could be an effective way to increase consumption of peanut butter sandwiches (more accurately, peanut butter-jelly sandwiches.)

We want to mention two limitations of the study. First, we recognize that allergy to peanut butter can be an important factor affecting the consumption participation. Due to the limit of the data, this piece of information is not available to the researchers.

Second, how frequently peanut butter sandwiches are included at a school as a choice for lunch may affect consumption frequency. In a survey of the food-service personnel of 67 schools in the four counties included in this study, the results show that the frequencies at which those schools include peanut butter sandwiches in lunch menus differ from once or twice a year to five times a week. For students at schools rarely serving peanut butter sandwiches, their consumption frequency is constrained, but we have difficulty matching which student is from which school.

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