Staff Paper P94-4 **March 1994**

STAFF PAPER SERIES

Non-Purchasing Households in Food Expenditure Surveys:

An Analysis for Potatoes in Sweden

by

Mari Andersson and Ben Senauer

DEPARTMENT OF AGRICULTURAL AND APPLIED ECONOMICS

COLLEGE OF AGRICULTURE

UNIVERSITY OF MINNESOTA

Staff Paper P94-4 March 1994

Non-Purchasing Households in Food Expenditure Surveys:

An Analysis for Potatoes in Sweden

Mari Andersson and Ben Senauer

Information on other titles in this series of Staff Papers may be obtained from:
Waite Library, University of Minnesota, Department of Agricultural and Applied Economics, 232 Classroom Office Building, 1994 Buford Avenue, St. Paul, MN 55108-6040, U.S.A.

Non-Purchasing Households in Food Expenditure Surveys:

An Analysis for Potatoes in Sweden*

Mari Andersson and Ben Senauer**

ABSTRACT

A common problem in food expenditure surveys is that many households report not purchasing some products. Usually the reason for these zero expenditures is unknown. The issue may be treated as a potential sample selection bias problem. This study estimates Engel functions for expenditures for fresh potatoes, processed products, and the value of home-grown potatoes with data from the 1989 Swedish Household Food Expenditure Survey. The two-step Heckman procedure is used. A strong generational pattern is found in potato consumption as well as several other significant effects.

Keywords:

food demand, potato consumption, household surveys, non-purchasers, Heckman model.

*This research was supported by a grant from the Swedish Forestry and Agricultural Research Foundation.

**Mari Andersson is a research associate in the Department of Economics at the Swedish University of Agricultural Science and Ben Senauer is a Professor in the Department of Agricultural and Applied Economics and Director of the Center for International Food and Agricultural Policy at the University of Minnesota. The work on this paper was completed while Mari Andersson was a visiting scholar at the University of Minnesota. The authors wish to thank Yacov Tsur for his comments on an earlier version of this paper.

Non-Purchasing Households in Food Expenditure Surveys: An Analysis for Potatoes in Sweden

Mari Andersson and Ben Senauer

1. INTRODUCTION

A common problem in food expenditure surveys is that a substantial number of households may report not purchasing the product during the survey period. The data for potatoes from the 1989 Swedish Household Food Expenditure Survey provide a good example. For the demand analyst non-purchasers present both a conceptual issue concerning the underlying reason and a statistical problem regarding the appropriate econometric methodology. Typically the reason for non-purchase can not be determined from the available survey data. With non-purchasers, the consumption decision can be viewed as a two-step process (Haines, et.al, 1988). Under these circumstances, the Heckman (1979) two-step procedure for sample selection bias provides a possible econometric approach to the estimation of Engel functions or demand equations.

Potatoes remain an important food in European diets as shown in Table 1. Potato consumption was over 60 kg per capita annually in 14 Western European countries in 1988, with Ireland not surprisingly the highest at 141.3 kg. Average annual per capita consumption in Sweden was 69.9 kg. In the food demand literature, potatoes are usually considered to be an inferior good, whose consumption declines at higher income levels (Smallwood and Blaylock, 1981). Potato consumption generally tends to be negatively related to GNP per capita in the OECD countries shown in Table 1.

This paper examines the effect of household income and other socioeconomic factors on expenditures for fresh potatoes, for processed potato products, and the value of home-produced potatoes consumed in Sweden. There is a long tradition of estimating such Engel functions in economics. The unique contribution of this work focuses on the consideration given to the issue of non-purchasers and the application of the Heckman two-step procedure.

The economic model is discussed in the next section. The third section briefly describes the Swedish survey data and provides descriptive statistics. The fourth section discusses the conceptual issues posed by households reporting zero expenditures for a product. The Heckman econometric model is described in the fifth section and the empirical results are presented and discussed in the sixth section. The final section provides some conclusions regarding our analysis and the methodology.

2. ECONOMIC MODEL

Engel functions are obtained from the underlying theoretical assumption that households act to maximize utility subject to a budget constraint. In Engel functions expenditures are dependent on household income and various demographic characteristics that might affect tastes and preferences. Prices are typically assumed constant with the cross-sectional data that are usually used to estimate Engel functions. The basic Engel function model in our analysis is:

$$E_i = \beta_0 + \beta_1 I_i + \beta_2 X_i + u_i \tag{1}$$

where E_i is expenditures in Swedish kronor (SwKr) by the i^{th} household on a particular product divided by household size measured in adult equivalents, I_i is household income per adult equivalent, and X_i represents a vector of additional explanatory factors which might affect demand. More specifically, the dependent variables in the estimated equations are household expenditures per adult equivalent for fresh potatoes, processed potato products, and the value of home-grown potatoes consumed. The adult equivalent scale was derived based on the Swedish recommended daily intake of calories. As is typical, an adult male was counted as one with other household members as some fraction of that norm (Buse and Salathe, 1978).

In addition to disposable income per adult equivalent, the other explanatory variables include the age of the female household head, her labor force participation, time spend cooking, whether it is a farm household, the availability of a potato storage facility in the household, location in terms of urbanization, and season. Each of these variables is precisely defined in the next section. However, the justification for the inclusion of some of these factors should be explained more fully. The female head's age is assumed to affect preferences. Potato consumption differs between the generations in Sweden.

About 80 percent of adult Swedish women are in the labor force (Swedish Statistics, 1993). Those not in the labor force are usually either involuntarily unemployed, studying, retired, or temporarily home with small children. Women in general work either full-time or half-time. A recent study shows that although they spend substantial time in the labor force, Swedish women still do the major part of all household work, including food preparation (Rydenstam, 1992). Increased work force participation decreases the time available for household work and increases the opportunity cost of time. In the context of Becker's (1965) model of household production, the full price including time costs of time-intensive activities, such as home cooking, rises. In addition to causing an overall decline in potato demand for preparation and consumption at home, this price effect might produce a shift in demand from time-intensive fresh potatoes to more convenient processed potato products. A major attraction of the latter is their ease of preparation for which consumers are willing to pay a price premium.

In addition, this analysis includes a variable for the actual time devoted to cooking to directly capture its effect. Decreased cooking time is presumably linked to a decline in potato demand and/or a shift from fresh to processed products. Both farm households and households with storage facilities are assumed to be more likely to raise their own potatoes for consumption and perhaps have higher overall demand. A storage facility could also affect the frequency of purchases since potatoes could be stored for longer periods. A more urban location will certainly decrease the possibility of the home production of potatoes and might be linked to an overall decline in household potato expenditures. The harvest season for fresh potatoes is the summer and fall and dummy variables were included to allow for a seasonal pattern.

Finally, a conscious decision was made to exclude prices from the analysis. The Swedish survey collected data on both expenditures in kronor and quantities. The former could presumably be divided by the later to obtain an implicit price per unit. However, this assumes a homogenous product which is not necessarily true because of variations in potato variety, quality and other factors such as package size. A recent retail study shows that there is substantial quality and product differentiation in the Swedish potato market (Andersson, et.al., 1994).

3. DATA

The data used in this study are from the 1989 Swedish Household Food Expenditure Survey, conducted by the Swedish Statistical Bureau. The total number of households in the survey was 2,079 and the response rate was 70 percent. All demographic data were collected by initial personal interviews. Food expenditures and quantities were recorded in a diary by each household during four weeks. Incomes for all participating household members were collected from official government data lists.

Sixty-seven percent of the households purchased fresh potatoes and 24 percent produced their own potatoes as shown in Table 2. In total 82 percent of the households had some consumption of fresh potatoes either from purchases or own-production and 60 percent registered expenditures for processed potatoes. This means that many of the households reported no expenditures. Thirty-three percent reported no purchases of fresh potatoes, 76 percent no home production, 18 percent no purchases or home production, and 40 percent no purchases of processed potato products.

Table 3 gives the descriptive statistics and the exact definitions for the variables used in the analysis. Expenditures and income are all in Swedish kronor (SwKr) per adult equivalent annually. The value of consumption from home production averages about 45 SwKr per year; expenditures on fresh potatoes 140 SwKr; and processed potatoes 136 SwKr per adult equivalent.

Three categories were created for the female head's age to better allow for a generational pattern and possible non-linearities, rather than use age as a continuous variable. For these 0:1 dummy variables, the mean indicates the proportion of the sample in each category when the variable is equal to one. For example, 46 percent of the households have a female head 35-54 years old. The category for households with female heads less than 35 years old or with no female head present is not shown, and is excluded from the estimated equations since one dummy variable must be dropped for estimation. This groups contains 36 percent of the sample.

Likewise, hours worked in the labor force was transformed into three discrete categories. The excluded category is women who worked less than 16 hours per week with 33 percent of the sample. This group would have the most time available for household activities, including shopping and cooking. Since 62 percent of the households have facilities to store 10 kg or more of potatoes, this may partially explain the substantial number of non-purchasers even though the survey period was four weeks, which is relatively long. Many of the non-purchasers may simply have been consuming potatoes from their stored inventories.

Households in the three largest cities in Sweden are grouped together and represent 31 percent of the sample. Thirty-three percent of the households are rural which is the missing category. However, only 3 percent are farm households. The season excluded is spring with 20 percent of the observations.

4. NON-PURCHASERS

When data from household food expenditure surveys are used in a study for a specific food group, like potatoes in this case, a substantial number of zero expenditures often occur. The proportion of households which are likely to report not purchasing a product during a survey tends to increase as the category becomes more specific or unusual or the survey period shorter. There would be more zero expenditures reported for potatoes than for vegetables and more for artichokes or kale than potatoes. The situation created by non-purchasers in demand analysis is an example of the more general econometric problem of limited dependent variables, in this case the limit value is zero. Due to a lack of awareness of the problems, ordinary least squares (OLS) was used in the past to estimate demand relations with data that contained substantial numbers of non-purchasers, and still frequently is used, which can be yield biased and inconsistent estimates (Amemiya, 1984; Cragg, 1971; Pudney, 1989; and Maddala, 1983).

Non-purchasers raise two general issues. First, do the observed households with zero expenditures contribute any additional information to the analysis, or can they simply be omitted? Second, if the households with zero expenditures differ from the rest of the sample, what econometric methods should be used for estimating the demand equations?

There are several possible reasons for non-purchasers in food expenditure surveys. Households can be divided into three major categories. The first category of households would simply never buy some food commodities, based on health concerns, religious beliefs or other reasons. These households can be considered as true non-consumers. In this case, the non-purchasing households could be excluded from the analysis since they would never by part of the market (Thomas, 1972, pp. 125-126).

With the second category of households, infrequent buyers, zero expenditures are reported because of the short duration of the consumer survey. The survey period is too short to register these households' purchases. People tend to seek variety in their diet and if the survey period had been extended, fewer non-purchases would have been reported. Food inventories in the household can also be a factor in these periodic purchases. Many food products, such as potatoes, are purchased in sufficient quantities to be stored and consumed over an extended period by the household.

If all households purchase the product over some longer period and those purchasers observed during the survey are random, OLS may be used to estimate demand equations with the observations for purchasing households. However, the estimated coefficients would be biased (Amemiya, 1984).

The third category can be described as potential buyers. These households might buy a certain food commodity if some economic factor changed, like lowered prices or increased household income. The potential buyers represent a corner solution to the conventional utility maximization problem. Tobit models have recently been widely used to estimate limited dependent variable models, particularly in the case of surveys that include zero expenditures. The standard Tobit model implicitly assumes that at some level of the explanatory variables (with a low enough price or high enough income, for example), non-purchasers will become purchasers.

The choice of econometric method for estimation should obviously be based on which of these categories the households with zero expenditures belong to (Blaylock and Blisard, 1991; Blisard and Blaylock, 1993). However, the typical household expenditure survey does not provide the information needed to determine to which category of non-purchasers a household belongs (Deaton and Irish, 1984). This is a general shortcoming of such surveys, which is also true for the 1989 Swedish Household Food Expenditure Survey. Questions would need to be added to the survey questionnaire for non-purchasers to answer with regard to whether they ever purchase the product, and if so when they last purchased it. Additional questions add to the respondent burden, though, and could reduce a survey's response rate.

5. THE HECKMAN PROCEDURE

The problem posed by non-purchasers may be approached as an issue of sample selection bias. Do the purchasers and non-purchasers represent random subsamples of the entire sample of households or does the self-selection involved yield non-random samples? In terms of the three categories discussed in Section 4, infrequency of purchase would likely yield random samples, whereas true non-consumers and potential consumers might produce select samples. However, it also might be the case that certain households that purchase the product less frequently are different from those who buy it more regularly.

With non-purchasers, previous research has found that food expenditure decisions should be modeled as a two-step process (Haines, et.al., 1988; and Yen, 1993). The standard Tobit model is particularly restrictive, not allowing for different factors to affect the probability of purchase and the conditional level of expenditures. It assumes "that the decision to consume a given food item is the same as the decision about the amount of the food to consume" (Haines, et.al., 1988, p. 543).

The most widely applied estimation technique in the context of possible sample selection bias is Heckman's (1979) procedure, which is a two-step model. It allows the decisions to purchase and the amount purchased to be modeled separately. The Heckman procedure has been widely used to estimate wage rates since an individual's employment status reflects self-selection, thus producing a selected sample of those employed in the labor force (Heckman, 1980).

In the context of this potato study the two-step Heckman model can be specified in the following way. Assume that P_i in Equation (2) is a variable representing whether the i^{th}

household reported expenditures for the product or not. P_i gets the value one if expenditures are reported by the i^{th} household and zero otherwise. Furthermore, D_i is a vector of exogenous explanatory factors and e_i the error term.

$$P_i = \alpha D_i + e_i \tag{2}$$

Probit analysis, a maximum likelihood (ML) technique is used to estimate Equation (2). Then to obtain consistent estimates of the β's in the expenditure Equation (1) the inverse Mills' ratio is used. The inverse Mills' ratio is calculated from the density (ϕ) and the distribution (Φ) functions for a standard normal variable in the ML estimate of Equation (2). The inverse Mills' ratio is:

$$\lambda_i = \frac{\phi(Z_i)}{1 - \Phi(Z_i)}$$

and

$$Z_i = -\frac{\alpha D_i}{\sigma_e}$$

The inverse Mills' ratio, lambda, is included in the second stage OLS estimation of Equation (1).[1] The regression used for estimation of expenditures greater than zero can then be written as:

[1]The LIMDEP 6.0 software program was used to estimate the Heckman model.

$$E_i | P_i > 0 = \beta_0 + \beta_1 I_i + \beta_2 X_i + \beta_\lambda \lambda_i + \varepsilon_i \qquad (3)$$

Equation (3) is thus estimated for the truncated subsample with positive expenditures only.

The Mills' ratio reflects the probability that an observation with specific characteristics will be selected into the observed, truncated sample (Heckman, 1980, p. 214). If sample selection bias exists and the lambda is excluded, the estimates of the β's from the OLS equation will be inconsistent. A statistically significant inverse Mills' ratio in Equation (3) implies that its inclusion is necessary to avoid a missing variable or sample truncation bias.[2]

6. EMPIRICAL RESULTS

The results from the probit analysis are shown in Table 4. Household income is not statistically significant. On the other hand, household size is. The larger the household, the higher the probability of potato consumption in each equation. In terms of other significant factors, households with a female head either 35-54 years old or 55 and over are more likely to buy fresh potatoes, but less likely to buy processed products. These results are in comparison to the omitted group of households headed by women less than 35 years old or without a female head.[3] Somewhat surprisingly, the probability of purchasing fresh potatoes increased in households in which the woman worked full-time.

As expected, farm households are more likely to raise their own potatoes for

---

[2] The two-step Heckman model can also be estimated by Maximum Likelihood Estimator. However, this estimator was unable to locate a function minimum for one category and needed more than 150 iterations to converge for the other food items in this study. The least squares estimates are therefore presented.

[3] The probit equations and regressions were also run excluding the 151 households without a female head. The empirical results were virtually unchanged.

consumption and less likely to purchase them. The presence of a storage facility for 10 kg of potatoes or more also raised the probability of own production and decreased that of purchasing potatoes. Conversely, urban households are less likely to produce and more likely to buy fresh potatoes. Not surprisingly, home production is more likely in the summer and fall. The probability of purchasing fresh potatoes is lower in the fall and winter and for processed potatoes in the fall. The Chi-squared statistics for all three equations are significant at the one percent level.

The OLS regressions for only households with positive expenditures are given in Table 5. The inverse Mills' ratio, or lambda, was estimated from the probit analysis and included as an additional explanatory variable. Lambda is statistically significant in each of the equations. These results suggest that sample selection bias is a potential problem with the sample.

Again, income is not significant. Time spent cooking has a significant and positive effect on both the value of home production consumed and expenditures for fresh potatoes. The effect for processed potatoes is negative but not significant. The age of the female household head is an important factor, as it was in the probit equations. Households with women 35 and older spend more on fresh potatoes, less on processed products, and consume more from home production. Home production and fresh potato purchases are highest in households with women over 55 years old and processed potato expenditures lowest.

The only significant effect of labor force participation is that households with women who work full- or half-time spend less money on processed potatoes. However, the labor force impact may be indirect and captured to some extent by other variables. Women who work are less likely to be 55 and over. Increased labor force participation is also related to decreased time spent cooking.

Home production is higher and purchases of fresh and processed potatoes lower among farm households and those with storage facilities. Consumers in urban areas produce less of their own potatoes as is expected and those in big cities spend more on buying fresh potatoes. Consumption from home production peaks during the summer and fall, with fresh potato purchases decreasing during the summer.

The R^2s are low, but this is typical for cross-sectional regressions for specific food products. Economic analysis leaves much of the variation in expenditures across households unexplained. The F-statistics are all highly significant, though.

Finally, although the variable specifications of the probit and regression equations in Tables 4 and 5 are quite similar, there are certain differences. Household size in adult equivalents is included in the probit equations, but excluded from the OLS regressions. In the latter, the dependent variables are specified on a per adult equivalent basis so it is not necessary to include a separate independent variable for household size. On the other hand, time spent cooking is included in the regressions, but not the probit equations in which it was not statistically significant in earlier estimates. Cooking time affects expenditure levels but not the probability of purchasing a product.

CONCLUSIONS

This analysis provides insights into both the specific factors affecting potato expenditures by Swedish households and the use of the Heckman procedure to correct for sample selection bias when the origin of zero expenditures is unknown. Potatoes are not an inferior product in Sweden. Some of the income coefficients are negative, but none are statistically significant. The finding that household income does not affect potato expenditures is consistent with potatoes being a relatively inexpensive food.

There is a clear generational pattern to Swedish potato purchases. Fresh potato expenditures increase and processed product purchases decline, plus the value of home-produced potatoes rises, as the age of the woman heading the household increases. However, it is not clear whether this is a cross-sectional or cohort effect. Will households headed by younger women who now buy relatively fewer fresh potatoes and more processed ones change their consumption pattern as they age? The younger generation likely will largely retain their food habits as they grow older. The age-related pattern probably reflects mostly generational differences.

Female labor force participation did not have the strong effect expected. This may be because of its correlation with the woman's age and cooking time which are included as variables. Therefore, its effect may be indirect. Cooking time does positively impact fresh potato expenditures. Farmers and households with storage facilities are more likely to raise their own potatoes which is certainly as expected. There is also still somewhat of a seasonal pattern to potato purchases.

As is typical with expenditure survey data, the reason some households did not purchase potatoes can not be determined with the available information. However, the Heckman procedure does provide a methodology for correcting for possible sample selection bias. The statistical significance of the inverse Mills' ratio in the regressions indicates that a sample selection bias problem exists which is corrected. The non-purchasers do not represent a random subsample of the surveyed households, due to self-selection in terms of purchasing the product. This study shows the value of modeling household food expenditures as a two-step decision, when there are non-purchasers. In the future, the addition of the necessary questions in household expenditure surveys to determine the reason for not purchasing a product could be extremely useful.

REFERENCES

Amemiya, T. (1984). "Tobit Models: A Survey." Journal of Econometrics 24:3-61.

Andersson, M; Assarsson, B. and Andersson, H. (1994). "Quality and Product Differentiation in the Swedish Potato Market." Paper submitted to the AEAA Annual Meetings in San Diego 1994; Department of Economics, Swedish University of Agricultural Science, Uppsala, Sweden.

Becker, G. S. (1965). "A Theory of the Allocation of Time." Economic Journal 75(299): 493-517.

Blaylock, J. and Blisard, N. (1991). "Consumer Demand Analysis When Zero Consumption Occurs: The Case of Cigarettes." U.S. Department of Agriculture, Economic Research Service, Technical Bulletin 1713, Washington, DC.

Blisard, N. and Blaylock, J. (1993). "Distinguishing Between Market Participation and Infrequency of Purchase Models of Butter Demand." American Journal of Agricultural Economics 75(2): 314-320.

Buse, R. C. and Salathe, L. E. (1978). "Adult Equivalent Scales: An Alternative Approach." American Journal of Agricultural Economics 60(3): 460-468.

Cragg, J. G. (1971). "Some Statistical Models for Limited Dependent Variables with Applications to the Demand for Durable Goods." Econometrica 39: 829-44.

Deaton, A. and Irish, M. (1984). "Statistical Models for Zero Expenditures in Household Budgets." Journal of Public Economics 23: 59-80. North-Holland.

Haines, P. S.; Guilkey, D. K. and Popkin, B. M. (1988). "Modeling Food Consumption Decisions as a Two-Step Process." American Journal of Agricultural Economics 70(3): 543-552.

Heckman, J. (1979). "Sample Selection Bias as a Specification Error." Econometrica 47(1): 153-161.

Heckman, J. (1980). "Sample Selection Bias as a Specification Error." In J. P. Smith (ed.), Female Labor Supply: Theory and Estimation. Princeton, NJ: Princeton University Press.

Maddala, G. (1983). Limited Dependent and Qualitative Variables in Econometrics. Cambridge: Cambridge University Press.

Organization of Economic Cooperation and Development (OECD). (1991). Food

Consumption Statistics 1979-1988, Paris.

Pudney, S. (1989). Modelling Individual Choice. The Econometrics of Corners, Kinks and Holes. New York: Basil Blackwell.

Rydenstam, K. (1992). At All Times. How Women and Men Use Their Time 1990/91. Living Conditions, Report No. 79, Statistics Sweden.

Smallwood, D. and Blaylock, J. (1981). Impact of Household Size and Income on Food Spending Patterns. U.S. Dept. Agriculture, Economic Research Service, Technical Bulletin 1650, Washington, DC.

Swedish Statistics. (1993). Swedish Statistics Yearbook, 1993.

Thomas, W. J. (1972). The Demand for Food. Manchester, England: Manchester University Press.

Tobin, J. (1958). "Estimation of Relationships for Limited Dependent Variables." Econometrica 26(1): 24-36.

Yen, S. T. (1993). "Working Wives and Food away from Home: The Box-Cox Double Hurdle Model." American Journal of Agricultural Economics 75(4): 884-895.

Table 1. Annual potato consumption in the OECD countries, 1988.

	Kg per capita
Ireland	14 1.3
United Kingdom	109.0
Spain	96.7
Benelux	94.1
Portugal	93.6
Greece	86.7
Netherlands	86.3
Norway	84.8
France	73.4
Germany	72.5
Sweden	69.9
Canada	67.9
Turkey	66.6
Denmark	64.5
Finland	63.7
Austria	61.9
Australia	59.6
New Zealand	56.5
Switzerland	44.8
Yugoslavia	43.0
Italy	38.9
U.S.	22.4
Japan	15.2

Source: OECD, 1989.

Table 2. Household expenditures for potatoes in the 1989 Swedish Household Food Expenditure Survey.

Household expenditures	Home produced potatoes		Purchased fresh potatoes		Total fresh potatoes		Total processed potatoes	
	obs	%	obs	%	obs	%	obs	%
Yes	498	24	1387	67	1706	82	1249	60
No	1581	76	692	33	373	18	830	40
Total:	2079	100	2079	100	2079	100	2079	100

Table 3. Description of variables, means and standard deviations.

Variable	Definition	Mean	St Dev
Endogenous			
home	Annual value of consumption per adult equivalent from home production for fresh potatoes in SwKr	44.83	122.69
fresh	Annual expenditures for fresh potatoes per adult equivalent in SwKr	139.65	203.25
process	Annual expenditures for processed potatoes per adult equivalent in SwKr	135.38	183.16
Exogenous			
income	Disposable annual household income per adult equivalent in SwKr	86770	39649
cook	Number of hours spent cooking in the household on the day preceding the survey	1.40	1.12
HH size	Household size in adult equivalents based on Sw. daily recommended intake of calories	2.38	1.03
agew35	=1 if female household head is aged 35-54	0.46	0.50
agew55	=1 if female household head is 55 years or older	0.18	0.39
halfw	=1 if female household head was working between 16 and 34 hours per week	0.32	0.47
fullw	=1 if female household head was working 35 hours per week or more	0.35	0.48
farmer	=1 if farm household	0.03	0.17
storage	=1 if household had storage facilities for 10 kg or more of potatoes	0.62	0.48
big city	=1 if household in Stockholm, Göteborg or Malmö urban areas	0.31	0.46
city	=1 if household within 30 km of an urban center with a population of 90000 or more and not in "big city."	0.36	0.48
summer	=1 if survey period for the household was July-Sept.	0.22	0.42
fall	=1 if survey period for the household was Oct-Dec.	0.33	0.47
winter	=1 if survey period for the household was Jan-March	0.25	0.43

Table 4. Probit analysis for the value of home produced potatoes and expenditures for fresh potatoes and processed potato products.

Variables	Home prod. potatoes Coeff.	Fresh potatoes Coeff.	Processed potatoes Coeff.
constant	-1.236	-0.104	-0.250
	(-7.23)***	(-0.69)	(-1.69)*
income	-1.44E-07	2.58E-08	-4.23E-07
	(-0.15)	(0.03)	(-0.52)
HH size	0.131	0.207	0.345
	(3.22)***	(5.44)***	(9.12)***
agew35	0.047	0.207	-0.183
	(0.61)	(2.86)**	(-2.56)**
agew55	0.190	0.547	-0.568
	(1.95)	(6.03)***	(-6.55)***
fullw	-0.117	0.207	0.100
	(-1.36)	(2.60)**	(1.29)
halfw	0.022	0.128	0.118
	(0.26)	(1.60)	(1.50)
farmer	1.112	-1.110	-0.516
	(6.21)***	(-6.14)***	(-3.01)**
storage	0.316	-0.484	-0.128
	(4.53)***	(-7.38)***	(-2.03)**
big city	-0.579	0.592	0.014
	(-6.95)***	(7.55)***	(0.19)
city	-0.403	0.318	0.059
	(-5.49)***	(4.54)***	(0.84)
summer	0.514	-0.123	-0.057
	(5.27)***	(-1.32)	(-0.63)
fall	0.301	-0.321	-0.159
	(3.27)***	(-3.79)***	(-1.94)**
winter	0.091	-0.235	-0.041
	(0.92)	(-2.61)**	(-0.48)
Chi-Squared:	233.477***	263.636***	267.956***
Obs:	2079	2079	2079

t-statistics are given in parentheses below the coefficients:

*denotes statistical significance at the 10% level,
**at the 5% level,
***at the 1% level.

Table 5. OLS regressions for the value of home produced potatoes and expenditures for fresh potatoes and processed potato products per adult equivalent.

	Home prod. potatoes	Fresh potatoes	Processed potatoes
Variables	Coeff.	Coeff.	Coeff.
constant	-370.810	51.653	194.150
	(-1.79)*	(1.00)	(5.56)***
income	-3.95E-04	6.97E-05	-9.62E-05
	(-1.03)	(0.32)	(-0.51)
cook	16.465	15.304	-4.674
	(2.34)**	(2.78)**	(-0.95)
agew35	55.725	40.157	-21.588
	(2.01)**	(2.09)**	(-1.49)
agew55	140.54	150.120	-197.110
	(3.94)***	(5.72)***	(-6.72)***
fullw	-41.477	18.883	-37.015
	(-1.41)	(0.95)	(-2.05)**
halfw	5.212	-4.948	-49.968
	(0.18)	(-0.26)	(-2.70)**
farmer	290.28	-156.530	-146.400
	(2.73)**	(-2.00)**	(-3.39)***
storage	140.530	-36.711	-44.984
	(3.20)**	(-1.77)*	(-3.25)***
big city	-192.770	46.886	-16.625
	(-2.95)**	(1.67)*	(-0.98)
city	-129.800	16.918	9.947
	(-2.76)**	(0.84)	(0.63)
summer	164.810	-39.354	-1.844
	(2.62)**	(-2.00)**	(-0.09)
fall	111.360	-18.722	-22.238
	(2.51)**	(-0.87)	(-1.19)
winter	51.090	-29.920	-9.747
	(1.45)	(-1.46)	(-0.51)
lambda	312.200	200.120	262.930
	(2.21)**	(2.64)**	(5.75)***
R^2:	0.17	0.06	0.11
F-stat:	6.876***	6.422***	11.288***
Obs:	498	1387	1249

t-statistics are given in parentheses below the coefficients:
*denotes statistical significance at the 10% level,
**at the 5% level,
***at the 1% level.