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Analysis of Bread Consumption Preferences by Urban Households, Using Demand System Approach

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ABSTRACT

Bread is a basic and essential good that has a special importance in the consumer basket of households and constitutes the main food of many people in the world. The main objective of this study was to investigate the consumption behavior of household bread basket using demand systems during 1998-2018. Therefore, estimates of various demand systems including generalized ordinary demand, Almost Ideal Differential Demand, Rotterdam, Central Bureau of Statistics (CBS) and National Bureau of Research (NBR) were used to select the appropriate demand system to calculate the price and income elasticities of bread demand. Based on statistical tests and econometric criteria, the results showed that the generalized ordinary demand system was the most appropriate model for estimating the consumption demand of the bread basket in urban households. The income elasticities of all types of bread were positive, and, for urban consumers, Barbari and industrial bread were essential and Lavash, Sangak, and Taftoon were luxury types. Also, according to the negative expectations and cross elasticities of Sangak with Barbari, self-price elasticities of different types of bread were positive, meaning that Sangak was replaced by Barbari. In addition, the variable effect of subsidy targeting was positive for Taftoon and Lavash breads, negative for Barbari, and meaningless for Sangak. According to the study results, it is suggested that government officials pay special attention to the importance of bread consumption basket and preferences of its consumers in economic policies regarding food and household consumption basket (such as targeted subsidies).

Keywords: Almost Ideal Differential Demand System, Bread basket, Price Elasticity of Demand, Self-Price Elasticity of Demand.

INTRODUCTION

Bread is the basic and inexpensive food consumed by humans. Although bread consumption has reduced with the improvement of living standards in developed countries (Sandvik *et al.,* 2017), it is still a major part of energy, protein, minerals and some B vitamins (thiamine, riboflavin, and niacin) provided daily for people, especially low-income classes. Therefore, bread has a special place in the food security of households.

The global market for bread production and bakery shows moderate and stable growth during 2007-2016, increasing from 122,000 tons in 2007 to 129,000 tons in 2016, which seems to have had an almost constant trend. Also, the performance of the world bread market is predicted to maintain its current trend and by 2025 the market volume will reach 135 million tons (IUBC, 2018). The global average per capita consumption of bread is 18 kg per year (World Bank, 2018). In 2016, exports accounted for only 9% of the world bread

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production and bakery, an increase of 3% compared to 2007. In other words, the demand for bread and bakery products is largely met by local products of countries. However, in general, the export trend of bread and bakery products is positive. During the past decade, bread exports have fluctuated somewhat significantly, reflecting instable prices of raw materials and mainly cereals (World Bank, 2016). Regarding value, consumption in 2016 was about $ 358 billion. In 2011, 70% of global bread sales were dedicated to packaged products and 30% to the unpackaged products. Global population growth and gradual increase in household income in developing countries (Gidlöf *et al.,* 2021) and the consequent change in consumer preferences, especially urban households (Gębski *et al*., 2019), are the main drivers of world demand for bread baskets. It also seems that in developing countries, bread consumption varies depending on various factors such as the dependence of the wheat market on the government, the difference in urban and rural population (food preferences, and differences in tendency to processed or unprocessed food), and income growth especially in China, South Asia, and the Middle East.

During the last three decades, population growth, relative improvement in nutritional indicators, and increased purchasing power (Pazarlioğlu *et al*., 2007) have increased the demand for agricultural products, including cereals. Moreover, higher growth rate of demand over the growth rate of production has led to provision of essential needs in the Middle East, especially in Iran. Regarding the national and transnational dimensions of food imports, the provision of more food is considered a strategic objective in Iran's economic, social and cultural development programs (Hosseini *et al.*, 2017). For this reason, estimating demand systems is essential to identify preferences and predict the future needs of Iranian consumers for policy making and planning.

Model of Cereal Consumption in the World and in Iran

Bread is a widely consumed food in families all over the world. Of course, it should be noted that the amount of consumption among households in developing countries is much higher. Bread consumption varies from country to country (Akdemir *et al.,* 2020). Cereals make up 50% of the calories consumed around the world (54% of energy sources in developing countries). The share of energy from cereals has dropped from 60 to 54% over 10 years. In the Middle East, the share of the group of cereals has reduced. In the world, it is predicted that the model of cereals consumption would decrease from 54% in 2001 to 49% in 2030. Consumption of cereals among Iranians is 40% higher than in other parts of the world and still constitute the main food of Iranians.

Bread in Iran

In Iran, bread is the dominant and the main food of the people. In this respect, 60-65% of protein and calories, about two to three grams of minerals, and most of the daily salt needed by people is gained through bread. Notably, per capita consumption of bread in Iran is 5% more than the recommended amounts in the desired food basket.

Among existing types of bread, flat bread has been one of the oldest and simplest breads prepared and consumed in different ways in the cities and villages of Iran for a long time. In Iran, four types of flatbread, namely, Barbari, Lavash, Taftoon, and Sangak are traditionally common. Figure 1 shows different types of bread baked in Iran.

Bread has had various price and consumption fluctuations in Iran in recent years. In the following, the consumption process and cost will be reviewed.

According to the statistics, bread has always been consumed more than other food items by households in Iran. Figure 1 clearly shows the trend of bread consumption in

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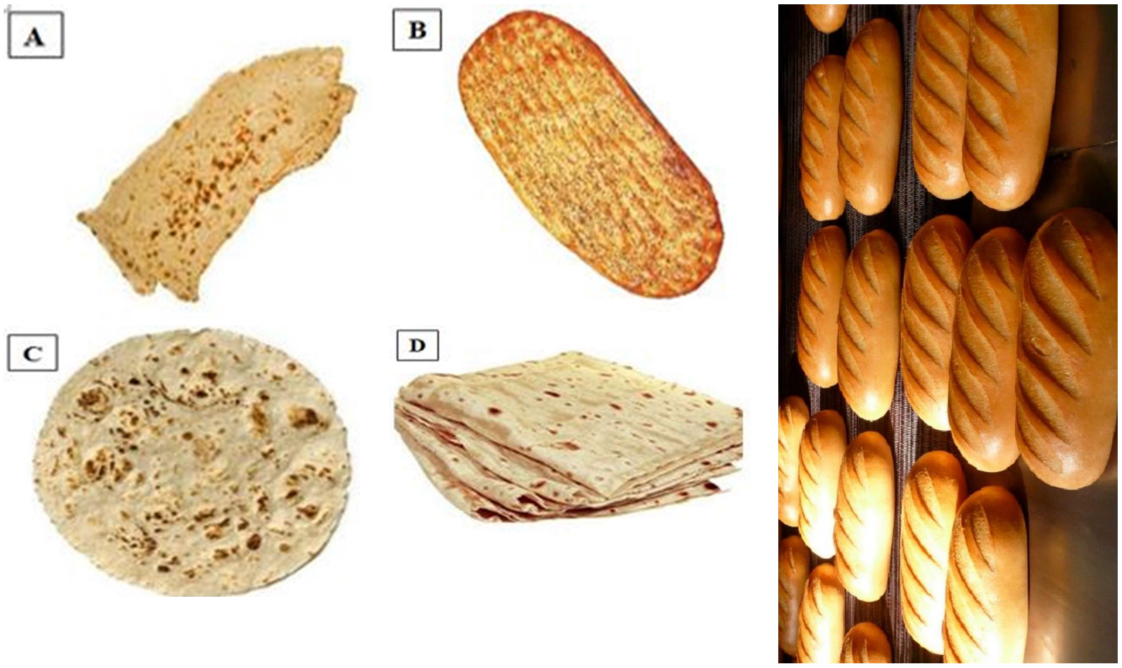

Figure 1. Baking bread in Iran. (Source: CNIOMH, 2021). **Bread A:** Sangak is a genuine Iranian bread as one of the best Iranian breads in terms of taste, flavor, easy digestion and nutritional value. It has a length of 70-80 cm, a width of 35-50 cm and a thickness of 4-5 mm, which is in the shape of a cone. **Bread B:** Barbari is 75-90 cm long, 20-30 cm wide and 1.5-2 cm thick, and rapid staling is one of its characteristics. For preparation of Barbari, Setareh flour (light flour with low bran) with an extraction grade of 82 is used while for the preparation of Sangak, whole meal flour or flour with an extraction grade of at least 93% is used. **Bread C:** Taftoon is a round and thin loaf of bread with a diameter of about 40-50 cm and a thickness of about 3-5 mm. This bread is thicker than Lavash and thinner than Barbari and Sangak, and stales later than Sangak and Barbari. Similar breads are also produced in some Arab countries and the Persian Gulf states. **Bread D:** Lavash is a thin bread 1-2 mm thick and almost oval in shape, 60-70 cm long and 30-40 cm wide, which can be frozen for up to 6 months. For the preparation of Lavash and Taftoon, bran flour (12% bran) is used. **Bread E:** Industrial bread is produced in large volumes and all the stages of dough preparation and bread production are performed automatically.

Iran. During the study period, per capita consumption of Taftoon and Lavash has a decreasing trend and shows considerable fluctuation. As shown in Figure 2 and according to the Iranian Household Expenditure Survey (HES), the mean consumption of bread in Iran during the past two decades has decreased from 626 kg in 2000 to 298 kg in 2017. The annual reduction in bread consumption cannot be considered as reducing the share of this product in household consumption because part of the bread is wasted in the country. According to the Center for Cereal Research, more than two million tons of wheat are wasted on poor and dry bread (about one-fifth of the bread consumed). Some of these wastes are due to the low quality of wheat and flour and others are related to bread baking procedure such as using baking soda, low experience of bread-making staff, inaccurate flour and sourdough formulations, inadequate baking conditions, and thin bread. The highest waste among the types of bread is related to Lavash and the lowest is related to industrial breads and

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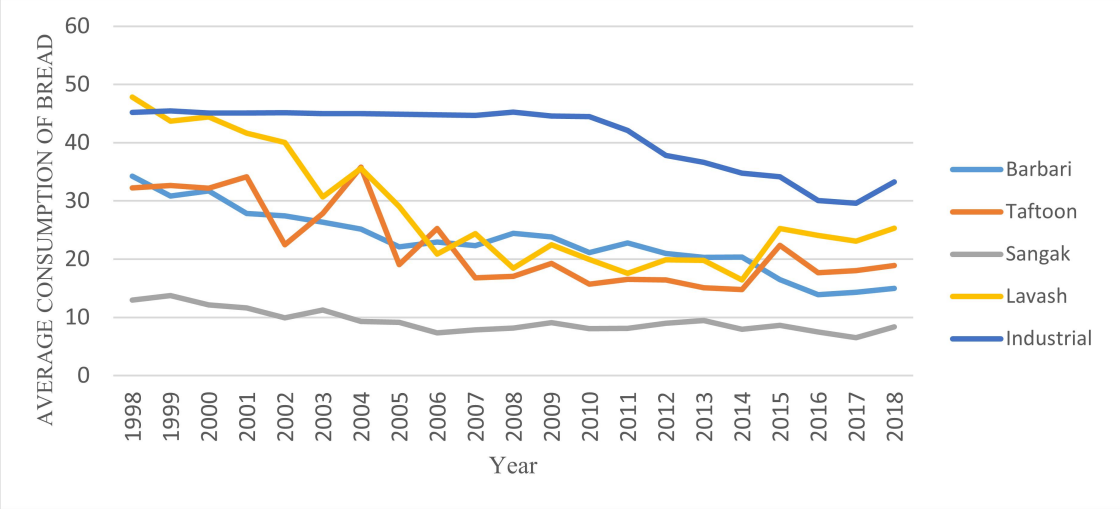

Figure 2. Mean consumption of breads in Iran during the period 1998-2017. (**Note:** The statistics and information used in the present study are the latest available and valid statistics by government organizations, Source: Central Bank of the Islamic Republic of Iran, 2019).

Sangak (Government Trading Corporation of Iran, 2019). In general, it can be said that the reduction in per capita bread consumption in Iran is mainly due to price correction, reduction in bread waste, correction of indirect flame baking method, dough making with quality machines, and correction of flour production and distribution according to global standards.

The other part of the statistics is the cost of bread. The mean cost of household bread has increased from 328 thousand Rls (7.8 $). in 2000 to five million and 62 thousand Rls (120.52 $) in 2017. In other words, urban households pay more for bread annually. There was a sharper increase in price especially since 2010 with the enactment of the "Law on Targeted Subsidies" (Figure 3).

The government argues that payment of public subsidies, benefiting all classes of society (including the poor and the rich), leads to the loss of financial resources without achieving the objective of eradicating poverty (Hosseini *et al.,* 2017).

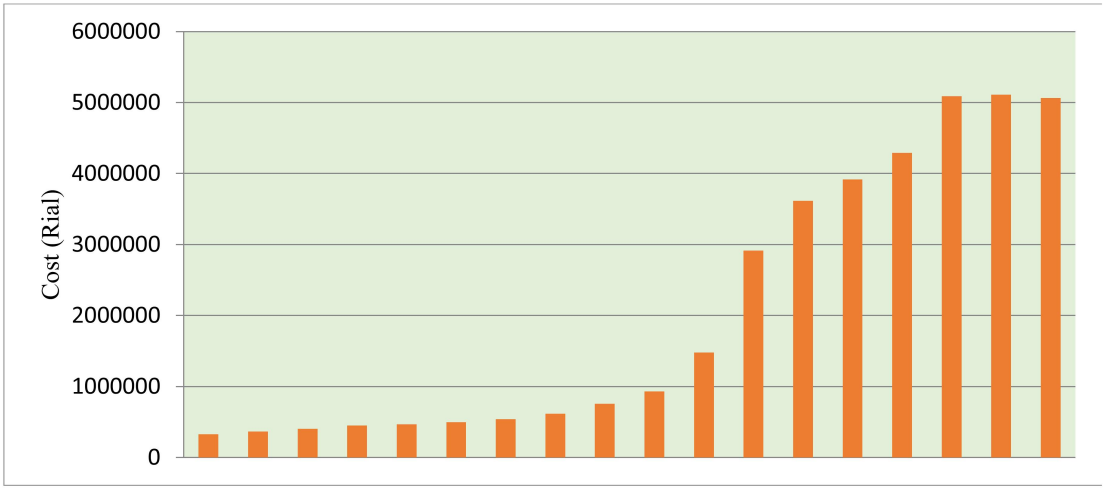

Figure 3. Mean annual gross cost of household breads in urban areas of Iran during 2000-2017. Source: Government Trading Corporation of Iran, 2019.

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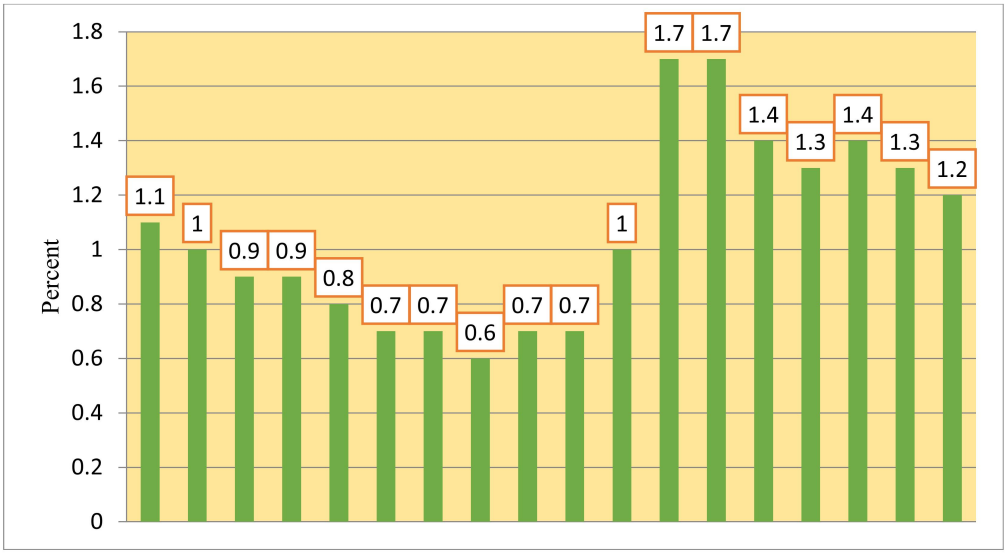

Figure 4. Percentage of total gross annual cost of household breads in urban areas of Iran during 2000-2017
Source: Government Trading Corporation of Iran, 2019.

The argument was seriously followed in December 2010 with the beginning of the "Law on Targeted Subsidies", assuming that bread has the highest amount of subsidies paid by the government after energy carriers. Increasing the price of goods will reduce the welfare of the consumer. In the case of bread, most of these consumers are from the first and second deciles of income ("in Iran, the government refers to the cost deciles to find low-income families who should be eligible for subsidies. In this way, three high-income deciles of society are excluded from receiving subsidies and the remaining seven deciles i.e. low-income groups, are eligible to receive subsidies. The first decile is the lowest income group and the tenth decile is the highest income group of families"), while it is regarded essential in the food basket. The governments often pursue different protectionist policies in such cases. In 2010, after the increase in the price of bread under the above law, the government provided 50,000 Rls (1.19 $). in cash as bread subsidy to the heads of households to compensate for part of their lost welfare in return for the price increase.

As shown in Figure 4, "share of bread cost in the total cost of household food in Iran" shows that targeted subsidy protection policy could only compensate for part of the reduction in welfare and share of bread cost in total household food costs from 1% in 2010 to 1.7% during 2011-2012, while in 2017 it decreases to 1.2%. The position, importance, price and subsidies of bread for the household depend on various factors that should be investigated before reducing or eliminating bread subsidies by governments. In Iran, various policies have been adopted regarding wheat, flour and bread including guaranteed purchase price policy of wheat, subsidies of production inputs and flour, and restrictions and prohibitions on the import of wheat and flour that have been applied at different times. According to expert opinion, healthy and desired bread in the Iranian nutrition basket has not been achieved. Part of wheat to produce good bread is still far from the desired quality; the process of turning wheat into flour and delivering it to the bakery should be still improved, the baking process should be improved according to the health standards, and the type of bread consumed (industrial or traditional, such as Lavash, Barbari, and Sangak) should change consumption models.

Regarding the importance of estimating demand and calculating elasticities in government planning and policy making, in this study, we compared and selected the

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superior model within the generalized ordinary differential demand system. We also calculated the almost ideal differential demand system, Rotterdam, CBS and NBR for bread price and income elasticities.

Many studies abroad have investigated the demand models of various agricultural and non-agricultural products. However, in Iran, less attention has been paid to them. The following are some national and international studies conducted.

Akdemir *et al.* (2020) analyzed the behavior and attitudes of bread consumption in Turkey in the province of Adana using a linear regression model. The surveys were carried out in a simple random among 100 households in the city center of Adana Province according to social class (including the wealthy class, the middle class and those of the lowest income). Analysis of the data collected shows that the behavior and attitudes of bread consumers in the province of Adana have changed over time in terms of not only quantity, but also types of bread, and places of purchase. This change in behavior and attitudes is influenced by socioeconomic and demographic characteristics such as education, occupation, household size, social class and monthly income of consumers. The increase in the selling price of unit bread significantly influences consumer behavior and attitudes. Gershon *et al.* (2020) investigated the demand characteristics of 14 food goods groups. The study was conducted in rural and urban areas of Ghana using quadratic almost ideal demand system. The results showed that very poor households spend the most on food, while the non-poor spend the least budget on food. The elasticity of expenditures (incomes) for all food categories showed positive signs, meaning that the goods are common to all consumer groups in Ghana. The price elasticity of food groups was positive in the very poor group compared to the non-poor group and had a higher value indicating more reaction of very poor people to changes in the price of food groups. Very poor families spend the largest share of their budget on food compared to the non-poor. Thus, very poor families spend 31.8% of their budget on food, while the poor spend 28.9%, but the non-poor spend only 22.7% of their budget on food. Therefore, the household food budget depends on the household income, and high-income households tend to spend less of their household budget on food. Survival is more important for poor and very poor families than for the non-poor. Hence, poor and very poor families tend to spend more of their budget on food. Nevertheless, low-income families spend more on food than the families with higher income. Alnafissa and Alderiny (2020), in a study entitled Analysis of Saudi Demand for Imported Honey Using the AIDS, concluded that the self-price elasticity of demand for natural honey imported from Yemen, Australia, Argentina, Mexico and Germany was significant and negative. Salem *et al.* (2019) investigated the effect of socio-economic variables on bread demand using AIDS model and micro data. In this model, socio-economic variables such as age, gender and marital status of head of the household, his/her own level of education and that of the spouse's, household size, and employment status and income level of household members have been used. A dummy variable is also used to calculate the effect of the policy for implementation of targeted subsidies law on bread consumption in Iran. This model has been estimated using the consolidated data and Seemingly Unrelated Regressions Equations (SURE) method and the information from more than 165,000 urban households in the country for the years 2007-2015 and for different income groups. The results of this research show that, during the period under study, bread was an essential goods for all income groups. The price elasticity of bread demand for all income groups was 0.5. Therefore, bread is an inelastic goods for all income groups. Also, the coefficients related to household size, level of education for the breadwinner and his/her spouse, employment status, and marital status of household breadwinner and the dummy

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variable of targeted subsidies law are positive and significant. The coefficient related to the age of household breadwinner for poor and middle-income households has been estimated to be positive and for wealthy households it has not been found to be significant. Stacey *et al.* (2017) estimated the demand for beverages subject to South Africa's proposed sugar beverage tax and calculated the price elasticity. The results showed that the demand for these products has a high price elasticity so that a significant reduction in consumption is due to taxes. Farazmand and Nateghi Shahrokni (2017) investigated the effects of eliminating bread subsidies on the demand of low-income and high-income groups in urban areas of Iran during 1997-2014 using the AIDS and the method of estimating the system of SURE. The results of their study showed that bread is a low-elasticity and essential goods for both low-income and high-income groups. In this respect, with a 100 percent increase in the price of bread, the low-income group reduced its demand by 48% and the high-income group by 25%. The cross-elasticity study of the low-income groups showed that the cereals were substitutes, flour and noodles were almost independent, and the out-of-home food was a complement to the bread. Moreover, the cross-elasticity for the high-income groups shows that cereals and the out-of-home food are substitutes. Flour and noodles are almost independent of bread. Another result of the research is that low-income and high-income groups are extremely sensitive to rising prices of cereals, flour, and noodles.

Regarding bread consumption statistics and its necessity for low income deciles, the present study attempted to estimate the demand systems in order to identify consumption preferences and predict the future needs of bread consumers for policy making and planning. According to studies conducted in developing countries, few studies have selected the optimal demand system of agricultural products, especially the types of bread consumed by households. Such investigations lead to more accurate and better understanding of the demand for different types of bread in various countries, thereby managers and policymakers in this field can implement programs and policies more purposefully.

In the present study, the main objective was to investigate the consumption behavior of household breadbasket in Iran using demand systems during 1998-2018.

MATERIALS AND METHODS

Statistics and Information

Annual data on consumption expenditures of urban households during 1998-2018 were used to estimate the demand for different types of bread. The statistics related to consumption expenditures of urban households were obtained from the data collected in the form of cost-income questionnaires by the Statistics Center of Iran, which are published annually by this center. This data was extracted from 30 provinces of Iran and included 260,000 families. It should be noted that in the present study, the dumts variable is considered as the dummy variable for targeted subsidies, that is, for this variable in the years 2011, 2012, 2013, 2014, and 2015 the value of one and zero for other years was included. Table 1 shows the statistical description of the studied variables.

There are basically two approaches to estimate a demand system in terms of methodology. One approach is that the single-equation demand is determined and estimated without resorting to economic theories. This has three drawbacks. Firstly, the method of selecting the system form of the demand equations and the existing variables is conventional and lacks theoretical justification. Secondly, in the system used, all variables are assumed to be exogenous, and thirdly, when estimating demand equations, the budget constraint is not taken into account, therefore, the estimated parameters do not meet the provisions imposed on them based on the

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Table 1. Statistical description of variables. [a]

Variable	Average	Standard deviation	Max	Min	Coefficient of variation
Price of Sangak	6343.574	7268.422	22184	246.7	1.145
Price of Barbari	5846.474	6891.577	22088	225.7	1.178
Price of Taftoon	5892.791	6338.109	18498.7	237.6	1.075
Price of Lavash	5836.561	6533.064	20561	260.7	1.119
Price of Industrial	5417.957	6102.417	17995	195.3	1.126
Consumption of Sangak	9.334	1.873	14	6.5	0.200
Consumption of Barbari	23.073	5.309	34.13	14	0.230
Consumption of Taftoon	22.182	6.823	36	15	0.307
Consumption of Lavash	26.986	10.263	48	13.6	0.380
Consumption of Industrial	40.326	5.964	45.5	29.6	0.147

[a] Source: Research findings.

demand theory. Another approach is the use of demand theory in determining the form of equations and selecting variables. This method first extracts the demand equations from the mathematical model of consumer behavior, then, imposes a provision on the existing variables, thereby estimating the independent factors and the amount of the required statistical data is also reduced (Alston and Chalfant, 1993).

By generalizing the public demand system provided by Barten (1993), Eales and Wessells (1999) introduced the Generalized Ordinary Differential Demand System (GODDS) as the Equation (1), which combines the most widely used systems in differential demand.

$$w_i dlnq_i = (\beta_i + \theta_1 \overline{w}_i) dln\, Q + \sum_{j=1}^{n} (\gamma_{ij} + \theta_2 \overline{w}_i (\delta_{ij} - \overline{w}_j) dlnp_j) \quad (1)$$

Where, β_i represents the cost coefficient of i-th foodstuff and γ_{ij} is the price coefficient of product i, θ_1 and θ_2 are the nested parameters, δ_{ij} Kronecker's delta, $dln\, Q$ is the quantitative index of Divisia and $\overline{w}_i = 1/2(w_i + lagw_i)$ is the mean of cost share of i-th foodstuff. Theoretical restrictions of demand are defined as Equations (2, 3, and 4).

$$\sum_i \gamma_{ij} = 0 \quad , \quad \sum \beta_i = -\theta_1 \qquad \text{Adding-up restriction (2)}$$

$$\sum_j \gamma_{ij} = 0 \qquad \text{Homogeneity restriction (3)}$$

$$\gamma_{ij} = \gamma_{ji} \qquad \text{Symmetry restriction (4)}$$

The GODDS includes the Rotterdam demand system, AIDS, and the two combined CBS and NBR models. Selection of the appropriate system is based on the restrictions imposed based on the nested parameters reported in Table 2.

Having estimated the GODDS demand system for different types of bread, restrictions of Table (1) for each model are applied separately and measured in the GODDS model. The general form of each of the Rotterdam demand systems, the almost ideal demand system, CDS, and NBR are listed below:

Almost Ideal Demand System

Deaton and Muellbauer (1980) introduced an almost ideal demand system based on the cost (expenditure) group with the Price Invariant Generalized Logarithmic (PIGLOG) form expressing a set of cost systems. In fact, this level indicates the minimum cost to achieve a certain level of utility at the given prices. These cost systems are shown as e (u, p), which are a system of the two factors of utility (u) and the price level (p). The PIGLOG group is shown as follows:

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$$ln\ \mathrm{e(u,p)} = (1-\mathrm{u})\ln\big(\mathrm{a(p)}\big) + \mathrm{u}\ \ln(\mathrm{b(p)}) \quad (5)$$

In this equation, the consumer utility is between 0 and 1. Utility 0 indicates living at the minimum livelihood level (subsistence) and utility 1 indicates maximum welfare (bliss). A (p) represents the cost of achieving the level of utility 0 or the cost of livelihood (subsistence), and b (p) indicates the necessary cost of achieving the utility level 1 or welfare cost (Bilgic and Yen, 2013).

The consumer expenditure system should be 1 degree homogeneous with respect to the level of prices, therefore, in this system, a (p) and b (p) should be considered in such a way that the system e (u, p) is a sum of them and is 1 degree homogeneous with respect to the level of prices (Barnett and Seck, 2008). To this aim, Deaton and Muellbauer introduced a (p) and b (p) as follows.

$$\ln a(p) = \alpha_0 + \sum_{k=1}^{n} \alpha_k \ln p_k + \frac{1}{2}\sum_{k=1}^{n}\sum_{j=1}^{n} \gamma^{*}_{kj} \ln p_k \ln p_j \quad (6)$$

$$\ln b(p) = \ln a(p) + \beta_0 \prod_{k=1}^{n} p_k^{\beta_k} \quad (7)$$

The Pi of the price index for ith good and n is the number of goods in the system. α, β and γ are parameters that must be estimated.

Rotterdam System

The Rotterdam model is obtained by taking the total differential from the logarithmic demand system:

$$\ln q_i = f(\ln p_1 \ln p_2 ..., \ln p_n, \ln m) \quad (8)$$

$$d\ln q_i = \sum_{j=1}^{n} \left(\frac{\partial \ln q_i}{\partial \ln p_j}\right) d\ln p_j + \left(\frac{\partial \ln q_i}{\partial \ln m}\right) d\ln m = \sum_{j=1}^{n} \mu_{ij} d\ln p_j + \eta_i d\ln m \quad (9)$$

Where, the η_i is the income elasticity (cost) of demand is for ith goods, and μ_{ij} is the cost of own-price elasticity and non-compensated cross elasticity.

CBS System

This model is a combination of the two systems of the almost ideal demand system and Rotterdam, such that it has the income coefficients of the almost ideal demand system and the price coefficients of the Rotterdam model. Consider the following Rotterdam model:

$$w_i d\ln q_i = b_i d\ln Q + \sum_{j=1}^{n} s_{ij} d\ln p_j \quad (10)$$

If we replace b_i with β_i+w_i and subtract $w_i d\ln Q_i$ from both sides, the CBS system will be obtained:

$$w_i d\ln q_i = (\beta_i + w_i) d\ln Q + \sum_{j=1}^{n} s_{ij} d\ln p_j$$
$$w_i (d\ln q_i - d\ln Q) = \beta_i d\ln Q + \sum_{j=1}^{n} s_{ij} d\ln p_j \quad (11)$$

Where, w_i is the budget share for the i-th goods and qi is the quantity of goods i, p_i is the price per unit of goods i, and b_i is the marginal budget share of the goods i, and $d\ln Q = d\ln m - d\ln p$, where m is the total expenditures.

NBR System

The NBR system proposed is another

Table 2. Restrictions of the Generalized Ordinary Differential Demand Model to provide an appropriate system form.

Models	θ_1	θ_2
AIDS	0	0
Rotterdam	-1	1
NBR	-1	0
CBS	0	1

Source: Eales and Wessells (1999).

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combination of AIDS and Rotterdam systems. In the almost ideal demand system, by replacing b_i-w_i with β_i and shifting $w_i d\ln Q$ to the left, Neves (1994) obtained the NBR system as follows:

$$dw_i = \alpha_i + (b_i - w_i)d\ln Q + \sum_{j=1}^{n}\gamma_{ij}d\ln p_j$$
$$\Rightarrow dw_i + w_i d\ln Q = \alpha_i + b_i d\ln Q + \sum_{j=1}^{n}\gamma_{ij}d\ln p_j \quad (12)$$

The above system has price coefficients for the AIDS system and income coefficients for the Rotterdam model.

Table 3 describes the appropriate formulas for calculating non-compensated price elasticity and income elasticity. In this study, all five models are used for estimating bread demand, and the model that can best explain the consumption behavior of urban households is selected and the price and income elasticity is calculated based on its coefficients.

Among the systems introduced, the model that can best explain the consumer behavior of urban households is selected and the price and income elasticity are calculated based on its coefficients. To select the appropriate model, the criteria of the number of significant parameters, the explanatory power of the demand system, stationary, normality and the lack autocorrelation of error term were used.

RESULTS AND DISCUSSION

In this section, the results of estimating different demand systems including GODDS, Differential AIDS, Rotterdam, CBS, and NBR for the bread basket (Barbari, Taftoon, Sangak, Lavash and industrial bread) for urban households are presented. In the first part, using the fit of the models, the most appropriate model was selected, showing that the consumption behavior of the demand for bread in Iran and the model econometrically well explained consistent data behavior. In the second part, after selecting the model, income and price elasticities of demand for different types of bread are calculated.

In this study, first GODDS for bread was estimated and then the constraints in Table 2 were applied to each of the demand systems separately in the model.

To estimate the presented equations, one of the equations was omitted, then, the other equations were solved accordingly, and

Table 3. Income and Price elasticity in AIDS, Rotterdam, NBR, CBS, and GODDS. [a]

Models	Income elasticity	Price elasticity
AIDS	$1+\frac{\beta_i}{w_i}$	$\frac{\gamma_{ij}}{w_i}-\beta_i\left(\frac{w_j}{w_i}\right)-\delta_{ij}$
Rotterdam	$\frac{\beta_i}{w_i}$	$\frac{s_{ij}-\beta_i w_j}{w_i}$
NBR	$\frac{\beta_i}{w_i}$	$\frac{w_i}{w_j}+\frac{\gamma_{ij}}{w_j}+w_j-\delta_{ij}$
CBS	$1+\frac{\beta_i}{w_i}$	$\frac{s_{ij}}{w_i}-\beta_i\frac{w_j}{w_i}-w_j$
GODDS	$1+\frac{\beta_i}{w_i}+\theta_1$	$\frac{\gamma_{ij}-w_j\beta_i}{w_i}+(\theta_2-1)\delta_{ij}-w_j(\theta_1+\theta_2)$

[a] Source: Eales and Wessells (1999).

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finally, the equations were estimated. Additionally, the equation for Sangak is omitted, and, based on it, the equations for Barbari, Taftoon, Lavash and machine breads are estimated. The system of demand equations in each of the proposed models was estimated nonlinearly, using the maximum likelihood estimator. The estimated GODDS parameters and nesting models in this model are shown in Table 4.

By reviewing Table 3, it can be seen that in GODDS, Differential AIDS, Rotterdam, CBS and NBR models, respectively, 75%, 50%, 42.9%, 42.9%, and 57.1% of the total model variables are significant.

Residual statics were tested in all five models using the generalized Dickey-Fuller method. The results of residual statics are given in Table 5. The results show that residual of Barbari, Taftoon, Lavash and machine bread equations in GODDS, Rotterdam, Differential AIDS, CBS and NBR equations are at a static level (Refer to Appendix 2 to check the statics of the variables).

Adjusted maximum likelihood ratio test statistics for the comparison of differential AIDS, Rotterdam, CBS and NBR models is shown in Table 6. Comparison of the adjusted maximum likelihood ratio test statistics calculated for GODDS, Differential AIDS, Rotterdam, CBS and NBR models with a critical value of χ^2 with a degree of freedom of two at the probability level of 5% indicates that GODDS is selected as a suitable system.

The value of Durbin-Watson (D-W) statistic and coefficient of determination of equations are presented in Table 7. The results of Table 6 show that the coefficient of determination of Taftoon equation is above 60%. The explanatory power of GODDS, Differential AIDS, Rotterdam, CBS and NBR models for Barbari is low and 0.49, 0.44, 0.50, 0.46 and 0.48, respectively. The explanatory power of the estimated models for Lavash is over 90%.

In this section, for statistical comparison between generalized ordinary demand systems, the almost ideal differential demand system, Rotterdam, CBS, and NBR Table 8 is given.

Investigation of the number of significant coefficients, normal Likelihood Ratio (LR) statistic, SC, AIC and MSE statistics in the estimated demand models shows that GODDS model has a better fit than the other models of the studied. It can better explain the behavior of bread goods group-related data. Therefore, in this study, this model was used to analyze the demand of urban households. It can be claimed that among GODDS, differential AIDS, Rotterdam, CBS and NBR models, GODDS is the best demand system to explain the behavior of urban consumers in the systematic estimation of bread types. Investigating the effect of targeted subsidy on the demand of bread types was considered in the GODDS demand model, which was statistically significant on the demand for Taftoon, Lavash and Barbari bread. Its transitory effect has been positive on the demand for Taftoon and Lavash and negative on the demand for Barbari (Table 9).

Using the estimated parameters of GODDS, the price and income elasticities of different types of bread were calculated, the results of which are shown in Table 10. Through analyzing the behavior of consumers and recognizing the position of goods, we can classify goods into low, necessary, and luxury based on income elasticity of demand. As shown in Table 10, the income elasticity of Barbari, Taftoon, Sangak, Lavash and machine bread is positive, meaning that Barbari, Taftoon, Sangak, Lavash, and machine bread are normal goods for urban consumers. Among the types of bread, the lowest income elasticity is related to Barbari and it shows that the consumer of this product group has the least impact on income. Also, the highest income elasticity belongs to Taftoon bread, which indicates that the consumption of Taftoon by urban households is strongly dependent on their income, and with the increase and decrease in income, the consumption amount of this bread also

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Table 4. Calculated parameters of GODDS model and nesting models in GODDS model.

	GODDS	Differential AIDS	Rotterdam	CBS	NBR
β_1	-0.16*	-0.13***	0.04	-0.13***	0.04
	(1.80)	(-2.67)	(0.80)	(-2.71)	(0.76)
β_2	0.18*	0.19***	0.38***	0.20***	0.38***
	(1.70)	(2.91)	(5.93)	(3.02)	(5.62)
β_3	-0.01	-0.01	0.07***	-0.007	0.07***
	(0.35)	(-0.34)	(2.86)	(-0.27)	(2.69)
β_4	0.07	0.15**	0.40***	0.14*	0.40***
	(0.48)	(2.16)	(6.12)	(2.04)	(6.20)
θ_1	0.19	-	-	-	-
	(0.43)				
θ_2	4.00***	-	-	-	-
	(4.61)				
γ_{11}	-0.47***	0.11*	-0.04	-0.03	0.10*
	(-3.40)	(1.90)	(-0.70)	(-0.64)	(1.80)
γ_{12}	0.07**	-0.05*	-0.02	-0.02	-0.05*
	(2.02)	(-1.72)	(-0.67)	(-0.68)	(-1.72)
γ_{13}	0.10***	0.02	0.04	0.04	0.02
	(3.51)	(0.68)	(1.33)	(1.43)	(0.56)
γ_{14}	٥٠.٢***	0.08	0.13**	0.12**	0.09
	(3.43)	(1.28)	(2.23)	(2.07)	(1.46)
γ_{22}	-0.53***	0.09**	-0.07*	-0.06*	0.09**
	(-3.79)	(2.29)	(-1.63)	(-1.65)	(2.06)
γ_{23}	0.05***	-0.02	-0.001	-0.002	-0.03*
	(2.51)	(-1.11)	(-0.08)	(-0.12)	(-1.76)
γ_{24}	0.14***	-0.02	0.04	0.03	0.02-
	(2.73)	(-0.28)	(1.00)	(0.65)	(-0.00)
γ_{33}	-0.27***	0.06*	-0.02	-0.02	0.06*
	(-3.60)	(1.81)	(-0.66)	(0.73)	(1.84)
γ_{34}	0.03	-0.03	-0.01	-0.01	-0.03
	(1.10)	(-0.94)	(-0.42)	(-0.42)	(-0.94)
γ_{44}	-0.62***	0.01	-0.16**	-0.15*	-0.004
	(-3.62)	(0.14)	(-2.09)	(-1.64)	(-0.04)

Source: Research findings (the numbers in parentheses indicate the value of the t statistic) (***, ** and * are significant at the levels of, respectively, one, five and ten percent).

increases or decreases. The price elasticity of demand for Lavash is 83%, which indicates that it is more sensitive to price than other types of bread, such that with a 1% increase in the price of Lavash, the amount of demand for this bread will decrease by 0.83%. The difference in cross elasticity between different types of goods shows the difference in their substitutability. For example, if the consumption of Sangak increases by 1%, the price of Barbari will decrease by 0.64%; however, if the consumption of Barbari increases by 1%, the price of Sangak will decrease by 0.39%. This result shows that consumers prefer Sangak over Barbari.

The results of the present study in terms of the necessity of the essentional of Barbari and industrial breads on the part of Iranian urban households and the negative price elasticity of breads with most domestic and foreign studies including (Akdemir *et al*, 2020; Farazmand and Nateghi Shahrokni, 2017; Salem *et al*, 2019) is aligned. However, regarding the luxury of Sangak, Lavash, and Taftoon breads, they are not consistent with the aforementioned studies.

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Table 5. Results of generalized Dickey-Fuller test of residual in GODDS model and nesting models in GODDS model.

Model	Variable	ADF-estimate	Critical value table	Degree of convergence
GODDS	Equation Barbari bread	3.46-	2.57-	I(0)
	Equation Taftoon bread	3.87-	2.57-	I(0)
	Equation Industrial (machine) bread	4.00-	2.57-	I(0)
	Equation Lavash bread	3.45-	2.57-	I(0)
AIDS differential	Equation Barbari bread	3.46-	2.57-	I(0)
	Equation Taftoon bread	-3.78	2.57-	I(0)
	Equation Industrial (machine) bread	6.47-	2.57-	I(0)
	Equation Lavash bread	3.59-	2.57-	I(0)
Rotterdam	Equation Barbari bread	3.32-	2.57-	I(0)
	Equation Taftoon bread	3.75-	2.57-	I(0)
	Equation Industrial (machine) bread	5.37-	2.57-	I(0)
	Equation Lavash bread	3.75-	2.57-	I(0)
CBS	Equation Barbari bread	3.45-	2.57-	I(0)
	Equation Taftoon bread	3.83-	2.57-	I(0)
	Equation Industrial (machine) bread	5.66-	2.57-	I(0)
	Equation Lavash bread	3.59-	2.57-	I(0)
NBR	Equation Barbari bread	3.33-	2.57-	I(0)
	Equation Taftoon bread	3.72-	2.57-	I(0)
	Equation Industrial (machine) bread	5.76-	2.57-	I(0)
	Equation Lavash bread	3.71-	2.57-	I(0)

Source: Research findings.

Table 6. Statistics of normal and adjusted maximum likelihood ratio tests to select a system form.

Model	Log likelihood	LR	LR-adjusted
GODDS	259.72	-	-
Differential AIDS	253.76	11.9	8.16
Rotterdam	254.28	10.9	7.48
CBS	256.12	7.02	4.95
NBR	252.29	14.9	10.21

[a] Source: Research findings.

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Table 7. Durbin-Watson statistic value and equation determination coefficient. [a]

Model	Variable	Coefficient	D-W
GODDS	Equation Barbari bread	0.49	1.83
	Equation Taftoon bread	0.61	2.25
	Equation Industrial (machine) bread	0.94	1.64
	Equation Lavash bread	0.50	2.14
Differential AIDS	Equation Barbari bread	0.44	1.63
	Equation Taftoon bread	0.61	2.42
	Equation Industrial (machine) bread	0.93	1.89
	Equation Lavash bread	0.50	1.93
Rotterdam	Equation Barbari bread	0.50	1.68
	Equation Taftoon bread	0.61	2.44
	Equation Industrial (machine) bread	0.92	1.61
	Equation Lavash bread	0.56	2.03
CBS	Equation Barbari bread	0.46	1.63
	Equation Taftoon bread	0.63	2.39
	Equation Industrial (machine) bread	0.94	1.70
	Equation Lavash bread	0.51	1.94
NBR	Equation Barbari bread	0.48	1.68
	Equation Taftoon bread	0.60	2.48
	Equation Industrial (machine) bread	0.91	1.80
	Equation Lavash bread	0.55	2.01

[a] Source: Research findings.

Table 8. Statistical comparison to select the superior model between GODDS and nesting models of GODDS. [a]

Model	SC	AIC	MSE			
			Barbari	Taftoon	Lavash	Industrial (Machine)
GODDS	-493.4	-479.4	9.25E-06	3.63E-05	1.52E-04	3.73E-05
Differential AIDS	-481.5	-471.6	1.38E-05	3.22E-04	3.69E-04	1.67E-05
Rotterdam	-482.5	-472.6	1.05E-05	2.28E-04	3.52E-04	2.41E-05
CBS	-486.2	-476.2	1.26E-05	2.24E-04	3.13E-04	2.33E-05
NBR	-478.6	-468.6	1.12E-05	3.25E-04	4.10E-04	1.70E-05

[a] Source: Research findings.

Table 9. Calculated parameters of the GODDS demand model for the dummy variable of subsidy targeting. [a]

Lavash bread	Sangak bread	Taftoon bread	Barbari bread	dummy variable
**0.016	-0.002	*0.012	***-0.02	DUMST
(2.27)	(-0.09)	(1.74)	(-3.37)	

[a] Source: Research findings (the numbers in parentheses indicate the value of the t statistic), (***, ** and * are significant at the levels of, respectively, one, five and ten percent).

Table 10. Self-price, cross- and income elasticities for different types of bread. [a]

bread	Barbari	Taftoon	Sangak	Lavash	Industrial (Machine)	Income elasticities
Barbari	0.15-	0.25-	0.39	0.71	0.88-	0.23
Taftoon	0.54-	0.78-	0.13-	0.44-	0.77-	2.06
Sangak	0.68	0.10-	-0.77	-0.63	0.23-	1.04
Lavash	0.34	0.23-	0.26-	0.83-	0.49-	1.48
Industrial (machine)	0.50-	0.23	0.002-	-0.11	-0.01	0.38

[a] Source: Research findings.

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Also, the results of the present study are not consistent with the results of Salem *et al*. (2019) regarding the effect of targeting subsidies for Taftoon and Lavash bread and regarding other breads. The reason for the non-alignment of some of the results of the present study with the aforementioned studies is the failure to calculate the elasticity and the variable targeting of subsidies by different types of bread in the aforementioned studies.

CONCLUSIONS

In this study, to select the most appropriate demand model of breads consumed by urban households in Iran, generalized ordinary demand system, almost ideal differential demand system, Rotterdam, CBS, and NBR were estimated. Finally, based on statistical and econometric criteria, generalized ordinary demand system shows the best fit and explains consumption behavior of types of bread of the studied households. In this study, after estimating generalized ordinary demand system, price and income elasticities of demand for breads consumed by urban households were calculated. The results showed that income elasticities are positive for all types of bread. In other words, Barbari and industrial breads consumed by urban households with a mean elasticity of less than one are considered two essential goods, and Sangak, Lavash, and Taftoon with income elasticity higher than 1 are luxury items. The level of income elasticity of Lavash also shows that by 1% increase in income, the demand for Lavash increases by 1.48%. In order to make the results consistent with the maximizing behavior of rational consumer welfare, all self-price elasticity should be negatively compensatory. In this study, self-price elasticities of Barbari, Taftoon, Lavash, Sangak and industrial breads are negative according to the expectations of demand theory based on maximizing consumer utility. The highest absolute value of self-price elasticity is related to Lavash (-0.83), indicating that urban households react more to the price changes in Lavash. Lavash is consumed less by households due to the use of white flour for baking, which also has less nutritional value. On the other hand, urban households have less reaction to price changes in Barbari and the demand for Barbari does not decrease significantly. Barbari has a long fermentation time and is baked for a long time with a gentle heat. This bread has a high caloric value so that there are 265 kcal of energy in 100 g. Also, this type of bread uses less baking soda and is a whole grain bread, hence having a higher nutritional value than other breads produced by white flour. Due to the high nutritional value of Barbari, households are less sensitive to price increases.

Also, according to the results of the present study, cross elasticities of Sangak and Barbari are positive, meaning that Sangak is a substitute for Barbari. The most important effect and value of breads is based on the amount of bran. In Sangak and Barbari flour, there is more bran than in other types of bread with high nutritional value. According to the statistics presented in Figure 1, their consumption in urban households is almost similar, so, the result of the substitution of Sangak and Barbari in the present study is definite. According to the coefficients obtained for the imaginary variable of subsidy targeting, the result is that the price increase caused by the targeting of subsidy not only did not decrease the demand for Taftoon bread and Llavash, but also increased consumption of Taftoon and Lavash. This can be explained by considering that Sangak and Barbari are also among the items that are subject to the "subsidy targeting law", and considering that according to the obtained coefficients, the effect of this law on the demand for Barbari is negative. It is noteworthy that after the adoption of this law, consumers have reduced their consumption of Barbari and replaced it with Lavash and Taftoon.

It is suggested not to use price changes to modify the consumption pattern of bread types, because they are inelastic products

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and price changes are not considered a suitable tool. On the other hand, the smallness of the cross-elasticity means that price policies affecting the demand of one product have a small effect on the composition of other consumer goods. However, improving the income situation can play a significant role in improving the consumption pattern of Taftoon, Sangak and Lavash bread.

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تحلیل ترجیحات مصرف نان توسط خانوارهای شهری (رویکرد نظام تقاضا)

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چکیده

با توجه به اینکه نان به عنوان یک کالای اساسی و ضروری در سبد مصرفی خانوارها اهمیت ویژه ای دارد و غذای اصلی بسیاری از مردم جهان را تشکیل می دهد، هدف اصلی این مقاله بررسی رفتار مصرف سبد نان خانگی با استفاده از سیستم های تقاضا در طول سال های ۱۹۹۸-۲۰۱۸ است. در این مطالعه، براوردهای سیستم های مختلف تقاضا از جمله تقاضای عادی تعمیم یافته، تقاضای دیفرانسیل تقریبا ایده ال، روتردام، اداره مرکزی امار (CBS) و دفتر ملی تحقیقات (NBR) برای انتخاب سیستم تقاضای مناسب برای محاسبه کشش قیمت و درامد تقاضای نان استفاده شد. نتایج مطالعه نشان داد که بر اساس ازمون های اماری و معیارهای اقتصاد سنجی، سیستم تقاضای عادی تعمیم یافته مناسب ترین مدل برای براورد تقاضای مصرف سبد نان در خانوارهای شهری است. کشش درامدی انواع نان مثبت است و برای مصرف کنندگان شهری، بربری و نان صنعتی ضروری است و لواش، سنگک و تفتون انواع لوکس هستند. همچنین کشش های خود قیمت انواع مختلف نان با توجه به انتظارات منفی و کشش متقابل سنگک با بربری مثبت است به این معنی که سنگک با بربری جایگزین می شود. همچنین تاثیر متغیر هدف قرار دادن یارانه برای نان تافون و لواش مثبت، برای نان بربری منفی و برای سنگک بی معنی است. بر اساس نتایج این مطالعه، پیشنهاد می شود مقامات دولتی توجه ویژه ای به اهمیت سبد مصرف نان و ترجیحات مصرف کنندگان ان در سیاست های اقتصادی مربوط به سبد مصرف مواد غذایی و خانوار (مانند یارانه های هدفمند) داشته باشند.

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