Distributional Effects of Lower Food Prices in a Rich Country

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Calculations Based on Estimates of Household Demand for Food

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Abstract

Controlling for differences in taxes and transportation costs, the Nordic Competition Authorities claim, in a report from 2005, that food prices are 11-percent higher in Sweden compared with average of the EU-15 countries. One explanation for this put forward in the report is the limited competition on this market which suggests that there is a potential for lower food prices. This paper focuses on the distributional effects of a price decrease on food. Based on a simple model of household utility, the household's demand for food is derived and estimated. Price- and income elasticities for different income groups are then calculated based on these parameter estimates. Our results suggest that food is a normal good with an average income elasticity of approximately 0.17 and a price elasticity of 0.45. In addition, and of importance from a policy perspective, the results indicate that the income elasticity differs across income groups while price elasticities are constant.

Keywords: Consumer behavior, Credit cards, Food demand, Food expenditures, Household composition

JEL: D12, H31, R22

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1. Introduction

Based on data from Eurostat[2] and their own calculations controlling for differences in VAT, other taxes, transportation costs, and price campaigns, the Nordic Competition Authorities claim in an report from 2005,[3] that food prices in Sweden are 11-percent higher compared with the average of the EU-15 countries. The Nordic Competition Authorities argue that part of this price difference is due to the limited degree of competition on the food retailing market, which suggests that there is a potential for lower food prices in Sweden. From an economic perspective, lower prices would be, all other things being equal, beneficial for consumers. However, if lower food prices are desirable from a policy perspective, but not achievable through increased competition, a price change could be accomplished through an appropriate change in VAT levels. On the other hand, if higher food consumption is desirable, an alternative is to stimulate this through income transfers to households. However, the effects of a price change and/or income transfers on food demand are not obvious. For instance, if food prices are lowered, households might consume more food items, more “luxury” items, or spend more money on other goods instead. The same reasoning holds for income transfers which suggest that the effect of price- and income changes on food demand is an empirical question. From a policy and redistribution perspective, it is of importance not only to analyze the effects of average price- and income elasticities in the design of VAT and transfer payment programs, but also whether and to what extend price- and income changes affect the demand for food differently across income groups. From a business perspective, the income elasticity is of importance as it (together with information on local income- and demographic changes) constitutes one indicator of the local market potential (see for instance Gould (2002) in a study of food demand in China). In other words, when it comes to the decision whether or not to enter a local market, a local income change is not a sufficient indicator of changes in market potential.

This paper constitutes a starting point for analyzing the effects of price- and income changes on households’ demand for food focusing on the Swedish situation. Based on a simple model of household utility, the main issue is to estimate the household demand for food and, using

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[2] Eurostat statistics show that Sweden together with Denmark, England, Finland, Iceland, Ireland, and Norway has food prices that are 20 percent or more above average compared to the rest of Europe. Account is not taken of differences in VAT.

[3] Report from the Nordic Competition Authorities (2005).

these estimates, calculate price- and income elasticities for food for different income groups. The demand for food is estimated using a dataset covering 1,313 households in a well defined area in Sweden. The dataset includes a large set of household characteristics collected from a survey. This information is then linked to price information from the food stores in which the households report they purchase their food. Price information has been collected on site from the stores and covers all food shops in the area ranging from hypermarkets to bakeries. Based on the estimated ordinary demand function, price- and income elasticities are calculated for different income groups in order to analyze potential distributional effects of a decrease in food prices and/or income transfers to households.

Food demand and food expenditures have gained quite a large amount of attention in the empirical literature in the last few decades. From a policy perspective, increased knowledge about what factors are important determinants of food demand is of importance as the world is still facing considerable problems with under- and malnutrition, especially in the developing countries[4] although problems with malnutrition in the developed world also need to be taken seriously.[5] A further reason is the fact that a large share of the household's budget is spend on food.[6] However, even though the literature on food demand and food expenditures is quite extensive, and given that income distribution is often skewed in developing countries where the problem of under- and malnutrition is most severe, surprisingly few of the existing studies have focused on distributional effects. One notable exception is Jensen and Manrique (1998) who use a SUR specification to estimate different parameter estimates for different income groups on a data set on Indonesian households. As they lack information on the income level within each household, Jensen and Manrique assume that households with similar consumption behavior belong to the same income group. This means that they actually estimate different parameter estimates for households with different consumption behavior. Another good example is Abdulai and Aubert (2004a) who find income and socio-economic variables to be of importance in explaining food demand among Tanzanian households. Sengul and Tuncer (2005) provide yet another good example. They use the Linearly Approximated Almost Ideal Demand System (LA/AIDS) to estimate the food demand of poor

[4] See, among others, Fan *et al*. (1995), Wan (1996), Hossain and Jensen (2000), Gould (2002), Abduali and Aubert (2004a), and Yen *et al*. (2004).
[5] See for instance Beatty and LaFrance (2005) and references therein.
[6] Statistics Sweden (SCB, 2005) estimated that about 12-percent of the Swedish households' budget is spend on food. For comparison, in sub-Saharan countries this figure is about 66-percent (Teklu (1996)) and in rural China about 60-percent (Jiang and Davies (2007)).

and extremely poor households in Turkey. They find that extremely poor households' food demand is more sensitive to changes in income and prices compared to poor households. This is important from a policy perspective as it suggests that equalization of incomes (i.e. income transfers from rich to poor and extremely poor) or decreases in VAT on food will have a positive effect on food consumption amongst the poorest. These results are partly confirmed in an overview of empirical findings based on food demand studies in sub-Saharan countries carried out by Teklu (1996). The general conclusion of this overview is that expenditure elasticities appear to be higher for low income groups, while price elasticities on different food items seem to decline as income increases.

The present paper contributes to the existing literature on household demand for food in several ways. First, previous studies strongly suggest regional differences in food demand[7] and, at least to our knowledge, this is the first empirical study of food demand and the distributional effects of lower prices and income transfers based on Swedish data. Second, the empirical analysis is based on detailed information on both household characteristics and prices. Even though previous studies have used different measures of the household's storing capacity, no previous studies, as far as we are aware, have used information on the households' access to different transportation devices. As 'economy packs' are often associated with some sort of rebate per unit, the availability of a car might be important in the analysis of food demand as it affects the household's ability to transport large quantities. Another variable that we have not seen in previous studies is the household's possession of credit cards as an explanatory variable. This variable could capture the extent to which households with a large number of credit cards have a significantly different shopping behavior. In addition, in contrast to, among others, Jensen and Manrique (1998), our estimations are based on information on the households' actual income. Further, our results are based on prices in the stores where the consumers make their purchases, which is not the case in, for example, Hossain and Jensen (2000) where it is assumed that all households within the same region face the same prices.

The rest of this paper is organized as follows. A simple theoretical model is developed and the demand for food is derived in Section 2. The data set is described in Section 3 followed by a

[7] See for instance Capps *et al.* (1985), Manrique and Jensen (1997), Deaton and Paxton (1998), Sabates *et al.* (2001), Dong *et al.* (2004), and Ma *et al.* (2006).

discussion of the estimation technique and the functional form in Section 4. The results are a presented in Section 5 and the final discussion and conclusions are given in Section 6.

2. A Simple Theoretical Framework

From a methodological perspective, the existing empirical literature on food demand and food expenditures can broadly be divided into two categories. One line of research has taken the Almost Ideal Demand System (AIDS) approach developed by Deaton and Muellbauer (1980) as the point of departure.[8] By applying this method, it is possible to capture cross-effects between food and other goods or between different food categories such as beef, vegetables, fruits etc. The method has also been applied to estimate the demand for different nutrients such as different vitamins (Beatty and LaFrance (2005)) which is important from a malnutrition perspective. However, one drawback with this approach is the complexity of the demand system and the increasing number of parameters to be estimated as the number of equations and covariates increases. This has, in some cases, been an argument for excluding covariates when applying this type of models (see for instance Yen (2004)). In order to include a large number of potentially important determinants of food demand and food expenditures, some authors have chosen to estimate one single demand function where all other consumption is regarded as the numerate good.[9] One of the advantages with this approach is the ability to include a large number of potentially important determinants of food demand which makes it possible to evaluate to what extend the different covariates correlate and "disturb" each other. Here, we build on this latter approach.

To be more specific, consider a representative household, i, which receives utility (U_i) from its consumption of two goods; food (g_i) and other goods (G_i). The utility function of household i could then be defined as

(1) $$U_i = u_i\left(g_i, G_i; Z_i\right)$$

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[8] See, among others, Capps *et al.* (1985), Fan *et al.* (1995), Manrique and Jensen (1997), Golan *et al.* (2001), Abdulai and Aubert (2004a), and Dong *et al.* (2004).
[9] See, for instance, Hassan *et al.* (1973), Benus *et al.* (1976), and later Dong *et al.* (1998), Sabates *et al.* (2001), and Abdulai and Aubert (2004b).

where other household characteristics are captured in Z_i. Denote by y_i the household's total income and by p_i the price level of food faced by the household (i.e. the price level in the food store where household i makes its food purchases). Normalize the price on other goods to 1, the household then maximizes its utility (1) subject to the budget constraint, $y_i = g_i \times p_i + G_i$ and solves the maximization problem

(2) $$\max_{g_i, G_i} L = u_i\left(g_i, G_i; Z\right) + l\left(y_i - g_i \times p_i - G_i\right)$$

As the household's maximum utility will be a function of its income y_i and the price of food p_i the indirect utility function, which indicates the maximum utility attainable at given prices and income, can be written as

(3) $$v_i = v_i\left(y_i, p_i; Z_i\right)$$

which is increasing in y_i and decreasing in p_i and must hold for all v and y. Hence, it can also be written as $y_i = y_i\left(p_i, v_i; Z_i\right)$ where y_i indicates the minimum income at given prices to achieve a given utility. Holding utility constant at v_i^0 the compensated demand curve is given by

(4) $$\frac{\partial y_i}{\partial p_i} = g_i\left(p_i, v_i^0; Z_i\right)$$

By totally differentiating (3) while still holding utility constant gives

(5) $$\frac{\partial v_i}{\partial p_i} dp_i + \frac{\partial v_i}{\partial y_i} dy_i = 0$$

As utility is held constant $dy_i = -g_i dp_i$ and by applying Roy's identity the ordinary demand function is

(6) $$g_i^* = g_i\left(p_i, y_i; Z_i\right) = -\frac{\partial v_i}{\partial p_i} / \frac{\partial v_i}{\partial y_i}$$

From (6) it is straight forward to calculate the income elasticity $E = \left(\partial g^* / \partial y\right) / \left(y / g^*\right)$ as well as the price elasticity $e = -\left(\partial g^* / \partial p\right) / \left(p / g^*\right)$. Both income- and price elasticities will then be calculated for different income groups.[10]

3. Data

Information on household demand (g), household income (y), other potentially important household characteristics (Z), and prices (p) have been collected from two different sources. Household characteristics and information on the household's food consumption have been collected by means of a questionnaire sent to a representative sample, with regard to age distribution, of 3,000 households in six Swedish municipalities: Bjurholm, Nordmaling, Robertsfors, Umeå, Vindeln and Vännäs. The questionnaire was developed in close collaboration with practitioners within the food retailing sector and the survey was carried out in October 2004. The number of questionnaires sent out in each municipality was weighted by the relative number of inhabitants.

Table 1. Population, number of questionnaires and respond-rate.

Municipality	Population in 2004 (%)	Questionnaires (%)	Usable answers (%)
Bjurholm	2,588 (1.8)	55 (1.8)	21 (1.6)
Nordmaling	7,511 (5.3)	164 (5.4)	68 (5.2)
Robertsfors	7,106 (5.0)	152 (5.0)	60 (4.6)
Umeå	109,390 (77.6)	2,320 (77.3)	1,029 (78.4)
Vindeln	5,773 (4.1)	126 (4.2)	47 (3.6)
Vännäs	8,525 (6.1)	183 (6.1)	88 (6.6)
Total	140,893 (100)	3,000 (100)	1,313 (100)

Note: Percentage is given in parenthesis.

The total number of usable answers from the survey was 1,313 (44-percent). As revealed in Table 1, the data is fairly representative in terms of the preserved weights attached to each

[10] Expression (6) can also be seen as an expenditure function. This does, however, not change the empirical set-up or interpretations.

municipality. The questionnaire provide information on store preferences, how much the household spend on food per month (g), the household's total monthly income before tax (y), and other household characteristics (Z). The household was also asked to name its primarily choice of store for three types of shopping; large scale, supplementary, and occasional. These three types of shopping correspond to the budget shares spent on each type.

Among the potential determinants of household demand, price (p) and income (y) are central in order to calculate price- and income elasticities. The price variable will be discussed in more detail below. In order to increase the response rate on income, the question regarding the household's total income before tax, which was originally discrete (the respondent was asked to mark the interval within which the household's total income fell), has been transformed into a continuous variable.

It is reasonable to assume that the demand for food depends on other household characteristics than income alone. Harmston and Hino (1970) argue that differences in taste may be of greater importance, compared to price and income, when it comes to food. They estimate an intertemporal demand equation for food and take shifts over time as evidence for changes in taste. As our data is a cross-section, we are not able to follow their approach. Instead, we make use of a large number of other potentially important determinants of food demand which could serve partly as proxies for taste. For instance, the access to a vehicle, storage space, and characteristics of living conditions are likely to affect the demand for food. The access to a vehicle is measured as the number of cars (*cars*) available to the household and is assumed to reflect the possibility for the household to transport large quantities and/or 'economy packs'. Note the broad definition; access to instead of ownership. This is an important variable and should not be mistaken for storing capacity at home. However, we also control for storage capacity at home by the use of several dummy variables. One is a dummy variable for external freezer (*ext*), which has previously been used by, for instance, Dong and Gould (2000), Sabates *et* al. (2001), Gould (2002), and Dong *et al*. (2004). As this variable only capture the storage capacity for frozen foods, three additional dummy variables reflecting housing conditions are used to capture the storage capacity of other items. These variables are information on whether the household lives in a student accommodation (*sd*), detached house (*ph*), terrace house (*th*), or apartment (*ap*). Similar settings of dummy variables have been used in several previous studies. Note that apartment includes both cooperative apartments and apartments with right of tenancy. In the empirical analysis below, apartment will serve as the reference category.

A natural substitute for buying food in a store is to visit a restaurant. Ma *et al.* (2006) argue that to understand household demand for in house food consumption the household's away from home food preferences need to be taken into account. Ma *et al.* (2006) estimate the away from home food expenditures using data from urban China and find that income is a strong predictor. To control for this, two variables are used; the number of dinners (*do*) and lunches (*lo*) that the members of the household eat at restaurants per week (this includes lunches at staff dining rooms). Note that lunches prepared at home and brought to work (lunch box, sandwiches etc.) are not included in *lo*.

It is also reasonable to assume that the age composition of the household, shopping frequency, and educational level might have effects on its demand for food. For instance, a large number of children aged 7-15 years or 16-19 years may have a different impact on the household demand compared to a household where members are aged 65 years or above. The importance of information on the age distribution is, among other things, acknowledged in Manrique and Jensen (1997), Gould (2002), Sabates *et al*. (2001), and in the survey by Teklu (1996). These effects are controlled for thorough the use of information on the number of children within the household aged 0-6 years (*a06*), 7-15 years (*a715*), 16-19 years (*a1619*), 20-24 years (*a2024*), 25-64 years (*a2564*), and above 65 (*a65*). Benus *et al.* (1976) discuss and find scale effects in the consumption of food. These results have later been confirmed by, among others, Tedford *et al*. (1986), and Deaton and Paxson (1998). They find the food budget share to decrease as the size of the household increases. Here, we incorporate scale effects by including the number of household members in the different age categories in squares which makes it possible to capture different scale effects for different age groups. That is, $a06^2$, $a715^2$, $a1619^2$, $a2024^2$, $a2564^2$, and $a65^2$ are included.

The household's shopping frequency is controlled for by the means of information on how often, each week, the household visits a food store (*of*) for large scale shopping. The educational level is measured by using the number of individuals within the household who hold a university degree (*ue*). Finally, five dummy variables are used to control for potential structural differences between regions, where a region is defined by the geographical borders of the households home.

The second source of information concerns prices and these have been collected directly in the stores. In total, the respondents listed 117 food stores which is basically all the stores selling food in the area. From each store, prices of up to 171 different items have been collected. Based on this information two different price indexes have been calculated for two typical food baskets defined by the Swedish Consumer Agency (KOV). One price index (p_1) is calculated for a typical single person household, the other one (p_4) for a typical 4 person household with two adults and two children. Here, (p_1) is used for households with less than three adults, otherwise (p_4) is used.[11] The price indexes from the different stores are then weighted by the share of the household's monthly food expenditures spent in each of the stores listed by the household. As all of the 171 items in the KO-basket were not supplied by the stores in the lower tail of the size distribution, two different price indexes have been tested. Firstly, the price for a missing item is assumed to be the mean price of that specific item within all the stores where the item was found. Alternatively the price for a missing item is assumed to be the highest price for that specific item within all the stores where the item was found. However, as it turned out, the results are not sensitive for the choice of price index. We argue that, if a given store does not hold a specific item, then it is reasonable to assume that the store's cost to add this item to its assortment is high. Therefore, the latter definition is used in the empirical analysis below.[12] The composition of the food basket is displayed in the appendix.

Descriptive statistics of household characteristics and prices used in the empirical analysis are displayed in Table 2. The dependent variable (g) is defined as the household's total monthly spending on food in SEK.[13]

Table 2. Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
Spend (g)	3,933.8	1,880.2	500.0	13,750.0
Price (p)	1,344.2	694.1	704.4	3,038.2

[11] Here, a household member under the age of 18 is calculated as ½ adult.
[12] This is actually a problem of missing observations. We are aware that by using the highest value instead of the mean value additional bias may be introduced in the estimated parameters. However, as we consider that the higher price is a better estimate of the actual price if the store were to hold that specific item, we argue that our definition is more accurate.
[13] The exchange rate on September 19th 2007 was \$1 = SEK 6.69.

Income (*y*)	30,491.2	16,599.4	5,000.0	75,000.0
Car (*car*)	1.2	0.8	0.0	7.0
External freezer (*ext*)	0.5	0.5	0.0	1.0
Student accommodation (*sd*)	0.02	0.15	0.0	1.0
Apartment (*ap*)	0.42	0.49	0.0	1.0
Detached house (*ph*)	0.43	0.50	0.0	1.0
Terrace house (*th*)	0.11	0.31	0.0	1.0
Credit cards (*cc*)	3.1	1.3	0.0	8.0
Lunch out (*lo*)	1.5	1.9	0.0	7.0
Dinner out (*do*)	0.3	0.7	0.0	7.0
Age 0-6 years (*a06*)	0.2	0.5	0.0	3.0
Age 7-15 years (*a715*)	0.4	0.8	0.0	6.0
Age 16-19 years (*a1619*)	0.1	0.4	0.0	3.0
Age 20-24 years (*a2024*)	0.2	0.6	0.0	9.0
Age 25-64 years (*a2564*)	1.3	0.8	0.0	4.0
Age 65- years (*a65*)	0.2	0.5	0.0	3.0
Often (*of*)	2.1	1.5	0.0	7.0
Univers. edu. (*ue*)	0.7	0.8	0.0	9.0

4. Functional form, pre-testing and estimation technique

The household's demand for food is defined as

$$(7) \qquad g_i = a + b_p p_l + b_y y_i + b_{y^2} y_i^2 + Z_i' l + e_i$$

where a and the $b:s$ along with the elements in the vector l are parameters to be estimated and e is the error term.

Even if there are good reasons to assume non-orthogonality between p and e which suggests that an estimator based on instrumental variable (IV) should be used as techniques such as OLS would in such a case be biased and inconsistent. However, IV estimation will be less efficient compared to OLS if p actually is orthogonal to e. In order not to make this erroneous assumption, the Durbin-Wu-Hausman test of the endogeneity of p based on the OLS estimate of the error variance is used.[14] With a test statistic of 4.60 and a p-value of 0.03

[14] The DWH test, which is distributed as chi-sq, was first proposed by Durbin (1954) and then by Wu (1973) and Hausman (1978) and comes in different versions. Here we have used the one based on the OLS estimate of the error variance (the Durbin statistic) because it is more efficient compared to the version based on the IV estimate of the standard errors. This version of the test also has the advantage that it performs better when the instruments are weak (see Staiger and Stock (1997)).

the hull hypothesis of orthogonality between p and e is rejected which suggests that IV-estimators should be used. Given this, the next issue is to select instruments for estimation of the endogenous variable p. Other than the requirement that these instruments should be correlated with the endogenous regressor and at the same time orthogonal to the errors, the literature gives little guidance on the matter of the selection of these instruments. This may be especially so in applied work based on cross-section data where the use of lagged values of the endogenous regressor is not an option.[15] Here, information on the distance between the household and the city centre of Umeå, the category of the store the household has chosen for its large scale food shopping (i.e. if it can be categorized as a supermarket or a middle-sized store) and whether this store is associated with the two largest retail chains in the region are used as instruments for p. Based on IV estimation of equation (7), the validity of the chosen instruments are then tested for by using the "partial R^2"-test proposed by Shea (1997).[16] An F-statistic of 13.39 and a p-value of 0.00 suggest that the selected instruments are valid.[17] Further, the Sargan statistic[18] is applied to test for overidentification of all instruments (this is a test of the instrument's independence from the unobserved error process). With a Sargan statistic of 4.16 and a p-value of 0.39, the null hypothesis could not be rejected which indicates that the instruments are not correlated with the error process.

Although the consistency of the IV coefficient estimates is not affected by the presence of heteroskedasticity, IV estimates of the standard errors become inconsistent which prevents us from being able to draw valid inference. This could partly be overcome by the use of heteroskedasticity-constant or "robust" standard errors and statistics. The conventional IV estimator is, even if it is still consistent, inefficient in the presence of heteroskedasticity. One common solution to this is the use of a robust General Method of Moments (GMM) estimator[19] which makes use of the orthogonality conditions to allow for efficient estimation in the presence of heteroskedasticity of unknown form. Here, the Pagan-Hall general test statistic, which is distributed as chi-sq, is applied to test the hypothesis of heteroskedasticity

[15] Lewbel (1997) discusses and suggests a solution to the problem of constructing instruments when no additional data are available. We have tried his approach with very mixed results.
[16] This test, which is an F-test, is actually similar to the one suggested by Bound *et al.* (1995) for the case with only one endogenous regressor. However, the statistic proposed by Shea (1997) has the advantage that it takes the inter-correlations among the instruments into account.
[17] As a rule of thumb, for a single endogenous regressor, an F-statistic < 10 is cause for concern (see Steiger and Stock (1997)).
[18] This test is distributed as chi-sq. For further details of this test, see Sargan (1958).
[19] GMM was first proposed by Hansen (1982) and is now frequently used in empirical research.

where the null is homoskedasticity.[20] As the Pagan-Hall test is non-significant (80.90, p-value = 0.00) the hypothesis of homoskedastic errors can be rejected and suggests that the GMM should be used. However, for reasons of comparability, both IV and GMM estimates are presented. Finally, to ascertain the instruments' independence from an unobserved error process, the Hansen *J* statistic is employed,[21] as this allows us to test for overidentifying restrictions. This is supported by the Hansen *J* statistic (5.30, p-value = 0.26).

5. Results

Let us first comment on the IV and robust GMM parameter estimates of equation (7) displayed in Table 3 below, and then turn to the calculation of price- and income elasticities. Note that the regional dummy variables are suppressed in order to save space.

As is evident from Table 3, the IV and robust GMM estimates are quite similar even though their level of significance differs in some cases. Both models predict the demand for food to be negatively correlated with price which suggests that the demand function has a negative slope with respect to price. This correlation is statistically significant in both models and in line with what is found in much of the previous literature. The parameter estimates also predict a positive correlation between the demand for food and the households' income (b_y), which is also reported for American households in Dong *et al.* (1998) and for Argentinean, Brazilian, and Mexican households in Sabates *et al.* (2001). However, both models predict that this effect decrease as income increases as b_{y^2} is estimated to be negative, even though this negative effect is not significant.

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[20] See Pagan and Hall (1983) for further details regarding this test. In comparison to other frequently used tests for heteroskedasticity such as those proposed by Godfrey (1978), White (1980), Koenker (1981), and Cook and Weisberg (1983), Pagan and Hall (1983) point out that these test will be valid only if heteroskedasticity is present in the IV regression and nowhere else in the system including the first stage regressions.
[21] The Hansen *J* statistic is distributed as chi-sq.

The accessibility of a car for transportation is estimated to have a positive effect on the demand for food as l_{car} is positive and significant in both models. This contradicts our previous assumption that access to a car (or cars) would facilitate transportation of large quantities and/or 'economy packs'. One possible explanation for this is that the possession of a car(s) correlates with income and hence is an indicator of purchasing power. However, as the correlation between the two variables y and *car* is only 0.35 this interpretation is ruled out. Another potential explanation is that car owners actually have an 'overconsumtion' of large so called 'economy packs'. That is, they tend to buy too large quantities which they, in the end, do not use up before the expiration of the 'best before' date.[22] However, this positive effect is only significant at the 90-percent level of significance and should, therefore, be interpreted with caution.

Turning to storage capacity which is captured by the dummy variables for external freezer (*ext*) and housing conditions (whether the household lives in a student accommodation (*sd*), detached house (*ph*), or terrace house (*th*), where those living in apartments serve as the reference group). The effects of external freezer $\left(l_{ext}\right)$ and if the household lives in student accommodation $\left(l_{sd}\right)$ are estimated to be positively and negatively correlated with g respectively. A positive effect of an external freezer on the demand for food is reported by Sabates *et* al. (2001) and for poultry and pork by Dong and Gould (2000). However, the significance of these effects is low. Significant positive effects are instead estimated for households living in detached- $\left(l_{ph}\right)$ and terrace houses $\left(l_{th}\right)$. Again, one suspects that these two variables are correlated with income as it is reasonable to assume that households with higher incomes are more likely to be able to afford to live in a detached- or a terrace house. However, with correlation coefficients of 0.26, 0.23 and -0.23 respectively (the last correlation is between income and student accommodation), we disregard the interpretation that these variables are indicators of the households income. Therefore, we once more suggest that the interpretation that households with large storage capacities tend to buy larger quantities which they, in the end, do not consume before the 'best before' date expires. Another potential explanation is that these households have preferences for more expensive items. Unfortunately, we are not able to discriminate between these two potential explanations.

[22] Major Swedish news papers report that Swedish households throw away a fifth of all purchased food. The same figure for British households is one third.

A further potentially important factor is the possession of credit cards. Again, it is likely that the number of credit cards within the household correlates with income. A correlation coefficient of 0.26 between income and the number of credit cards indicates this is not the case. The estimates presented in Table 3 suggest a positive correlation between g and *cc*. If the number of credit cards within the household also reflects the use of credit cards, one potential interpretation is that households who use credit cards are less price conscious than households who pay cash. This suggests that there is a different consumption pattern amongst households who use credit cards than among those who pay in cash.

The argument by Ma *et al.* (2006) that, in order to understand the household demand for in house food consumption, the household's food away from home preferences need to be taken into account is not fully supported by the parameter estimates presented in Table 3. As only the parameter $\left(l_{do}\right)$ is significant in the IV-model, there is no strong evidence of such an effect for the household included in our data. This suggests that there is a difference in behavior between the Swedish households in our data and the households from urban China.

Table 3. IV and GMM estimates and corresponding t-values of equation (7).

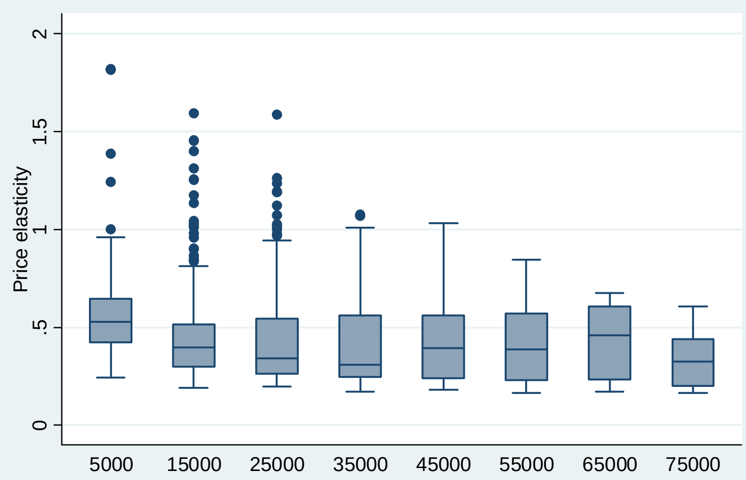
	IV		GMM	
	Estimate	t-value	Estimate	t-value
Price **Fel! Objekt kan inte skapas genom redigering av fältkoder.**	-1.21	-2.32	-1.26	-2.41
Income (b_y)	0.02	2.33	0.03	2.03
Income sq. (b_{y^2})	-5.08×10^{-8}	-0.38	-3.63×10^{-8}	-0.23
Car (l_{car})	128.66	1.87	138.11	1.91
External freezer (l_{ext})	106.49	1.07	101.71	0.94
Student accommodation (l_{sd})	-338.69	-1.14	-311.56	-1.76
Detached house (l_{ph})	348.93	2.92	324.75	2.65
Terrace house (l_{th})	372.82	2.39	369.94	2.25
Credit cards (l_{cc})	111.16	3.19	109.79	3.26
Lunch out (l_{lo})	-11.39	-0.42	-10.87	-0.40
Dinner out (l_{do})	142.35	2.23	89.18	0.78
Age 0-6 (l_{a06})	1549.74	2.89	1,620.92	2.99
$(\text{Age } 0\text{-}6)^2$ $(l_{(a06)^2})$	-305.85	-1.81	-312.47	-1.85
Age 7-15 (l_{a715})	1,1364.38	3.88	1,399.59	3.94
$(\text{Age } 7\text{-}15)^2$ $(l_{(a715)^2})$	-104.25	-1.65	-113.68	-1.64
Age 16-19 (l_{a1619})	2,464.37	4.93	2,500.37	4.79
$(\text{Age } 16\text{-}19)^2$ $(l_{(a1619)^2})$	-603.92	-3.54	-614.17	-3.67
Age 20-24 (l_{a2024})	931.35	3.53	1,000.40	3.72
$(\text{Age } 20\text{-}24)^2$ $(l_{(a2024)^2})$	-55.42	-1.90	-61.59	-2.62
Age 25-64 (l_{a2564})	581.11	1.80	722.84	2.12
$(\text{Age } 25\text{-}64)^2$ $(l_{(a2564)^2})$	160.42	1.85	98.07	0.90
Age 65- (l_{a65})	1,775.80	4.40	1,831.25	4.20
$(\text{Age } 65\text{-})^2$ $(l_{(a65)^2})$	-523.48	-3.10	-538.72	-3.11
Often (l_{of})	267.05	2.68	255.93	2.49
Often sq. (l_{of^2})	-18.33	-1.20	-16.57	-1.03
Univers. edu. (l_{ue})	-126.24	-2.12	-126.10	-2.00
(a)	1,193.02	3.54	1,215.13	3.41

As expected, the number of household members is estimated to have a positive effect on the household's expenditures on food. However, our model predicts the magnitude of this effect to be quite different depending on the age of the family members, which is also found in Sabates ***et al.*** (2001) and Manrique and Jensen (1997). For instance, an additional individual aged between 16 and 19 years (l_{a1619}) is estimated to increase the households' expenditures on food by approximately SEK 2,464 (the average of the IV and GMM estimates), while an additional family member aged between 25 and 64 (l_{a2564}) is estimated to increase the household's expenditures by approximately SEK 651. The low value for an extra individual aged between 25 and 64 could be a combination of two factors. First, these individuals work and many eat lunches out. This, in combination with the second factor shows that least at the upper end of this age interval the individual's metabolic needs tend to decrease. This difference between the age groups is significant for $(l_{a06} - l_{a2564})$, $(l_{a715} - l_{a1619})$, $(l_{a7156} - l_{a2564})$, $(l_{a1619} - l_{a2024})$, $(l_{a2024} - l_{a65})$, and $(l_{a2564} - l_{a65})$. Another interesting result is that our estimates suggest economic of scale in the sense that the squared variables describing the number of household members in each age interval are estimated with a negative sign, which is in line with Benus ***et al.*** (1976) and Tedford ***et al.*** (1986), and later Deaton and Paxson (1998) and Sabates ***et al.*** (2001). The only exception is $l_{(a2024)^2}$ which is positive.

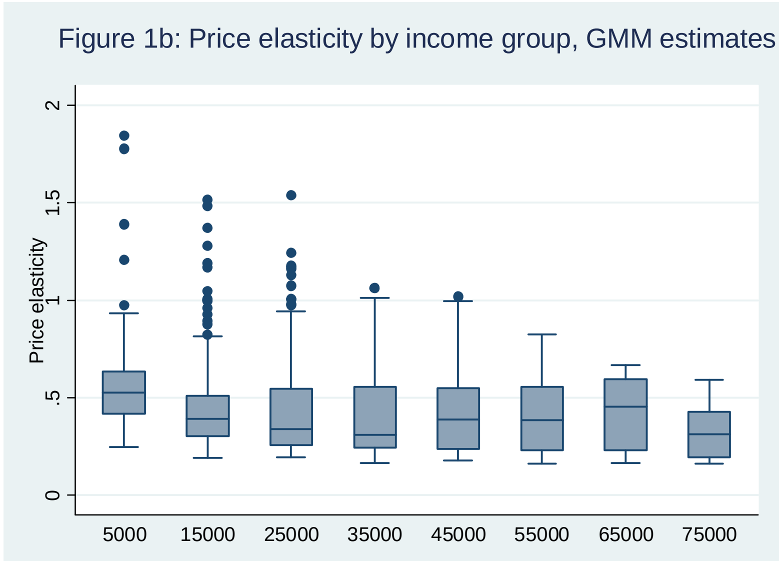
Turning to the effect of education, in this case measured as a dummy variable capturing whether at least one of the household members holds a university degree (l_{ue}), the model predicts a negative effect on food demand. This contradicts the findings by Sabates ***et al.*** (2001) and suggests a behavioral difference between Swedish and South American households.

Let us continue with calculations of price- and income elasticities. Based on the estimates of equation (7) displayed in Table 3, the average price elasticity (e) is 0.43 and 0.45 for the IV and GMM estimates respectively with a standard deviation of 0.23 and 0.24. This suggests $0 < e < 1$ (at least at the 90-percent level of significance). Hence, based on these calculations we conclude that food is, on average, a normal good. Similar results have been found for other countries, for example, China[23], Paraguay[24], Tanzania[25], and USA[26]. As shown in Table A1 and visualized in Figure 1a and 1b, the price elasticity ranges from an average of 0.55 for the households with the lowest incomes to an average of 0.33 for the group of households with the highest incomes. However, these differences between income groups are not significant. This should be compared with the general findings for sub-Saharan countries which indicate lower price elasticities for higher income groups (see Teklu (1996)). Moreover, Sengul and Tuncer (2005) find that the food demand of extremely poor households in Turkey is more sensitive to price changes than that of poor households. The results presented in Jensen and Manrique (1998) indicate mid- and high income households in Indonesia are more price- sensitive than to low income households.

Figure 1a: Price elasticity by income group, IV estimates



[23] Gao *et al*. (1996) and Gould (2002).
[24] Alfonzo and Petersen (2006)
[25] Abdulai and Aubert (2004a).
[26] Beatty and LaFrance (2005)



The average income elasticity (E) is calculated to be 0.16 and 0.17 with a standard deviation of 0.06 and 0.07 for the IV and GMM estimates respectively, which suggests $0 < E < 1$ at the conventional 95-percent level of significance. Differences in income elasticities between income groups are more evident than are the differences in price elasticities, see Figures 2a and 2b. Income elasticity ranges from 0.06 for households with the lowest incomes to approximately 0.28 for households with the highest incomes. At first glance, these findings may seem strange as it could be expected that it would have been more likely to find high income elasticities among low income households. However, one potential explanation for these findings is as follows: In comparison with many other countries, Sweden is a rich country where under nutrition is not a serious problem (even though malnutrition might be), not even among households at the lower end of the income distribution. When these households receive extra incomes, they have other needs than food to fulfill. Accordingly, they use this extra money to consume other goods and services. Another possible explanation is that households at the upper end of the income distribution tend to buy more expensive food items when receiving extra income.[27] These findings are in strong contrast to what is found for sub-Saharan countries and Turkey (see Teklu (1996) and Sengul and Tuncer (2005)). Findings for Indonesia and Tanzania indicate that the demand for food is responsive to income changes for all income groups (see Jensen and Manrique (1998) and Abduali and Aubert (2004a)).

[27] According to recent figures from Statistics Sweden (SCB), in general, Swedish households tend to buy more exclusive food.

Figure 2a: Income elasticity by income group, IV estimates

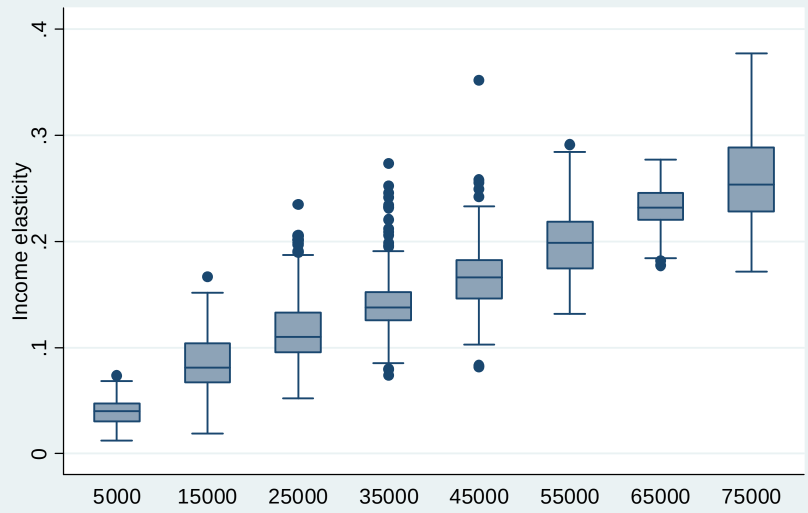
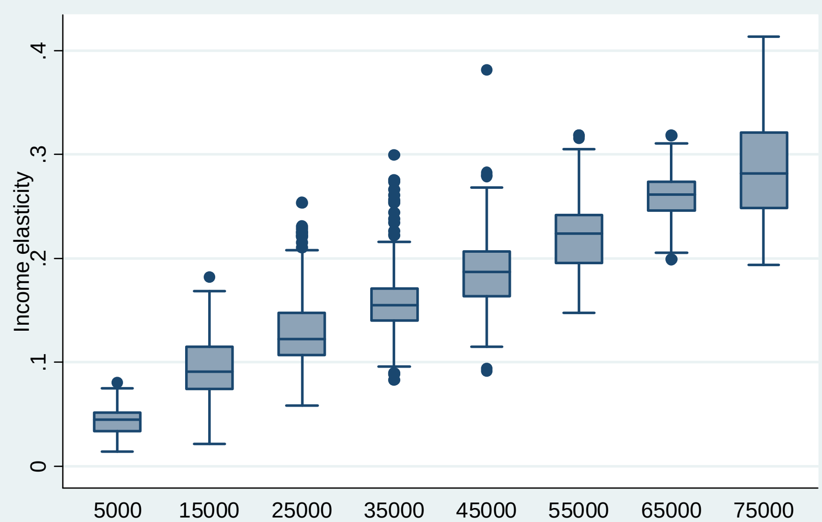


Figure 2b: Income elasticity by income group, GMM estimates



6. Concluding remarks

The issue of lower food prices has recently been of topical interest as the Nordic Competition Authorities, in a report from 2005, claim that food prices are 11-percent higher in Sweden compared to the EU-15 countries. One potential explanation for the price difference revealed in the report is a low level of competition between retail chains. However, if, for any reason, there is a political desire to reduce food prices an alternative to stimulating competition would be encourage price reduction by means of appropriate changes in VAT. Alternatively, if politicians would like to encourage food consumption, this could be achieved through monetary subsidies to households. This paper serves as a starting point in the discussion regarding distributional effects of such changes based on calculated price- and income elasticities. Using a detailed data set covering 1,313 Swedish households in the mid-northern part of Sweden, an ordinary demand function is estimated and then income- and price elasticities are calculated.

The main findings are that the effect of a decrease in food prices will not affect households with different incomes differently. The calculations indicate an average price elasticity of 0.43 with no significant difference between income groups. However, the calculations suggest that the income elasticity is significantly higher for high income households (0.29) than for to low income households (0.06). That is, high income households tend to spend a greater share of their income increase on food compared to low income households. This difference is significant. Taken together, these results indicate that food is a normal good and the high income groups probably change to more exclusive food when they obtain an increase in income. These results indicate a regional difference as they differ from the findings in studies based on Turkish, sub-Saharan, Indonesian, and Tanzania households.

Further, based on our results, the Swedish household's demand for food is positively correlated with access to a vehicle and storage capacity. A possible explanation is over consumption. That is, households tend to buy economy-packs that are not consumed before the best before date. Another interesting result is that demand is increasing in the number of credit cards that the household possesses suggesting that there is a difference in shopping behavior between credit card users and those less reluctant to shop on credit. Irrespective of the interpretations, the results suggests that access to a vehicle and the possession and use of credit cards are important determinants of food demand and should, therefore, at least be tested for in future studies within this field.

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Appendix

Table A1. Price- and income elasticities by income group

		IV		GMM	
	Obs.	Mean	Std. Div.	Mean	Std. Div.
Price elasticity **Fel! Objekt kan inte skapas genom redigering av fältkoder.**	1.313	0.43	0.23	0.45	0.24
Income elasticity (E)	1.313	0.16	0.06	0.17	0.07
0-10,000					
(e)	136	0.55	0.29	0.58	0.30
(E)	136	0.06	0.02	0.06	0.02
10,000-20,000					
(e)	260	0.45	0.22	0.46	0.23
(E)	260	0.12	0.03	0.12	0.03
20,000-30,000					
(e)	272	0.43	0.24	0.45	0.25
(E)	272	0.16	0.04	0.16	0.04
30,000-40,000					
(e)	283	0.40	0.21	0.42	0.22
(E)	283	0.18	0.04	0.19	0.04
40,000-50,000					
(e)	212	0.41	0.19	0.43	0.19
(E)	212	0.20	0.04	0.21	0.04
50,000-60,000					
(e)	81	0.41	0.19	0.42	0.21
(E)	81	0.23	0.04	0.25	0.05
60,000-70,000					
(e)	42	0.41	0.18	0.42	0.19
(E)	42	0.24	0.03	0.27	0.03
70,000-					
(e)	27	0.33	0.14	0.34	0.15
(E)	27	0.25	0.05	0.28	0.06

Table A2: VIF values.

Variable	VIF	1/VIF
y	16.13	0.06
y^2	13.84	0.07
of	11.18	0.09
of^2	11.17	0.09
p	3.20	0.31
Umeå	3.11	0.32
a2565	2.94	0.34
a65	1.95	0.52
ph	1.93	0.52
Nordmaling	1.73	0.58
a715	1.73	0.58
Robertsfors	1.67	0.60
a2024	1.67	0.60
a06	1.65	0.61
car	1.56	0.64
Vindeln	1.52	0.66
ext	1.42	0.71
A1619	1.42	0.71
th	1.37	0.74
ue	1.28	0.78
lo	1.26	0.79
Bjurholm	1.25	0.80
sd	1.16	0.86
cc	1.13	0.88
do	1.12	0.89
Mean VIF	3.35	

Note: A VIF value above 10 is reason for caution.

The food basket, defined by the Swedish Consumer Agency. Weights given by household size is not presented.

Cucumber	Mini baguette	Soft whey-cheese	Fish au gratin	Ice cream cake
Iceberg lettuce	Sponge-cake	Cheese	Strawberry (frozen)	Bilberry pie
Green pepper	Biscuit	Philadelphia cheese	Sprinkles	Almond
Red pepper	Hamburger bread	Salmon filet	Raspberry, Bilberry (frozen)	Prune
Leek	Cinnamon bun	Caviar (tube)	Sliced canned pineapple	Honey
Tomato	Wafers (filled)	Caviar (spawn)	Apple sauce	Porridge oats
White cabbage	Macaroon	Liver paste	Blackcurrant jelly	Wheat flour
Garlic	Milk 3% fat	Smoked ham, sliced	Lingonberry jam	Wheat-bran
Potatoes	Milk 1.5% fat	Potatoes salad	Orange fruit syrup	Muesli
Baked potatoes	Low fat milk	Black pudding	Mincemeat sauce	Cereal
Swedish turnip	Eco Milk	Falun sausage	Canned grain of maize	Sugar
Carrot	Low fat yoghurt	Swedish meat balls	Canned mini maize	Cube sugar
Parsnip	Sour milk 1.5% fat	Smoke-cord loin of pork	Canned crushed tomatoes	Salt
Celeriac	Cream 40% fat	Pork chop	Canned sliced mushroom	Chocolate (O'boy)
Red onion	Cream 27 – 30 % fat	Minced beef	Tomato ketchup	Tea
Onion	Cream for cooking	Beef	Tomato purée	Low alcohol beer
Orange	Crème Fraiche 34% fat	Chicken	Mustard	Medium strong beer
Banana	Sour crème 12% fat	Parsley (frozen)	Rape seed-oil	Soft drinks (33cl)
Lemon	Vanilla custard 12% fat	Broccoli (frozen)	Olive oil	Black pepper (grinded)
Grapes (green)	Butter 60% fat	Brussels sprouts (frozen)	Vinegar	Thyme
Apple	Butter 40% fat	Spinach (chopped, frozen)	Soya	Microwave popcorn
Crisp bread	Butter 80% fat	Green peas (frozen)	Rhode island dressing	Chips (potato)
Thin flat unleavened bread	Butter, vegetable fat	Vegetables mix (frozen)	Vinegar dressing	Peanuts
Finn crisp	Egg	Wok mix (frozen)	Beef stoke cub	Milk chocolate (bar)
Wheat biscuit	Orange juice, concentrate	Sliced potatoes (frozen)	Sauce (mix)	Mixed candy
Rye bread	Apple juice (ready to drink)	Chicken filet (frozen)	Rice	Salt
Whole meal bread	Orange juice (ready to drink)	Shrimps, frozen	Jasmine rice	Chocolate (O'boy)
Round loaf	Berry juice (no sugar added)	Hamburger, (frozen)	Spaghetti	Tea
Tin loaf bread	Bilberry soup	Frozen pizza	Tagliatelle	Low alcohol beer
Farmhouse bread	Soft cheese	Plaice (frozen)	Vanilla ice cream 2 liter	