Microeconometric Modeling of Household Food Demand: The Case of Transition Bulgaria*

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Key words: food demand, transition economy, Kuhn-Tucker model

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1 Introduction

The transition economies of Central and Eastern Europe have undergone significant structural adjustments over the past decade. Profound political changes have brought about equally significant economic changes as steps toward the transition to a market environment were undertaken. These changes were especially severe in Bulgaria. Jones and Miller note that the cumulative output decline of the Bulgarian economy was worse than all other Eastern European countries other than Albania and Macedonia. As state-run industries and collective agricultural operations were dismantled, the Bulgarian economy underwent a significant contraction that was accompanied by severe inflation, labor market adjustments, and a reduction in purchasing power. Bristow notes that, early in the transition period, the price of basic foods such as bread, milk, and rice rose tenfold while the official consumer price index rose only by a factor of five. At the same time, the proportion of households below the poverty level rose from 45% to 66%. Mihailova notes that agricultural output declines by over 30% over this period.

The Bulgarian economy experienced a significant contraction in the mid-1990s. Mihailova notes that GDP decreased by 8.2% in the first 9 months of 1996, reducing real per capita income by 27%. This added to a reduction in real income of over 50% between 1989 and 1995. Consumption was hit hard, even among basic necessities such as food items. Mihailova notes that consumption of all major food products declined in 1996 (meat and dairy products by 10%, bread by 8%, fruit by 40%). Widespread poverty and a reliance on government pensions and other benefits by much of the population has led to food security concerns.

At one time, there was considerable optimism regarding the prospects of economic transition for growth in the demand for imported food products by many of these countries. In a 1997 evaluation of the prospects for the growth of exports of U.S. agricultural products to Central and Eastern Europe, Avidor noted that "U.S. exporters looking for European growth markets may want to spin the globe a litter farther to the east." The slow pace of economic reforms and growth have, however, dampened this optimism, at least for the short-run. The prospects for an increased demand for imported food products in this region critically depend upon strengthening in income available for consumption. The pace of agricultural reforms and the transition and recovery of domestic production sectors in these markets will also be relevant to the future of exports to the region. Of course, comprehension of the likely effects of price changes and income growth on the demand for imported products depends critically on an understanding of price and income elasticities for the products in question. Herein lies a factor motivating our research.

The objective of our analysis is to evaluate the demand for food commodities in transition Bulgaria. Our analysis is conducted in two segments. The first considers an analysis of broad food item categories. The second portion of our study focuses on the demand for individual meat and poultry commodities. As a recent USDA-ERS (1998) report noted, the main effect of economic reform on agriculture in the transition economies has been the severe contraction of the livestock sector, with decreases in inventories of 30-50%. In 2000, meat and poultry products comprised 61.5% of the total value of U.S. agricultural exports to Bulgaria (USDA, 2001). Our application is to individual household survey data, collected from 2,467 Bulgarian households in 1995 (some five years into the transition process). The second segment of our analysis encounters a modeling issue that is common in evaluations of household survey data—zero consumption levels. We utilize a variation of the Kuhn-Tucker model developed by Wales and Woodland to consistently model demand conditions in the presence of such corner solutions.

The plan of our paper is as follows. The next section briefly reviews the transition experience in Bulgaria. The third section outlines our econometric approach to estimating food demand systems using micro data. The fourth section contains an application of the econometric models to Bulgarian household data. Food and meat demand elasticities are presented and discussed. The final section of the paper briefly reviews the analysis and offers some concluding remarks.

2 The Transition Experience in Bulgaria

From the end of the Second World War until 1989, Bulgaria was closely aligned with the former Soviet Union (FSU). The policies and institutions underlying the development of the Bulgarian economy closely paralleled those of the FSU, and thus Bulgarian agricultural policies closely followed those that shaped Soviet agriculture. The formal transition period in Bulgaria began in November

1989 with the ouster of Todor Zhivkov, who had led the country since 1954. Free elections were held 9 months later. Instability has characterized Bulgarian politics over the transition period. In a fashion similar to the "Big Bang" experienced by other transition economies in the region, prices and international trade were liberalized in February 1991 and aggregate prices increased rapidly. Aggregate prices rose by 122.9% in February 1991 and inflation exceeded 570% in 1991 (Bristow).

Transition brought about significant changes in the Bulgarian agricultural sector. Direct subsidies to agriculture had reached a high of over 7% of GDP in 1990 (Bristow). The rapid liberalization measures of February 1991 ended these subsidies. The elimination of subsidies, together with the liberalization of controls on basic agricultural inputs, brought about a severe contraction in agricultural output in Bulgaria. Real net output from the agricultural sector fell by 14% in 1992 and by 16% in 1993 (Bristow). Livestock inventories also experience declines, with 1994 inventories being about one-half of their 1990 levels (Bristow). Liberalization also brought about a breakup of the large collective farms and agro-industrial complexes.

Bulgarian labor markets have also undergone significant structural adjustments since 1991. Employment in the private sector has increased significantly. In contrast, state employment declined by 18% between 1992 and 1994, with the largest proportional decline being experienced by agriculture. The transition also brought about the elimination of formal provisions for lifetime employment and the institution of unemployment compensation. A range of other social benefit programs provide stipends and in-kind benefits which may influence household consumption behavior.

3 Modeling Framework

As we pointed out above, our analysis is conducted in two parts, both of which utilize household-level consumption data. The first portion of our analysis considers a standard almost ideal demand system (AIDS) model for broadly-defined food categories. In that almost all households consume from each of these categories, the problem of zero consumption/expenditure levels is avoided. However, in light of the importance of meat exports to this region, we also estimate a demand model that provides elasticity estimates for individual meats— beef, pork, lamb, chicken, and other meats. In this case, we frequently encountered zero consumption levels and thus must consider a switching regime model of demand.

3.1 A Demographics-Augmented AIDS Model

We utilize the standard AIDS model of Deaton and Muellbauer to evaluate a demand system for six broad categories of goods— cereals; pulses, fruits, and vegetables; meats; dairy products; other foods, including food consumed outside the home; and all other non-food goods. The AIDS share equations are of the form:

$$w_i = \alpha_i + \sum_{j=1}^{M} \gamma_{ij} \ln p_j + \beta_i \ln(y/P), \tag{1}$$

where w_i is the share of total income (expenditures) devoted to good i, p_j is the price of good j, y is total income (expenditures), and P is an aggregate price index.[1]

In that our data are taken from households that may be demographically heterogeneous, it is important that we allow for preference differences across different demographic factors. We have chosen to include two demographic factors— adult equivalents, which account for differences in the makeup and size of households, and an indicator variable taking the value of 1 if the household is rural and 0 otherwise. Inclusion of these demographic variables is undertaken by including intercept shifters to the share equations:

$$\alpha_i = \alpha_{i0} + \alpha_{i1} \ln AEQ + \alpha_{i2} RURAL, \tag{2}$$

where AEQ represents adult equivalents and $RURAL$ which is the 0/1 indicator variable. The demographically-augmented AIDS model parameters must satisfy the following adding-up, symmetry, and homogeneity conditions:

$$\sum_{i=1}^{M} \gamma_{ij} = \sum_{j=1}^{M} \gamma_{ij} = \sum_{i=1}^{M} \beta_i = 0, \quad \gamma_{ij} = \gamma_{ji}, \quad \sum_{i=1}^{M} \alpha_{0i} = 1, \quad \text{and} \quad \sum_{i=1}^{M} \alpha_{ki} = 0, \quad \text{for} \quad k = 1, 2. \tag{3}$$

Our empirical AIDS model includes a residual category representing expenditures on all non-food items. Likewise, some method is required to construct aggregate good category price indices. Following convention, we utilize expenditure share weighted averages of logarithmic prices to generate aggregate price indices (i.e., Stone price indices).[2] We utilize an aggregate regional price deflator to represent the overall price index P. A price index for the residual kth good category representing

[1] The full AIDS model uses a translog version of the price index. Much has been written about the limitations of linear approximations to the AIDS model. While acknowledging these limitations, we adopt a linear specification in order to derive a price measure for the residual category comprised of all non-food goods.

[2] In particular, we use each good's share of total expenditures in that category as weights and thus construct a weighted average of all prices for goods purchased in each individual category.

all non-food goods is constructed by inverting Stone's price index representation, assuming overall prices are represented by the regional price deflator P:

$$\ln p_k = \frac{\ln CPI - \sum_{i=1}^{k-1} w_i \ln p_i}{w_k}, \tag{4}$$

where CPI is the regional price deflator.

Of course, aggregation of quantities and prices in applied demand analysis always raises concerns regarding the combining of heterogeneous goods. This concern is exacerbated as more aggregation is undertaken, as is the case for he first segment of our analysis. Thus, it should be recognized that our constructed prices, expenditures, and quantities may inherently be comprised of heterogeneous goods, especially in our analysis of aggregate food categories. Of course, this concern is inherent in any such aggregate analysis.

The AIDS model is estimated using maximum likelihood techniques. The restrictions given by equation (3) are imposed in estimation. The equation for non-food items is deleted in light of the singular nature of the system of share equations and its parameters are recovered using the cross-equation restrictions.

3.2 Estimating Preferences Using the Kuhn-Tucker Model

The Kuhn-Tucker model from Wales and Woodland provides a consistent approach for modeling binding non-negativity constraints in agent level demand data. The model integrates the behavioral and econometric models to provide a theoretically consistent explanation for both the intensive margin choice of how much of a good to consume, and the extensive margin choice of which goods are consumed in positive quantities. The model begins with the statement of the household's direct utility function, which is maximized subject to income and binding non-negativity constraints. The resulting first order Kuhn-Tucker maximization conditions form the basis for deriving the estimating equations that characterize the parameters of the preference function. Formally, the direct utility maximization problem is given by:

$$max_{x,z} u(x, z, s, \gamma, \varepsilon) \quad s.t. \quad y = p'x + z, \quad x_i \geq 0, \tag{5}$$

where x is an M-dimensional vector of consumption levels of the goods of interest, p is the vector of prices for these goods, z is a numeraire good with price normalized to one representing spending on all other goods, y is disposable income for the period of interest, s is a vector of household characteristics, and γ is a vector of utility function parameters to be estimated. The term ε is a M-dimensional random vector capturing the aspects of choice that are unobservable from the analyst's perspective but known to the individual. Thus the errors are an actual component of the preference function and need to be accounted for in estimation and policy analysis.

Assuming that spending on all other goods z is strictly positive, the problem in (5) implies first order conditions of the form:

$$u_j(\cdot) \leq p_j u_z(\cdot), \quad x_j \geq 0, \quad x_j[u_j(\cdot) - p_j u_z(\cdot)] = 0, \quad j = 1, \ldots, M, \tag{6}$$

where subscripts on the functions denote first derivatives. These equations provide the building blocks for deriving the estimating equations. Assuming a particular form for the utility function allows the first order conditions to be rearranged into the convenient statement:

$$\varepsilon_j \leq g_j(x, y, x, \gamma), \quad x_j \geq 0, \quad x_j[\varepsilon_j - g_j(x, y, s, \gamma)] = 0, \quad j = 1, \ldots, M, \tag{7}$$

where the form of $g_j(\cdot)$ derives from the choice of functional form for utility. Given an assumption on the distribution $f_\varepsilon(\varepsilon)$ of the error terms, the probability of observing any outcome in the data can be derived. For example, if the first k goods are positively consumed, the probability of this outcome is given by:

$$Pr(x_1, \ldots, x_k, 0_{k+1}, \ldots, 0_M) = \int_{-\infty}^{g_{k+1}} \cdots \int_{-\infty}^{g_M} f_g(g_1, \ldots, g_k, \varepsilon_{k+1}, \ldots, \varepsilon_M) |det(J_k)| d\varepsilon_{k+1}, \ldots, d\varepsilon_M, \tag{8}$$

where J_k is the Jacobian of transformation from ε to x. To estimate the utility function parameters via maximum likelihood a probability as in (8) is calculated for each individual in the sample, and the likelihood function formed as the product of the probabilities.

Estimation of the utility function parameters provides a characterization of household preferences up to the unobserved error term, which can be used to construct measures of policy interest such as elasticities and welfare effects. Because of the binding non-negativity constraints, however, the functional form for the demand equations associated with the choice of preference function can only be written conditional on the *demand regime*, or pattern of positively consumed goods. In the case of M goods, there are 2^M unique demand regimes. Denote Ω as the set of all possible demand regimes; that is:

$$\Omega = \{\emptyset, \{1\}, \{2\}, \ldots, \{M\}, \{1,2\}, \ldots, \{1,M\}, \ldots, \{1,2,\ldots,M\}\}. \tag{9}$$

Furthermore denote $x_\omega(p, s, y, \gamma, \varepsilon)$ where $\omega \in \Omega$ as the regime-specific demand relationship implied by (5). Given this functional form and an implied value for ε (e.g. the mean of the distribution), it is possible to calculate regime-conditional price and income elasticities of the type reported in Wales and Woodland and Lee and Pitt.

Rather than reporting regime-conditional elasticities, we investigate a different technique in this paper to recover unconditional elasticities. In measuring the extent of demand sensitivity to explanatory variables, conditional elasticities ignore the possibility for regime switching that the estimation stage of the Kuhn-Tucker model takes pains to allow. To improve upon this we propose calculating elasticities using simulation techniques similar to those employed by Phaneuf, Kling, and Herriges in calculating compensating variation measures using a Kuhn-Tucker model of recreation demand. Our strategy for computing price elasticities proceeds as follows. For a given individual in the sample define $\hat{\varepsilon}_r$ as a draw from the estimated distribution function for the random errors in the model. Conditional on this draw of the error it is possible to compute the predicted demand vector for the initial level of the price of interest and the predicted demand given a marginally changed value of the price. Denote these demands as $x_\omega(p_0, y, s, \gamma, \hat{\varepsilon}_r)$ and $x_{\omega'}(p_1, y, s, \gamma, \hat{\varepsilon}_r)$ where p_0 and p_1 are the initial and marginally changed prices and the subscripts ω and ω' denote the initial and final demand regimes that maximize utility for this draw of the error. In practice computing these involves calculating demand levels for every possible demand regime under the initial and changed prices, evaluating the utility level associated with each of these, and choosing the demand regime that yields the highest utility for the initial and changed price cases. Importantly, this calculation allows regime switching as a response to the new price vector.

Given the initial and final demand vectors two possibilities exist for proceeding further. The first calculates the elasticity of interest conditional on the draw of $\hat{\varepsilon}_r$; i.e. the elasticity of the i^{th} good with respect to the j^{th} price is computed for $\hat{\varepsilon}_r$ as:

$$\eta_{ij}(\hat{\varepsilon}_r) = \frac{x^i_\omega(p_0, y, s, \gamma, \hat{\varepsilon}_r) - x^i_{\omega'}(p_1, y, s, \gamma, \hat{\varepsilon}_r)}{p^j_0 - p^j_1} \times \frac{(p^j_0 + p^j_1)/2}{(x^i_\omega(\cdot) + x^i_{\omega'}(\cdot))/2}. \tag{10}$$

From this the *expected elasticity* for the individual is given by:

$$\bar{\eta}_{ij} = R^{-1} \sum_{r=1}^{R} \eta_{ij}(\hat{\varepsilon}_r), \tag{11}$$

where R is the number of draws of the error vector.

The second possibility is to compute the *elasticity of expected demand.* Under this option the simulation process is used to compute the initial and final expected demands, defined as:

$$\bar{x}(p_0, y, s, \gamma) = R^{-1} \sum_{r=1}^{R} x^i_{\omega}(p_0, y, s, \gamma, \hat{\varepsilon}_r), \quad \text{and} \tag{12}$$

$$\bar{x}(p_1, y, s, \gamma) = R^{-1} \sum_{r=1}^{R} x^i_{\omega'}(p_1, y, s, \gamma, \hat{\varepsilon}_r). \tag{13}$$

Given the values for the initial and final expected demands the i^{th} good elasticity with respect to the j^{th} price is given by:

$$\tilde{\eta}_{ij} = \frac{\bar{x}^i(p_0, y, s, \gamma) - \bar{x}^i(p_1, y, s, \gamma)}{p_0^j - p_1^j} \times \frac{(p_0^j + p_1^j)/2}{(\bar{x}^i(p_0, y, s, \gamma) + \bar{x}^i(p_1, y, s, \gamma))/2}. \tag{14}$$

There are important conceptual differences between these two calculations. In the first case regime switching is allowed to enter directly into the calculation of the expected elasticity, while in the second case regime switching is blended into the calculation of the expected demand. As such the latter calculation reflects the flexibility of average demand, while the former is the flexibility of actual (simulated) demands and as such likely contains more noise. The issue of preference between these two measures is a question for additional research. To examine the practical differences we present both measures in our empirical section below.

Estimation of the model requires statement of the functional form for utility and the error distribution. In applications to recreation demand, Phaneuf et al. employ relatively restrictive assumptions that allow for ease of estimation and elasticity calculations. In our application to the demand system for five meat commodities, we follow their example. Specifically we assume utility takes a form of the Stone-Geary function, given by:

$$u(x, z, s, \gamma, \varepsilon) = \sum_{j=1}^{5} \Psi_j(s, \varepsilon_j) \ln(x_j + \theta_j) + \ln(z), \tag{15}$$

where $\gamma = (\delta, \theta)$ and Ψ_j is a strictly positive aggregator of the observed and unobserved household specific characteristics, given in our application by $\Psi_j = exp(\delta_0 + \delta_{j1}AEQ + \delta_{j2}RURAL + \varepsilon_j)$ for all j. The regime-specific demand equation implied by maximization of this function is:

$$x_i^{\omega} = -\theta_i + \frac{\Psi_i}{1 + \sum_{k \in w} \Psi_k} \frac{1}{p_j}(y + \sum_{k \in w} p_k \theta_k). \tag{16}$$

As we discussed above, the estimating equations are derived from the first order conditions. For this particular utility function the Kuhn-Tucker conditions corresponding to equation (7) are:

$$\varepsilon_i \leq g_i = \ln p_i + \ln(x_i + \theta_i) - \ln(y - \sum_{k=1}^{5} p_k x_k) - (\delta_0 + \delta_{j1}AEQ + \delta_{j2}RURAL), \quad i = 1, \ldots, M. \tag{17}$$

For our error distribution we continue to follow Phaneuf et al. and assume ε_i is distributed extreme value. Specifically we assume each error is independent and identical type I extreme value with scale parameter ν. While more general error distributions are possible, this assumption is convenient in that a simple and tractable closed form for the probability corresponding to equation (8) exists, given by:

$$\ln pr(x) = -\sum_{k=1}^{5} I_{x_k>0} \times \frac{g_i}{\nu} - \sum_{k=1}^{5} I_{x_k>0} \times \ln(\nu) + \ln(abs|J_k|), \tag{18}$$

where $I_{x_k>0}$ indicates positive consumption of x_k and the form of the Jacobian transformation derives from differentiating the equations in equation (16) with respect to each x_j.

4 Empirical Application and Results

The empirical analysis utilizes data taken from a survey of 2,467 Bulgarian households. The survey, administered in 1995 under the Bulgarian Integrated Household Survey (IHS) project, was conducted by Gallup International under the auspices of the Bulgarian Ministry of Labor, the Ministry of Social Affairs, and the National Institute of Statistics. The data were made available under the World Bank's Living Standards Measurement Survey (LSMS) project. Incomplete responses were deleted from the sample used for analysis. Likewise, a number of households were rejected from the analysis if their survey responses yielded unreasonable prices or quantities. The first segment of the analysis utilized data drawn from 1,876 households. The second segment of the analysis, which drew from a much smaller portion of the budget survey (i.e., only that pertaining to meats), utilized data for 2,449 households. Summary statistics for relevant variables are presented in Table 1.

Maximum likelihood estimates of the aggregate food category AIDS model are presented in Table 2. The individual parameter estimates are almost all highly statistically significant. In light of the cross-sectional nature of our data, a reasonably large degree of the relative variation in shares is explained by the AIDS share equations. A likelihood ratio test confirms the statistical significance of the demographic terms that are allowed to shift the intercept terms in the share equations. As might be expected, larger households (with size being represented by adult equivalents) tend to devote more of their budget shares toward cereals and dairy products and less toward meats, fruits and vegetables, and other foods. Rural households tend to devote a larger share of their total expenditures toward all food commodities except for the residual category representing all other foods. This is not surprising in that the all other foods category is largely comprised of prepared and ready to eat foods and food consumed away from home.

Perhaps of greatest interest are the food demand elasticity estimates, which are presented in Table 3. Elasticity estimates are evaluated at the means of price, income, and adult equivalents and are evaluated for urban households.[3] The elasticity estimates would appear entirely reasonable and are consistent with what is typically revealed in analyses of food demand, even in non-transition market economies. The income elasticity is greatest for "other foods." The estimate of 1.25 suggests that food away from home and prepared foods are "luxury" items. Meats also have an elastic income response, though the income elasticity is quite close to unitary. The income elasticity for fruits and vegetables is also quite close to unitary, though the elasticity is slightly inelastic. The smallest income elasticities are revealed for cereals, at 0.33, and dairy products, at 0.70. Such items are more likely to be considered as necessities and thus increasing incomes would be expected to result in less consumption of cereals and dairy products and more consumption of the food luxury items—meats and other foods. Non-food items also have an elastic income response. The income elasticity for non-foods is 1.14. Our expenditure (income) elasticities are quite similar to those reported by Balcombe, Davidova, and Morrison, who obtained expenditure elasticites of 1.04, 1.80, 1.40, 1.72, and 0.92 for bread, milk, cheese, meat, and other goods, respectively, using time-series data on Bulgarian food consumption. Much smaller income elasticities are reported by Balcombe and Davis. In particular, their food expenditure elasticities are all inelastic, ranging from 0.31 to 0.79 for the same set of goods.

The own-price elasticities are also consistent with expectations. As might be expected, cereals have the most price inelastic demand, with an own-price elasticity of -0.31. Fruits and vegetables and meats both have own-price elasticity estimates of about -0.70. Dairy products have an own-price elasticity estimate of -0.82. The own-price elasticity for other foods is -0.76 while the estimate for non-food items is -0.97. These price elasticity estimates are quite similar to those reported by Balcombe and Davis, though the elasticities are considerably smaller than those reported by Balcombe, Davidova, and Morrison. The estimates are again consistent with expectations and with

[3]Price and the adult equivalents variables were scaled by dividing though by their mean values. This simplifies evaluation of elasticity estimates and ensures that the consistency under unit scaling (CUUS) property is not violated.

most analyses of the demand for aggregate food commodity categories. The elasticity estimates are also consistent with curvature conditions when evaluated at the data means. In particular, no eigenvalues of the substitution matrix are positive and thus the results are consistent with convexity of preferences.

The second phase of the analysis utilized the household consumption data in the Wales and Woodland Kuhn-Tucker model to evaluate the demand for individual meat products. Five meats—beef, pork, lamb, chicken, and other meats—and one residual category representing all other goods, were included in the demand system. Parameter estimates and summary statistics are presented in Table 4. Again, almost all parameter estimates are statistically significant. The parameter estimates generally have the expected signs and magnitudes. The results again suggest that larger households tend to consume lower quantities of meat products.[4]

Elasticity estimates for the Kuhn-Tucker meat demand model are presented in Table 5. As we noted above, two different elasticity estimates are possible in such cases of regime switching models. The first considers the *expected elasticity*, which is constructed by taking the average of elasticities over simulations that perturb the random error components and calculate the effects on demand. The second considers elasticities for the *expected quantities*, which takes the average over quantities obtained by perturbations of the random error components. The elasticities are clearly conceptually distinct and permit different inferences regarding demand effects from changing prices.

The elasticity estimates are all of the expected signs, with all own-price elasticities negative and all cross-price elasticities being positive, indicating that the individual meat products are substitutes for one another. The cross-price effects are all quite close to zero, indicating that, although substitutability appears to exist among the individual meat products, the cross-price effects are very modest. The own-price elasticities indicate meat product demands that are quite elastic, ranging from -1.58 to -3.41 for the expected elasticities and -1.36 to -1.84 for the elasticities of expected demand. The expected elasticity estimates generally indicate a more elastic response. This reflects the fact that there is considerable regime switching inherent in the elasticities, where consumers are implied to shift from zero to positive levels of consumption. In most cases, income elasticities are quite similar for the two alternative methods and across the different commodities.

[4]In that the LES system considers quantity-dependent demands rather than expenditure share equations, the interpretation of the demographic terms is different. In the AIDS system, the effects pertained to expenditure shares which in the LES model the demographics influence actual quantities consumed.

The estimates indicate that all meat commodities are luxury items. The elasticity estimates are generally larger than what was obtained for the aggregate analysis of meat demand (1.26 to 3.16 as compared to 1.04 for aggregate meats). Again, this may reflect the regime switching nature of the problem.

In all, the estimates suggest that food demands in transition Bulgaria are similar to what is observed in many other non-transition market economies. Cereals and dairy products appear to be necessity-type food items while meats and prepared foods are luxury food items. Thus, as the transition progress proceeds and if real incomes grow as expected, Central and Eastern Europe, at least as it is represented by Bulgaria, might be expected to expand their consumption of meats and processed food products. A Kuhn-Tucker model that allows for zero levels of consumption indicates very elastic price and income demands for individual meat products. Thus, imports of meats by Bulgaria may be especially sensitive to price and income changes.

5 Concluding Remarks

Though the short-term outlook for increased exports of food products to Central and Eastern Europe is cloudy at best, considerable optimism has been expressed about these markets as eventual destinations for U.S. food products. A clear understanding of the potential for increased exports to this region if (and when) the transition process increases real incomes in the region requires comprehension of consumers' demands for food products. The objective of this analysis was to estimate and present detailed elasticity estimate for food commodities in transition Bulgaria.

Our analysis was conducted in two segments. The first considered demand for five aggregate food commodities—cereals, fruits and vegetables, meats, dairy products, other foods (including food consumed away from home and prepared foods), and all other goods. Our results suggest that food demand elasticities in transition Bulgaria are quite similar to what is generally found for other countries. The estimates suggest relatively price inelastic demands. Income elasticities are perhaps of greatest interest in that they indicate how demand for food products in Bulgaria might be expected to increase if real incomes grow. We find that cereals and dairy products tend to be income-inelastic while meats and other foods are income-elastic. Thus, the potential for expanded food exports to Bulgaria would appear to be greatest for meats and processed food commodities.

In light of the current importance of meat exports from the U.S. to Bulgaria, we also considered a Kuhn-Tucker model of demand for individual meats. These results indicated that the demand for individual meat products is very price and income elastic. Our analysis distinguishes between expected elasticities and elasticities of expected demands and finds much more elastic responses for the former. These differences reflect switching that recognizes the discrete decision reflected in observed zero levels of consumption.

Table 1. Summary Statistics

Variable	Mean	Standard Deviation
.... Aggregate Good Analysis[a] (n=1876)		
p_1	17.9698	11.7791
p_2	43.7523	13.3755
p_3	114.4271	44.2016
p_4	58.6200	28.7258
p_5	61.4663	44.1102
w_1	0.0747	0.0497
w_2	0.1893	0.0849
w_3	0.1699	0.0871
w_4	0.0971	0.0627
w_5	0.1051	0.0638
w_6	0.3639	0.1394
Adult Equivalents	2.2385	0.9655
Rural	0.2921	0.4549
Food Expenditures	7073.0400	4704.9900
Non-Food Expenditures	4609.4000	4272.0000
.... Meat Demand Analysis (n=2449)		
p_{beef}	191.0240	42.8065
q_{beef}	0.5582	1.7318
p_{pork}	187.5748	42.8785
q_{pork}	1.7616	3.1640
p_{lamb}	223.1176	127.7658
q_{lamb}	1.9076	5.0401
p_{chick}	115.6408	13.4789
q_{chick}	2.5562	2.7619
p_{other}	162.4434	51.6003
q_{other}	4.1085	5.0913

[a]Aggregate good categories are defined as: 1=cereals, 2=fruits and vegetables, 3=meats, 4=dairy, 5=other foods, and 6=all other goods. Number of observations is 1876 households.

Table 2. Aggregate AIDS Model Parameter Estimates

Parameter	Estimate	Standard Error
γ_{11}	0.0245	0.0025*
γ_{12}	−0.0102	0.0023*
γ_{13}	−0.0110	0.0014*
γ_{14}	−0.0010	0.0017
γ_{15}	−0.0015	0.0015
γ_{22}	0.0564	0.0042*
γ_{23}	−0.0226	0.0024*
γ_{24}	−0.0082	0.0025*
γ_{25}	−0.0125	0.0024*
γ_{33}	0.0504	0.0027*
γ_{34}	−0.0012	0.0018
γ_{35}	−0.0120	0.0019*
γ_{44}	0.0082	0.0026*
γ_{45}	0.0037	0.0018*
γ_{55}	0.0223	0.0025*
α_{10}	0.5520	0.0170*
α_{11} (Adult-Eq)	0.0551	0.0028*
α_{12} (Rural)	0.0182	0.0021*
α_{20}	0.2157	0.0327*
α_{21} (Adult-Eq)	−0.0114	0.0053*
α_{22} (Rural)	0.0056	0.0040
α_{30}	0.0114	0.0319
α_{31} (Adult-Eq)	−0.0076	0.0052
α_{32} (Rural)	0.0107	0.0038*
α_{40}	0.3310	0.0247*
α_{41} (Adult-Eq)	0.0044	0.0040
α_{42} (Rural)	0.0243	0.0030*
α_{50}	−0.1333	0.0269*
α_{51} (Adult-Eq)	−0.0187	0.0044*
α_{52} (Rural)	−0.0136	0.0032*
β_1	−0.0500	0.0019*
β_2	−0.0057	0.0035
β_3	0.0060	0.0035*
β_4	−0.0289	0.0027*
β_5	0.0267	0.0029*
Adjusted R_1^2	0.4016	
Adjusted R_2^2	0.2458	
Adjusted R_3^2	0.3143	
Adjusted R_4^2	0.2069	
Adjusted R_5^2	0.0940	
Likelihood Ratio Test of Demographics	532.97*	

[a] Aggregate good categories are defined as: 1=cereals, 2=fruits and vegetables, 3=meats, 4=dairy, 5=other foods, and 6=all other goods. Asterisks indicate statistical significance at the $\alpha = .10$ or smaller level.

Table 3. Aggregate Food Category AIDS Model Elasticity Estimates

Quantities	Prices						
	Cereals	Fruits and Vegetables	Meats	Dairy Products	Other Foods	Nonfood Items	Income
Cereals	−0.3442	0.0216	−0.0666	0.2119	−0.0979	−0.0561	0.3311
Fruits and Vegetables	−0.0392	−0.6951	−0.1159	−0.0330	−0.0696	−0.0172	0.9700
Meats	−0.0819	−0.1415	−0.7078	−0.0191	−0.0663	−0.0189	1.0356
Dairy Products	0.1354	−0.0137	0.0231	−0.8153	0.0034	−0.0356	0.7026
Other Foods	−0.1385	−0.1791	−0.1441	−0.0503	−0.7581	0.0165	1.2536
Nonfood Items	−0.0721	−0.0416	−0.0270	−0.0522	0.0165	−0.9660	1.1424

Table 4. Kuhn-Tucker Meat Demand Model Parameter Estimates

Parameter	Estimate	Standard Error
θ_{beef}	3.6698	0.2494*
θ_{pork}	2.8374	0.1106*
θ_{lamb}	4.7846	0.2336*
$\theta_{chicken}$	2.1773	0.1233*
$\theta_{othergoods}$	1.6913	0.0601*
Intercept	−2.4965	0.0350*
δ_{11} (Adult-Eq$_{beef}$)	−0.4897	0.0277*
δ_{21} (Adult-Eq$_{pork}$)	−0.2322	0.0180*
δ_{31} (Adult-Eq$_{lamb}$)	−0.2599	0.0199*
δ_{41} (Adult-Eq$_{chicken}$)	−0.3442	0.0252*
δ_{51} (Adult-Eq$_{other}$)	−0.1109	0.0136*
δ_{12} (Rural$_{beef}$)	−0.0508	0.0933
δ_{22} (Rural$_{pork}$)	−0.2290	0.0603*
δ_{32} (Rural$_{lamb}$)	0.6292	0.0522*
δ_{42} (Rural$_{chicken}$)	0.0376	0.2530
δ_{52} (Rural$_{other}$)	−0.2960	0.0392*
ν	0.7121	0.0093*
Log-Likelihood Fn.	-21,606.08	

[a]Asterisks indicate statistical significance at the $\alpha = .10$ or smaller level.

Table 5. Kuhn-Tucker Meat Demand Model Model Elasticity Estimates

Quantities	Prices					
	Beef	Pork	Lamb	Chicken	Other	Income
Expected Elasticity						
Beef	−1.5806	0.0422	0.0580	0.0357	0.0446	1.4977
Pork	0.0446	−2.9150	0.0847	0.0681	0.0813	2.8130
Lamb	0.0300	0.0605	−2.1524	0.0530	0.0734	2.0475
Chicken	0.0544	0.0951	0.1115	−3.4128	0.0993	3.1614
Other	0.0469	0.0777	0.0900	0.0766	−2.9735	2.7379
Elasticity of Expected Quantities						
Beef	−1.8229	0.0291	0.0321	0.0277	0.0342	1.7318
Pork	0.0142	−1.6120	0.0298	0.0246	0.0317	1.5103
Lamb	0.0152	0.0275	−1.8371	0.0261	0.0339	1.7471
Chicken	0.0126	0.0241	0.0269	−1.4352	0.0288	1.3379
Other	0.0123	0.0228	0.0258	0.0214	−1.3560	1.2681

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