Economies of Scale in Household Consumption

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ABSTRACT
This research empirically analyses the influence of scale economies on household consumption and the resulting implications for birth-promoting policies. For this purpose, the relation between an increase in household size and food, clothing, household goods, healthcare, energy, transport as well as education expenditures per person was investigated. Data of 10,858 Georgian households from the Integrated Household Survey 2015 was evaluated using regressions. It was found that there are significant economies of scale in consumption of food, clothing and energy but diseconomies of scale for household goods, transport and education. For healthcare expenditures, no significant relation with household size was found.

Keywords
Economies of scale, households, children, expenditures.

INTRODUCTION

Can we afford to have another child? This is a question that many families are facing some day. However, many people nowadays answer negatively, deciding not to have another or any child at all. Due to a lack of time, financial means or other personal reasons, many households in Western Europe went through a decrease in the number of children. In Great Britain for example, the average number of children per mother has dropped to 1.56, compared to an average of 2.2 four decades ago (Bingham, 2015). The European Union exhibits a very similar average of 1.55, which might have serious consequences (Kassam, et al., 2015). In many countries, the population is shrinking, e.g. in Spain, where some regions report two deaths per new-born child. Thus, many demographic problems arise, as young people are needed to care for the elderly, secure pension systems and help sustain Western societies. Georgia, situated in Eastern Europe, faces a similar problem. To intervene in a serious decrease in population and demographic issues, Georgia's non-profit Demographic Development Fund has even proposed a project promoting marriages and hence, as they hope, births (Lomsadze, 2016). Therefore, Georgia represents a suitable target nation for an in-depth investigation of household patterns and their economic implications.

When it comes to economics, it might be relatively beneficial for families to have more children. By passing on toys, books or clothes it is possible to save money.

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Moreover, having more children justifies buying in bulk, which can lead to economies of scale (O'Connell, 2012). However, there might be additional expenses related with e.g. a bigger car. It remains to be analysed, whether a larger number of household members necessarily worsens the economic position of a household. Hence, the central question is formulated as follows:

How does increasing household size affect different types of per capita expenditures in Georgia?

The above-mentioned categories include food, clothing, household goods, healthcare, energy, transport and education expenditures per person. To analyse potential economies of scale in households, the number of persons living together is used as output and per capita spending as average cost.

Other researches have evaluated similar questions already, however none of them are very broad or recent. The focus clearly lies on food expenditures, however there are also many other important goods for households. Therefore, investigating food only gives insight into the behaviour of a fraction of total expenditures. Another focus of academic literature were childless households. This might be problematic for the validity of results as large adult-only households are rare and more of an exception.

To give an overview of the background for this research, relevant literature will be discussed first. Moreover, the household data used to empirically investigate the given topic will be described and a methodology for analysis of this data will be explained. Then, the outcomes of various regressions will be presented and interpreted in the context of economies of scale. Finally, a conclusion will be drawn and the results summarized.

THEORETICAL FRAMEWORK

The production of a specific good exhibits economies of scale if the total cost per unit produced decreases with increasing output size. In this case, the average cost (AC) is decreasing and the cost of production of additional unit, i.e. the marginal cost (MC), is lower than the AC. Average cost curves show the relationship between AC and output. Usually they are U-shaped, i.e. AC declines up to a certain production level. After this level, AC rises again due to e.g. capacity constraints or agency costs. The initial decrease of AC can be explained by quantity discounts or spreading of fixed costs over a larger amount of output. However, average cost curves can also be L-shaped. In this case, AC drops until the minimum efficient scale (MES) of production is reached. After this point, AC remains constant for different production levels (Besanko, Dranove, Shanley, & Schaefer, 2017).

Several papers have investigated the topic of household economies of scale, however most of them focus on food expenditures. One related research states that larger households should be relatively better off than similar

smaller ones because fixed costs, such as rent, will be lower per person (Deaton & Paxson, 1998). They call those items, for which expenditures remain fixed with increasing household size, public goods, and those for which expenditures increase private goods. Public goods are shared by all household members, whereas private goods cannot be shared. While Deaton and Paxson (1998) expected to find that per capita spending on private goods, such as food, would increase due to reduced fixed costs per person, empirical analysis showed the opposite. This can be explained by economies of scale, which may arise because of quantity discounts.

The interest of this study are household economies of scale in general and therefore the relation between household size and per capita expenditures. To answer the research question and draw a conclusion on the existence of scale economies in consumption of food, clothing, household goods, healthcare, energy, transport and education, the following hypothesis is formulated:

H1: Household size negatively affects per capita expenditures on different categories of goods.

The distinction between public and private goods was picked up by other researchers, such as Jacobson, Mavrikioub and Minas (2010), who studied households in Cyprus and further investigated whether food can be classified as a public good and compared it to clothing. Using different regression methods, e.g. the specific-to-general approach, they also analysed patterns of consumption for different food categories. The authors used age and education of the leading woman in the household as control variables. It was found that food is a private good that is more responsive to changes in household income than in household size. For clothing, which was found to be a private good as well, the opposite relation was observed.

In a study of Swedish households, which investigated the effects of scale economies and public goods on food consumption, it was shown that the per capita demand for food decreases as households increases (Abdulai, 2003). Similar to Deaton and Paxson (1998), Abdulai expected an increasing demand for food in larger households if the money gained by reducing per capita costs of public goods would not be substituted towards these goods. For instance, when more people live together and share the rent, they might decide to move into a larger, more expensive accommodation. Hence, there are two factors that could cause the negative relation between household size and per capita expenditures on food, namely substitution towards the relatively cheaper public goods or economies of scale. Abdulai (2003) made use of different regression methods.

An alternative method to analyse economies of scale in household consumption might be to find the precise shape of the average cost curves that households face, using per capita expenditures in total as well as for public and private goods as average costs and the number of household members as output. Hence, the second hypothesis is:

H2: The average cost curve of households is monotonically decreasing with household size.

Another research aimed to find scale parameters for the consumption of food, shelter, housing furnishings and operations, clothing and transportation in American adult-only households (Nelson, 1988). Nelson focused on two-person households and found significant economies of scale in consumption of all five goods. Shelter was affected the most, as rent per capita decreases substantially with each additional household member.

Finally, the impact of scale economies in terms of the number of children should be investigated to extend previous research on adult-only households. For this purpose, a third hypothesis is stated:

H3: Households with many children are relatively better off in terms of per capita expenditures on different types of goods than those with fewer children.

DATA

The data used comes from the Integrated Household Survey in 2015 conducted by the National Statistics Office of Georgia, which includes information on 10,999 households. This information was collected in personal interviews with Georgia's residents excluding armed forces, foreigners, people living in institutions and in the regions of Abkhazia and former South Ossetia. Those areas are excluded because of Georgian-Abkhaz and Georgian-Ossetian ethno-political conflict. The outcome contains numerical and categorical data about family structure, monthly income and expenditures. The data can be considered reliable as it stems from a legal entity of public law that conducted this survey numerous times.

Logarithms of income and total per capita expenditures (PCE) are taken as suggested by previous literature (Abdulai, 2003). This transformation helps to reduce the influence of outliers, which is especially useful here as there is much variation in the data. However, there were 62 households that reported zero income and hence those must be excluded to make a logarithmic transformation feasible. Moreover, cases with missing data are omitted, reducing the final sample size to 10,858 households.

Furthermore, expenditures are split into spending on private and public goods. According to the definition proposed by Deaton and Paxson (1998), food and healthcare are private, while the other five goods are public. A dummy variable for families with more than one child, which is the average number of children, is created for investigating the third hypothesis.

METHODOLOGY

To evaluate the existence and influence of economies of scale, Ordinary Least Squares (OLS) is used to estimate the coefficients of household size in linear models. Moreover, the specific-to-general approach is considered to determine which control variables are significant in a regression of expenditures on household size (measured by the number of household members). This method was suggested to bring accurate results in a similar research (Jacobson, Mavrikioub, & Minas, 2010). Potential control variables include the logarithm of total per capita expenditures and total income, location of the household (i.e. urban or rural), the percentage of children and the percentage of females as well as the age and education of the household head. These variables are chosen because they affect expenditures as was argued by previous studies (Abdulai, 2003; Jacobson, Mavrikioub, & Minas, 2010).

Several models are constructed in this way, to investigate scale economies in consumption of the seven categories of

goods. Hence, the dependent variables used are per capita expenditures on these categories. The independent variable is household size. For OLS it is assumed that the data is generated by a linear data generating process (DGP):

$$PCE_i = \alpha + \beta_1 * HouseholdSize_i + \beta_2 * x_{2i} + \cdots + \beta_m * x_{mi} + \varepsilon_i$$

The shape of the average cost curve is investigated using Non-linear Least Squares (NLS) and forward selection with the abovementioned control variables. To evaluate the model fit of an L-shaped average cost curve, the DGP below is used:

$$PCE_i = \alpha + \beta_1 * HouseholdSi\ _i^{-1} + \beta_2 * x_{2i} + \cdots + \beta_m * x_{mi} + \varepsilon_i$$

If this model is found to be a good representation of total PCE, it is implied that average costs never increase and the second hypothesis is confirmed. However, it might be the case that average costs increase within a certain range. For analysis of a possible U-shaped average cost curve, the following model is investigated:

$$PCE_i = \alpha + \beta_1 * HouseholdSiz\ _i^2 + \beta_2 * HouseholdSiz\ _i + \cdots + \beta_m * x_{mi} + \varepsilon_i$$

Lastly, to draw a conclusion regarding the third hypothesis, an independent-samples t-test for the difference in mean PCE on the seven categories of goods is conducted. This enables to check whether families with more than one child spend significantly less per person than households with only one or no child.

RESULTS

First hypothesis

Table 1: Linear regression results using per capita expenditures of the given categories as dependent variables and household size as independent variable (N=10,858).

	Food	Clothes	HG	Health	Energy	Transp.	Educ.
Constant	-146.38 ***	-32.07 ***	-55.44 ***	-164.67 ***	-56.24 ***	-136.99 ***	-22.19 ***
	(4,28)	(1.19)	(2.89)	(7.05)	(3.17)	(7.15)	(1.86)
Household size	-1.50 ***	-0.49 ***	0.42 **	-0.25	-1.02 ***	1.57 ***	1.21 ***
	(0.38)	(0.09	(0.21)	(0.50)	(0.23)	(0.57)	(0.15)
Log total PCE	60.60 ***	5.15 ***	11.98 ***	32.24 ***	18.58 ***	29.70 ***	4.38 ***
	(0.78)	(0.19)	(0.48)	(1.17)	(0.53)	(1.16)	(0.30)
Log income	-11.41 ***	3.37 ***	1.31 ***	2.77 **	-1.25 **	5.82 ***	0.93 ***
	(0.77)	(0.19)	(0.47)	(1.14)	(0.51	(1.14)	(0.30)
Urban location	-5.23 ***	0.89 ***	-3.07 ***	-6.71 ***	3.81 ***	-3.00 **	3.03 ***
	(1.02)	(0.25)	(0.61)	(1.53)	(0.67)	(1.48)	(0.40)
% Female	-10.10 ***	-1.09 **	3.74 ***	6.85 **	7.01 ***	-17.26 ***	1.63 **
	(1.93)	(0.49)	(1.19)	(2.88)	(1.31)	(2.93)	(0.76)
% Children	-13.47 ***	6.11 ***				-11.40 **	-6.09 ***
	(3.19)	(0.83)				(5.00)	(1.29)
Age household head		-0.11 ***	-0.09 ***	0.46 ***	-0.09 ***	-0.38 ***	-0.14 ***
		(0.01)	(0.02)	(0.05)	(0.02)	(0.05)	(0.01)
Education household head	1.47 ***			-2.32 ***			0.18 **
	(0.23)			(0.34)			(0.09)
R^2	0.491	0.223	0.094	0.117	0.201	0.117	0.075

** = p-value < 0.10; ** = p-value < 0.05; *** = p-value < 0.01*
HG = household goods; standard errors in brackets; income and expenditures given as monthly averages over the year 2015

To assess the first hypothesis, stating that household size negatively affects per capita expenditures, the results in Table 1 are considered. They show that there are significant negative effects of household size for food, clothing and energy, which are significant at the 1% level. Therefore, for these categories the first hypothesis is supported. Due to the forward selection method, all control variables are highly significant as well. Large households usually include children, which can be seen from the relatively high correlation between household size and the percentage of children (ρ=0.59).

If household size increases by one person, monthly per capita expenditures on food, clothing and energy decrease by approximately -1.50, -0.49 and -1.02 GEL, keeping all other characteristics fixed. Hence, there exist significant economies of scale in consumption of food, clothing and energy. Food is affected the most, while clothing is least sensitive to household size. Economies of scale for food were already researched and can be explained by quantity discounts. Similarly, scale economies for clothing were already discussed and might result from the fact that clothes are not a private good. Energy, however, was not focus of previous literature. It can be concluded that energy is a public good, as it exhibits economies of scale.

In contrast, the categories household goods, transport and education exhibit significant positive coefficients, with household goods being least significant. The only category for which no significant relation was found is healthcare with a p-value of 0.62. Hence, the first hypothesis is rejected for those goods.

According to the coefficients, one more person increases PCE on household goods, transport and education by 0.42, 1.57 and 1.21 GEL respectively, all other things being equal. This might be a result of people spending the money saved by achieving lower PCE in the first three categories on household goods, transport and education. Hence, the income effect outweighs the substitution effect here. Another reason for diseconomies of scale could be that consumption of those categories can only be shared up to a certain extent. At some point, a new car or a new kitchen table must be purchased.

Second hypothesis

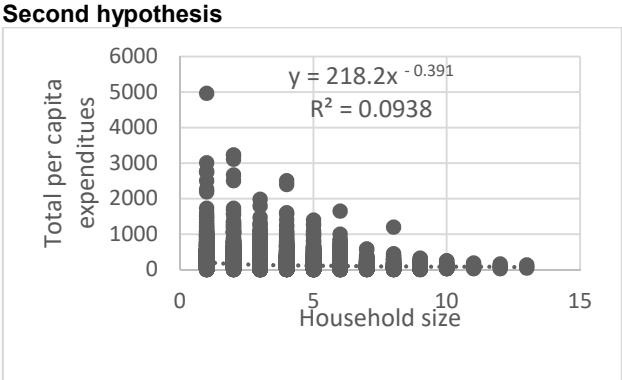

Figure 1: Scatterplot of total monthly per capita expenditures.

Figure 1 illustrates the relation between the AC as represented by PCE and the number of household members, which seems to resemble a hyperbola. Therefore, the AC curve is expected to be L-shaped. To analyse the second hypothesis, the shapes of the AC curves for total PCE as well as for private and public goods were estimated. For all three groups of expenditures, the curve seems to have an L-shape. This means that the AC is falling until the MES after which the cost remains

constant. Consequently, increasing household size would always be relatively beneficial. The results for private and public goods are very similar. In all cases the model fit of the L-shape is only slightly better than that of the U-shape. Hence, no clear conclusion can be drawn for the second hypothesis.

Third hypothesis

The third hypothesis, which states that households with many children are relatively better off, was tested using an independent-samples t-test for a difference in mean PCE for families with up to and above one child. The results show that for all categories of goods there is a significant difference in PCE. Mean PCE on all goods except clothing are significantly lower for households with more than one child. Mean total expenditures are even 69.45 GEL lower per person. The next largest mean difference is for food, with 31.39 GEL. The least significant difference between means occurs for transport. The mean spending on clothes is about 1.02 GEL higher for families with more children. This could be a result of a larger turnover of clothes for children. In general, households with more children have lower PCE than those with fewer children, which is also supported by the fact that an L-shape is more explanatory than a U-shape. Therefore, the third hypothesis is confirmed by empirical evidence.

DISCUSSION AND CONCLUSION

In summary, the first hypothesis stating that household size negatively affects per capita expenditures was supported for food, clothing and energy, which means that those PCE are affected by economies of scale. Scale economies for the other categories of expenditures were, however, rejected. Because of the insignificant differences in model fit, the second hypothesis could not clearly be supported or rejected. This uncertainty might be caused by limitations in the data, which only contained households with up to 13 people. When it comes to the third hypothesis, stating that households with many children are relatively better off, it was found that PCE on all goods except clothes are lower for families with more children. This might be due to the existence of economies of scale. Therefore, the third hypothesis was confirmed by empirical evidence.

Consequently, the research question was answered. Increasing household size negatively affects spending on food, clothing and energy and hence both public and private goods. However, an additional person increases the PCE on household goods, transport and education. As a result, a new approach for a pro-natalist policy can be suggested. Governments can encourage people to have more children by subsidizing children and explaining that the monthly costs per person will not raise significantly. If this strategy proves successful it can be implemented in other countries, thus, helping to solve the problem of an ageing European society.

Unfortunately, this research also has some limitations. The data was obtained only from certain areas of Georgia and therefore the sample is not perfectly representative. Moreover, the number of big households is very small. Another factor that might have influenced the data is the fact that children were treated in the same way as adults.

In further research, it might prove helpful to use equivalent units and weight children with a certain percentage. However, an appropriate percentage is difficult to determine, which is why this is beyond the scope of this research. Moreover, it would be interesting to research household economies of scale in different countries to compare developed and undeveloped countries. There is plenty of room for similar research and it should be conducted sooner rather than later as it might have a very significant effect on policies and the demographic problems that Europe is currently facing.

ROLE OF THE STUDENT

Lisa-Marie Plag wrote this report together with Ewelina Dera. Both students were undergraduate students when the research was performed and were supervised by Jelmer Quist. Lisa-Marie Plag proposed the topic and data set, carried out the regression analysis and wrote the introduction, methodology and results parts. The theoretical framework, data and conclusion parts were written by Ewelina Dera. The supervisor gave constructive feedback and suggestions during the writing process.

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