Price and Income Elasticities of Food Demand in Kyrgyzstan

Assist.Prof. Dr. Nurbek Madmarov American University of Central Asia

Assist.Prof. Dr. Junus Ganiev Kyrgyz–Turkish Manas University

Assist.Prof. Dr. Damira Baigonushova Kyrgyz-Turkish Manas University

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Food demand and elasticity of demand

- Main purpose of this research is to determine the income and price elasticities of demand for food products in 2016 in Kyrgyzstan. It is aimed to calculate other elasticities as well.
- Estimating income and price elasticities of demand for food products is crucial in many aspects:
 - As for an agrarian country like Kyrgyzstan, for the peasants, farmers and the private sector, estimating food elasticities guide what food products and by how much to produce.
 - Since share of food products in a household's expenditures is quite high, information about income elasticities of demand can be used as policy guideline for redistributing income and reducing poverty.
 - Hence, the estimated elasticities will help the government to come over issues like food security, income redistribution and inflation control.
 - Finally, they enable to prevent supply shortages, strengthen food security and decrease import dependency in a country.

Food demand and price elasticity of demand

- Due to the existence of such issues, there are many empirical studies examining the food demand factors in several world countries. However, there have been no research that analyze this topic for the case of Kyrgyz households and consumers.
- So, we have decided to do some research on this topic by focusing on the Kyrgyz HH and consumers.

Household consumer expenditure (soms per month)

	1990	in %	2000	in %	2010	in %	2020	in %	2021	in %
Total	4.52	100.0	406.57	100.0	2111.93	100.0	3350.91	100.0	4012.04	100.0
Food products	1.72	38.0	220.76	54.3	1105.70	52.4	1716.72	51.2	1961.86	48.9
Alcoholic drinks	0.18	3.9	5.72	1.4	8.78	0.4	2.21	0.1	2.03	0.1
Non-food products	1.60	35.3	104.39	25.7	574.17	27.2	846.76	25.3	1126.44	28.1
Services	1.03	22.8	75.69	18.6	423.28	20.0	787.43	23.5	923.74	23.0
Housing and communal services	0.10	2.3	20.07	4.9	119.46	5.7	253.45	7.6	271.65	6.8
Healthcare	0.04	0.8	4.02	1.0	36.83	1.7	107.26	3.2	104.68	2.6
Preschool education	0.10	2.3	1.20	0.3	11.55	0.5	7.86	0.2	13.83	0.3
Education	0.00	0.0	8.07	2.0	56.18	2.7	37.06	1.1	57.53	1.4
Services of cultural institutions	0.03	0.6	0.40	0.1	1.51	0.1	0.47	0.0	1.16	0.0
Public transport services	0.13	2.9	18.98	4.7	85.61	4.1	124.26	3.7	164.83	4.1
Communication services	0.02	0.4	3.19	0.8	61.57	2.9	143.27	4.3	161.07	4.0
Other services	0.61	13.5	19.77	4.9	50.56	2.4	113.79	3.4	148.99	3.7
Average per capita income of households (soms per month)	<mark>0.52*</mark>		495.5		2494.4		5625.4		6647.8	
Average real per capita income of households (soms per month)	6176.28		2566.11		5731.05		6523.7		6647.8	

Source: National Statistical Committee of the Kyrgyz Republic, <u>http://stat.kg/en/statistics/uroven-zhizni-naseleniya/</u>

Purchasing capacity of income by main food items (per month, kilograms)

ltems	1990	2000	2010	2020	2021
Beef	23.0	8.8	13.9	15.7	14.7
Milk (liter)	386.0	77.2	122.6	184.9	194.0
Eggs (piece)	1042.0	200.6	437.9	713.0	665.4
Frozen fish	116.0	15.4	22.8	25.7	26.9
Granulated sugar	120.0	26.3	49.1	121.3	105.3
Vegetable oil	72.0	15.7	34.5	59.2	44.2
Animal oils	29.0	5.0	12.4	16.6	18.3
Potatoes	232.0	133.2	195.7	241.4	210.4
Wheat bread	274.0	42.5	86.6	119.2	130.1

Source: National Statistical Committee of the Kyrgyz Republic, http://stat.kg/en/statistics/uroven-zhizni-naseleniya/

Per capita consumption of food items (kg per month)

ltems	1990	2000	2010	2020	2021
Bread and products	10.7	10.3	10.6	10.2	10.0
Potatoes	5.1	4.5	4.0	3.5	3.5
Vegetables and melons	7.2	5.5	7.0	6.8	6.8
Fruits and berries	2.8	2.1	2.1	2.5	2.5
Meat and products	3.5	1.1	1.7	1.8	1.8
Milk and products	20.1	7.3	7.5	7.0	7.1
Vegetable oil and fats	0.8	0.7	1.0	0.9	0.9
Sugar, confectionery products					
(Sugar and confectionery in					
recalculation on sugar)	1.6	1.0	1.3	1.1	1.0
Eggs (pieces)	13.2	4.3	5.2	7.1	7.1
Fish and products	0.4	0.1	0.1	0.1	0.1
Alcohol consumed (liters)	0.3	0.1	0.1	0.1	0.1

Source: National Statistical Committee of the Kyrgyz Republic, http://stat.kg/en/statistics/uroven-zhizni-naseleniya/

Number of households with incomes below subsistence level (percentage)

	1996	2000	2010	2020	2021
Total	43.5	62.6	33.7	25.3	33.3
Urban area	30.3	53.3	23.6	18.3	33.3
Rural area	49.6	67.6	39.5	29.3	33.3
Genaral information about households:					
Number of surveyed HH	1950	2789	4979	4993	5016
Number of actual persons in HH	8930	12395	18846.0	19033	19241
Average HH size	4.6	4.4	3.8	3.8	3.8

Source: National Statistical Committee of the Kyrgyz Republic, http://www.stat.kg/en/statistics/download/dynamic/538/

Literature review

Author	Year	Method	Results
Ruth Pomboza and Msafiri Mbaga 2007	Food Expenditure Survey (EOODEX) data	Almost Ideal Demand System (AIDS) model	Expenditure elasticities are positive and less than 1 apart from fruit and vegetables. The adjusted expenditure elasticities of other meat, dairy, cereal, fruit, vegetables, non-alcoholic beverages and other foods
Country – Canada	was used.		are highly responsive to increases in total food expenditures.

Author	Count ry	Year	Subject of analyze	Method	Results
Coelho et al. (2010)	Brazil	Data from Brazilian Household Budget Survey carried out in 2002 and 2003 (POF 2002/2003) was used	Estimated price and income elasticities for 18 food products	Two stage Shonkwiler and Yen approach	While the purchasing probabilities of staple foods are negatively correlated, meat, the purchasing probabilities of milk and other products are positively correlated with monthly family income. Regional, educational and urban variables are significant in the first stage estimations. The households with women heads have smaller purchasing probabilities for most of other commodities.

Author	Year	Method	Results		
Kumar etc. (2011)	The household data collected under major rounds of	Quadratic Almost Ideal Demand System (QUAIDS) and	The estimated income elasticities vary across income classes and are found to be lowest for the cereals group and highest for the horticultural and livestock products. Even though the demand for staple foods (rice, wheat and sugar) may not be affected adversely, high-value		
India	Survey (NSS) covered the	Food Characteristics Demand System	Characteristics Demand System	Characteristics Demand System	food commodities are likely to be affected negatively by the increasing food price inflation.
Subject of analysis - food demand elasticity	years 1983, 1987- 88, 1993- 94, 1999-2000, and 2004-05.	(FCDS) models			

Author	Year	Method	Results
Sacli and Ozer (2017) Country – Turkey Subject of analysis – factors affecting red and chicken meat consumption	Survey data was obtained through 1-on- 1 consumer interviews in 12 provincial centers representing each region in Nomenclature of Territorial Units for Statistics (NUTS) Level 1 areas in Turkey	Almost Ideal Demand System (AIDS) model	The gender, education level, income and birthplace of consumers are found to be significant in determining veal and beef demands. Chicken meat has the highest expenditure elasticity (0.9394), followed by veal and beef (0.8691), eggs (0.8528) and mutton (0.7415) elasticities. While examining the cross-price elasticities for veal and beef, the goat meat is estimated to have a negative coefficient (complementary goods) and other product groups are found to have a positive coefficient (substitute goods).

Author	Year	Method	Results
Cialani and Mortazavi (2018) Country – 29 European countries Subject of analysis – household and industrial electricity demand	Aggregate panel data for the EU-29 countries from 1995 to 2015	GMM (generalized method of moments) model	Although the price elasticities are very small especially in the short run, the income elasticities are relatively higher especially in the long run.

Author	Year	Method	Results
Jidong Huang et al. (2018) Country – USA Subject of analysis – own- and cross-price elasticities of tobacco and nicotine	Market-level quarterly data for sales and prices of 15 different tobacco products and NRPs during 2007- 2014	Fixed effects models with controls	Except for cigars, the demand for combustible tobacco products is generally elastic, with the estimated own-price elasticity greater than unity (10% increase in prices reduces sales more than 10%). The demand for tobacco products and NRPs are sensitive to changes in their own prices. Substitutions or positive cross-price impacts among cigarettes and certain other products exist.

Author	Year	Method	Results
Xiangling Liu (2019) Country – Australia Subject of analysis – the income elasticity of housing demand	Data for 144 local government areas (LGA) over 25 years from 1991 to 2015 in the state of New South Wales, Australia	Panel data models were estimated for housing prices using the common correlated effects (CCE) estimators	The income elasticity of house prices for the state is estimated to be 1.07 in the multi-factor panel data models and the cointegration analysis. The income elasticities across locations demonstrate a spatial pattern, that is especially higher in Sydney and the locations around Sydney and diminishing as approching to the regional and rural areas. The Granger Causality of the cointegration relationship was studied sequentially and the results showed that there is a unidirectional causality from the income to the housing prices.

The impact of remittances on the household expenditure structure in the Kyrgyz Republic

- According to the results of Akilay et al. (2015), the laborers' remittances do not change the consumption pattern of the household significantly.
- I. SUR results showed that a rise in remittances leads to a rise in expenditures on durable goods, investment in human capital, construction, and weddings.
- According to the results of the PSM, families receiving remittances spend less on food and utilities than do others, and the significant part of the income is spent on construction and durable goods.

*seemingly unrelated regressions (SUR) *propensity score matching (PSM)

RESEARCH METHODOLOGY

- We use the 2016 Life in Kyrgyzstan dataset in this study.
- Using the household data enables estimation of demand equations that capture heterogeneity among consumers. Also, in the consumer demand models, detailed demographic indicators allow exogenous preferences treatment (Yen et al., 2002).
- On the other hand, there are zero expenditures or consumptions of different food products, which in turn leads OLS estimators to be biased and inconsistent (Greene, 2003).

RESEARCH METHODOLOGY

In estimating individual demands, maximum likelihood estimation of Tobit, or Probit + Truncated, regression models can be used:

First Step: for each i = 1, 2, ..., M food products and n = 1, 2, ..., N households

$$\begin{cases} d_{in}^* = Z_{in}^T \delta_i + \varepsilon_{in} & \text{if } d_{in}^* > 0 \\ d_{in} = 0 & \text{if } d_{in}^* \le 0 \end{cases}$$
(1)

 d_{in}^{*} is an unobserved variable that shows the utility difference of when a consumer purchases or does not purchase the ith good, d_{in} is a binary variable showing whether a consumer buys (=1) or does not buy (=0) the ith good, Z_{in} is a set of exogenous variables like ln of income in soms, 9 region variables, urban (=1 if a HH head lives in a city), ethnicity (=1 if the nationality of a HH head is Kyrgyz), gender (=1 if a HH head is male), refrigerator (=1 if a HH owns a refrigerator), and own production consumption (=1 if a HH consumes from its own production). Lastly, δ_i is a coefficient vector of exogenous variables. If the equation (1) is estimated by using the probit model, then the resulting preference dummy variable will be within (0, 1) (Wooldridge, 2016).

RESEARCH METHODOLOGY

Second Step: for each *i* = 1, 2, ..., *M* food products and *n* = 1, 2, ..., *N* households

$$\begin{cases} y_{in}^* = f(X_{in}, \phi_i) + u_{in} \\ y_{in} = y_{in}^* + \theta_i \varphi \left(Z_{in}^T \delta_i \right) + v_{in} \end{cases}$$
(2)

 y_{in} is an observed dependent variable, log of expenditure spent to the food product *i* by the HH *n*, $f(X_{in}, \phi_i)$ is a functional form of the demand function, ϕ_i is a vector of coefficients showing the elasticities of demand, ε_{in} , u_{in} , and v_{in} are error terms. Here X consists of log on income, square log of income, number of adults in a HH, marital status (=1 if married), age21_59 (=1 if a HH member is between 21 and 59), agemt60 (=1 if a HH member is older than 60), 9 region variables, urban (=1 if a HH head lives in a city), gender (=1 if a HH head is male), refrigerator (=1 if a HH owns a refrigerator), and own production consumption (=1 if a HH consumes from its own production). Lastly, $\varphi(Z_{in}^T \delta_i)$ is the normally distributed pdf obtained from the first step. We will be estimating the second step models by the truncated regression as the 0 consumption values will be eliminated here (Wooldridge, 2016).

Descriptive Statistics: Model Variables

Variables	Obs.	Percentage (%)
Household characteristics:	N=2228	
HH head gender (male=1)	1650	74.06
HH head ethnicity (Kyrgyz=1)	1545	69.34
Household size (mean)	3.6	
Number of children (0-14 year) and	0 and 418	0 and 18 76%
dependents (>65 year) (mean)		0 and 18.70%
Number of male adults in the household	3.77	74.06%
(mean)		74.00%
Income per capita (annual, mean)	32,010.16	
Residence (1=urban)	657	29.5%
Consumption from own production (=1 if	394 (out of 2519)	15.67%
he/she consumes)		15.07%
Households with a refrigerator (=1 if it owns)	1979 (out of 2227)	88.86%
Households with an air-conditioner (=1 if it	75 (out of 2227)	2 2 7%
owns)*		5.57%
Members who are illiterate, with a primary	10, 44, and 10	15.63%, 68.75%, and 15.63%
educ., a secondary educ., and higher educ.**		respectively
Married (=1 if married)	1591	71.41%

Source: Authors' own calculations by using Stata; * and ** are removed from the regression models, should have been taken from LiK 2013 dataset!?

Descriptive Statistics: Expenditure (Top 20 Consumed Products)

Average Expenditure on Products		Obs.	KGS	Percentage (%)
1	Beef	2252	1121.61	8.26%
2	Flour	2350	990.72	7.30%
3	Cigarettes	616	642.06	4.73%
4	Lamb	1247	636.65	4.69%
5	Bread	2101	470.36	3.47%
6	Pork	246	429.33	3.16%
7	Sausages	1256	408.63	3.01%
8	Horse meat	259	403.53	2.97%
9	Butter	1523	398.73	2.94%
10	Cooking oil	2382	380.99	2.81%
11	Rice	2428	374.36	2.76%
12	Sweets	1758	355.28	2.62%
13	Fish	1155	323.63	2.38%
14	Chicken	1471	320.56	2.36%
15	Cookies	2002	300.51	2.21%
16	Margarine	773	297.52	2.19%
17	Beer	221	281.15	2.07%
18	Vodka	426	271.91	2.00%
19	Noodle products	2389	253.62	1.87%
20	Cheese	1091	250.5	1.85%
	Total	75962	8911.65	65.66%

Source: Authors' own calculations by using Stata

Income Elasticities of Demand

	PRODUCT	Number of Observations (% of total obs's)	Coefficient
1	Pork	129 (5.1%)	-5.374***
2	Sausages	944 (37.34%)	-1.211***
3	Coffee	583 (23.06%)	-1.164***
4	Pepper	1015 (40.15%)	-1.066***
5	Bananas	984 (38.92%)	-0.887***
6	Margarine	548 (21.68%)	-0.794*
7	Chicken	813 (32.16%)	-0.791*
8	Sugar	1937 (76.62%)	-0.661***
9	Sweets	1440 (56.96%)	-0.553***
10	Cigarettes	523 (20.69%)	-0.509*
11	Smetana	798 (31.57%)	-0.502*
12	Теа	2006 (79.35%)	-0.392***
13	Noodle	1944 (76.9%)	-0.369***
14	Cookies	1704 (67.41%)	-0.353**
15	Beef	1837 (72.67%)	0.385**
16	Potato	1320 (52.22%)	0.411**
17	Eggs	1385 (54.79%)	0.418**
18	Butter	849 (33.58%)	1.014***
19	Beer	181 (7.16%)	3.531***

Source: Authors' own calculations by using Stata; Only significants are given; *p<0.10, **p<0.05, ***p<0.01

Price Elasticities of Demand

	PRODUCT	Number of Observations (% of total obs's)	Coefficient
1	Tomato	1196 (47.31%)	-0.0793**
2	Cucumber	1387 (54.87%)	-0.0814**
3	Bananas	984 (38.92%)	-0.153***
4	Aubergine	821 (32.48%)	-0.162**
5	Eggs	1385 (54.79%)	-0.262**
6	Cooking Oil	1957 (77.41%)	-0.453***

Source: Authors' own calculations by using Stata; *p<0.10, **p<0.05, ***p<0.01

Price Elasticities of Demand (Giffen/Veblen Goods)

	PRODUCT	Number of Observations (% of total obs's)	Coefficient
1	Теа	2006 (79.35%)	0.161***
2	Smetana	798 (31.57%)	0.193**
3	Cabbage	1454 (57.52%)	0.221***
4	Sausages	944 (37.34%)	0.255**
5	Fresh milk	1198 (47.39%)	0.283***
6	Margarine	548 (21.68%)	0.31**
7	Kefir	618 (24.45%)	0.312***
8	Cookies	1704 (67.41%)	0.341***
9	Sweets	1440 (56.96%)	0.409***
10	Airan	825 (32.63%)	0.425***
11	Chicken	813 (32.16%)	0.557***
12	Carrot	1712 (67.72%)	0.567***
13	Beef	1837 (72.67%)	0.683***
14	Potato	1320 (52.22%)	0.684***
15	Sugar	1937 (76.62%)	0.846***
16	Horse meat	199 (7.87%)	0.981**

Source: Authors' own calculations by using Stata; *p<0.10, **p<0.05, ***p<0.01

Other Elasticities of Demand (Mean Effects)

	Variable	Coefficient (mean)	#Food Products
1	Yssyk–Kul	-0.292**	18
2	Naryn	-0.292**	19
3	Talas	-0.272**	20
4	urban	0.024**	19
5	Batken	0.073**	20
6	adult	0.078***	33
7	Osh region	0.140**	18
8	refrigerator	0.238**	14
9	Chui	0.275**	23
10	Jalal-Abad	0.498**	26
11	Consumption from own production	0.623**	14
12	Bishkek	0.688**	18
nt	age21_59	-1.120**	4
ot ica	agemt60	-0.043*	2
N if	married	0.007**	3
sig	male	0.130**	5

Source: Authors' own calculations by using Stata; #Food Products: number of food products that are significantly affected by the respective variables; p<0.10, p<0.05, p<0.01

- Most (23) of the food products are income-independent; that is, only 19 out of 42 products have significant income elasticities of demand. These goods like bread, flour, rice etc. are maybe often used goods such that they are independent of household income.
- > Out of these 19 goods, majority of them are inferior:
 - Pork, sausages, coffee, pepper, bananas, margarine, chicken, sugar, sweets, cigarettes, smetana, tea, noodle products, and cookies.
 - Perhaps these products have more expensive alternatives so that the consumers shift to these new goods when they have higher income. Nonetheless, the coefficients of pork and beer should be interpreted carefully due to the low demand for these products.
- While cookies, noodles, and tea have the lowest (in absolute value) income elasticities, pork, sausages, coffee, and pepper have the highest income elasticities. If the total income increases by 1%, ceteris paribus (hereafter c.p.), the consumers tend to consume cookies, noodles, and tea less by 0.353%, 0.369%, and 0.392%. on the other hand, if the total income increases by 1%, c.p., the consumers tend to consume pork, sausages, and coffee less by 5.374%, 1.211%, and 1.164%. According to their degrees of inferiority, bananas, margarine, chicken, sugar, sweets, cigarettes, and smetana are found to be inferior as well.

- But except pork, sausages, coffee, and pepper, other goods have elasticities less than the unity. We can say with certainty that these goods are inferior in Kyrgyzstan. This could be explained with the arguments that households with higher income tend to buy
 - more beef rather than pork and sausages,
 - more beer rather than maybe coffee,
 - more potato rather than pepper.

- There are only two luxury goods such as beer and butter; that is, when the income increases by 1%, c.p., the consumption for beer and butter increases by 3.531% and 1.014%.
- Among above two goods, eggs, potato, and beef found to be normal goods; that is, consumers consume these products more with higher level of income.

- Only 6 out of 42 food products have expected negative price elasticities of demand. These can be interpreted as the following:
 - All are significant either at 5% or 1% significant levels.

- When the price of tomato and cucumber increases by 1%, c.p., the households consume them less by 0.0793% and 0.0814%.
- When the price of banana and aubergine increases by 1%, c.p., the households consume them less by 0.153% and 0.162%.
- When the price of eggs and cooking oil increases by 1%, c.p., the households consume them less by 0.262% and 0.453%.
- Only 16 out of 42 food products are Giffen/Veblen goods; that is, their income effects surpass their substitution effects so that these products have positive rather than negative price elasticities of demand. According o their degrees, these products are horse meat, sugar, potato, beef, carrot, chicken, airan (yoghurt), sweets (candies), cookies, kefir, margarine, fresh milk, sausages, cabbage, smetana (sour cream), and tea. The coefficient of the horse meat should be carefully interpreted as there are only small number of consumers for this product.

Other 20 products have no significant price elasticities or they are price inelastic.

Lastly, the results show that

- While the households in Yssyk-Kul, Naryn, and Talas regions tend to have on average 29%, 29%, and 27% less consumption, the consumers in Bishkek, Jalal-Abad, Chui, Osh and Batken regions have on average 69%, 50%, 28%, 14% and 7% more consumption respectively. The consumption expenditure is higher in Bishkek city, Osh and Batken regions, as the significant part (about 90%) of remittances flow to these regions.
- Urban consumers tend to have (2.4%) more consumption than rural ones.
- Households with more adults have (7.8%) more consumption than others.
- Households with a refrigerator have 24% more consumption than the ones without a refrigerator.
- Households consuming from their own productions tend to have 62.3% more consumption than others.
- Dummy variables of household members between 21 and 59, older than 60, marital status, and gender have no significant impacts on food consumptions.

Contribution and Limitations

- The main contributions of this study are (i) analyzing the income and price, as well as other, elasticities of demand in Kyrgyzstan, which will be enough for offering the policies for reducing food security and poverty among households, (ii) revealing the interesting facts behind the elasticities.
- The main limitations of this study are (a) it does not cover the education and age dummy variables which should be derived from the 2013 LiK dataset. By the way, they were dropped from the probit models as they led to the serious fall in the number of observations, (ii) further analyses should be done by using the *quaids* command in Stata to examine the uncompensated (Marshalian) and compensated (Hicksian) price elasticities discussed in the studies of Lecocq & Robin (2015) and Poi (2012), (iii) maybe Heckman selection model should used to overcome the zero consumptions in the products especially pork, beer, horsemeat etc.

Many Thanks!!