Empirical evidence of changing food demand and consumer preferences in the USA

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ABSTRACT

Consumer demand for food is an important component to policy makers, entrepreneurs, and market intermediaries to ensure sufficient food supply and profitable business. Consumers' food demand and preferences in the USA are changing due to increase in per capita income, price, population and urbanization, health consciousness, etc., for which, a clear understanding of the distributions of changing price and expenditure elasticities for major food items is crucial. This study employs the Almost Ideal Demand System (AIDS) to assess the changing food demand and consumer preferences in the United States using household survey data from January 1959 to February 2016. Consumers' price and expenditure sensitivity of demand for food was examined for 15 major food items. The empirical results illustrate the change in food preferences of the consumers' in the USA from carbohydrate to protein mostly due to health consciousness. The compensated own price elasticities indicate that all food items are price inelastic except other meats. The compensated cross price elasticities specify that beef and veal is a significant substitute for pork, other meats, fish and sea foods and eggs while complementary to poultry. Fresh milk and processed dairy products are substitutes for each other. Fresh fruits are also substitute of processed fruits and vegetables. Most of the food categories are normal based on expenditure elasticity. Cereals, bakery products, poultry and fruit (fresh) were expenditure elastic while pork, other meats, fish and seafood, processed dairy products, eggs, fats and oils, vegetables, processed fruits and vegetables and sugar and sweets were inelastic interpreting that those were of necessity. The finding of the study would be helpful for the policy makers and industry participants to formulate effective policies and strategies for the improvement of consumers', as well as producers' welfare. In future research, there is a need to conduct separability tests to understand how consumers allocate their food budget into different food products.

Introduction

Recent unpredictability in agricultural production and prices, incorporated with trade war between the United States and China, raise trepidations of the policy makers in the USA about the capability of local agricultural production to meet future demand (Li *et al.,* 2018). Ensuring the balance between demand and supply of food is one of the major concerns of the policy makers. To achieve this objective, the accurate estimation of consumers' demand for food considering price and income sensitivity is noteworthy. Consumer demand for food is also an important element in the formulation of various agricultural and food policies. For consumers, changes in food prices and per capita income are influential determinants of food demand. Estimates of consumer demand quantify the effects of prices and total expenditures on the demand for food, which in turn, informs policymakers and researchers about how consumers make food purchasing decisions and helps

policy makers design effective nutrition policy. Since, the demand for food is in general inelastic and production and supply somewhat variable, accurate estimates of demand parameters are important as inputs for the development of national price, stabilization, trade, storage, production and other policies (Hassan and Johnson, 1976).

Consumers' demand for food in the USA is changing due to several economic and demographic factors like increase in per capita income, price, population and urbanization, health concerns, older population, women in work force etc. Because of improved health facilities, population in the USA is getting older. The fraction of the population that is 65 years old or greater is 13% and is expected to reach 20% by 2050 (Kotkin, 2010). At the same time, according to the Centers for Disease Control and Prevention (CDC), 69% of U.S. adults are overweight or obese (CDC, 2015). As a result, there are greater concerns about health among the older and obese as well as other people in the USA. This health concerns

leads to change in food preferences specially preferences towards healthier foods. Consumers' are more concern to lose weight and thus consumers' preferences are shifting from more caloric food items to less caloric, and nutritious food items (Ford and Dietz, 2013). Additionally, women are participating in work force increasingly and also households are working longer time than before. This creates demand for convenient foods such as processed meats, fruits and vegetables, ready-to-eat meals that can be served for the family members. Furthermore, changes in preferences due to changes in taste, lifestyle and occupation structure are also triggering the change in food demand structure. Thus, a clear understanding of the distributions of changing price and expenditure elasticities for major food items is crucial for the policy makers to ensure food balance in the country.

Consumer demand is often measured as an elasticity, which is a relative measure, providing a useful means of comparison across all ranges of quantities. Food policy analysis implicitly or explicitly makes use of food demand elasticity. This article examines consumers' price and income sensitivity of demand for food by estimating the demand elasticities of food employing linear aggregation to the Almost Ideal Demand System (LA-AIDS). The extent to which the demand for foods responds to price changes is an important economic question not only for policy makers, but also for retailers and other intermediaries in the USA and worldwide. To formulate suitable production and distribution policy, a thorough knowledge on demand of different food items is needed (Huq *et al.,* 2004). For the projection of demand for different food items, estimation of price elasticities and income elasticities is also required (Salazar *et al.,* 2005; Islam and Nabiul, 2003; Baffes and Gautam, 2001).

In recent years, Almost Ideal Demand System (AIDS) model is being widely used by different economists for demand estimation (Grant *et al.,* 2009; Wadud, 2006; Karangiannis *et al.,* 2000; Balcombe *et al.,* 2003; Verbeke and Ward, 2005). Several studies have estimated demand systems for food to determine whether the impacts of price and expenditure on food consumption vary among income groups or between food stamp program participants and others (Raper *et al.*, 2002; Yen *et al.*, 2003). Other studies use the elasticity of demand for food in equilibrium displacement models of the food sector to determine how farm policy may affect food markets (Wohlgenant, 1989) and how such price changes may affect the economic welfare (Okrent, 2010). Radhakrishna and Ravi (1990) employed the linear expenditure system model while Kumar *et al.* (1994) employed the food characteristic demand system modelling approach to examine the structure of food demand of households in India. Significant scholarly contributions have been made in the literature for demand analysis of specific food items. Consider, for instance, Eales and Unnevher

(1988 & 1993), Hayes *et al.* (1990), Ragaert *et al.* (2004), Moschini and Meilke (1989), Liu and Forker (1988) and Gould *et al.* (1990). Few empirical studies have developed a complete demand system for food commodities in the United States. Two notable examples are Brandow (1961) and George and King (1971) who applied a synthesis approach to generate a demand system. That means little work has been done to evaluate a detailed anatomy of food products elasticity and there is no recent research work on estimation of food demand elasticities in the United States. But it is known that consumer taste and preference are changing always and these can affect the consumer purchasing behavior. Changes in prices and income can also lead to changes in purchasing behavior of consumer that can be predicted by elasticity estimates. In this study, an attempt has been made to evaluate the changing food demand and to estimate the demand elasticity of 15 major food items in the USA by drawing meaningful interpretation.

Materials and Methods

Data sources

National level monthly per capita personal consumption expenditures on food categories and price indices corresponding to each expenditure categories were used as a base for analysis. The data range from January 1959 to February 2016 and is readily available at the Bureau of Economic Analysis (BEA), USA Department of State website (BEA, 2016). This data set is compiled using retail sales, tax receipts and household survey data. The data include disaggregated major food items like cereals, bakery products, beef and veal, pork, other meats, poultry, fish and seafood, fresh milk, processed dairy products, eggs, fats and oils, fruit (fresh), vegetables (fresh), processed fruits and vegetables, and sugar and sweets. Other meats consist of mutton and lamb. Table 1 and Table 2 present the summary statistics of personal consumption expenditures and price indices respectively.

It is evident from Table 1 that the consumers spent the highest amount of money on purchasing bakery products while they spent the lowest amount of money in purchasing eggs. Furthermore, consumers in the USA spent a significant amount of money on cereals, meats, dairy products, vegetables and sugar and sweets.

Table 2 depicts that the average price of major food commodities was more or less similar ranging from 51 cents to 65 cents. However, the average price of pork appears to be the highest and the price of bakery products is the lowest during the period.

Analytical technique

The Almost Demand System (AIDS) of Deaton and Muellbauer (1980) and its variants have been extensively used in the estimation of consumer demand over three decades. The reasons behind the popularity of

AIDS models are that they are consistent with theory, i.e. satisfy budget constraints and the axioms of order, aggregate over consumers without invoking parallel linear Engle curves, and have approximate versions that can be estimated by linear regression (Zhen *et al.*, 2013). In this study, Linear Aggregation to Almost Ideal Demand System (LA-AIDS) was used to estimate a disaggregated food demand system. It is anticipated that the disaggregation of food categories will help better understand any structural changes in the demand for food products in the United States.

Table 1. Summary statistics of personal consumption expenditure by type of product (range: January 1959 to February 2016)

Food category	No. of observation	Average expenditure (cents)	Std. Dev.	Min	Max
Cereals	686	17978.45	13945.54	1510	44280
Bakery products	686	35619.41	27173.48	6000	92256
Beef and veal	686	23045.02	8905.461	7253	41719
Pork	686	14090.79	8514.834	2522	31497
Other meats	686	12425.73	9204.547	2095	33178
Poultry	686	19551.52	16259.21	1644	52818
Fish and seafood	686	6172.87	3791.277	981	13537
Fresh milk	686	12979.47	5747.74	5547	25620
Processed dairy products	686	18270.79	12534.55	2914	44037
Eggs	686	4239.411	3197.045	1134	11449
Fats and oils	686	7970.528	4705.232	1548	17198
Fruit (fresh)	686	12431.99	9883.306	2113	35300
Vegetables (fresh)	686	17463.23	13527.05	3307	47432
Processed fruits and vegetables	686	13729.85	7384.692	2408	27920
Sugar and sweets	686	20499.54	12379.68	3151	42768
Other foods	686	48956.85	42830.98	3394	131242

Source: BEA, 2016

Table 2. Summary statistics of price indices by type of products (range: January 1959 to February 2016)

Food Category	No. of observation	Average price (cents/unit)	Std. Dev.	Min	Max
Cereals	686	57.67944	28.59397	19.325	106.163
Bakery products	686	51.49045	30.89201	13.36	111.358
Beef and veal	686	57.2284	33.6992	16.38	150.528
Pork	686	65.31342	30.61017	18.992	128.511
Other meats	686	60.41544	29.38767	18.686	118.31
Poultry	686	62.70062	26.63535	24.967	117.89
Fish and seafood	686	55.20252	33.28262	10.836	121.811
Fresh milk	686	62.28712	31.01245	21.677	122.877
Processed dairy products	686	56.68614	31.97143	12.154	114.666
Eggs	686	63.31885	28.45329	25.27	174.351
Fats and oils	686	57.84852	29.70305	17.645	116.354
Fruit (fresh)	686	57.95869	30.72563	14.72	113.701
Vegetables (fresh)	686	52.84119	31.7511	11.702	113.738
Processed fruits and vegetables	686	53.81374	28.86499	15.899	107.22
Sugar and sweets	686	55.99415	31.52439	12.491	110.799
Other foods	686	57.11008	30.93006	16.585	110.054

Source: BEA, 2016

The empirical model is based on Almost Ideal Demand System (AIDS) presented by Deaton and Muellbauer, (1980). The general form of the AIDS model with time trend is given below:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \ln(p_j) + \beta_i \ln\left(\frac{X}{P}\right) + \delta_i t \quad \forall_i \ \ .....\ (1)$$

Where w_i is the budget share of the *ith* good, p_j denote prices, X is total expenditure on all goods, t is the time trend and α_i, γ_{ij}, β_i are unknown parameters. P is the price index and defined as:

$$\ln P = \alpha_o + \sum_i \alpha_i \ln p_i + 0.5 \sum_i \sum_j \gamma_{ij} \ln p_i \ln p_j \ \ ..... \ (2)$$

The demand function presented in equation (1) satisfies the Engel aggregation and Slutsky symmetry restrictions, is homogeneous of degree zero in prices and expenditure, which in turn imply the following restrictions:

Adding up restriction:

$$\sum_i \alpha_i = 1, \ \sum_i \gamma_{ij} = 0, \ \sum_i \beta_i = 0, \ \sum_i \delta_i = 0 \ ..... \ (3)$$

Homogeneity restriction:

$$\sum_i \gamma_{ij} = 0 \quad \text{.. (4)}$$

Symmetry restriction:

$$\gamma_{ij} = \gamma_{ji} \quad \text{.. (5)}$$

The estimation of linear approximation to the AIDS model (LA-AIDS) in differences with a time trend:

$$\Delta w_i = \delta_i + \sum_j \gamma_{ij} \Delta \ln(p_j) + \beta_i \Delta \ln\left(\frac{X}{P}\right) + \delta_i \Delta t \quad \forall_i \quad \text{....... (6)}$$

The intercept in the equation (6) indicates the exogenous gradual growth or decline in the budget share of good *i*. The model was estimated using iterative zellner's seemingly unrelated regressions.

Results and Discussion

Results for disaggregated food demand models are presented in Table 3. The coefficient estimates seem to be reasonable and in addition note that the most of the coefficients are significant. The intercept in each equation allows for the exogenous growth or decline in the share of each food category. We can use these intercepts to discuss the evidence of structural change in disaggregated models. In the disaggregate model, the intercept is significant for all food categories indicating gradual growth or decline in the share of these food categories independent of relative price movements. The intercept is negative for cereals, bakery products, poultry and fresh fruits and positive for the rest of the food categories.

The food preferences of the consumers' of the USA are shifting from carbohydrate to protein indicating health consciousness. The result also indicates that while the budget share of beef and veal, pork and other meats have increased, the share of food expenditure on poultry has slightly decreased. The expenditure share on fresh fruits has declined and that of processed fruits and vegetables has experienced growth. If we link this change to the significant increase in the budget share of processed fruits and vegetables, we can see a shift in preference from fresh fruits to processed fruits and vegetables. This change can be attributed to lifestyle changes over the course of time. In addition, the budget share of milk and dairy products have increased over time. This is confirmed by the positive intercepts of individual equations of fresh milk and processed dairy products. Similarly, the budget share of eggs, fats and oils, and sugar and sweets have gone up.

Price elasticity of demand measure the responsiveness of quantity demanded for with a change in price and are specific to the product, market conditions and time period over which the analysis is done (Petersen, 2005). The diagonal elements of Table 4 represent the compensated own-price elasticities. Own price elasticities of all of the food items were of appropriate sign, i.e., negative and also significant. The compensated own price elasticities indicate that all food items are price inelastic having elasticities between -.0278 to -0.857, except other meats with own price elasticity -1.021. The estimates suggest that households were not so responsive to change in prices because firstly, in developed countries like USA, consumers spend a small share of total expenditure on food consumption that do not affect significantly with the change in price and secondly, the demand is also saturated.

Cross price elasticity measures the responsiveness of the demand for one commodity to a change in price of another (Petersen, 2005). Cross price elasticity indicates the relationship between the two products, i.e., whether the products are compliment or substitutes. A negative cross price elasticity indicates that the two products so considered are complements and positive cross elasticity indicates that the two products are substitutes. The estimated cross-price elasticities as shown in the off-diagonal entries of the Table 4 may reflect the consumers' view of substitute or complement relations of certain price changes, but strictly speaking this depends on the sign of the compensated cross-price elasticity. The compensated elasticity estimates indicate that Beef and veal is a significant substitute for pork, other meats, fish and seafood, and eggs but complement to poultry. Poultry is a significant substitute for cereals, fish and sea food and eggs. Huang and Haidacher (1983) also found same findings. Fresh milk and processed dairy products are substitutes for each other. Fresh fruits also substitute of processed fruits and vegetables.

Expenditure elasticity measures the responsiveness of demand to a change in consumer income and is affected by the time period over which they are measured (the shorter the time period the lower the income elasticity of demand) and the degree of necessity of the good (the more necessary good, the lower the income elasticity of demand) (Sloman and Norris, 2002). A commodity can be classified as superior, inferior, necessity or luxury depending on the degree of fluctuation of demand with a change in the income. The estimated expenditure elasticities are shown in the Table 4. The result indicates most of the food categories are normal goods except beef and veal and fresh milk.

On an average almost all food items had a positive expenditure elasticity of demand fluctuating from 0.308 to 2.50. Cereals, bakery products, poultry and fruit (fresh) were expenditure (income) elastic and while pork, other meats, fish and seafood, processed dairy products, eggs, fats and oils, vegetables, processed fruits and vegetables and sugar and sweets were expenditure inelastic meaning necessary commodities. Expenditure elasticities of all food commodities are significant. Some of the income elasticity estimates are negative, perhaps in contrast to expectations and conventional wisdom, but this occurrence reflects the sample observations and certainly is not precluded on theoretical grounds. This finding is similar to Huang and Haidacher (1983).

Table 3. Coefficient estimates of disaggregate food model

	Cereals	Bakery products	Beef and veal	Pork	Other meats	Poultry	Fish and seafood	Fresh milk	Processed dairy products	Eggs	Fats and Oils	Fruit (fresh)	Vegetables (Fresh)	Processed fruits and vegetables	Sugar and sweets	Expenditure	Inter-cept
Cereals	**0.016**	**-0.023**	**-0.008**	0.001	**-0.017**	**0.010**	**0.013**	**-0.010**	**-0.013**	**-0.005**	**0.011**	0.000	**-0.009**	**-0.013**	**0.017**	**0.054**	**-0.40**
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.02)
Bakery products	**-0.023**	**0.035**	**-0.016**	**-0.029**	**0.042**	**-0.011**	**-0.021**	**0.011**	**-0.007**	**0.017**	0.003	**0.007**	**0.027**	**-0.027**	0.004	**0.031**	**-0.135**
	(0.002)	(0.006)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.001)	(0.002)	(0.001)	(0.003)	(0.002)	(0.002)	(0.005)	(0.04)
Beef and veal	**-0.008**	**-0.016**	**0.019**	**0.011**	**0.084**	**-0.020**	**0.003**	**0.022**	**0.006**	0.000	**0.012**	**0.008**	**0.005**	**0.007**	**-0.010**	**-0.157**	**1.41**
	(0.002)	(0.003)	(0.005)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.004)	(0.03)
Pork	0.001	**-0.029**	**0.011**	**0.009**	**0.006**	**-0.007**	**0.005**	**-0.006**	**-0.006**	**-0.007**	**0.002**	**-0.005**	**-0.017**	**0.020**	**0.007**	**-0.014**	**0.16**
	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.02)
Other meats	**-0.017**	**0.042**	**0.007**	**0.006**	-0.003	-0.001	**-0.011**	-0.002	**0.015**	**0.005**	**-0.012**	**-0.002**	0.000	**-0.005**	**-0.003**	**-0.011**	**0.13**
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.19)
Poultry	**0.010**	**-0.011**	**-0.020**	**-0.007**	-0.001	**0.020**	0.002	-0.002	**-0.012**	0.000	**-0.012**	0.002	-0.002	**-0.022**	**-0.010**	**0.088**	**-0.684**
	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)	(0.003)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.029)
Fish and seafood	**0.013**	**-0.021**	**0.003**	**0.005**	**-0.011**	0.002	**0.007**	**-0.008**	**0.003**	**-0.005**	**-0.006**	**0.003**	0.000	**0.009**	**-0.007**	**-0.008**	**0.08**
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.01)
Fresh milk	**0.010**	**0.011**	**0.022**	**-0.006**	-0.002	-0.002	**-0.008**	**0.009**	**0.005**	**0.011**	0.000	**-0.003**	**0.011**	**-0.004**	**-0.014**	**-0.106**	**0.94**
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.028)
Processed dairy products	**-0.013**	**-0.007**	**0.006**	**-0.006**	**0.015**	**-0.012**	**0.003**	**0.005**	**0.018**	**0.008**	**-0.007**	**-0.011**	**-0.004**	**0.008**	**0.018**	**-0.011**	**0.16**
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.01)
Eggs	**0.009**	**0.017**	0.000	**-0.007**	**0.005**	0.000	**-0.005**	**0.011**	**0.008**	**0.007**	**-0.008**	**0.001**	**0.004**	**0.002**	**-0.006**	**-0.008**	**0.08**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.009)
Fats and Oils	**0.011**	0.003	**0.012**	**0.002**	**-0.012**	**-0.005**	**-0.006**	0.000	**-0.007**	**-0.008**	**0.019**	**0.001**	**-0.014**	**0.020**	**0.010**	**-0.016**	**0.16**
	(0.011)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.013)
Fruit (fresh)	0.000	**0.007**	**0.008**	**-0.005**	**-0.002**	0.002	**0.003**	**-0.003**	**-0.011**	**0.001**	**0.001**	**0.005**	**0.011**	-0.001	**-0.014**	**0.011**	**0.05**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.01)
Vegetables (Fresh)	**-0.009**	**0.027**	**0.005**	**-0.017**	0.000	-0.002	0.000	**0.011**	**-0.004**	**0.004**	**-0.014**	**0.011**	**0.023**	**-0.021**	**-0.029**	**-0.006**	**0.11**
	(0.001)	(0.003)	(0.002)	(0.0010)	(0.001)	(0.002)	(0.0010)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.003)	(0.02)
Processed fruits and vegetables	**-0.013**	**-0.027**	**0.007**	**0.020**	**-0.005**	**-0.022**	**0.009**	**-0.004**	**0.008**	**0.002**	**0.020**	-0.001	**-0.021**	**0.058**	**0.022**	**-0.044**	**0.42**
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.01)
Sugar and sweets	**0.017**	**0.004**	**-0.010**	**0.007**	**-0.003**	**-0.010**	**-0.007**	**-0.014**	**0.018**	**-0.006**	**0.010**	**-0.014**	**-0.029**	**0.022**	**0.042**	**-0.026**	**0.29**
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.02)

Note: i) Estimates in bold are statistically significant at or below 5% level.

    ii) Underlined estimates are not significant at 5% level

    iii) Corresponding standard errors are provided below each coefficient within parenthesis

Table 4. Compensated elasticity estimates of disaggregate food items

Food Category	Cereals	Bakery products	Beef and veal	Pork	Other meats	Poultry	Fish and seafood	Fresh milk	Processed dairy products	Eggs	Fats and Oils	Fruit (fresh)	Vegetables (fresh)	Processed fruits and vegetables	Sugar and sweets	Expenditure elasticity
Cereals	-0.656	-0.301	-0.041	0.072	-0.263	0.247	0.257	-0.128	-0.168	-0.020	0.269	0.067	-0.107	-0.162	0.374	1.979
Bakery products	-0.140	-0.590	-0.024	-0.19	0.395	-0.032	-0.154	0.152	0.005	0.205	0.089	0.124	0.292	-0.162	0.098	1.257
Beef and veal	-0.021	-0.027	-0.715	0.152	0.819	-0.127	0.053	0.264	0.123	0.060	0.179	0.134	0.109	0.129	-0.031	-0.451
Pork	0.076	-0.435	0.316	-0.766	0.152	-0.066	0.109	-0.046	-0.044	-0.062	0.103	-0.036	-0.260	0.449	0.196	0.727
Other meats	-0.337	1.087	0.262	0.183	-1.021	0.035	-0.228	0.020	0.411	0.189	-0.205	0.016	0.069	-0.043	-0.002	0.756
Poultry	0.234	-0.066	-0.235	-0.059	0.026	-0.596	0.062	0.019	-0.144	0.064	-0.145	0.090	0.035	-0.316	-0.104	2.500
Fish and seafood	0.627	-0.810	0.254	0.250	-0.436	0.161	-0.675	-0.299	0.201	-0.164	-0.190	0.199	0.054	0.445	-0.232	0.661
Fresh milk	-0.117	0.300	0.471	-0.040	0.015	0.018	-0.112	-0.797	0.144	0.243	0.056	0.015	0.250	-0.001	-0.173	-0.739
Processed dairy products	-0.146	0.009	0.209	-0.036	0.279	-0.132	0.071	0.140	-0.650	0.183	-0.044	-0.102	0.004	0.189	0.350	0.822
Eggs	-0.092	0.384	0.101	-0.050	0.128	0.059	-0.058	0.234	0.183	-0.826	-0.066	0.074	0.119	0.089	-0.026	0.877
Fats and Oils	0.234	0.166	0.303	0.084	-0.140	-0.023	-0.068	0.056	-0.044	-0.066	-0.643	0.084	-0.157	0.371	0.215	0.754
Fruit (fresh)	0.058	0.233	0.227	-0.030	0.011	0.083	0.071	0.018	-0.102	0.074	0.084	-0.857	0.232	0.047	-0.150	1.174
Vegetables (fresh)	-0.093	0.547	0.185	-0.213	0.047	0.032	0.019	0.241	0.004	0.119	-0.157	0.232	-0.571	-0.261	-0.386	0.903
Processed fruits and vegetables	-0.141	-0.303	0.218	0.367	-0.029	-0.289	0.159	0.002	0.189	0.089	0.371	0.047	-0.261	-0.023	0.416	0.308
Sugar and sweets	0.325	0.183	-0.053	0.160	-0.001	-0.095	-0.082	-0.162	0.350	-0.026	0.215	-0.150	-0.386	0.416	-0.278	0.588

Note: i) Estimates in bold are statistically significant at or below 5% level.
ii) Underlined elasticity estimates are not significant at 5% level.

Conclusion

The extent to which the demand for foods responds to price changes is an important economic question not only for policymakers, but also for retailers and other intermediaries in the USA and worldwide under the changing socioeconomic and business environment. Therefore, this study examines consumers' price and income sensitivity of demand for food for better understanding of price and expenditure elasticities for major food items in the USA. AIDS model of Deaton and Muellbauer (1980) was applied to examine the structure of demand for 15 major food items using national level monthly data from January 1959 to February 2016. The coefficient estimates seem to be reasonable and also most of the coefficients are significant. The negative intercepts for cereals and bakery products and positive intercepts for some protein intensive food categories like beef, pork, egg, milk, etc. indicate the changes in food preferences of the consumers' in the USA from carbohydrate to protein mostly due to health consciousness. The result also indicates that while the budget share of beef and veal, pork and other meats have increased, the share of food expenditure on poultry has slightly decreased. The declining expenditure share on fresh fruits and the rising share of processed fruits and vegetables are meaning shift in preference from fresh fruits to processed fruits and vegetables. This change can be attributed to lifestyle changes over the course of time. The growth or decline in the disaggregated food products is very important in explaining the shift in consumer preference for any aggregate food category.

The compensated own price elasticity indicate that all food items are price inelastic except other meats. The compensated cross price elasticity specify that beef and veal is a significant substitute for pork, other meats, fish and sea foods and eggs while complementary to poultry. Poultry is a significant substitute for cereals, fish and seafood, and eggs. Fresh milk and processed dairy products are substitutes for each other. Fresh fruits are also substitute of processed fruits and vegetables. Most of the food categories are normal based on expenditure elasticity. Cereals, bakery products, poultry and fruit (fresh) were expenditure elastic while pork, other meats, fish and seafood, processed dairy products, eggs, fats and oils, vegetables, processed fruits and vegetables and sugar and sweets were inelastic interpreting that those were of necessity. The findings of this study will be helpful for the policy makers to ensure food balance in the country as well as to formulate suitable production and distribution.

Investigation of changes in demographic characteristics in the USA may help to identify the sources of consumer preference shifts over time. Demand analysis provides as an important source of information related to own and cross price elasticity for intermediaries who are involved in food marketing related activities. In addition, there is a need to conduct separability tests to understand how consumers allocate their food budget into different food products.

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