Eurasian Journal of Business and Economics 2011, 4 (7), 25-51.

Testing Household Economies of Scale in Uzbekistan

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Abstract

This paper investigates empirically the relationship between household economies of scale and consumption in Uzbekistan. Particular attention is paid to the so-called "zero consumption problem" and Tobit estimator is utilized to deal with the problem. Using the household survey dataset made available recently, we test presence (or lack) of household economies of scale in seven different consumption categories (food, meals out, clothing, education, health, transportation and shelter). We find evidence of strong and positive household economies of scale in consumption of meals out, clothing, education, health, transportation and shelter, while consumption of food fails to indicate this pattern. We also estimate food Engel curve using non-parametric kernel estimates and fail to find the existence of household economies of scale through food consumption data.

Keywords: *Household economies of scale, Engel curve, Tobit*

***JEL Classification Codes**: D11, D12, D13*

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1. Introduction

Social scientists have long observed that poor households adopt different strategies to improve their livelihood and cope with limited resources, such as opting for living in extended families and pooling resources to achieve economies of scale in consumption. With economies of scale, an additional household member requires fewer resources than the comparable existing member because household members share public goods such as shelter and utilities, making larger households better off at lower per capita expenditures. By sharing public goods, household members can spend more on private goods in per capita terms. This way, households with multiple members are able to achieve the same standard of living at lower per capita expenditures on public goods than smaller households.

The basic idea has strong intuitive appeal: living standards for households of different sizes could differ even if per capita income is the same. This is because larger households are able to spend less on public goods, and consequently can spend greater amount on private goods. Household economies of scale are therefore fundamental to measuring the distribution of income, the costs of children, the extent of poverty, and poverty thresholds necessitates an accounting for these economies of scale.

The discovery of household economies of scale is attributed to the German statistician Ernst Engel, who analyzed data for about 200 households in the mid-19th century and formulated his now famous Law. Engel noted that the percentage of income allocated for food purchases decreases as income rises. Thus budget share of food can be used to judge well-being of households. Another corollary of the so-called Engel's Law is that, keeping per capita income constant, increasing household size should lead to the increase in relative well-being of the households. The reason is when several members of households share public goods, such as housing and utilities, they can save greater proportion of their income to be spent on private goods, such as food and clothing.

Household economies of scale are traditionally measured by an Engel curve, which describes how a consumer’s purchases of a good like food varies as the consumer’s total resources such as income or total expenditures vary. Engel curves are used to distinguish whether the particular good is an inferior, normal, or luxury good. Engel curves are indispensable in equivalence scale calculations and related welfare comparisons of households with different compositions.

This phenomenon has been observed in many countries across all continents, both developing and developed ones. In Uzbekistan, economies of scale might be more pronounced in rural areas, where 3/4 of the poor live and poverty rate is three times higher compared to the urban settlements.

In this paper we study the importance of economies of scale in Uzbekistan using a household survey recently made public by the World Bank. Specifically, we ask three related questions: are there economies of scale and how the size of household relates to per capita consumption? Will the marginal effect of household size on per capita consumption decline in income level? And, finally, how economies of scale should affect our thinking on poverty?

2. Brief literature review

In his Econometrica article, celebrating centennial anniversary of Engel's Law, Houthakker (1957) reviews over 40 econometric studies from over 30 countries. The literature on Engel's Law or utilizing one of its predictions since then has probably multiplied many times. In this section we will not try to do a comprehensive review of the burgeoning literature. Instead, we will concentrate on a small number of studies to emphasize the direction of recent debates in the field.

Lazear and Michael (1977) find large economies of scale in food and shelter and smaller savings in other goods, such as medical and personal care. Similarly, using U.S. Consumer Expenditure Survey, Nelson (1988) finds large economies of scale in shelter and smaller economies of scale in furnishings, maintenance, food, clothing and transportation.

However, Deaton and Paxson (1998) criticize the economies of scale estimates based on Engel's method as those without clear theoretical underpinnings. They derive a theoretical model of the economies of scale, based on Barten's (1964) two-good (private and public) model. Deaton and Paxson (1998) start with the assumption that when household size increases at constant per-capita income, additional resources will be directed towards private goods, such as food. This assumption is derived from the condition that food income elasticity exceeds own price elasticity. Thus, relationship between food expenditures and household size at constant per-capita income should be positive. The theoretical model provides this intuition with the necessary and sufficient condition: price elasticity of the private good must be less than its income elasticity in absolute terms, which should be true for poor households.

In their empirical study of seven different countries, Deaton and Paxson (1998) tested the Barten model and, surprisingly, found precisely the opposite pattern, that is, the share of food decreases with the increase in the size of households. Moreover, in the poorest countries, where Deaton and Paxson believe the income elasticity of food should be the greatest, they find the strongest negative correlation between household size and per capita food expenditure. This contradiction has become known as the Deaton- Paxson puzzle.

The Deaton-Paxson puzzle has sparked a lively discussion in the academic circles. Since the Deaton and Paxson (1998) appeared, many studies have confirmed the empirical regularity that higher household size leads to lower share of food consumption throughout the world[1]. Several studies attempt to explain the Deaton-Paxson puzzle by extending the Barten model. In particular, Horowitz (2002) develops a N-good model and shows that the condition that generates the Deaton-Paxson puzzle is not necessary or sufficient for the positive relationship between household size and per-capita food expenditures. Horowitz's model predicts that in the poorest countries, where the food shares are highest, household size and food expenditures will have greater tendency to be negative.

Gan and Vernon (2003) tackle the Deaton-Paxson puzzle from another angle. They note that that Barten's prediction that at constant per-capita expenditures, the food share will rise with household size contradicts the Engel's century-old observation. They argue that dividing consumption into food and non-food components and considering them as a more private in the case of food and more public in the case of non-food items is not plausible. Since non-food expenditures include such diverse items as transportation, clothing and shelter, the condition that income elasticities of those expenditures exceed own-price elasticities may not be satisfied. Gan and Vernon (2003) consider not only as a food share in total expenditures as Deaton and Paxson (1998) did, but also as a more restricted versions of food share: in food plus shelter, and in food plus transportation (more private good) expenditures. They first replicate Deaton and Paxson's results with the food share in total expenditures, and then show that share of food plus shelter indeed increases with household size as it is predicted by the Barten model. However, share of food plus transportation declines as household size increases. Gan and Vernon (2003) explain this diverging empirical regularity by the fact that shelter is a more public good than food, while transportation might be more private good.

Deaton and Paxson (2003) point out that Gan and Vernon (2003) results shed light to some interesting features of economies of scale for different groups of consumption, but fail to address the central puzzle which is larger households have lower food expenditures per capita. They also show that, contrary to results obtained by Horowitz (2002), Barten's model can be generalized easily to the multiple goods case with minimal modifications but essentially with the same implications.

The discussion so far shows that it is very difficult to explain the Deaton-Paxson puzzle without reverting to some special assumptions about the model set-up (like in Horowitz, 2002) or arguing that some non-food goods (such as clothing or transportation) are more private than food (Gan and Vernon, 2003).

Another explanation that was put forward is that have suggested that measurement error explains a portion of the "food puzzle". Gibson (2002) and

[1] Studies analyzing various aspects of this "food puzzle" include Gardes and Starzec (2000), Perali (2001), Horowitz (2002), Gibson (2002), Gan and Vernon (2003), Deaton and Paxson (2003), Vernon (2005), and Gibson and Kim (2007).

Gibson and Kim (2007) argue that the problem lay in the recall method use by expenditure surveys. However, even after correcting for measurement error in contemporary surveys, Gibson and Kim (2007) find that the foodshare is still negatively related to household size.

Using historical household surveys from the United States, covering the period 1888 to 1935, Logan (2010) investigates Deaton-Paxson puzzle for four consumption categories - food, clothing, entertainment and housing. His findings show that households in the past had even fewer scale economies in food than today. He also finds that the other expenditure categories are consistent with theoretical predictions, although there are certain variations over time. Thus not only modern cross-sectional studies support the food puzzle, but also historical evidence verifies it.

While our goal is to reliably estimate household scale economies, we cannot sidestep the Deaton-Paxson puzzle. We will briefly highlight the controversy surrounding economies of scale for foodshare and estimate parameters of economies of scale using the Uzbekistan Regional Panel Survey 2005. Second, we will investigate whether the puzzle holds for groups with different income levels. For that, we will divide the whole sample into quartiles and test for economies of scale for different per capita consumption levels. But we also test the Barten model for wide range of consumption categories, which are a priori known whether they are public goods (shelter) or private goods (food away from home, education, health,

3. Data

The data to be used in this paper is taken from a survey undertaken by the World Bank, called Uzbekistan Regional Panel Survey (URPS). The URPS is modeled after the World Bank's standard Living Standards Measurement Survey (LSMS). It was envisioned at the time that the same households will be followed later and the survey will become a panel survey. But the World Bank could not get Uzbek Government's agreement to continue the survey and it was discontinued.

It should be noted that the Uzbek Government is extremely suspicious of any large-scale surveys. In rare cases when national or international organizations succeed in obtaining a permission to conduct the survey, the Government does not allow the dataset to become public. The URPS is the only exemption to this rule and it can be freely downloaded from the World Bank's website.

The data was collected in three waves between March and December 2005. The first wave of the URPS was carried out in March-April of 2005, the second in October-November of 2005. A third wave was conducted in December of 2005 mainly to collect data on disabilities.

The consumption module of the survey, to be used in the paper, was collected by interviewing the best informed member of the household. The survey covered about 3,000 households from three regions – Andijan, Kashkadarya and Tashkent city. The survey is representative for those three regions, but not for the country as a whole. About half of surveyees reside in rural areas. The survey contains data on 15636 individuals, about 39 percent of which (6045 individuals) are children below 18 years old.

We have identified 7 consumption categories which we use to test for economies of scale. These are expenditures on food, meals bought outside the house, clothing, education, health, shelter and transportation. Food, clothing and shelter generally top the list of basic human needs. We also add expenditures on education, health and transportation as necessary elements of modern life. We consider food and meals out separately because we think that meals out has much more pronounced characteristics of private good, whereas food consumed inside the household has such properties as strong internal economies of scale. As it was emphasized by Vernon (2005), meals prepared and consumed inside the home have large 'own' economies of scale through bulk purchase, storage and joint preparation of food. This also implies that larger families consume fewer meals out of the home. If that was true, larger households would have lower food expenditures since meals out of the home are usually more expensive than those consumed in the home.

Table 1 summarizes selected variables which are of interest to us. It shows that the average age of household head is 49 years and 22 percent of households are headed by women. The mean household size is 5.23 people per household that is very close to the national average of 5.6 people. Out of almost 2948 households, all households reported the consumption of food and shelter (which is defined as household expenses on house/apartment plus utilities), 2610 - the consumption of clothing, 2139 – education expenditures, 2122 – expenditures on transportation, 1897 – healthcare expenditures and 1420 – the consumption of meals outside.

Out of the expenditure categories, biggest share went to food (44% on average), followed by shelter (18%), health (11.2%), meals out (9.8%), education (6.6%), clothing (6%) and transportation (4.6%). Overall, these 7 expenditure categories make up about 90% of all consumption expenditures in our sample. It should be noted that budget share of transportation in our case does not include transportation related to education and health, these being the respective parts of education and health expenditures. We also excluded a cost of fuel, since people who buy fuel are most likely to have their own vehicle which is frequently used to transport their family members. We consider food and meals out separately because meals out is close to pure public good, whilst food probably has a big internal economies of scale. We will come back to the discussion of food later.

Table 1. Summary statistics of selected variables

Variable	Obs	Mean	St. dev.	Min	Max
Household size	2948	5.234	2.329	1	18
Aggregate consumption	2948	2100345	1524315	273372	15800000
Per capita expenditures	2948	501054	494125	52844	7069330
Age of household head	2948	49.347	14.331	17	101
Gender of household head	2948	0.224	0.417	0	1
Female aged 0_4	2948	0.228	0.499	0	3
Female aged 5_10	2948	0.331	0.579	0	3
Females aged 11_15	2948	0.319	0.585	0	3
Female aged 16_60	2948	1.570	0.973	0	7
Female aged over 61	2948	0.204	0.410	0	2
Male aged 0_4	2948	0.247	0.514	0	4
Male aged 5_10	2948	0.319	0.566	0	3
Male aged 11_15	2948	0.324	0.575	0	3
Male aged 16_60	2948	1.523	1.070	0	6
Male aged over 61	2948	0.164	0.372	0	2
Share of food	2948	0.440	0.167	0.032	0.915
Share of meals out	1420	0.098	0.081	0.001	0.685
Share of clothing	2610	0.060	0.062	0.000	0.855
Share of education expenditures	2139	0.066	0.085	0.000	0.618
Share of health expenditures	1897	0.112	0.131	0.000	0.835
Share of transportation	2122	0.046	0.077	0.001	0.677
Share of shelter	2948	0.180	0.139	0.005	0.836
Andijan dummy	2948	0.332	0.471	0	1
Tashkent dummy	2948	0.320	0.466	0	1
Kashkadarya dummy	2948	0.331	0.471	0	1
Urban dummy	2948	0.476	0.500	0	1
Uzbek	2948	0.805	0.396	0	1
Karakalpak	2948	0.004	0.063	0	1
Russian	2948	0.084	0.277	0	1
Tajik	2948	0.033	0.180	0	1
Tatar	2948	0.029	0.168	0	1
Kazakh	2948	0.004	0.060	0	1

Table 2 shows that as purchasing power increases, share of food and health expenditures decline, while shares of meals out, education, transport and shelter increase. Clothing does not exhibit any discernible pattern as we move from one quintile to another. For the poorest households major expenditure items are food (56%), health (15.8%), shelter (13.4%). The richest households also spend the biggest share of their budget on food, but food expenditures constitute only about 1/3 of the overall expenditures. They spend sizable share of their income on shelter (24.7%), meals out (10.5%) and education (9.1%).

Table 2. Means of selected consumption categories at different quintiles

	Food	Meals out	Clothing	Education	Health	Transport	Shelter
Poorest	0.559	0.080	0.047	0.050	0.158	0.032	0.134
2nd quartile	0.518	0.085	0.066	0.055	0.121	0.045	0.130
3rd quartile	0.428	0.103	0.070	0.065	0.111	0.047	0.170
Richest	0.328	0.105	0.057	0.091	0.086	0.053	0.247

4. Methodology and estimation strategy

4.1. Parametric specification of the Barten model

Here we present a summary of Barten's model, on which Deaton and Paxson and the consequent literature is based. The starting point is a household with n identical members, who allocate their total expenditure x across two goods. They consume a public good and a private good. Plausible candidates for these two goods are housing and food. Household expenditure allocation problem is as follows:

$$\max_{q_f, q_h} u = nv\left(\frac{q_f}{\phi_f(n)}, \frac{q_h}{\phi_h(n)}\right) \quad \text{s.t.} \quad p_f\left(\frac{q_f}{n}\right) + \left(\frac{p_h}{n}\right)q_h = \frac{x}{n} \tag{1}$$

$\phi_f(n)$ and $\phi_h(n)$ are scaling functions for food and housing respectively, and they show the economies of household size for the consumption of these two goods. $\phi_i(n) = n^{1-\sigma_i}$, where σi is the scale elasticity for good i. If σi =0, then ϕi = n, which means the good is a pure private good and cannot be shared. If If σi =1, then ϕi = 1, which means the good is a pure public good and can be enjoyed by all members of household with no crowding effects. In reality, food may not be a pure private good as there are economies of scale in food preparation. The larger the household, the shorter is the time of food preparation per household member. Similarly housing is not a pure public good, as there are crowding effects of household size. The larger household gets, the less space becomes available per household member. But it is obvious that food is "more private" than housing and housing is "more public" than food. That means σh > σf .

There is alternative interpretation of these parameters. If household size goes up by one percent, then the consumption of good i should go up by 1- σi percent for all i to leave all household members at the same level of consumption. In other words, if one percent increase in household size is accompanied by 1- σi percent increase in consumption of good i, then per capita consumption of good i does not change. If σi =0 or 1-σi=1, then we say there are no economies of scale in consumption of good i, as any increase in household size has to be fully compensated with the same rate of increase in good i to make the residents as well of as they were. In other words, household size does not provide any "economies" and good i is obviously a private good. If, on the other hand, σi >0 or 1-σi<1, then we say there are economies of scale in consumption of good i, as one percent increase in household size can be compensated with less than one percent increase in consumption of good i to leave the residents at the same level of consumption. Thus, there are some household economies of scale in consumption of this good or there is some "publicness" in good i. If σi =1, then the good is purely public. Now, if there are economies of scale in consumption of some of the goods, then additional person who brings in own income equal to the average household income (to keep it constant) will result in greater consumption of all normal goods. The reason is that person will bring positive income effect exactly because of household economies of scale. Solution of problem (1) gives us the rigorous version of this argument.

First order conditions for problem (1) give us the following demand functions.

$$\frac{q_f}{n} = \frac{\phi_f(n)}{n} g_f\left(\frac{x}{n}, \frac{p_f \phi_f(n)}{n}, \frac{p_h \phi_h(n)}{n}\right) \tag{2}$$

Taking log of both sides and differentiating with respect to ln n gives us

$$\frac{\partial \ln(q_f / n)}{\partial \ln n} = \sigma_h(\varepsilon_{fx} + \varepsilon_{ff}) - \sigma_f(1 + \varepsilon_{ff}) \tag{3}$$

where εff is the own-price elasticity for food, εfx is the income elasticity of food.

The expression (3) shows what kind of effect an additional person in the household makes on food consumption per capita. If the right hand side of (3) is positive, then an extra person in results in the increase of food consumption per capita. The argument with the sign of (3) is as follows. If food is normal good and has few substitutes, then own price elasticity εff should be small in absolute value. As said above σf should be close to zero, since food is a private good. On the contrary, housing is a public good and σh should be closer to one. If food is a normal good, a necessity and has few substitutes as it is the case in developing countries, then εfx should be high and εff should be low in absolute terms. Together these arguments imply (3) should be positive.

For practical purposes, we adopt the following parametric Engel curve specification from Deaton and Muellbauer (1980):

$$w_i = \frac{p_i q_i}{x} = \alpha_i + \beta_i \ln\left(\frac{x}{n}\right) + \eta_i \ln n + \sum_{j=1}^{J-1} \gamma_{ij}\left(\frac{n_j}{n}\right) + \delta \cdot z + u_i \tag{4}$$

where wi is a share of food in total expenditures, x is total expenditures and n is population size. The other factors z include regional and employment variables. The parameter estimate of ln(n) is indicative of the economies of scale effect. Following Deaton and Paxson, we extend this Engel curve with the level and square of ln(x/n), because usually there is strong negative correlation between PCE and the food share. The empirical model (4) is estimated by Tobit estimator. The sign and significance of household size' is indicative of the effect of household size on food per capita consumption. That is how we test our first hypothesis. It is important to note that the hypothesis says that the household size has positive impact on per capita food consumption. The reason is the share of food in household budget moves in the same direction and proportion as the per capita food consumption if per capita expenditures, x/n, is kept constant (controlled for), because

$\frac{p_i q_i}{x} = \frac{p_i q_i / n}{x / n}$. The second hypothesis (that the effect of household size on per capita food consumption changes with income level) is tested by splitting the sample into quartiles and checking if the coefficient of ln n decreases for wealthier households.

Before moving to the empirical part of the paper, we would like to turn reader's attention to the fact that only two out of seven categories of expenditures are represented in all households (Table 1). This is a manifestation of the so-called "zero consumption problem", where some households do not report that they have spent on particular category of products in the reporting period, such as education, health, meals out and others. But this does not mean that those households did not consume those products in the past or will not consume them in the future. Thus the expenditures on particular categories are reported as zero, but it is very likely to be a temporary corner solution. In other words, part of the consumption is censored from below at or around zero[2].

As McCracken and Brandt (1987) emphasize, using OLS in the presence of zero consumption would result in biased and inconsistent estimates because of the large number of households who had not consumed particular categories. If the data is censored from below, as it is in our case, OLS estimates will be biased downward. Deleting the non-consuming households and using OLS does not solve the problem of inconsistency and would reduce the efficiency of the estimates. In this regard Tobit is a preferred estimation technique that uses information about all households in estimating the regression coefficients and their standard errors.

In Table 3, we report estimated OLS coefficients of household size and compare it with Tobit estimates. As expected, OLS and Tobit estimates for share of food and share of shelter identical, since these variables do not have censored observations. But Tobit estimates in all other cases are higher and highly significant. We take it as a sign of the downward bias in OLS due to data censoring and proceed with Tobit estimates in this paper.

Table 3. Comparison of OLS and Tobit estimates of household size elasticity

	OLS		Tobit	
Share of food	-0.041***	[0.006]	-0.041***	[0.006]
Share of meals out	0.020***	[0.003]	0.060***	[0.007]
Share of clothing	0.021***	[0.003]	0.027***	[0.003]
Share of education expenditures	0.036***	[0.004]	0.081***	[0.005]
Share of health expenditures	0.005	[0.006]	0.028***	[0.008]
Share of transportation	0.007**	[0.003]	0.018***	[0.004]
Share of shelter	-0.105***	[0.004]	-0.105***	[0.004]

Note: Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

[2] See, for instance, Beatty (2006) for a good summary of the zero consumption problem

4.2. Non-parametric specification

Deaton and Paxson (1998) employ both nonparametric and parametric methods of estimation of Engel curves. We will also conduct a nonparametric regression analysis, but only with regard to the first hypothesis. While nonparametric results provide useful information, the product comes at the expense of limiting the number of factors that can explain food consumption. As in parametric exercise, the hypothesis in nonparametric part of our empirical study concerns the share of food expenditures for various household sizes at constant levels of PCE. We want to test the inequality

$$E\left(\frac{p_f q_f}{n}\middle| i, \frac{x}{n}\right) > E\left(\frac{p_f q_f}{n}\middle| j, \frac{x}{n}\right) \tag{5}$$

where i is a larger household than j. Since children usually consume less food than adults, we would like to keep number of children fixed and vary number of adults in comparing households. For example, we can compare a 3 adult and 2 children household with a 2 adult and 2 children household.

In order to fit (5) we use Fan's (1992) local regression smoother. First we choose an interval of ln(x/n) over which Engel curves are fit. The lower boundary of our interval is 11.3 and the upper boundary is 15.0. Within these boundaries most observations for households that pick for this exercise (those with no children, those with equal number of adults and children, and those with twice as many adults as children) are concentrated. Then we divide this interval by 24 to obtain a grid of equally spaced 25 points. Deaton and Paxson use a 50-point grid, but we had to lower the number of points because of insufficient number of observations for certain household types. Then for each point on this grid, we calculate a weighted regression of the food share on ln (x/n). The kernel estimate assigns each observation of household of the same type gets with the following weight

$$\varpi_{im} = \frac{1}{h}\kappa\left(\frac{z_i - g_m}{h}\right), \quad i = 1, \dots, N;\ m = 1, \dots, 25 \tag{6}$$

where z is log of PCE, g is a point on the grid and h is the bandwidth. The kernel function κ in our case is quartic, i.e. it is

$$\kappa(t) = \frac{15}{16}\left(1 - t^2\right)\mathrm{I}\left(|t| \le 1\right) \tag{7}$$

where I is the indicator function, i.e. it is 1 when an observation lies within the bandwidth and 0 otherwise.

Once we estimate the expected food shares for all values of z on our grid, we can then compute the weighted average of expected food shares. It is

$$\int E\left({p_f q_f}/{n} \,|i, z \right) f(z)dz \tag{8}$$

where f(z) is a kernel density function.

We calculate (8) for each household type i. Note that the density function in (8) is common for all household types, since it is estimated using all observations. Therefore, once the weighted average expected food shares are calculated, they can be compared with each other as PCE is being kept fixed. The average expected food shares provide a summary measure for all households of the same type, so it is useful to compare them. On the hand, very often Engel curves cross (we will see that it is true for our case too) and thus do not provide conclusive results. That is another reason for why we need the results of (8).

5. Empirical results

5.1. Parametric Engel curves

We first proceed to estimate Tobit Engel curves for all seven expenditure categories we have defined in previous sections. The reference group for the effect of demographic composition is males aged over 60. The choice of the reference group is random. Other control variables include the log of per capita expenditures, age of household head, square age of household head, urban and regional dummies (Tashkent city is the reference). Our main coefficient of interest is the log of household size.

Each column in Table 4 shows Tobit estimates of Engel curve for particular expenditure category. It should be noted that the log of household size is negative and significant for food and shelter, while it is positive and statistically significant for meals out, clothing, education, health, and transportation shares. The estimated coefficients of household size shall be interpreted as how much 100% change in household size (say, its doubling) leads to percent change in the budget share of particular expenditure item, keeping per capita expenditures and other control variables constant.

Table 4. Marginal effects of household size on expenditure categories

	Food	Meals out	Clothing	Education	Health	Transport	Shelter
Log PCE	-0.088***	0.091***	0.032***	0.027***	-0.017***	0.016***	-0.061***
	[0.005]	[0.005]	[0.002]	[0.004]	[0.006]	[0.003]	[0.003]
Log HH size	-0.041***	0.060***	0.027***	0.081***	0.028***	0.018***	-0.105***
	[0.006]	[0.007]	[0.003]	[0.005]	[0.008]	[0.004]	[0.004]
Female 0_4	-0.043	0.070*	0.050***	-0.078**	-0.016	0.028	-0.031
	[0.036]	[0.041]	[0.018]	[0.036]	[0.048]	[0.026]	[0.025]
Female 5_10	-0.069**	0.124***	0.051***	0.181***	-0.067	-0.021	-0.034
	[0.031]	[0.035]	[0.016]	[0.031]	[0.041]	[0.022]	[0.021]

Female 11_15	-0.039	0.051	0.037**	0.258***	-0.125***	0.037*	-0.033
	[0.031]	[0.036]	[0.016]	[0.031]	[0.042]	[0.022]	[0.021]
Female 16_60	-0.063**	0.050	0.056***	0.153***	-0.018	0.030*	-0.041**
	[0.025]	[0.031]	[0.013]	[0.029]	[0.034]	[0.018]	[0.017]
Female over 60	-0.016	-0.049	0.012	0.017	0.035	-0.015	-0.008
	[0.031]	[0.041]	[0.017]	[0.040]	[0.042]	[0.023]	[0.021]
Male 0_4	-0.040	0.129***	0.046***	-0.046	0.010	0.001	-0.030
	[0.034]	[0.039]	[0.018]	[0.034]	[0.046]	[0.024]	[0.023]
Male 5_10	-0.022	0.091**	0.035**	0.183***	-0.140***	0.020	-0.034
	[0.031]	[0.036]	[0.016]	[0.031]	[0.042]	[0.022]	[0.021]
Male 11_15	-0.066**	0.085**	0.039**	0.254***	-0.107***	0.001	-0.022
	[0.030]	[0.035]	[0.016]	[0.030]	[0.041]	[0.022]	[0.021]
Male 16_60	-0.072***	0.103***	0.031**	0.157***	-0.089***	0.024	-0.012
	[0.023]	[0.028]	[0.012]	[0.027]	[0.031]	[0.017]	[0.016]
HH head's gender	-0.009	-0.003	-0.009***	0.011**	0.007	0.003	0.012**
	[0.007]	[0.008]	[0.004]	[0.005]	[0.009]	[0.005]	[0.005]
Urban dummy	-0.048***	0.018**	-0.012***	0.010*	0.005	0.001	0.048***
	[0.007]	[0.007]	[0.003]	[0.005]	[0.010]	[0.005]	[0.005]
Andijan dummy	0.091***	0.068***	0.037***	0.004	-0.031***	-0.010*	-0.154***
	[0.009]	[0.009]	[0.004]	[0.007]	[0.012]	[0.006]	[0.006]
Kashkadarya dummy	0.097***	0.027***	0.035***	-0.012*	-0.004	-0.018***	-0.153***
	[0.009]	[0.009]	[0.004]	[0.007]	[0.012]	[0.006]	[0.006]
Uzbek	-0.002	0.008	-0.000	0.023**	-0.007	-0.008	-0.015*
	[0.012]	[0.013]	[0.006]	[0.010]	[0.016]	[0.008]	[0.008]
Karakalpak	-0.001	-0.017	-0.014	0.038	0.008	-0.025	-0.008
	[0.038]	[0.042]	[0.019]	[0.029]	[0.053]	[0.027]	[0.026]
Russian	-0.031**	0.018	-0.005	0.009	-0.014	-0.001	0.023**
	[0.014]	[0.016]	[0.007]	[0.012]	[0.019]	[0.010]	[0.010]
Tajik	0.011	0.023	-0.007	0.019	0.024	-0.034***	-0.001
	[0.018]	[0.019]	[0.009]	[0.014]	[0.023]	[0.013]	[0.012]
Tatar	-0.009	-0.010	-0.011	0.023	-0.000	-0.010	0.017
	[0.018]	[0.021]	[0.009]	[0.016]	[0.025]	[0.013]	[0.013]
Kazakh	-0.034	0.026	-0.025	0.004	0.067	-0.013	-0.024
	[0.040]	[0.040]	[0.021]	[0.031]	[0.053]	[0.027]	[0.027]
Constant	1.651***	-1.394***	-0.464***	-0.611***	0.278***	-0.217***	1.243***
	[0.069]	[0.080]	[0.035]	[0.058]	[0.093]	[0.049]	[0.047]
/sigma	0.127***	0.120***	0.062***	0.090***	0.160***	0.084***	0.087***
	[0.002]	[0.002]	[0.001]	[0.001]	[0.003]	[0.001]	[0.001]
LR ch2 statistics	1626.89	487.95	460.62	842.09	89.6	120.62	2755.16
Observations	2,948	2,948	2,948	2,948	2,948	2,948	2,948

Note: Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

The results in Column 1 indicate that if we double household size (100% increase), budget share of food in overall expenditures will fall by 4.1%. Likewise, share of shelter will fall by 10.5% if we double the household size. On the other hand, we can see that shares of meals out, clothing, education, health and transport are going to increase (by 6%, 2.7%, 8.1%, 2.8% and 1.8%, respectively) as the size of household increases. Thus we reject the null hypothesis of existence of economies of scale for food and shelter, while we cannot reject it for other 5 categories. Third, we see a clear impact of rural-urban and regional dummies, presumably indicating large inter- and intra-regional price and consumption differences, but our ethnicity dummies and as well as gender of household head do not yield such differences.

To look into obtained coefficients in more detail, we divided the sample into quartiles and estimated Engel curves for each group separately. Our purpose was to see whether the effect of household size on expenditure categories declines with income. Barten's model predicts that this effect is less for richer households than for poorer households. Equation 3 shows that the effect of household size on per capita food consumption and other private goods is positively related to the income elasticity and negatively related to the price elasticity of the demand for them. For richer households the income elasticity of food should be lower and the price elasticity of food should be higher in absolute terms. The former part should be unambiguous, which is due to the fact that food is less of a necessity for richer households. The latter part of the statement should also be clear if we remind that we are talking about the price of the whole food basket, not of a particular food item. The poor may consume less quantity due to increase in prices, but they most likely spend at least as much if nor more on food. On the contrary, the richer households may consider reducing food expenditures a bit because again food is not a necessity for them. The combined effect of income and price elasticities of food expenditures should drive the effect of household size on food consumption down for richer households according to Equation 3.

Deaton and Paxson (1998) could not find an evidence for this outcome in their study. When they compared the results for richer countries (US, UK) with poorer countries (Thailand, Taiwan, South Africa, Pakistan), they found the evidence opposite to the theoretical prediction, namely that food consumption per capita declines to the greater extent with household size in poorer countries. It only added to their puzzle.

In line with the previous studies, our results in Table 5 (full regressions are shown in Appendix) show that food share exhibits negative effect of household size for 3 quartiles of population and it is statistically insignificant for the poorest 25% of population. Negative effect of household size on food is the largest for the richest group, while it declines steadily for the 3rd and 2nd income quartile. The coefficient of food share is not statistically from zero for the poorest quartile, indicating that there are no economies of scale manifesting themselves clearly for this group.

Table 5. Log of HH size estimations for different quartiles of population

Dependent variable	Poorest	2nd quartile	3rd quartile	Richest
Share of food	0.013	-0.040***	-0.046***	-0.048***
	[0.019]	[0.015]	[0.014]	[0.009]
Share of meals out	0.062***	0.067***	0.054***	0.056***
	[0.024]	[0.016]	[0.015]	[0.010]
Share of clothing	0.026***	0.042***	0.030***	0.014***
	[0.007]	[0.008]	[0.007]	[0.005]
Share of education	0.032***	0.048***	0.082***	0.139***
	[0.009]	[0.009]	[0.011]	[0.012]
Share of health	0.039	0.044*	0.048***	0.008
	[0.033]	[0.022]	[0.017]	[0.011]
Share of transportation	0.021***	0.018	0.012*	0.013**
	[0.008]	[0.017]	[0.007]	[0.006]
Share of shelter	-0.084***	-0.088***	-0.099***	-0.120***
	[0.009]	[0.008]	[0.009]	[0.008]

Note: Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

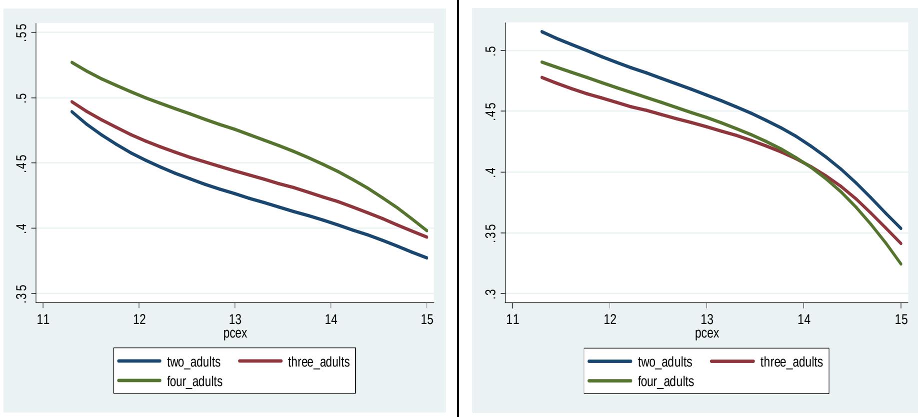
It is also worth noting that as expected the share of shelter is statistically significant and negative for all income groups. Share of health expenditures is positive and significant in the 2nd and 3rd quartile, but for the poorest and richest groups its coefficients are not statistically different from zero. As expected, we obtain positive and significant coefficients for other categories at most income groups, confirming the existence of positive economies of scale for them. We find the declining effect of household size in income level for meals out, clothing and transportation, but it tends to increase for education and health categories. Thus the hypothesis that the effect of household size on expenditure shares is lower for richer households yields mixed results.

5.2. Nonparametric Engel curves

Figure 1, Panel A displays nonparametric Engel curves for households with 1 child but with differing number of adults. The differing number of children makes conclusions less clear, since economies of scale for children differ depending on the age of children. In households with many children many private goods such as clothing and school textbooks might become more public Thus, considering households with fixed number of children and different number of adults makes the conclusions less ambiguous. The number of observations for different household types are 147 for (2, 1), 117 for (3, 1), and 177 for (4, 1). In Panel B, Engel curve for households with 2 children and 2, 3 and 4 adults is depicted. There are 224 households of (2, 2), 138 households of ((3, 2) and 145 households with (4, 2) types.

Non-parametric Engel curves in both cases are declining with in increasing PCE, confirming findings of the parametric estimates. The relationship is not monotonous, indicating there are possible nonlinearities. In Panel A, "2 adult" households lie below "3 adult" households, which in turn lie below "4 adult" households. This is in line with the implications of Barten's model, which predicts that greater household size should increase per capita food consumption.

A. households with 1 child and 2, 3 and 4 adults	B. households with 2 children and 2, 3 and 4 adults



Note: the horizontal axes stands for ln(x/n) (log of per capita expenditures, i.e. proxy for per capita income), and the vertical axes stands for the expected food share (which is supposed to move in the same direction as per capita food consumption in response to the change in household size)

Figure 1. Non-parametric Engel curves

In panel B, the picture does not exhibit the same pattern since "2 adult" Engel curve lies above both "3 adult" and "4 adult" Engel curves. This contradicts the implications of Barten's model, which predicts that greater household size should increase per capita food consumption. And to complicate matters further, "3 adult" and "4 adult" Engel curves cross each other for households with higher per capita expenditures. It should be noted, however, that many other studies including Deaton and Paxson (1998) obtained similar results. Our non-parametric estimates confirm the findings of earlier literature that there is empirical contradiction to the predictions of Barten's model regarding the effect of household size on food consumption.

6. Discussion

Our results in general cannot resolve the Deaton-Paxson puzzle, namely the relationship between food budget share and household size are negative keeping per capita income and other control variables fixed. And this negative effect of household size increases slightly with the increase in income/expenditure level. Our results in this respect reinforce similar results obtained by Deaton and Paxson

(1998), Logan (2006), Gan and Vernon (2003), our estimations of relationship between food share and household size is negative and statistically significant. We will discuss implications of this result in more detail later.

We also find that increase in household size leads to decrease in budget share of shelter. Since shelter is a clear-cut example of public good (as long as congestion is tolerable), this result is in line with the theory of public finance. And the coefficient of household size with respect to budget share of shelter becomes more negative as we move along the income ladder.

As for the remaining expenditure categories, they exhibit statistically significant and economically sizable economies of scale. The existence of positive economies of scale for these consumption categories is confirmed for almost all income quartiles.

But major remaining puzzle is the finding of negative effect of household size on food budget share. Deaton and Paxson (1998) themselves considered several explanations of why the expectations stemming from the Barten model are not supported by the empirical results, such as measurement errors, economies of scales arising from buying in bulk and others. Another explanation that may make the crucial predictions of the Barten model invalid is that there are large fixed costs for households in food consumption so that an addition of another member does not really result in the sufficiently large economies of scale. But Deaton and Paxson (1998) concede that it is very difficult to think about the large fixed costs that can have such dramatic effect on the food consumption, especially in developing countries where share of food in overall consumption is so big.

We have also considered some possible explanations for the Deaton-Paxson puzzle. We considered the possibility that larger households in rural areas manage to cut their food expenditures by being able to grow some of the food themselves for internal consumption. When asked about their consumption, those households might mainly focus on the items they buy and "forget" the items they grow themselves. We divided the sample into two groups – rural and urban households - and run our regressions to see whether there is any discernable difference between rural and urban households. We found none. Both rural and urban households have shown persistent negative effect of household size on consumption.

Out of several explanations floated in the literature, the most plausible one seems to be food's high own economies of scale. This can be seen more clearly when we compare food consumed inside the household and food taken away from home. Take for example two single adult persons. When they marry and start living together (doubling the size of household), they might realize considerable economies of scale due to bulk purchase, storage and preparation of food at home, that their combined budget share of food might decrease. Vernon (2004) notes that "If the time and effort required to prepare a meal rises less than proportionally with the number of people served the meal, then the per capita cost of a home-cooked meal will be lower for larger households. The per capita cost of restaurant meals and other types of food eaten away from home, in contrast, does not decline with family size (page 24)." Certainly, we need sufficiently large potential economies of share in food preparation for that to happen. These scale economies then will make it possible to substitute food with other private goods, such as clothing, entertainment, health. If this happens, we should see the declining budget share of food and increasing budget shares of other private goods.

Another possibility that we considered is that part of the food might be an inferior good. There is growing evidence in economics literature that some staple foodstuffs such as rice in a number of Asian economies (Ito et al, 1989), bread and wheat in Morocco (Laraki, 1990) might be either inferior goods or close to becoming ones.

We constructed bread variable as total expenditures on bread and flour. Urban households predominantly buy bread in the market, while rural households buy flour and bake breads. Some portion of flour bought by both urban and rural households is used for preparing wheat based national dishes such as noodles, manti and samsa. But the data does not allow us to distinguish flour used for those purposes. Judging from a small amount of flour purchases by urban population, we can include all flour purchases into bread category.

Table 6. Tobit estimations: Dependent variable – Bread

	Full sample	Poorest	2nd quartile	3rd quartile	Richest
Log PCE	-0.053***	-0.065**	-0.078**	-0.071***	-0.033***
	[0.003]	[0.029]	[0.037]	[0.022]	[0.003]
Log HH size	-0.009**	0.010	-0.018	-0.018**	-0.007**
	[0.004]	[0.021]	[0.012]	[0.008]	[0.003]

Table 6 shows that income elasticity of bread consumption for full sample, as well as for all four quartiles of population is consistently negative and statistically significant, indicating that bread is an inferior and income inelastic good (necessity). The inferior nature of bread in Uzbekistan means that people, especially the poorest households, might be consuming too much bread than they really would like. And when income increases, they will decrease their consumption of bread by substituting it away with other more desirable food. Likewise, other food items with significant shares such as potato and sugar might also prove inferior goods. When majority of households diets is composed from inferior goods, this might result in entire food expenditures having negative income elasticity of demand for food.

The interpretation of the fact that bread is an inferior good, is complicated by the subsidies provided through state procurement system in Uzbekistan. The Government is the sole buyer of wheat, for which it pays significantly below-market prices to farmers. The price of wheat and bread is set at the same level by the

Government: price changes are infrequent and uniform all over the country. This way the burden of subsidies are mainly born by farmers. The interesting question then is to what extent subsidies affect the degree of inferiority of bread. Since the current system de facto subsidizes consumption of bread, it might increase the degree of inferiority through making it much cheaper than other alternatives. Whether this is the case or not is a good topic for another study.

7. Conclusion

In this paper we empirically investigate the relationship between household economies of scale and consumption in Uzbekistan. Particular attention is paid to the so-called "zero consumption problem" and Tobit estimator is utilized to deal with the problem. We test presence (or lack) of household economies of scale in seven consumption categories (food, meals out, clothing, education, health, transportation and shelter). We find strong and positive economies of scale in meals out, clothing, education, health and transportation, while food and shelter exhibit strong negative economies of scale. We also estimate food Engel curve using non-parametric kernel estimates and confirm the existence of negative effect of household size on the food budget share.

Thus we confirm the existence of the food puzzle for Uzbekistan, namely, budget share of food decreases in response to an increase in household size. We investigate further several possible factors behind such puzzling results. Food's high own elasticity of scale might be one factor, while another possibility is some food items might be inferior goods. Indeed, we confirm that the main staple foodstuff - bread – is an inferior good. We speculate that significant subsidies for bread provided through the state procurement system might be contributing to the degree of inferiority of bread in particular, and of food in general.

Apart from food, we find strong household economies of scale for all of our public goods. When we re-estimate our equations for expenditure quartiles, we find that the economies of scale remain strong and positive. The implication of our results is that there might be different degree of economies of scales in different consumption items, which might imply that one needs to approach the household economies of scale differently for each categories of households. If it is so, policy interventions shall take the peculiarity of the economies of scale between different groups.

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Statistical Appendices

Table A1. Tobit quartile estimations. Dependent var. – budget share of food

VARIABLES	Poorest	2nd quintile	3rd quintile	Richest
Log PCE	0.020	-0.075	-0.229***	-0.087***
	[0.026]	[0.046]	[0.036]	[0.009]
Log HH size	0.013	-0.040***	-0.046***	-0.048***
	[0.019]	[0.015]	[0.014]	[0.009]
Female 0_4	0.018	-0.170	0.024	-0.055
	[0.122]	[0.105]	[0.079]	[0.054]
Female 5_10	-0.052	-0.194**	-0.105	0.051
	[0.114]	[0.097]	[0.069]	[0.044]
Female 11_15	0.063	-0.238**	0.079	-0.043
	[0.114]	[0.094]	[0.069]	[0.044]
Female 16_60	-0.014	-0.202**	-0.011	-0.042
	[0.120]	[0.097]	[0.065]	[0.028]
Female over 60	0.213	-0.209	0.034	-0.002
	[0.176]	[0.147]	[0.087]	[0.032]
Male 0_4	0.051	-0.159	-0.028	-0.028
	[0.123]	[0.103]	[0.076]	[0.048]
Male 5_10	0.075	-0.190**	0.018	0.009
	[0.114]	[0.095]	[0.070]	[0.046]
Male 11_15	-0.067	-0.121	0.029	-0.106**
	[0.113]	[0.093]	[0.068]	[0.043]
Male 16_60	-0.036	-0.206**	-0.102*	-0.020
	[0.107]	[0.086]	[0.055]	[0.026]
HH head's gender	-0.025	-0.002	-0.005	-0.016
	[0.020]	[0.016]	[0.015]	[0.010]
Urban dummy	-0.028	-0.038***	-0.065***	-0.027**
	[0.018]	[0.014]	[0.013]	[0.014]
Andijan dummy	0.190***	0.157***	0.054***	0.098***
	[0.046]	[0.025]	[0.016]	[0.014]
Kashkadarya dummy	0.205***	0.163***	0.067***	0.092***
	[0.047]	[0.025]	[0.016]	[0.013]
Uzbek	-0.045	0.032	-0.005	0.001
	[0.042]	[0.037]	[0.031]	[0.014]
Karakalpak	-0.194	0.110	0.002	0.001
	[0.141]	[0.097]	[0.073]	[0.052]
Russian	-0.024	-0.035	-0.057	-0.019
	[0.106]	[0.061]	[0.037]	[0.015]
Tajik	-0.017	0.017	0.030	0.010
	[0.048]	[0.045]	[0.042]	[0.027]
Tatar	-0.044	0.115	0.088	-0.018
	[0.074]	[0.082]	[0.066]	[0.019]
Constant	0.155	1.535***	3.470***	1.598***
	[0.345]	[0.579]	[0.473]	[0.132]
/sigma	0.132***	0.126***	0.129***	0.112***
	[0.004]	[0.003]	[0.003]	[0.003]
LR ch2 statistics	1626.89	46.68	124.05	203.02
Observations	2,948	586	646	717

Note: Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

Table A2. Tobit quartile estimations: Dependent variable - share of expenditures on meals out

VARIABLES	Poorest	2nd quintile	3rd quintile	Richest
Log PCE	0.126***	0.059	0.172***	0.060***
	[0.034]	[0.045]	[0.038]	[0.011]
Log HH size	0.062***	0.067***	0.054***	0.056***
	[0.024]	[0.016]	[0.015]	[0.010]
Female 0_4	-0.133	0.201*	0.058	0.110*
	[0.155]	[0.117]	[0.087]	[0.064]
Female 5_10	0.067	0.242**	0.078	0.132**
	[0.140]	[0.108]	[0.078]	[0.053]
Female 11_15	0.021	0.226**	-0.086	0.074
	[0.140]	[0.107]	[0.077]	[0.054]
Female 16_60	-0.064	0.198*	-0.025	0.073*
	[0.147]	[0.111]	[0.075]	[0.038]
Female over 60	-0.220	0.230	-0.137	-0.047
	[0.222]	[0.158]	[0.109]	[0.048]
Male 0_4	-0.058	0.415***	0.045	0.123**
	[0.155]	[0.114]	[0.086]	[0.058]
Male 5_10	-0.008	0.290***	0.031	0.053
	[0.141]	[0.108]	[0.078]	[0.057]
Male 11_15	0.054	0.246**	0.067	0.023
	[0.139]	[0.106]	[0.076]	[0.054]
Male 16_60	-0.005	0.256**	0.014	0.125***
	[0.131]	[0.100]	[0.064]	[0.036]
HH head's gender	0.021	0.007	-0.017	-0.000
	[0.024]	[0.016]	[0.017]	[0.011]
Urban dummy	0.015	-0.001	0.027**	0.013
	[0.020]	[0.013]	[0.013]	[0.016]
Andijan dummy	0.137**	0.046*	0.087***	0.039**
	[0.067]	[0.025]	[0.017]	[0.016]
Kashkadarya dummy	0.038	0.023	0.045***	0.024
	[0.068]	[0.026]	[0.017]	[0.015]
Uzbek	0.033	-0.023	0.045	0.001
	[0.053]	[0.034]	[0.037]	[0.016]
Karakalpak	-0.728	-0.047	0.001	-0.004
	[0.000]	[0.094]	[0.083]	[0.060]
Russian	-0.583	-0.108	0.057	0.015
	[0.000]	[0.076]	[0.043]	[0.018]
Tajik	0.025	0.012	0.046	0.021
	[0.060]	[0.042]	[0.046]	[0.031]
Tatar	-0.008	-0.655	0.070	-0.015
	[0.096]	[0.000]	[0.069]	[0.024]
Constant	-1.800***	-1.117*	-2.392***	-0.972***
	[0.461]	[0.569]	[0.493]	[0.157]
/sigma	0.120***	0.107***	0.121***	0.121***
	[0.008]	[0.005]	[0.005]	[0.004]
LR ch2 statistics	83.47	54.5	95.33	160.07
Observations	586	646	717	999

Note: Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

Table A3. Tobit quartile estimations: Dependent variable - share of expenditures on clothing

VARIABLES	Poorest	2nd quintile	3rd quintile	Richest
Log PCE	0.041***	0.056**	0.037*	0.022***
	[0.009]	[0.025]	[0.019]	[0.005]
Log HH size	0.026***	0.042***	0.030***	0.014***
	[0.007]	[0.008]	[0.007]	[0.005]
Female 0_4	0.024	0.111*	0.030	0.101***
	[0.044]	[0.058]	[0.043]	[0.029]
Female 5_10	0.044	0.110**	0.078**	0.049**
	[0.041]	[0.053]	[0.038]	[0.024]
Female 11_15	0.028	0.087*	0.066*	0.028
	[0.041]	[0.052]	[0.038]	[0.024]
Female 16_60	0.066	0.084	0.080**	0.056***
	[0.043]	[0.053]	[0.036]	[0.016]
Female over 60	0.065	0.122	0.045	-0.003
	[0.063]	[0.081]	[0.048]	[0.019]
Male 0_4	0.044	0.053	0.039	0.094***
	[0.044]	[0.057]	[0.042]	[0.026]
Male 5_10	0.065	0.055	0.063*	0.022
	[0.041]	[0.052]	[0.038]	[0.025]
Male 11_15	0.058	0.057	0.045	0.055**
	[0.040]	[0.051]	[0.037]	[0.024]
Male 16_60	-0.005	0.081*	0.065**	0.028*
	[0.038]	[0.048]	[0.031]	[0.015]
HH head's gender	-0.002	-0.014	-0.013	-0.010*
	[0.007]	[0.009]	[0.008]	[0.005]
Urban dummy	-0.010	-0.021***	-0.014**	-0.002
	[0.007]	[0.007]	[0.007]	[0.007]
Andijan dummy	0.030*	0.021	0.046***	0.038***
	[0.017]	[0.014]	[0.009]	[0.007]
Kashkadarya dummy	0.039**	0.018	0.035***	0.036***
	[0.017]	[0.014]	[0.008]	[0.007]
Uzbek	-0.010	-0.001	-0.009	0.001
	[0.015]	[0.020]	[0.017]	[0.008]
Karakalpak	-0.008	0.005	-0.024	-0.013
	[0.049]	[0.052]	[0.038]	[0.028]
Russian	0.026	-0.011	-0.017	-0.004
	[0.038]	[0.034]	[0.020]	[0.008]
Tajik	-0.015	-0.007	-0.011	-0.007
	[0.017]	[0.024]	[0.022]	[0.014]
Tatar	-0.072**	-0.022	-0.024	-0.005
	[0.031]	[0.046]	[0.036]	[0.010]
Constant	-0.558***	-0.803**	-0.531**	-0.327***
	[0.125]	[0.313]	[0.251]	[0.072]
/sigma	0.046***	0.067***	0.068***	0.059***
	[0.001]	[0.002]	[0.002]	[0.001]
LR ch2 statistics	54.56	61.98	140.06	229.74
Observations	586	646	717	999

Note: Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

Table A4. Tobit quartile estimations: Dependent variable - share of expenditures on education

VARIABLES	Poorest	2nd quintile	3rd quintile	Richest
Log PCE	0.006	-0.020	0.063**	0.065***
	[0.012]	[0.025]	[0.027]	[0.011]
Log HH size	0.032***	0.048***	0.082***	0.139***
	[0.009]	[0.009]	[0.011]	[0.012]
Female 0_4	0.045	-0.082	-0.151**	-0.129
	[0.063]	[0.063]	[0.070]	[0.082]
Female 5_10	0.235***	0.149***	0.058	0.230***
	[0.057]	[0.057]	[0.061]	[0.069]
Female 11_15	0.251***	0.255***	0.181***	0.292***
	[0.057]	[0.056]	[0.059]	[0.068]
Female 16_60	0.175***	0.135**	0.088	0.210***
	[0.060]	[0.058]	[0.060]	[0.060]
Female over 60	0.150*	0.102	-0.084	0.021
	[0.086]	[0.084]	[0.085]	[0.080]
Male 0_4	0.030	-0.116*	-0.148**	-0.010
	[0.062]	[0.063]	[0.068]	[0.074]
Male 5_10	0.252***	0.138**	0.063	0.230***
	[0.057]	[0.056]	[0.060]	[0.070]
Male 11_15	0.282***	0.181***	0.117**	0.387***
	[0.056]	[0.055]	[0.058]	[0.067]
Male 16_60	0.225***	0.128**	0.073	0.214***
	[0.053]	[0.052]	[0.052]	[0.057]
HH head's gender	0.001	-0.008	0.012	0.029**
	[0.009]	[0.009]	[0.012]	[0.012]
Urban dummy	0.000	-0.000	0.010	0.053***
	[0.009]	[0.008]	[0.010]	[0.016]
Andijan dummy	0.005	-0.013	0.014	0.037**
	[0.021]	[0.013]	[0.012]	[0.017]
Kashkadarya dummy	-0.007	-0.019	0.006	-0.018
	[0.022]	[0.013]	[0.012]	[0.015]
Uzbek	0.016	-0.003	0.040	0.030*
	[0.021]	[0.019]	[0.026]	[0.017]
Karakalpak	0.261***	0.031	0.083	-0.038
	[0.065]	[0.050]	[0.055]	[0.062]
Russian	0.060	-0.044	0.035	0.014
	[0.051]	[0.032]	[0.031]	[0.020]
Tajik	0.021	-0.020	0.030	0.050*
	[0.024]	[0.024]	[0.033]	[0.030]
Tatar	0.076**	0.011	-0.004	0.022
	[0.036]	[0.042]	[0.056]	[0.025]
Constant	-0.302*	0.095	-1.023***	-1.317***
	[0.165]	[0.312]	[0.351]	[0.170]
/sigma	0.060***	0.064***	0.090***	0.118***
	[0.002]	[0.002]	[0.003]	[0.004]
LR ch2 statistics	136.31	186.81	184.23	412.45
Observations	586	646	717	999

Note: Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

Table A5. Tobit quartile estimations: Dependent variable - share of expenditures on healthcare

VARIABLES	Poorest	2nd quintile	3rd quintile	Richest
Log PCE	-0.050	-0.006	0.033	-0.021*
	[0.045]	[0.067]	[0.044]	[0.011]
Log HH size	0.039	0.044*	0.048***	0.008
	[0.033]	[0.022]	[0.017]	[0.011]
Female 0_4	-0.088	-0.187	-0.101	0.004
	[0.215]	[0.154]	[0.096]	[0.065]
Female 5_10	-0.014	-0.277*	-0.095	-0.110**
	[0.199]	[0.142]	[0.084]	[0.053]
Female 11_15	-0.300	-0.276**	-0.180**	-0.042
	[0.200]	[0.139]	[0.084]	[0.054]
Female 16_60	-0.144	-0.244*	-0.064	0.023
	[0.209]	[0.143]	[0.079]	[0.033]
Female over 60	-0.087	-0.310	0.054	0.054
	[0.306]	[0.215]	[0.106]	[0.038]
Male 0_4	-0.117	-0.162	-0.035	0.056
	[0.214]	[0.151]	[0.092]	[0.057]
Male 5_10	-0.400**	-0.221	-0.177**	-0.050
	[0.200]	[0.141]	[0.086]	[0.055]
Male 11_15	-0.261	-0.319**	-0.102	-0.037
	[0.197]	[0.137]	[0.083]	[0.052]
Male 16_60	-0.260	-0.220*	-0.047	-0.072**
	[0.187]	[0.127]	[0.067]	[0.032]
HH head's gender	-0.009	0.041*	0.009	0.000
	[0.035]	[0.024]	[0.019]	[0.012]
Urban dummy	0.007	0.005	-0.002	0.014
	[0.032]	[0.020]	[0.016]	[0.016]
Andijan dummy	-0.134*	-0.040	-0.017	-0.009
	[0.078]	[0.036]	[0.020]	[0.017]
Kashkadarya dummy	-0.082	-0.010	-0.000	-0.003
	[0.079]	[0.036]	[0.019]	[0.015]
Uzbek	0.023	-0.027	0.026	-0.014
	[0.072]	[0.056]	[0.039]	[0.017]
Karakalpak	0.127	-0.101	0.082	-0.018
	[0.228]	[0.149]	[0.086]	[0.067]
Russian	-0.078	-0.031	0.037	-0.027
	[0.197]	[0.090]	[0.045]	[0.018]
Tajik	0.065	-0.002	0.077	-0.015
	[0.083]	[0.067]	[0.051]	[0.032]
Tatar	-0.004	-0.041	0.004	-0.007
	[0.130]	[0.126]	[0.078]	[0.022]
Constant	0.819	0.303	-0.416	0.323**
	[0.600]	[0.846]	[0.570]	[0.158]
/sigma	0.212***	0.172***	0.147***	0.128***
	[0.009]	[0.007]	[0.005]	[0.004]
LR ch2 statistics	37.76	27.15	27.86	40.92
Observations	586	646	717	999

Note: Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

Table A6. Tobit quartile estimations: Dependent variable - share of expenditures on transportation

VARIABLES	Poorest	2nd quintile	3rd quintile	Richest
Log PCE	0.025**	-0.073	0.030*	0.005
	[0.011]	[0.049]	[0.017]	[0.006]
Log HH size	0.021***	0.018	0.012*	0.013**
	[0.008]	[0.017]	[0.007]	[0.006]
Female 0_4	0.023	0.227*	0.029	-0.016
	[0.049]	[0.119]	[0.039]	[0.037]
Female 5_10	-0.043	0.161	-0.037	-0.002
	[0.045]	[0.109]	[0.035]	[0.030]
Female 11_15	-0.003	0.283***	0.012	0.002
	[0.046]	[0.107]	[0.034]	[0.030]
Female 16_60	0.004	0.187*	0.046	0.021
	[0.048]	[0.110]	[0.032]	[0.019]
Female over 60	-0.027	0.124	0.010	-0.025
	[0.070]	[0.162]	[0.043]	[0.023]
Male 0_4	0.061	0.136	-0.038	0.010
	[0.050]	[0.116]	[0.037]	[0.032]
Male 5_10	0.001	0.209*	0.041	-0.010
	[0.046]	[0.108]	[0.034]	[0.031]
Male 11_15	0.031	0.065	0.017	0.000
	[0.045]	[0.106]	[0.033]	[0.030]
Male 16_60	0.032	0.148	0.034	0.018
	[0.043]	[0.098]	[0.027]	[0.018]
HH head's gender	-0.006	0.008	0.002	0.006
	[0.008]	[0.017]	[0.007]	[0.007]
Urban dummy	0.006	-0.008	0.009	-0.011
	[0.007]	[0.015]	[0.006]	[0.009]
Andijan dummy	0.025	-0.031	-0.022***	-0.020**
	[0.020]	[0.026]	[0.008]	[0.010]
Kashkadarya dummy	0.011	-0.048*	-0.014*	-0.013
	[0.020]	[0.027]	[0.008]	[0.009]
Uzbek	-0.005	-0.028	-0.019	-0.004
	[0.016]	[0.038]	[0.015]	[0.009]
Karakalpak	-0.311	-0.090	-0.020	-0.035
	[0.000]	[0.111]	[0.034]	[0.037]
Russian	-0.317	-0.090	-0.025	0.006
	[0.000]	[0.069]	[0.018]	[0.010]
Tajik	-0.026	-0.102**	-0.030	-0.014
	[0.019]	[0.049]	[0.020]	[0.018]
Tatar	-0.027	-0.049	0.032	-0.004
	[0.031]	[0.088]	[0.031]	[0.013]
Constant	-0.355**	0.778	-0.382*	-0.057
	[0.141]	[0.627]	[0.227]	[0.090]
/sigma	0.049***	0.128***	0.060***	0.073***
	[0.002]	[0.004]	[0.002]	[0.002]
LR ch2 statistics	40.21	25.69	61.89	32.43
Observations	586	646	717	999

Note: Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

Table A7. Tobit quartile estimations: Dependent variable - share of expenditures on shelter

VARIABLES	Poorest	2nd quintile	3rd quintile	Richest
Log PCE	-0.073***	-0.038	-0.053**	-0.071***
	[0.013]	[0.024]	[0.023]	[0.009]
Log HH size	-0.084***	-0.088***	-0.099***	-0.120***
	[0.009]	[0.008]	[0.009]	[0.008]
Female 0_4	0.014	0.050	-0.008	-0.058
	[0.060]	[0.056]	[0.050]	[0.051]
Female 5_10	-0.014	0.028	0.019	-0.064
	[0.055]	[0.052]	[0.044]	[0.041]
Female 11_15	-0.038	0.061	-0.018	-0.053
	[0.055]	[0.051]	[0.044]	[0.042]
Female 16_60	0.012	0.059	-0.036	-0.076***
	[0.058]	[0.052]	[0.041]	[0.026]
Female over 60	-0.028	0.036	-0.038	-0.027
	[0.085]	[0.079]	[0.055]	[0.030]
Male 0_4	0.024	0.031	-0.001	-0.057
	[0.060]	[0.055]	[0.048]	[0.045]
Male 5_10	-0.020	0.045	-0.016	-0.044
	[0.055]	[0.051]	[0.044]	[0.043]
Male 11_15	0.012	0.045	-0.005	-0.039
	[0.055]	[0.050]	[0.043]	[0.041]
Male 16_60	0.036	0.045	0.041	-0.053**
	[0.052]	[0.046]	[0.035]	[0.025]
HH head's gender	0.009	-0.005	0.026***	0.013
	[0.010]	[0.009]	[0.010]	[0.009]
Urban dummy	0.032***	0.045***	0.071***	0.019
	[0.009]	[0.007]	[0.008]	[0.013]
Andijan dummy	-0.194***	-0.149***	-0.134***	-0.181***
	[0.022]	[0.013]	[0.010]	[0.013]
Kashkadarya dummy	-0.201***	-0.154***	-0.135***	-0.160***
	[0.023]	[0.013]	[0.010]	[0.012]
Uzbek	-0.012	0.008	-0.029	-0.014
	[0.020]	[0.020]	[0.020]	[0.013]
Karakalpak	-0.055	-0.031	-0.024	0.014
	[0.069]	[0.052]	[0.046]	[0.049]
Russian	0.039	0.110***	0.004	0.014
	[0.052]	[0.033]	[0.023]	[0.014]
Tajik	0.003	0.016	-0.027	0.010
	[0.024]	[0.024]	[0.027]	[0.025]
Tatar	0.068*	-0.015	-0.074*	0.019
	[0.036]	[0.044]	[0.042]	[0.018]
Constant	1.350***	0.825***	1.096***	1.447***
	[0.168]	[0.311]	[0.300]	[0.125]
/sigma	0.064***	0.067***	0.082***	0.106***
	[0.002]	[0.002]	[0.002]	[0.002]
LR ch2 statistics	224.89	378.43	701.87	876.29
Observations	586	646	717	999

Note: Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1