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Demand Analysis of Selected Food Groups in Syria

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Table of Contents

Abstract

The new conditions of international trade as well as Syrian attempts to join the World Trade Organization (WTO), to strengthen partnership with the European Union (EU) and to interact within the Great Arab Free Trade Area (GAFTA) require giving priorities to food demand estimation in Syria in order to both cover adequately the increasing food demand from the population and the food industry and maintain food security in urban and rural areas. Therefore, this research focuses on food demand estimation in Syria using the Linear Expenditure System (LES).

As a consequence, the major activities and policies affecting food demand in Syria are briefly presented including macro policies, food policy development and foreign trade. Food availability and food consumption in Syria are overviewed giving special attention to descriptive characteristics. The main approaches and methods applied to demand analysis are briefly described focusing mainly on the LES models and the principles of the economic theory presented in the literature.

Based on above, various alternative approaches are applied to Syrian data. Hence, the basic parameter estimates, price elasticities and income elasticities are assessed using the single equation approach and the LES model six food groups namely: cereals & legumes, vegetables, fruits, meats & eggs, milk & its products and vegetable oils & fats. Then, a comparison between the estimates of this study and international estimates is conducted using the estimates of other demand studies as a benchmark. Consequently, the results of this research can be considered as consistent with both economic theory and international estimates. Furthermore, the data of the selected groups were used to conduct an Engel curve and nutrient intake analyses[1].

Finally, recommendations are made to conduct more accurate demand estimation and to improve the effectiveness of the analysis.

[1] It will be presented in a separate paper.

Chapter 1 - Background and Objectives of the Research

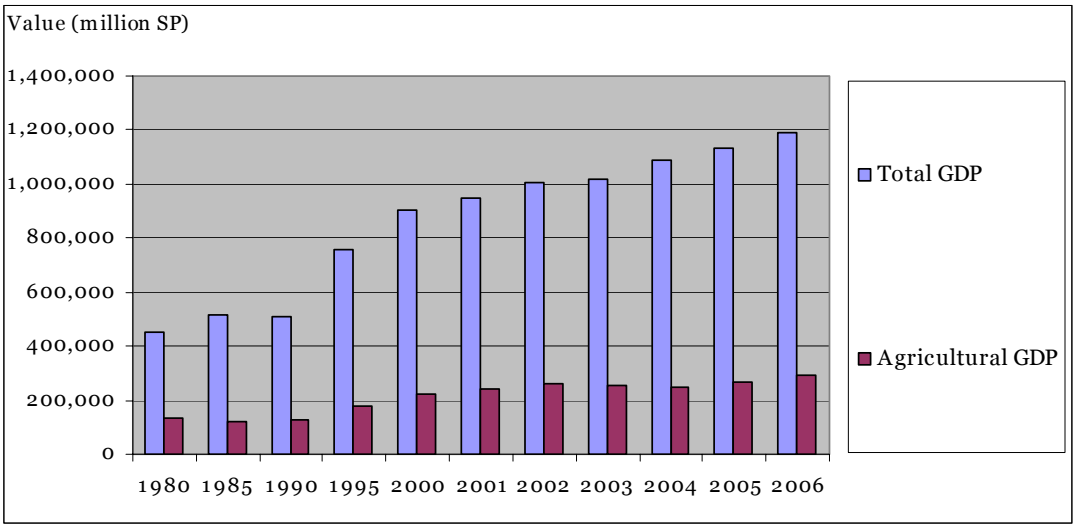
This chapter is dedicated to the statement of presenting the background and justification of the research, its objectives and expected output and its organization. The focus is also on illustrating the various activities and policies affecting food demand.

1.1. Relevance of the research in the national economy

Verkil (2004) illustrated the economic, social, environmental, and cultural roles of agriculture in the national economy. These functions of the agricultural sector have drawn the attention of the Syrian government since the 1980s for the following reasons:

- Agriculture has a high contribution to the GDP (Gross Domestic product). The share of agriculture in GDP was about 23-29 % in the past 25 years dominating economic growth together with the Mining & Manufacturing sector. This means that a large portion of the Syrian population relies on agriculture, economic growth of agriculture has a strong impact on reducing poverty level and improving food security, and there is a strong relationship between agricultural GDP and total GDP (Figure 1.1). The boost of economic growth in both Agriculture and Mining & Manufacturing impacted positively the growth in the per capita GDP at constant prices of 2000, which increased from 51.8 thousand SP in 1980 to 62.9 thousand SP in 2005.

Figure 1.1. Evolution of agricultural GDP and total GDP at constant prices of 2000, 1980-2005



Source: Elaborated from CBS, ASA, 2006.

- The agricultural sector contributes substantially to covering the increasing food demand of the population and the food industry. Thus, the state of food security will be stabilized.
- Agriculture supports the balance of payments and the export ability of the economy.
- Agricultural activities represent a main source of employment. The agricultural labor force amounts to about 26-30% of the total labor force of which 70% female and 30% male.

Accordingly, identifying the changes in consumer and market demands is essential to improve the profitability and competitiveness of the agro-food sector. In addition, Knowing demand structure and analyzing food consumption patterns are important for sectoral and macroeconomic policy analysis and the assessment of food security-related policy issues in the agricultural sector.

1.2. Development of agricultural and food policies

To achieve food security objectives and to improve the state of food security in the country policies in Syria had been oriented to attain high level of self-sufficiency until the early 1980s. However, this goal had led to inefficient use of domestic resources. Therefore, the market orientation has been necessary in order to adjust to global changes, to exploit the opportunities offered through international trade, and to improve the efficient use of domestic resources. As a result high levels of self-sufficiency ratios in a wide range of food commodities have been accomplished and agricultural exports have been boosted and diversified such as wheat, legumes, vegetables and fruits, with an attempt to enhance self-reliance in the other important crops (imported ones) according to the principle of economic efficiency, such as sugar, vegetable oils and fats, red meat, dairy products and the needed feeds for livestock (Table 1.1). In this regard, it is worthy to note that the produced olives are used either as table olives, which had a self-sufficiency ratio of 100% in 2005, or for the production of olive oil, which its self-sufficiency ratio amounted to 208% in 2005; the total quantity of milk is used either as fresh consumed milk, which had a self-sufficiency ratio of 100% in 2005 or as processed milk, which its self-sufficiency ration amounted to 85% in 2005.

Table1.1. Self-sufficiency and import dependency ratios for selected products, 1996-2004 (%)

Item	Self-sufficiency ratio (%)			Import dependency ratio (%)		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Wheat	111.1	99.4	141.2	1.2	0.0	5.1
Barley	86.0	26.5	150.7	29.4	0.0	73.5
Lentil	273.9	121.0	972.5	0.3	0.0	1.5
Chickpeas	127.0	90.9	218.7	4.7	0.0	15.1
Tomato	130.6	125.5	136.1	0.5	0.0	1.5
Potato	103.6	96.1	124.6	2.4	0.0	7.0
Olives	100.0	100.0	100.1	0.0	0.0	0.0
Citrus	103.0	101.1	105.5	0.7	0.0	2.2
Red meat	120.7	93.6	207.0	3.7	0.4	10.8
Poultry meat	100.0	100.0	100.1	0.0	0.0	0.0
Fish	83.8	55.6	100.0	16.2	0.0	44.8
Milk	100.1	100.0	100.8	0.1	0.0	0.6
Eggs	101.8	100.3	103.5	0.0	0.0	0.0
Sugar	45.3	9.5	100.0	54.7	0.0	90.5

Source: Elaborated from NAPC database.

Marketing

One of the most important goals of the Syrian Agricultural Strategy is to improve *marketing and processing* of agricultural products in order to increase the generated value added and export of these goods. Changes in marketing systems lead to income improvement, which in turn impacts the demand for food.

Pricing policy

Price and food distribution policies have their effects on food prices from both the supply and demand sides. High increases in food prices negatively affect the ability of consumers to get their food needs, especially within less privileged groups. This impact is exacerbated in cases of low cross elasticity.

Liberalization of marketing polices has gradually affected of the liberalization of price polices since 1987. Analyzing price policies before the policy reforms reveals that their main characteristics may be summarized in the following three main points:

1. Administering the prices of a large number of agricultural products, including food grains, potatoes, a number of fruit crops, onions, garlic, industrial crops, and animal feed crops;
2. Keeping administered prices fixed all the year round and for more than one year, irrespective of changes in amount or cost of production; and
3. Prevalence of large discrepancies between domestically administered prices and international prices for agricultural products.

On the other hand, main changes have been introduced to these policies since 1987 include:

1. Increasing the administered prices for all commodities delivered to governmental agencies, which included wheat, chickpeas, lentils, yellow corn, cotton, sugar beets, tobacco, soybeans, and groundnuts. Rates of increase ranged between 175% (for groundnuts) and 436% (for sugar beets) during the period 1986-98;
2. Establishing indicative price list for a number of products including poultry meat, milk, apples, grapes, garlic, and dry onions. These prices are not obliging, even for the public sector;
3. Leaving prices of the other products (vegetables, fruits, livestock and poultry products) to be determined according to market forces; and
4. Allowing the private sector to participate in the marketing of products handled by the public sector, without being obliged by their fixed prices.

Hence, post 1987 polices, the private sector has been allowed to buy and sell all products at market prices, except cotton, sugar beet and tobacco, witch have administered prices. The government provides also for guarantee prices for major crops, including wheat, chickpeas, lentils, barley, and maize. Marketing of industrial crops (cotton, sugar beet and tobacco) is still confined to the public sector, as they are manufactured by public sector plants. These changes in price polices have had their effect on retail prices for all consumer commodities.

Subsidy policy

Food subsidies are under the responsibility of the Economic Committee of the Prime Minister's Office. The Ministry of Economy and Trade and the Ministry of Finance usually prepare subsidy resolutions for discussion and approval by the Economic Committee. Main food commodities such as rice, sugar, and flour for bread had been subsidized for a long time, with the main objective of improving the living standard. This policy resulted in a huge burden on the government budget. Sugar and rice are distributed to consumers according to the ration cards at very limited quantities (reduced gradually) at prices equal to 35-50% of their international price; flour and bread prices are still subsidized.

Food industry

Food industry contributes in many ways to the development of a modern agro-food sector. It enhances income by adding value to raw agricultural products. It promotes modernization of the farming systems in terms of technological innovation as well as in terms of relations with the market. Moreover, it responds to consumers' demands for variety in type and quality of food

and contributes to smooth out seasonal variability of food supply, reducing its negative price effects on consumers and farmers. In Syria, food processing occurs at three levels simultaneously: farm level (traditional), village level (traditional), and industrial level (Grad 2004).

Due to the growth in agricultural production and the need to meet the demand of local markets for food commodities, several food processing plants were established by private, public, and joint sectors. These processing firms are basically involved in food preserving such as peas, tomatoes, chickpeas, jams, treacle, sugar refining, dairy products, and oils. Several food and oil processing plants were licensed under the investment Law No.10 of 1991. These plants obtain some of their raw materials from the local markets and import the remaining quantities. There are also firms of small size licensed under Law No. 103 of 1952, Law No. 3 of 1952 and Law No. 21 of 1958.

The major strategy that is proposed here, which has been tried successfully in many other developing countries, is to promote the establishment and operation of rural based non-agricultural small-scale companies. Such companies do not have to be included under the provisions of investment Law No. 10 of 1991, as the capital requirements for such companies and the bureaucracy involved are prohibitive. The idea is that such companies could produce a range of domestically demanded non-tradable products that would be demanded by rural residents. Given the density of rural areas in Syria, there seem to be ample opportunities for the establishment of such small enterprises. It appears that this is the most promising way to create a viable and thriving rural sector, as it would promote labor intensive enterprises with little initial capital requirements. In this regard, many rural development projects have been established.

Finally, the increasing urbanization in Syria affects the food spending patterns towards more convenient types of foods that easy and fast to prepare. This means that the trend towards fast food chains is increasing.

Foreign trade

Increasing integration of international markets is associated with less hunger, not more because poor access and integration with foreign markets limit the ability of countries where hunger is widespread to import enough food to compensate for shortfalls in domestic production. Trade will be beneficial for all countries because it leads to specialization of the countries in the products in which they have comparative advantages as well as to transition traditional food system, which is production oriented, to a modern food system, which is market oriented; see FAO, the state of food insecurity in the world (2003), Mustafa (1995), Saadi and Grad (2001), and Grad (2004). Accordingly, the main components of international trade are import and export policies, including agricultural and food trade.

Trade policies, which are import oriented, induce excluding of local commodities by imported ones. Overvalued exchange rate will lead also to such policies. Of course, government policies encourage local produced commodities. Thus, import should occur for a certain time of the year to meat domestic demand when domestic supply unable to cover it, and in combination with export policies. Import policies in Syria emphasize the added role of the private sector in ensuring the market efficiency. In addition to public sector, private sector is allowed to import food products.

Furthermore, export policies aims at making a positive balance of external trade and foreign exchange earning. Devalued exchange rate will lead to export promotion. Syria export policies highlight the added role of the private sector in export earning. The private sector is allowed to export food products. The exchange rate for export is currently liberalized.

It is expected an increase in the volume of agricultural and food trade because of the recent reforms in policies especially banking and exchange rate, the establishment of the Great Arab

Free Trade Area (GAFTA), the partnership with the EU, and the intention to joining the GATT (Table 1.2). Table 1.2 shows an increasing trend for total and agricultural trade regarding the absolute values and a decreasing trend for the relative share of agriculture.

Table 1.2. Evolution of Syrian total and agricultural trade, 2000 – 2005 (million US dollar)

Item	2000	2001	2002	2003	2004	2005	AGR 2000/2005 %
Total trade	8,733	10,033	11,938	10,854	12,446	18,533	16
Agricultural trade	1,621	1,701	2,368	2,223	2,518	2,559	10
Share of agricultural trade %	18.6	17.0	19.8	20.5	20.2	13.8	-6
Total imports	4,033	4,747	5,070	5,092	7,033	10,047	20
Agricultural imports	835	878	1,034	1,086	1,391	1,444	12
Share of agricultural imports %	20.7	18.5	20.4	21.3	19.8	14.4	-8
Total exports	4,700	5,286	6,868	5,762	5,413	8,486	13
Agricultural exports	786	823	1,333	1,137	1,127	1,115	7
Share of agricultural exports %	16.7	15.6	19.4	19.7	20.8	13.1	-5

Source: Elaborated from SAT 2005 and 2006, NAPC.
AGR: Annual Growth Rate (base 2000).

Finally, the growing complexity of the interrelations between Syrian agriculture and the other sectors of the Syrian economy especially the industrial and the trade sectors, the new conditions of international trade and the rapidly growing Syrian population require the use of adequate analysis tools such as those used in demand analysis to improve policy making, efficiency, food availability, and the nutritional status of the Syrian population.

1.3. Statement of objectives

"The objective of analyzing individual consumer behavior is to explain the level of demand for the commodities an individual consumes given the structure of relative prices faced, real income, and a set of individual characteristics such as age, education, professional status, type of household to which he belongs, and geographical environment (for example, rural versus urban)"; see Sadoulet and de Janvry (1995). Accordingly, the objective of the this research is analyzing individual consumer behaviors in Syria and determining the level of demand for the major food groups, comprising cereals & legumes, vegetables, fruits, meats & eggs, milk & its products and vegetable oils & fats, given the structure of relative prices and income for food security and policy making objectives. Hereby, both a single equation approach and a system of demand equations approach are used to assess the demand estimates. These estimates can be used to perform a welfare analysis of markets, poverty, and inequality measurement, to estimate a social welfare function given by the sum of consumer and producer surplus and to carry out taxation analysis. In addition, the relationship between food expenditure and total expenditure (Engel laws) is studied and the changing structure in food consumption is depicted. Hence, the main findings of the research can be summarized as follows:

1. **The estimated models and their parameters**

   These models are necessary for demand projection and policy making especially for partial equilibrium analysis. Their parameters are tested if they coincide with the economic theory. Some applications can be:

   - Policy interventions to improve the nutritional status of particular individuals, households, or individuals within households such as infants and pregnant

women and to compare the income elasticity of calorie intake with the income elasticity of food expenditure.

- Analysis of the country strategy of food subsidies to minimize the budgetary cost of nutritional improvement of the malnourished.
- Sectoral and macroeconomic policy analysis to improve welfare and efficiency. For example, conducting a sensitivity analysis of the market equilibrium by various scenarios, and building a welfare function.

2. **The estimated elasticities (own price, cross price, and income)**

   The elasticities can be used for demand projection and decision making. They can also be used to determine the nature of goods (non-giffen goods, giffen goods, gross substitutes, gross complements, normal goods (luxury, necessity), neutral goods, and inferior goods.

To perform the above mentioned tasks, the paper is divided into 3 chapters. The first chapter is concerned with the background and justification of the research. Therefore, the main activities and policies affecting food demand are explained to deduce the importance of this finding in the context of a general understanding of the Syrian economy. The second chapter conducts a descriptive analysis of the selected food groups including the evolution of the availability of the major components of agricultural production and their shares in total expenditure. A descriptive analysis is performed to examine the existence of rational consumption behaviors. Food consumption is also overviewed. The third chapter explains the theoretical background of demand estimation based on previous research done and the various approaches used (system approach, single equation approach) in order to enable conducting the analysis and making use of the theory to be applied to Syrian data. Then, the Linear Expenditure System (LES) is used to conduct the assessment using Syrian data taking into account the single equation models and Engel curve analysis. Finally, the demand estimates (results) are discussed in the light of economic theory and previous research done and concluding remarks are made.

Chapter 2- Demographics and the Trends in Food Availability, Food Consumption and Expenditure

Food security has been constantly a major and fundamental objective of agricultural development in Syria. Up to the mid 1980's, agricultural strategies and policies were geared towards assuring self-sufficiency in important and strategic food commodities. Large-scale programs of natural resource mobilization and government intervention in agricultural activities under a central planning system led to exceptional increases in agricultural production. The price policies for inputs and outputs as well as other government intervention measures, particularly in marketing, introduced however serious price distortions which led to inefficiencies in resource use and proved ineffective in ensuring high levels of overall self-sufficiency. They represented also a heavy burden on government budget.

The policy reform program, introduced thereafter, aimed at removing or reducing these distortions, thus ensuring increasing efficiency in domestic resources use. Initially input subsidies were reduced, producer prices were augmented and planning intervention started being less rigid. At a later stage, at the end of the 90', trade liberalization policies were put in place. Crop diversification policies were also promoted and increased attention was given to the comparative advantages of Syrian agriculture. The concept of self-reliance was gradually substituting the concept of self-sufficiency and this implied a more active participation of the country in international trade. Agricultural trade expanded and played a more important role than in the past in achieving food security. Policies aiming at making exports more competitive in international markets were implemented with success. At present agricultural trade is an essential element for the country's food security.

Studies undertaken on food consumption in Syria are, more or less, confined to two major issues, family budget surveys undertaken by the Central Bureau of Statistics, and food balance sheets prepared and published by the Department of Food and Nutrition of the Directorate of Agricultural Economic and Investment of the Ministry of Agriculture and Agrarian Reform (MAAR). This same division also undertakes field studies to estimate annual food budgets for a limited sample selected according to given bases. This chapter presents only a general review of food availability and the descriptive analysis of selected major components of agricultural production based on the relevant official statistics for the period 1980-2005.

2.1. Population

In addition to prices and income, population growth is considered as a major determinant of food demand.

Early 2005, the population of Syria amounted to about 18 millions out of which 51% female and 49% male, or 53% urban and 47% rural. The Syrian inhabitants are characterized for their young structure because 62% of the people are below 24 of age.

The Syrian population is distributed approximately evenly between rural and urban inhabitants and characterized by a process of urbanization. During the period 2000-2005 the annual growth rate amounted to 1.1% for rural and 4.4% for urban indicating a diminishing share for rural and an increasing share for urban.

The agricultural labor force constituted 17-25% of the total labor force from 2000 to 2005 showing a sharp decrease in 2004 and 2005. This plummet diminishing is related to the development of the other sectors of the economy accompanied with their increasing demand for labor force, while the agricultural sector is limited in scope to offer new job opportunities because of adopting advanced technologies and the lower intensification in irrigated areas due to water shortages and varied climatic conditions, which affected negatively the seasonal labor force. Therefore, there is also continuous immigration to urban areas and to neighboring countries as well.

The female labor force makes up 30% of total labor force, of which 50% is operating in agriculture. This means that the agricultural sector has the major share of female employment.

Syria is characterized by a high population growth. The annual growth rate of the population amounted to 2.8% during the period 2000-2005. This high growth rate lays high pressure on employment and farm size, which in turn affect income and food demand.

2.2. Major components of food availability

The diverse climatic conditions in Syria enable the production of a wide variety of agricultural products such as cereals, legumes, vegetables, fruits, and animal products, which enhances both the competitiveness of these products on the one hand and the ability to modify the components of the crop rotation to meet the demands of both local consumers and foreign markets.

Cereals

Cereals comprise wheat, barley, maize, sorghum, rice and oat. However, only wheat and rice are important for food demand estimation because the others are considered feed crops. Rice is totally imported. Wheat has both administered prices (indicative) and free market prices. Limited quantities of rice are distributed by ration cards. This group is considered very important as source of vegetable (vegetal) protein and carbohydrates for the Syrian inhabitants. Cereals are consumed in the form of bread, crushed wheat, flour, rice, macaronis & noodles and others. Its consumption differs by urban, rural, governorates and expenditure groups[2]. There are 10 expenditure groups from low to high expenditure.

Legumes

There are two kinds of legumes: food legumes and fodder legumes. Demand estimation conducted in this research focuses on legumes used for food consumption. This group includes lentils, chick- peas, dry broad beans, dry haricot beans, dry peas, and dry kidney beans and represents an important source of both vegetable protein and carbohydrate for the Syrian population. Lentil and chickpeas are economically the most important crops because of their nutritional value and export earning potential. Therefore, the Syrian government purchases these two products when they are delivered. The consumed quantities of this group vary by urban, rural, governorates and expenditure groups.

Industrial crops

This sub-sector encompasses cotton, sugar beet, soy beans, oily sun flower, sun flower, Indian millet, tobacco, peanut, sesame, aniseed, cumin, lupines, black cumin, and others. The importance of this group for demand estimation results from both its use for the extraction of

[2] CBS, Family expenditure survey, 2003-2004.

vegetable oils and sugar (cotton, soy beans, oily sun flower, sugar beet) and its inclusion of export oriented crops (cumin and black cumin). As before, the demographic dimensions (urban, rural, governorates and expenditure groups) affect to a great extent the consumption of these goods.

Vegetables

This group incorporates green peas, green broad beans, green haricot beans, green kidney, cucumber, snake cucumber, eggplant, pumpkins, lettuce, green onion, leaf beat, cauliflower, cabbages, potatoes, tomatoes, dry onion, green pepper, okra, squash, dry garlic, water melon, musk melon and others. Demographic patterns and the increasing trend in export liberalization have enormous impact on the demand for vegetables. Such goods represent a core component of a healthy diet.

Fruits

This group consists of olives, grapes, apples, pistachio, citrus, pomegranate, apricots, cherries, almonds, green plums, plums, pears, peaches, quince, nuts, figs, loquats, and palm. The most important trees are olives, citrus, apples, and grapes. The major part of olives is used for olive oil production. This sub-sector is promising because of the increasing trend in export liberalization. Again, demographics and export promotion affect considerably the demand for fruits. In this regard, fruits contribute substantially to the nutritional status of the Syrian population.

Animal products

They can be classified into 4 major groups namely: milk & dairy products, meat, eggs and others. The other products comprise honey, honey wax, silk cocoons, fish, skin, animal hair and wool. This group has a potential impact on a healthy diet to balance vegetal and animal protein. Therefore, a great attention has to be given for the demographic aspects.

2.3. Availability of foodstuffs for consumption

2.3.1. Total availabilities

The considerable growth of agricultural production realized in the last decades enabled Syria to meet the fast growing demand for food both raw and processed, resulting from the high population growth, improvement of income and expanding agro-industrial sector. Thus, self-sufficiency ratios improved for a wide range of food commodities leading to large surpluses in some commodities, which started being exported such as wheat, legumes, potatoes, vegetables and fruits.

In this section, the review of availability in the period under study is based on the annual food balances prepared by the Ministry of Agriculture and Agrarian Reform. These food balances define the quantities "Available for Consumption" for a given commodity as equal to Production + Imports – Exports. They include therefore not only quantities available for food but also for other uses such as seeds, losses, waste and changes in stocks. In the absence of comprehensive Supply/Utilizations Accounts for agricultural commodities, they remain the best indicator available for the review of the evolution of food supply in Syria.

Table 2.1 illustrates the descriptive statistics of the total availabilities for the selected food groups during the period 1982 – 2005 indicating a moderate variability around the trend line excluding vegetable oils & fats, which shows a high variability as a result of the considerable improvement of this sector. The annual rate of growth was positive for all groups attaining its highest value by vegetable oils & fats excluding vegetables, which showed a negative growth rate.

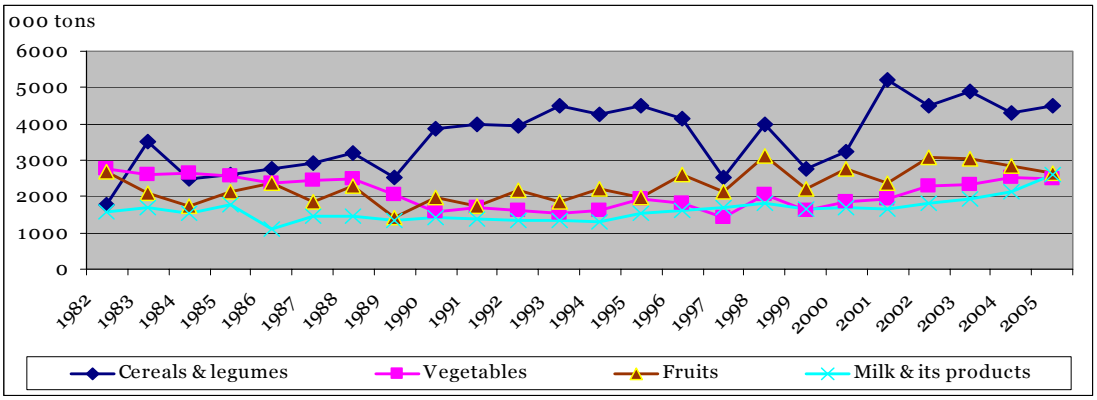
Table 2.1. Summary statistics of the total availabilities for selected food groups, 1982-2005 (000 tons)

Item	Mean	Minimum	Maximum	AGR %	CV %
Cereals & legumes	3,621	1,759	5.221	2.5	19.0
Vegetables	2,095	1,439	2,749	-0.9	19.2
Fruits	2,306	1,431	3.122	1.7	17.1
Meats & eggs	362	261	557	3.2	13.3
Milk & its products	1,621	1,121	2,608	1.7	15.4
Vegetable oils & fats	177	55	352	8.4	38.9

Source: Elaborated from MAAR, The Annual Agricultural Statistical Abstract, various issues and CBS, The ASA, various issues.

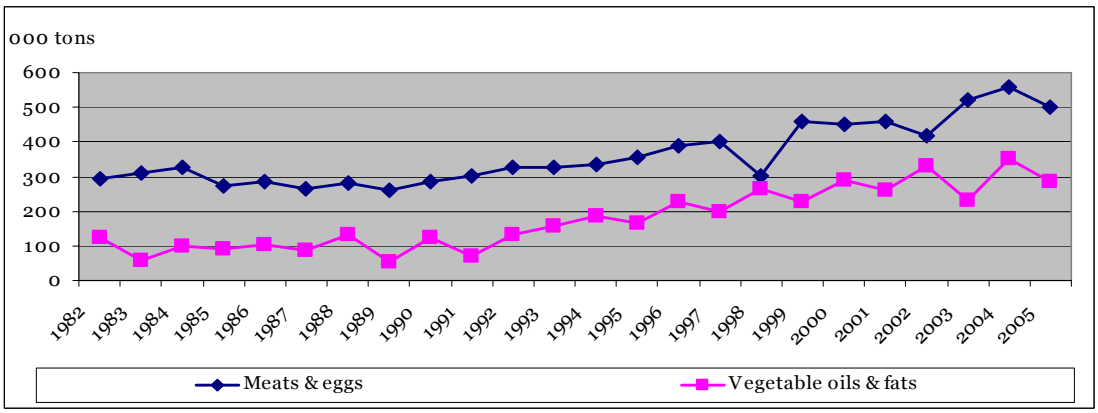
Figure 2.1 illustrates the evolution of the total availability of cereals & legumes, vegetables, fruits and milk & its products from 1982 to 2005. For the same period, Figure 2.2 depicts the evolution of the total availability for meats & eggs and vegetable oils & fats. The figures show an increasing trend for all groups except for vegetables, which follow a decreasing trend.

Figure 2.1. Evolution of total food availability by selected food groups, 1982-2005 (000 tons)



Source: Elaborated from MAAR, The Annual Agricultural Statistical Abstract, Various issues and CBS,The ASA, various issues.

Figure 2.2. Evolution of total availability by other selected food groups, 1982-2005 (000 tons)



Source: Elaborated from MAAR, The Agricultural Annual Statistical Abstract, Various issues and CBS, The ASA, various issues.

2.3.2. Per capita availabilities

Availabilities can be better assessed on a per capita basis. Per capita availability changed in line with the evolution of total availabilities for almost all food groups.

Table 2.2 shows the descriptive statistics of the per capita availability for the selected food groups during 1982 – 2005 indicating a moderate variability around the trend line excluding meats & eggs, which showed a low variability. The annual rate of growth was negative for all groups attaining its highest value by vegetables excluding vegetable oils and fats, which showed a positive growth rate.

Table 2.2. Summary statistics of per capita food availability for selected food groups, 1982-2005 (kg/person)

Item	Mean	Minimum	Maximum	AGR %	CV %
Cereals & legumes	266	168	280	-0.5	19.0
Vegetables	163	96	242	-4.6	26.2
Fruits	172	122	203	-1.6	17.4
Meats & eggs	26	19	27	-0.2	12.1
Milk & its products	121	94	144	-1.6	16.4
Vegetable oils & fat	12	5	17	3.8	26.3

Source: Elaborated from MAAR – The Annual Agricultural Statistical Abstract, Various issues and CBS, The ASA, various issues.

Figure 2.3 depicts the evolution of the per capita availability for cereals & legumes, vegetables, fruits and milk & its products from 1982 to 2005. For the same period, Figure 2.4 illustrates the evolution of the per capita availability for meats & eggs and vegetable oils & fats. The figures show a decreasing trend for all groups except for cereals & legumes and vegetable oils & fats, which followed an increasing trend.

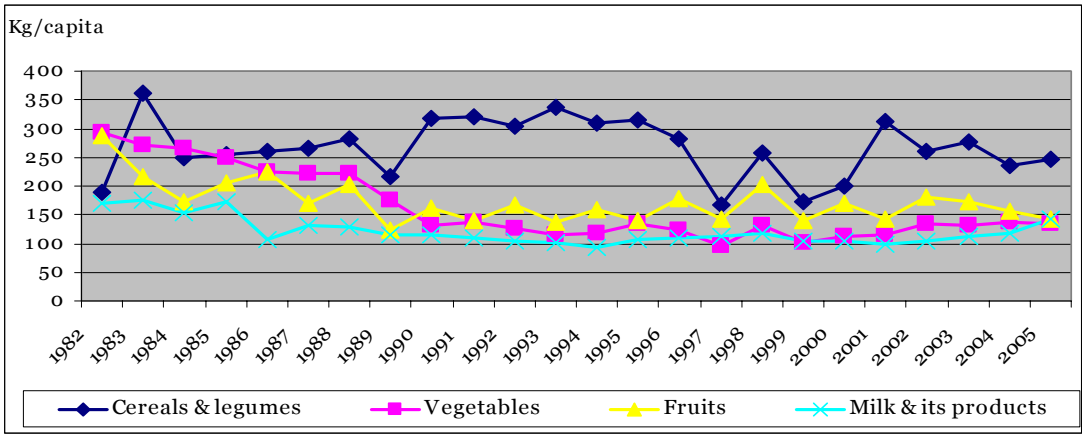
2.3.3. Nutrient intakes

The food balance sheets published by FAO and MAAR have been used to illustrate the evolution of calorie, protein and fat intakes.

There has been an enormous improvement in the standard of living of urban and rural areas accompanied with an increase of the per capita availability of food products leading to an average enhancement of the per capita calorie intakes from 2,350 kilo calories (kcal) per day in the 1970s to 3,200 kcal per day in recent years.

Table 2.3 traces the evolution of the major nutrient intakes per capita per day in Syria from 2000 to 2004[3].

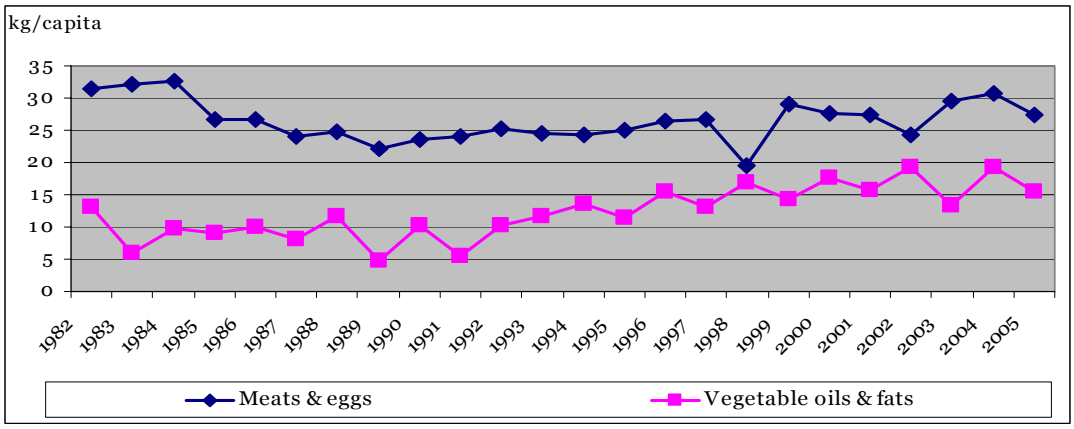
Figure 2.3. Evolution of the per capita availability for various food groups, 1982-2005 (kg/person)



Source: Elaborated from MAAR – The Annual Agricultural Statistical Abstract, Various issues and CBS, The ASA, various issues.

[3] Data of 2003 and 2004 elaborated from MAAR, Directorate of Agricultural Economics.

Figure 2.4. Evolution of the per capita availability for meats & eggs and vegetable oils & fats, 1982-2005 (kg/person)



Source: Elaborated from MAAR – The Agricultural Annual Statistical Abstract (AASA), Various issues and CBS, ASA, Various issues.

Table 2.3. Daily intakes of major nutrients in Syria, 2000-2004

Item	Unit	2000	2001	2002	2003	2004	Index 2000-2004 %
Total calories	kcal	3,052	3,038	3,038	3,193	3,390	111
From vegetal sources	kcal	2,635	2,670	2,625	2,851	3,004	114
From animal sources	kcal	417	368	413	342	386	93
From vegetal sources	*%*	*86*	*88*	*86*	*89*	*89*	*103*
From animal sources	*%*	*14*	*12*	*14*	*11*	*11*	*83*
Total protein	Gram	74.8	74.7	77.0	86.0	86.7	116
From vegetal sources	Gram	53.4	55.5	55.4	65.0	63.8	119
From animal sources	Gram	21.4	19.2	21.6	21.0	22.9	107
From vegetal sources	*%*	*71.4*	*74.3*	*71.9*	*75.6*	*73.6*	*103*
From animal sources	*%*	*28.6*	*25.7*	*28.1*	*24.4*	*26.4*	*92*
Total fat	Gram	104.5	100.4	105.0	74.0	96.0	92
From vegetal sources	Gram	71.8	71.2	72.8	54.0	73	102
From animal sources	Gram	32.7	29.2	32.2	20.0	23	70
From vegetal sources	*%*	*68.7*	*70.9*	*69.3*	*73.0*	*76.0*	*111*
From animal sources	*%*	*31.3*	*29.1*	*30.7*	*27.0*	*24.0*	*77*

Source: Elaborated from FAOSTAT and MAAR.

Table 2.3 indicates an increasing trend of total calorie intakes and calorie intakes from vegetal sources during 2000-2004. For the same period, on the other hand, there was a decreasing trend for the calorie intakes from animal sources. It can be noticed also that most of the calories are obtained from vegetal sources and the share of calories from animal sources is decreasing. The protein intakes are increasing during the studied period, but the share of animal protein is decreasing. Both the total intakes of fat and the fat intakes from animal sources are diminishing.

Table 2.4 shows the descriptive statistics of the shares of various food groups in total calorie intakes during the period 1982-2005. Accordingly, most of the calories are obtained from cereals & legumes.

It is useful to compare the per capita intake of calories, proteins and fats distributed by vegetal and animal origin in Syria to those of other countries. For this purpose four Arab countries have been selected namely Lebanon, Jordan, Morocco and Tunisia, in addition to Turkey, France, Italy and the USA. The choice of countries of different levels of income has been made to show the effect of per capita income on the structure of calories and nutrient intakes. Figure 2.5

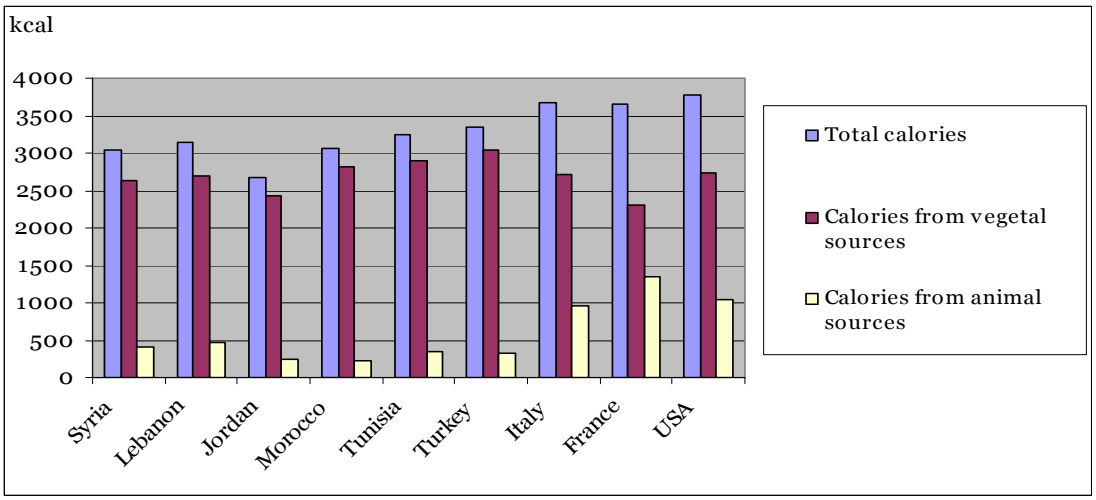
compares between calorie intakes by countries in 2002. Figure 2.6 illustrates the protein and fat intakes by the same countries in 2002 as well. These figures imply large differences among the selected countries.

Table 2.4. Summary statistics of the shares of various food groups in total calorie intakes, 1982-2005 (%)

Item	Mean	Minimum	Maximum
Cereals and legumes	60.8	46.6	69.3
Vegetables	6.4	4.3	12.0
Fruits	7.3	4.7	10.4
Meats & eggs	4.3	3.3	6.5
Milk & its products	6.0	4.2	9.0
Vegetable oils & fats	6.9	2.4	12.4
Others	8.3	1.9	13.2
Total	100.0		

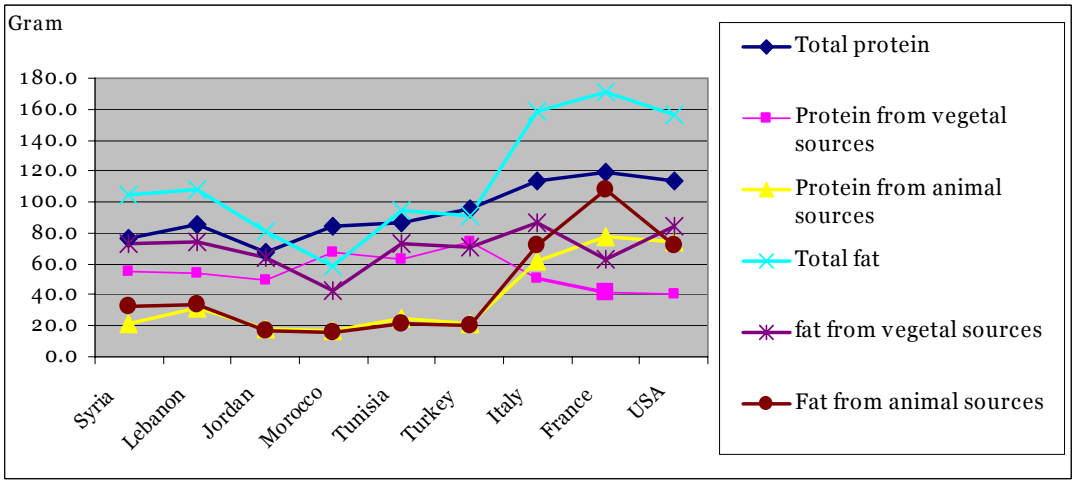
Source: Elaborated from MAAR, The Annual Agricultural Statistical Abstract, Various issues.

Figure 2.5. Calorie intakes by countries, 2002



Source: Elaborated from FAOSTAT.

Figure 2.6. Protein and fat intakes by countries, 2002



Source: Elaborated from FAOSTAT.

In 2002, the total daily per capita calorie intake was 3,153 kcal in Lebanon, 3,038 kcal in Syria, and 2,673 kcal in Jordan. Calories of animal sources amounted to 469 kcal in Lebanon, 413 kcal in Syria, and 246 kcal in Jordan. Per capita consumption of protein was higher in Lebanon (85.4 g /day) than that in Syria (77 g /day) and in Jordan (67.4 g /day). Similar pattern is observed for fat consumption. Syria had the same level of calorie intake as Morocco. The percentage of total calories of vegetable origin was higher in this country (92%) and so was the intake of protein (85 g/day). The average daily calorie consumption in Syria in 2002 was lower than that in Tunisia and Turkey by an average of about 250 calories. Protein intake was also lower than in these two countries.

When comparing food consumption of Syria in terms of calorie and nutrient intake to high income countries in 2002, the daily-consumed calories were 3,654 kcal in France, 3,671 kcal in Italy, and 3,774 kcal in USA. These levels are higher than in Syria (by more than 600 calories per day) and reflect the income effect and the differences in consumption patterns. Moreover, the share of calories of animal sources in these countries is higher than that in Syria and represented 37 % in France, 26% in Italy, and 28 % in USA.

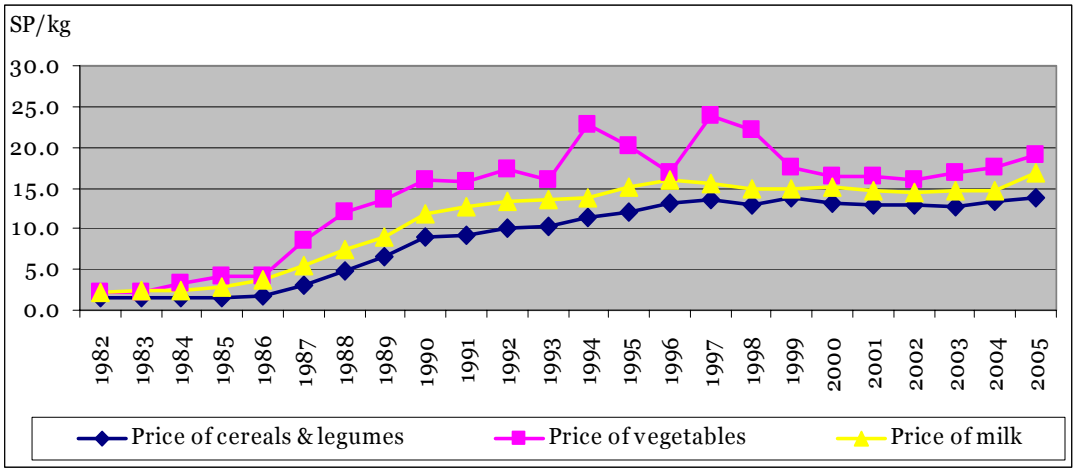
In conclusion, it should be noted that the level of per capita daily calorie intakes in Syria is well above the UN established minimum daily requirements according to the average nutritional food standards. The total availability of food commodities and stability of supplies have been secured in line with the demand and the changing consumption habits. Data available suggest that the availability and access may have improved in the period under consideration thanks to the policies followed (particularly the producer and consumer price support policies).

2.4. Prices, total expenditure and food expenditure

Prices, income and changes in food consumption are key determinants of food demand.

Figure 2.7 traces the evolution of the current retail prices for cereals & legumes, vegetables and milk over the period 1982-2005 indicating an increasing trend of the prices and an inverse relationship between the prices of these groups and the consumption level.

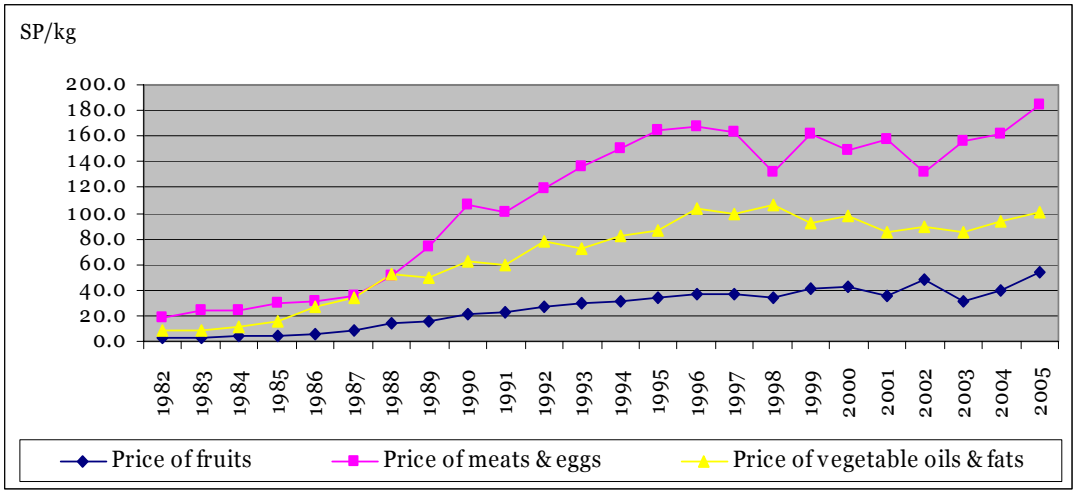
Figure 2.7. Evolution of the current prices of selected food groups, 1982-2005 (SP/kg)



Source: Elaborated from MAAR, The Annual Agricultural Statistical Abstract, Various issues and CBS, The ASA, Various issues.

Figure 2.8 depicts the evolution of the current retail prices for fruits, meats & eggs and vegetable oils & fats indicating an inverse relationship between the price and consumption level except for vegetable oils & fats, which show a positive relationship.

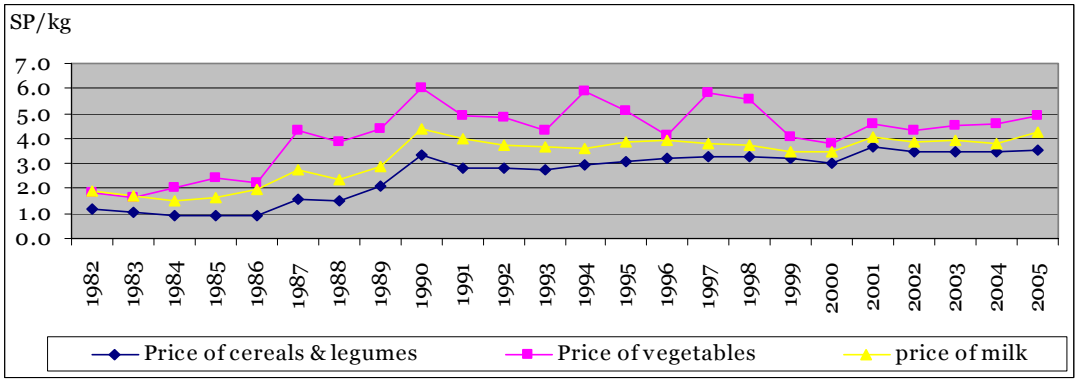
Figure 2.8. Evolution of the current prices of other selected food groups, 1982-2005 (SP/kg)



Source: Elaborated from MAAR, The Annual Agricultural Statistical Abstract, Various issues and CBS, The ASA, Various issues.

Figure 2.9 illustrates the evolution of the deflated retail prices by the General Consumer Price Index (GCPI) considering 1980 as base year for cereals & legumes, vegetables and milk over the period 1982-2005 indicating an increasing trend. The trend line is highly significant at the 5% level of significance.

Figure 2.9. Evolution of the deflated prices of selected food groups, 1982-2005 (SP/kg)



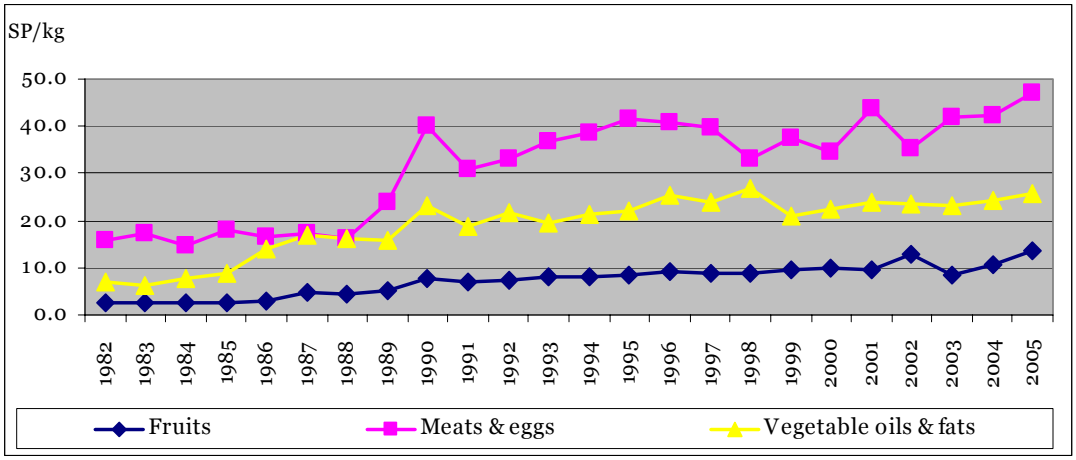
Source: Elaborated from MAAR, The Annual Agricultural Statistical Abstract, Various issues and CBS, The ASA, Various issues.

Figure 2.10 illustrates the evolution of the deflated retail prices by the GCPI (base 1980) for fruits, meats & eggs and vegetable oils & fats over the period 1982-2005 indicating an increasing trend. The trend line is highly significant at the 5% level of significance.

Figure 2.11 depicts the evolution of the current and deflated[4] (real) total per capita expenditure and per capita food expenditure pointing out to an increasing trend. The trend lines are highly significant at the 5% level of significance.

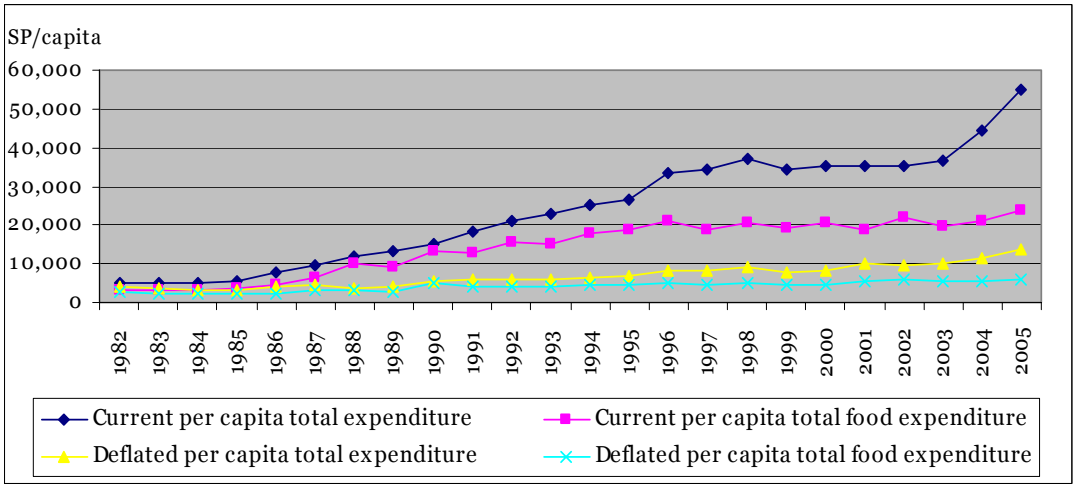
[4] The deflator is the GCPI base 1980.

Figure 2.10. Evolution of the deflated prices of other selected food groups, 1982-2005 (SP/kg)



Source: Elaborated from MAAR, The Annual Agricultural Statistical Abstract, Various issues and CBS, The ASA, Various issues.

Figure 2.11. Evolution of the current and deflated per capita expenditure, 1982-2005 (SP/person)



Source: Elaborated from MAAR, The Annual Agricultural Statistical Abstract, Various issues and CBS, The ASA, Various issues.

Table 2.5 illustrates the descriptive statistics of the current and deflated retail prices of the individual food groups over the period 1982-2005 indicating moderate variations around the trend line.

Table 2.5. Summary statistics of the current and deflated retail prices, 1982-2005 (SP/kg)

Item	Current prices			Deflated prices			
	Mean	Min	Max	Mean	Min	Max	CV %
Cereals & legumes	9.0	1.4	13.9	2.6	0.9	3.6	21.5
Vegetables	14.2	2.2	23.9	4.2	1.7	6.0	26.8
Fruits	26.2	3.2	53.8	7.3	2.5	13.7	14.9
Meats & eggs	109.5	19.1	185.0	31.5	14.8	47.1	18.7
Milk & its products	11.1	2.3	16.8	3.3	1.5	4.4	19.1
Vegetable oils & fats	66.6	8.2	106.5	19.1	6.2	26.8	20.3

Source: Elaborated from NAPC database and CBS, The ASA, Various issues.
Min: Minimum. Max: Maximum. CV: Coefficient of variation.

Table 2.6 depicts the descriptive statistics of the current and deflated per capita food expenditure and per capita total expenditure from 1982 to 2005 indicating moderate fluctuations.

Table 2.6. Summary statistics of the current and deflated expenditures, 1982-2005 (SP/capita)

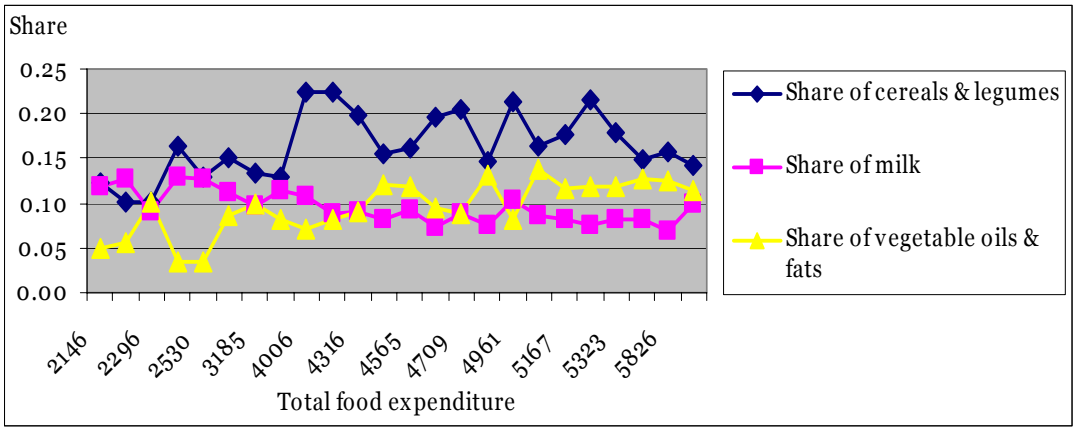
Item	Current expenditures			Deflated expenditures			
	Mean	Min	Max	Mean	Min	Max	CV %
Cereals & legumes	2,455	364	4,056	704	230	1134	30.5
Vegetables	1,957	610	2,924	615	409	955	21.6
Fruits	4,205	734	8,793	1206	535	2351	18.9
Meats & eggs	2,868	600	5,060	828	396	1297	19.5
Milk & its products	1,262	368	2,387	381	205	608	16.5
Vegetable oils & fats	1,524	106	2,801	422	78	724	16.5
Total food expenditure	14,270	3,052	23,880	4157	2146	6079	12.8
Total expenditure	32,745	5,323	54,836	6852	3063	13960	18.8

Source: Elaborated from NAPC database and CBS, The ASA, Various issues.

Graphical analysis is important to verify whether the data reflect rational or optimizing behavior of the consumer. Visual inspection should provide an answer to the relation between the share consumed of a good and the logarithm of income (Engel curves). Engel Law implies that *the share devoted to food decreases as income increases*.

Figure 2.12 traces the evolution of the budget shares of various food groups subject to the total per capita food expenditure over the period 1982-2005. Accordingly, as income increases, the share is increasing for both cereals & legumes and vegetable oils & fats, whereas it is decreasing for milk.

Figure 2.12. Evolution of the shares of various food groups subject to per capita food expenditure, 1982-2005



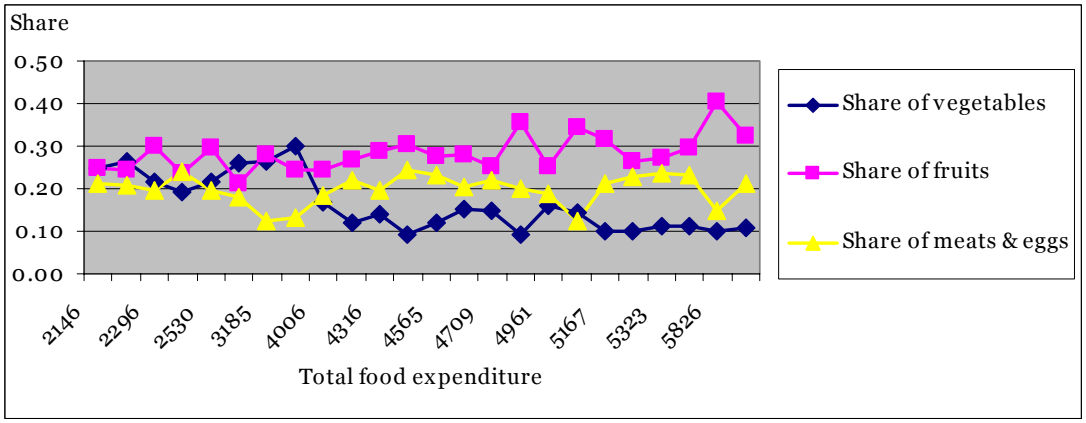
Source: Elaborated from MAAR, AASA, Various issues; CBS, ASA, Various issues; NAPC database.

Figure 2.13 depicts the same relationship, but for other food groups. The devoted share is increasing for fruits and decreasing for both vegetables and meats & eggs.

Figure 2.14 depicts the relationship between the share of the food expenditure in total expenditure and logarithm of total expenditure. The figure shows an inverse relationship between the share of food in total expenditure and income increase complying with Engel Law.

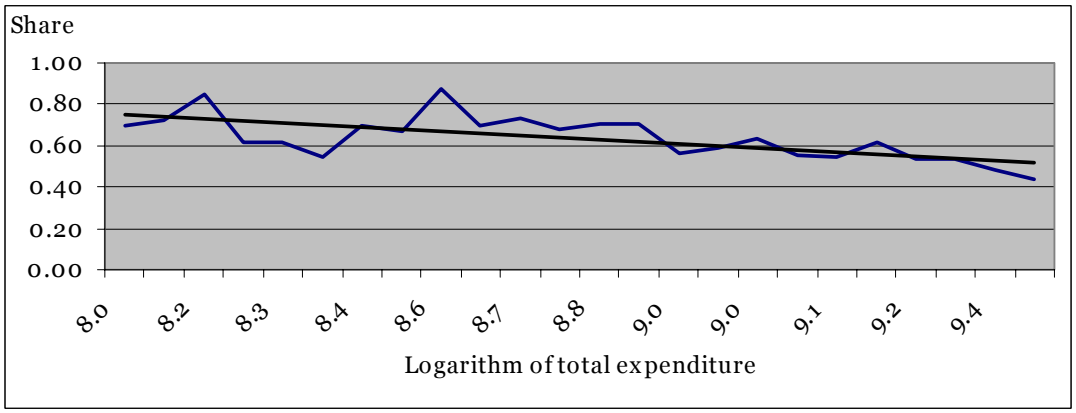
The CBS undertakes periodic family budget surveys. These surveys are normally based on representative samples drawn from groups of different consumption expenditure levels and patterns, from all regions of the country.

Figure 2.13. Evolution of the shares of other food groups subject to per capita food expenditure, 1982-2005



Source: Elaborated from MAAR, AASA, Various issues; CBS, ASA, Various issues; NAPC database.

Figure 2.14. Share of food expenditure in total expenditure



Source: Elaborated from MAAR, AASA, Various issues; CBS, ASA, Various issues; NAPC database.

Table 2.7 covers the food surveys conducted in the period 1996-2007 including urban and rural population where the last official survey was in 2007. There are differences in food expenditure between rural and urban population. The portion of total expenditure devoted to food decreased for both groups during the considered period. The major food expenditure is spent for meat, fish, and eggs, cereals and its products, and vegetables. Structural changes in consumption are to observe for both urban and rural population.

The data used in this research are annual time series data on personal consumption expenditure, prices, aggregate consumption and private consumption expenditure obtained from the official statistics of Syria as well as from international sources. The major sources for obtaining the data are: the Syrian Ministry of Agriculture and Agrarian Reform (MAAR) including the Central Administration, Directorate of Agricultural Economics, and National Agricultural Policy Center (NAPC), Syrian Central Bureau of Statistics (CBS); and Food and Agriculture Organization of the United Nations. The used publications are Annual Agricultural Statistical Bulletins (MAAR), Annual Statistical Bulletins (CBS), FAOSTAT (FAO) and database (NAPC). The data cover the period 1982-2005.

Table 2.7. Composition of food expenditure, 1985 – 2004 (%)

Item	1996-1997				2003-2004				2006-2007			
	% on food expenditure		% on total expenditure		% On food expenditure		% on total expenditure		% on food expenditure		% on total expenditure	
	U	R	U	R	U	R	U	R	U	R	U	R
Cereals and its products	13.4	18.0	8.0	10.8	11.5	16.9	4.37	7.50	10.5	13.7	4.12	6.41
Dry legumes	1.4	1.8	0.8	1.1	1.0	1.3	0.38	0.57	1.5	2.1	0.58	0.99
Meat, fish and eggs	21.6	16.9	12.9	10.2	19.8	17.8	7.58	7.86	22.2	18.5	8.69	8.66
Dairy products	9.2	7.3	5.5	4.4	10.1	8.6	3.85	3.80	9.4	8.1	3.68	3.78
Oils and fats	9.6	13.1	5.7	7.9	9.6	11.6	3.68	5.11	7.8	11.6	3.06	5.45
Vegetables	16.0	16.6	9.5	10.0	16.6	16.7	6.33	7.41	15.8	17.0	6.18	7.98
Fruits and nuts	7.9	5.6	4.7	3.4	8.3	6.2	3.16	2.77	8.7	7.2	3.40	3.40
Other food products	20.9	20.7	12.3	12.4	23.1	20.9	8.84	9.26	24.1	21.8	9.43	10.24
Total food expenditure	100.0	100.0	59.4	60.2	100.0	100.0	38.2	44.3	100.0	100.0	39.1	46.9

Source: Elaborated from NAPC database and CBS, Family budget survey, 2003-2004.
U: Urban. R: Rural.

Finally, to organize the basic time series data for applying demand estimation models several special transformations are required. The individual food groups comprise cereals & legumes, vegetables, fruits, meats & eggs, milk & its products and vegetable oils & fats. The per capita quantity demanded is calculated through dividing the aggregate consumption by the number of population for each food group. The weighted prices of each group are estimated with weights determined according to the quantities within the group. Milk products were transformed to milk equivalent. Prices, income and food expenditure were deflated by the corrected general consumer price index. Then, the individual expenditure of each group, total food expenditure and respective shares were assessed.

2.5. Acquisition of food

The ability of the less privileged groups of the population to continue having access to food they need depends on different factors among which price and income are very important. In fact, the evolution of prices and income affects not only the quantities of food consumed but also the structure of this consumption through the substitution effect.

Data on consumer price index (CPI), index of per capita GDP and index of per capita private expenditure on GDP were reviewed to assess the possible effects of the evolution of price and income on access to food in the period 2000-2005 (Table 2.8).

Table 2.8. Evolution of the consumer price index and the indices of other economic aggregates (base 2000), 2000-2005 (%)

Item	2000	2001	2002	2003	2004	2005	AGR % 2000-2005
General CPI	100	103	104	109	114	123	4.2
CPI of food	100	105	103	107	113	122	4.1
Index of per capita GDP	100	105	107	110	124	146	7.9
Index of per capita FPC	100	101	101	104	127	156	9.3

Source: Elaborated from CBS, ASA, various issues. FPC: Final Private Consumption.

Official figures show that prices increased at a lower rate than that of per capita GDP leading to a positive income effect and to more expenditure on non-food items during 2000-2005. Based

on indices of prices and per capita GDP, it can be concluded that access to food has not been impacted negatively by the evolution of prices and income during this period. This situation, however, changed after the big crisis in the increase of world prices during 2007 and early 2008.

Chapter 3-Demand Systems Estimation with Syrian Data

3.1. Literature review and methodology

Johnson, Hassan, and Green (1984) mentioned three areas of interest that attracted the attention of economists namely: consumer demand, Engel curve analysis, and consumption functions in more aggregated contexts. Accordingly, in this section both the theory of consumer demand and Engel curves are briefly reviewed relying on previous research done.

A demand carves for an individual specifies the units of a good or service that the individual is willing and able to purchase at alternative prices during a given period of time. A market demand curve is a graphic presentation of a market demand schedule, which shows the quantities of a commodity that consumers are willing and able to purchase during a period of time at various alternative prices, while holding constant everything else that affects demand (ceteris paribus); see, Salvatore (1996) and Binger and Hoffman (1998). So, demand shifters can be number of consumers (population), consumers' tastes, money incomes, and the price of related commodities. Thus, the demand function can be depicted as follows:

$$Q_{di} = f(P_i, P_j, y/N, z)$$

Where: Q_{di} – Per capita quantity demanded for the commodity i, P_i – Own price, P_j – Cross price, N – Population, y – Money income, z – Individual characteristics, demographic, and other exogenous variables.

There are two alternative approaches to estimate the parameters of demand equations namely: the single equation approach and the demand systems approach.

3.1.1. Single equation approach

By this approach, the demand functions will be estimated in a pragmatic fashion without recourse to the economic theory. Thus, these ad hoc models or single equation models can not represent preferences for all goods we buy, so the total expenditure function and utility based on the consumption of the complete basket can not be derived. However, such models can be implemented in the context of a welfare analysis where a great accuracy is not required like the one achieved by estimating a system of demand equations. A typical situation, for instance, is to estimate from time series data the income and price elasticities for a commodity in a constant elasticity demand equation such as:

$$\ln Q_i = \alpha_i + \sum E_{ij} \ln P_j/P + \eta_i \ln y/P + \sum b_{ik} \ln z_k$$

Where: Q_i = Quantity purchased of good i per capita, P_j = Prices of good i and of selected other commodities j which are close substitutes or complement, y = Total expenditure per capita, P = Consumer price index, E_{ij} = Direct and cross price elasticities, η_i = Expenditure elasticity, z_k = Household characteristics, time (to account for steady changes in tastes, in the distribution of income, and in the quality of products), and other exogenous variables, b_{ik} = Elasticities of

demand with respect to z_k; see Perali (2003), Sadoulet and de Janvry (1995), and Oezcan, Tan and Dellal (Ankara, Turky).

The use of relative prices (P_i/P) and real income (y/P) as exogenous variables makes the demand equations homogenous of degree zero in prices and income. This insures that there is no "money illusion" in demand in the sense that it is not affected by a proportional increase in all prices and income. Moreover, this approach is designed to answer policy questions that are specific to a particular commodity or commodity group.

The drawbacks of this approach can be summarized as follows:

- The choice of functional forms for the demand equations and of the variables to be included is arbitrary (combination of common sense, interest in specific elasticities, computational convenience, and goodness of fit criteria).
- The log functional form used above assumes constant elasticities over all values of the exogenous variables. This is true only over a short range of prices and income (because of switching between luxuries and necessities as income increases).
- Predictions relying on this approach may not satisfy the budget constraint.

More flexibility to the model can be introduced in the case of nonlinearities by adding a quadratic term (income, price, and demographic). For example, when the model is non-linear in income, the model can be written as follows; see, Perali (2003) and Raunikar and Huang (1984).

$$\text{Ln } Q = a_0 + a_1 \ln d + a_2 \ln p + a_3 \ln y + a_4 \ln y^2$$

Where: a_0, a_1, a_2, a_3, a_4 are parameters to be estimated, d = demographic variable, p = price, y = income.

3.1.2. Engel's curves

Holding prices constant is considered a link to study the relationship between the consumption of food and income, which is expressed through Engel laws and Engel curves (Table 3.1); see, Binger and Hoffman (1998) and Perali (2003).

Table 3.1. Engel's curves

Engel's curve	Mathematical formula	Income elasticity
Linear	$q = a + b*y$	$\eta_i = b*y/(a + b*y)$
Double-logarithmic	$\ln q = a + b*\ln y$	$\eta_i = b$
Semi-logarithmic (semi-log)	$q = a + b*\ln y$	$\eta_i = b/q = b/(a + b*\ln y)$
Logarithmic reciprocal	$\ln q = a - b/y$	$N_i = b/y = a - \ln q$
Working – Leser (WL) Engel curve (semi-log)	$w = a + b \ln (y/N)$**	$\eta_i = b/w + 1$
WL Engel curve with demographic	$w = a + b \ln d + c \ln (y/N)$	
WL Engel curve with prices	$w = a + b \ln p + c \ln(y/N)$	
WL Engel curve with prices and demographic	$w = a + b \ln d + c \ln p + d \ln y$	

Source: Elaborated from Sadoulet and de Janvry (1995) and Perali (2003)
$y^* = y/N$. ** $\eta_i = b/y = a\text{-}\ln q$.

***First Engel Law*:** As the log of income increases, the food share decreases.

***Second Engel Law*:** As family size increases, the share of expenditure allocated to food also increases.

The estimated Engel curves should have several qualities (Sadoulet and de Janvry, 1995):

- They should satisfy the budget constraints. The predicted expenditure for each commodity should add up to the total expenditure.
- They should be able to represent luxuries, necessities, and inferior goods.
- They should have variable income elasticities due to the empirical fact that income elasticities tend to decline as income increases.
- The consumption of many commodities should reach a saturation point as income increases.

According to Johnson, Hassan and Green (1984), Engel's curves can be also used to estimate income or expenditure elasticities taking into consideration the change in income levels across commodity groups and among sample partitions generated by socioeconomic characteristics.

3.1.3. Demand systems approach

To estimate demand, this approach uses a complete system of demand equations relying on the economic theory. This system of equations aims at taking into account consistently the mutual interdependence of large numbers of commodities based on the structure of relative prices, real income, and a set of individual characteristics and demographic variables such as age, education, professional status, type of household, and rural versus urban population. The analysis of demand at the regional and national level is affected by both the average level of these variables in the unit of analysis and by their distribution across the population. The estimation results can be used to study behavior (forecasting) and to conduct welfare analysis; see Perali (2003).

Study of behavior

- Demand for goods (wheat, nutrients, etc.).
- Analysis of structural changes: habits, heterogeneity of tastes.
- Demand for quality characteristics.

Welfare analysis

- Estimation of the expenditure function and utility in order to derive the compensating variation which is an exact measure of consumer surplus.
- Poverty and inequality.
- Social welfare functions: Producer Surplus (PS) + Consumer Surplus (CS).
- Demand and optimal taxation.

The Level of demand can be determined by static or dynamic demand models:

3.1.3.1. Static models

According to static models, the consumer is assumed to adjust instantly to a new equilibrium when income or prices change. Thus, adjustments to habit formation and purchases of durable goods are ignored.

$$\text{Example: } QD_t = G * P_t + B * X_t + UD_t$$

Where: QD_t = quantity demanded, P_t = price of the commodity, X_t = set of exogenous variables affecting demand, UD_t = disturbance term, and G, B = parameters.

Johnson, Hassan, and Green (1984) traced the development of the static demand theory. Accordingly, demand and utility theory were not integrated until the seminal work of Slutsky (1915). Recently, the frequent use of demand systems estimation made the integration of these two areas of research more tractable. Jevons (1871) gave useful insights regarding the relationship between utility and demand. However, not until the time of Walras (1854) and Marshall (1890) did systematic and cumulative work on demand theory begin. Walras linked

utility to demand and used a system of equations to describe a general equilibrium of prices and quantities in interrelated markets. In this system, the quantity demanded of a commodity depends upon the prices of all products holding money income and tastes constant. Marshall, on the other hand, explained the concept of market demand in a partial equilibrium framework, by which the quantity demanded is a function of the price of the commodity in question and the income of the consumer holding all other prices and marginal utility for income constant. Thus, the concept *ceteris paribus* emerged in full force with Marshall. Furthermore, Leser (1941), Stone (1954), Frisch (1959), and Houthakker (1960) can be mentioned as applicants of complete demand systems.

The microeconomic theory of consumer behavior postulates that a consumer's choice can be described as deriving from utility maximization subject to a budget constraint. Thus, the objective of the theory is to explain how a rational consumer chooses what to consume when confronted with various prices and a limited income. Consequently, the solution to this maximization problem is a system of demand equations (first order conditions) restricted to several homogeneity and aggregation conditions.

Mattila (2002) derived both the Marshallian* demand ($X^M = X^M (P_i, P_j, m)$) from a utility maximization problem and the compensated demand ($X^C = X^C (P_i, P_j, U^o)$ from expenditure minimization problem (Duality Theory). In addition, the Marshallian and compensated elasticities and their interrelationship using Euler's theorem and Hoteling Lemma rule were calculated; see Binger and Hoffman (1998).

$$E_{Mii} = Ec_{ii} - w_i * \eta_i \qquad \text{(Own – Price Slutsky Equation)}$$

$$E_{Mij} = Ec_{ij} - w_j * \eta_i \qquad \text{(Cross – Price Slutsky Equation)}$$

Where: X^M – Marshallian demand, X^C – Compensated** demand, P_i, P_j – Prices of commodities i and j , M – Income, U^o – Utility, $E_{M\ ii}$ – Own price Marshallian elasticity, E_{Cii} – Own-price compensated elasticity (Hicksian), E_{Mij} – Cross price Marshallian elasticity, E_{Cij} – Cross price compensated elasticity, η_i – Income elasticity, w_i, w_j – Shares of i and j in expenditure.

Marshallian elasticities express price and income effects, whereas Hicksian elasticities consider only price effect.

Sadoulet and Janvry (1995), Johnson, Hassan, and Green (1984), and Perali (2003) illustrated the theory of consumers behaviors and the restrictions imposed on the system of equations. Accordingly, the consumer maximization problem can be described as follows:

$$\text{Max } L = u(q,z) + \lambda\ (y - p'\ q) \text{ subject to } \lambda \text{ and } q$$

Where: L – The consumer objective function, u(q, z) – Utility function of the consumer,

q- Vector of quantities of n commodities on which a consumption decision must be made, z- Individual characteristics, λ - Langrange multiplier, y – The amount of income which can be spent, p' – N – dimensional vector of prices, y = p'q.

The solution to the aforementioned maximization problem is a set of demand equations $q_i = q_i (p, y, z)$ with i = 1… n. The n equations include n income slopes $\partial\ q_i/\partial y$ (partial derivative) or income elasticities $\eta_i = \partial q_i/\partial y * y/q_i$ and n^2 price slopes $\partial q_i/\partial p_j$ or price elasticities $E_{ij} = \partial q_i/\partial p_j * p_j/q_i$. According to the signs and magnitudes of these elasticities the goods are classified as follows:

Own-Price Elasticity

- Non-Giffen good: $E_{ii} < 0$ ($E_{ii} < -1$ elastic; $E_{ii} > -1$ inelastic).

* Marshallian: Related to the Economist Marshall. It depends on prices and income.

** Compensated demand: Relies on price only holding income and utility constant.

- Giffen good: $E_{ii} > 0$ (see Binger and Hoffman (1998)).

Cross-Price Elasticity

- Gross substitutes: $E_{ij} > 0$.
- Gross complements: $E_{ij} < 0$.

Income Elasticity

- Normal good: $\eta_i > 0$ ($\eta_i > 1$ luxury; $\eta_i < 1$ necessity).
- Neutral good: $\eta_i = 0$.
- Inferior good: $\eta_i < 0$.

The parameters of the demand equations must satisfy the following constraints:

1. The Engel aggregation equation derived from the budget constraint:

   $\Sigma\, p_i\, \partial q_i/\partial y = 1$ or $\Sigma\, w_i\, \eta_i = 1$, where $w_i = p_i\, q_i/y$ is the budget shares.

2. The n Cournot equations derived also from budget constraint:

   $\Sigma\, p_i\, \partial q_i/\partial p_j = -\, q_j$ or $\Sigma\, w_i\, E_{ij} = -\, w_j$, for $j = 1, \ldots, n$.

The two sets of equations together lead to the n Euler equations (not additional restrictions) which represent the homogeneity conditions ($\Sigma\, E_{ij} + \eta_i = 0$; $i = 1, \ldots, n$). These conditions state that demand functions are homogeneous of degree zero in prices and income. In other words, if all prices and income increase in the same proportion, demand remains unchanged.

3. The n (n-1)/2 Slutsky equations that express symmetry in substitution effects:

   $E_{ij} = w_j/w_i * E_{ji} + w_j\, (\eta_j - \eta_i)$, for $i \neq j = 1, \ldots, n$.

Consequently, several demand systems approaches have been evolved to solve this maximization problem, the most important of which are the Linear Expenditure System (LES), the Almost Ideal Demand System (AIDS), and the Generalized Almost Ideal Demand System (GAIDS); see, Sadoulet and Javry (1995) and Perali (2003), Raunikar and Huang (1984), Johnson, Hassan, and Green (1984), and Little (1985). It is worth to note that demand systems are used when accuracy is required in demand estimation.

The advantages and disadvantages of applying a demand systems approach can be summarized as follows:

- It delivers more reliable estimates.
- It uses the theory of demand as a guideline for the choice of functional forms and variables to be included.
- It imposes constraints on demand parameters.
- However, it requires data on individual consumer (which are not easily available).

The research at hand investigates the Linear Expenditure System.

The Linear Expenditure System

The demand equations of the LES are derived from maximizing the Stone-Geary utility function ($u = \sum b_i \ln(q_i - c_i)$ subject to a budget constraint (Sadoulet and de Janvry, 1995). Where the symbols denote the following:

u- Utility.
b_i – Constant greater than zero ($0<b_i<1$) and $\sum b_i = 1$.
$q_i - c_i > 0$ – Where q_i is quantity consumed and c_i is the subsistence quantity below which consumption cannot fall.

The derived demand functions are estimated from the following equations:

$$p_i q_i = c_i p_i + b_i (y - \sum c_j p_j),\ i = 1, \ldots, n.$$

Where:

p_i – The price of the commodity.
p_j – The price of the other commodities.
c_i, c_j – Parameters to be estimated.
bi - The marginal budget shares ($\partial pq/\partial y$) telling how expenditure on each commodity changes as income varies.
$\sum c_j p_j$ – The subsistence expenditure.
y – The total expenditure.
$y - \sum c_j p_j$ – The "uncommitted" income which is spent in fixed proportions bi between the commodities.

The price and income elasticities are calculated as follows:

$$E_{ii} = -1 + (1 - b_i)\, c_i/q_i,\ E_{ij} = -\, b_i c_j p_j / p_i q_i,\ \eta_i = b_i/w_i,$$

where E_{ii} = Own-price elasticity, E_{ij} = Cross-price elasticity, η_i = Income elasticity and w_i = The budget share of commodity i.

The following characteristics underlie the LES:

- It doesn't allow for inferior goods since $b_i > 0$.
- It assumes linear Engel functions. So, it can be used only for short-term predictions.
- It is better applied to large categories of expenditure than to individual commodities.
- It postulates that all goods are gross complements ($E_{ij} < 0$).

3.1.3.2. Dynamic models

By these models, adjustments due to habit formation, purchases of durable goods, and persistence in consumption patterns will be taken into account through various considerations (Johnson, Hassan and Green, 1984) by adding:

1. Trend variables to the demand equations derived from static theory to account for changes in tastes and other socioeconomic factors.
2. Lagged variables for consumption to consider the influence of past consumption behaviors on current consumption patterns.
3. Lagged variables for prices and expenditure.

Example: State adjustment model

$$Q_t = A_0 + A_1 * Q_{t-1} + A_2 * DM_t + A_3 * M_{t-1} + A_4 * DP_t + A_5 * P_{t-1} + E_t$$

Where: Q_t = Consumption in time t, Q_{t-1} = Consumption in past period, D = Change, M = income, M_{t-1} = Income in past period, P_t = Price, P_{t-1} = Price in past period, E_t = Disturbance term.

A dynamic version of the LES

The assumptions in these models rely on the fact that past consumption behaviors influence current consumption patterns. Hence, the model in this study assumes that the current expenditure of the food group is affected by the same variables mentioned in the static model and the time trend. So the model can be written as follows:

$$q_{it} p_{it} = a_{io} + c_i\, p_i/p + \sum c_j\, p_j/p + b_i\, y/p + t$$

Where:

$q_{it}p_{it}$ – Fitted expenditure of the group.
a_{io} – Intercept.
c_i, c_j, and b_i – Parameters to be estimated.
p_i– Price of the commodity.
p_j – Price of the other commodities.
y – Total expenditure or total food expenditure.
p – General consumer price index (GCPI).
t- Time trend

3.2. Applying the demand systems approach to Syrian data

This section mainly focuses on applying the demand systems approach using Syrian data. It tries to explain how food consumption evolves with income, prices and socio-demographic characteristics (like urban and rural residence) to identify differences in consumption patterns.

3.2.1. Estimation methods

The methods applied to the time series data (1982-2005) in Syria are the LES model in unrestricted (single equations without imposing the restriction of the demand theory) and restricted (system of equations with imposing the restrictions of the demand theory) forms for six food groups namely: cereals & legumes, vegetables, fruits, meats & eggs, milk & its products and vegetable oils & fats taking into consideration the trend line.

Ordinary Least Squares (OLS) was used to estimate the parameters of the single equations. The single equations were tested for auto-correlation and heteroskedasticity. Seemingly Unrelated Regressions (SUR) procedure was used to solve the demand system equations simultaneously and to correct the standard errors.

The applied LES model

The estimated expenditures of the unrestricted demand equations for the selected food groups, considering the deflated financial values by the GCPI, are written as follows:

$$q_{cl}p_{cl} = a_{cl} + c_{cl}p_{cl} + c_{clv}p_v + c_{clf}p_f + c_{clme}p_{me} + c_{clm}p_m + c_{clof}p_{of} + b_{cl}y + t$$

$$q_vp_v = a_v + c_vp_v + c_{vcl}p_{cl} + c_{vf}p_f + c_{vme}p_{me} + c_{vm}p_m + c_{vof}p_{of} + b_vy + t$$

$$q_fp_f = a_f + c_fp_f + c_{fcl}p_{cl} + c_{fv}p_v + c_{fme}p_{me} + c_{fm}p_m + c_{fof}p_{of} + b_fy + t$$

$$q_{me}p_{me} = a_{me} + c_{me}p_{me} + c_{mecl}p_{cl} + c_{mev}p_v + c_{mef}p_f + c_{mem}p_m + c_{meof}p_{of} + b_{me}y + t$$

$$q_mp_m = a_m + c_mp_m + c_{mcl}p_{cl} + c_{mv}p_v + c_{mf}p_f + c_{mme}p_{me} + c_{mof}p_{of} + b_my + t$$

$$q_{of}p_{of} = a_{of} + c_{of}p_{of} + c_{ofcl}p_{cl} + c_{ofv}p_v + c_{off}p_f + c_{ofme}p_{me} + c_{ofm}p_m + b_{of}y + t$$

Where:

cl, v, f, me, m, of – Cereals & legumes, vegetables, fruit, meats & eggs, milk, and vegetable oils & fats, respectively.
q, p – Quantity consumed and price, respectively.
$q_{cl}p_{cl}$ – Deflated expenditure of cereals & legumes.
q_vp_v – Deflated expenditure of vegetables.
q_fp_f – Deflated expenditure of fruits.
$q_{me}p_{me}$ – Deflated expenditure of meats & eggs.
q_mp_m – Deflated expenditure of milk.
$q_{of}p_{of}$ – Deflated expenditure of vegetable oils & fats.
a_{cl}, a_v, a_f, a_{me}, a_m, a_{of} – Intercept of Cereals & legumes, vegetables, fruit, meats & eggs, milk, and vegetable oils & fats, respectively.

c's – Parameters to be estimated (regression coefficients). For example, c_{cl} denotes the regression coefficient of cereals & legumes with respect to its own price; c_{clv} denotes the regression coefficient of cereals with respect to the price of vegetables.
b's – Parameters to be estimated representing the regression coefficients with respect to total expenditure or total food expenditure. For example, b_{cl} denotes the regression coefficient of cereals & legumes with respect to expenditure.
y – Total expenditure or total food expenditure.
t- Time trend.

The restricted model of the aforementioned equations represents the same aforementioned equations, but after imposing the restrictions of the demand system mentioned in section 3.1.3.1.

3.2.2. Empirical results

The .results are for the LES model in unrestricted (single equation models) and restricted (demand systems estimation) forms using six commodity groups namely: cereals & legumes, vegetables, fruits, meats & eggs, milk & its products and vegetable oils & fats. The results of Engel curve analysis are also presented. The major results comprise basic parameters estimates, elasticities, and testing results.

3.2.2.1. Results of the single equation approach

Cereals & legumes

Table 3.2 includes the results of applying the cereals & legumes demand equation of the LES to Syrian data comprising the estimates of the regression parameters, testing results and the Marshallian (M) and compensated (Hicksian (H)) elasticities with respect to total food expenditure.

Table 3.2. LES estimates for cereals & legumes with respect to total food expenditure, 1982-2005

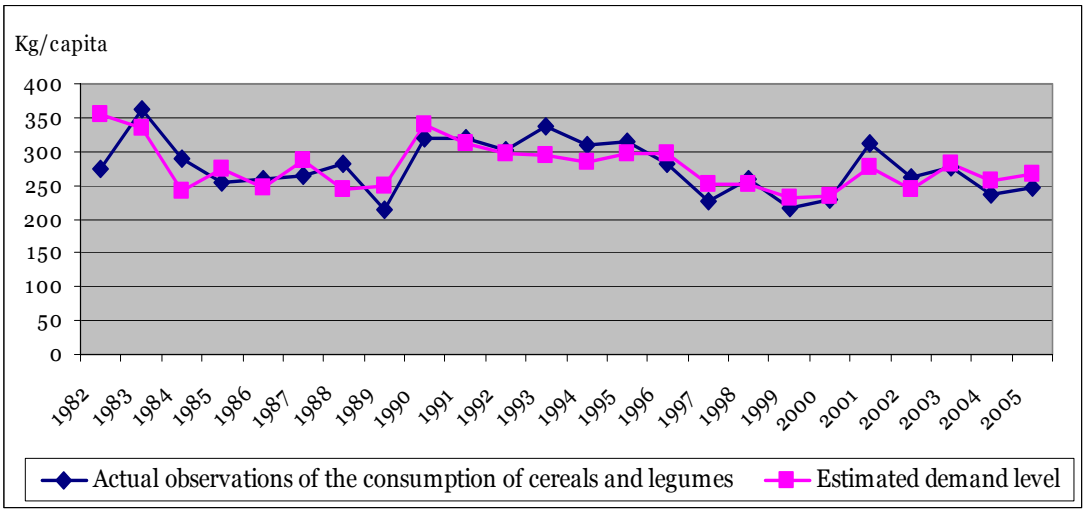
Variable	Coefficient	Standard Error	P-Value	Elasticities	
				M	H
Intercept	-320.18	111.10	0.01		
Retail price of cereals & legumes	137.03	117.90	0.26	-0.51	-0.37
Retail price of meats & eggs	6.24	5.47	0.27	0.28	0.44
Retail price of vegetables	-20.33	34.60	0.57	-0.12	0.01
Retail price of fruits	-33.49	21.34	0.14	-0.35	-0.12
Retail price of milk	184.34	109.57	0.11	0.85	0.93
Retail price of vegetable oils & fats	-10.62	11.12	0.35	-0.29	-0.21
Time trend	-12.28	10.24	0.25	-0.22	
Total food expenditure	0.14	0.07	0.09	0.83	

Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

As depicted in Table 3.2, all regression coefficients are statistically insignificant at the 5% level of significance except the intercept which is significant at the 5% level. The regression coefficient with respect to total food expenditure is statistically significant at the 10% level. The joint F test is significant at the 5% level. Adjusted R-Square denotes that 92% of the variations in cereals & legumes expenditure are explained by the demand equation. The signs and magnitudes of the Marshallian elasticities coincide with economic theory. The compensated (Hicksian) elasticities can be higher or less than the Marshallian elasticities. The own-price elasticity indicates an inverse relationship between the consumption level and the retail price of cereals & legumes and a rigid demand. The cross-price elasticities denote that cereals & legumes are gross substitute with meats & eggs and gross complement with the other groups. The income elasticity of demand shows a positive relationship between consumption level and expenditure pointing out to a necessity good.

Figure 3.1 compares between the actual consumption and the estimated aggregate total demand for cereals & legumes over the period 1982-2005. The figure shows a decreasing trend for the consumption of cereals & legumes.

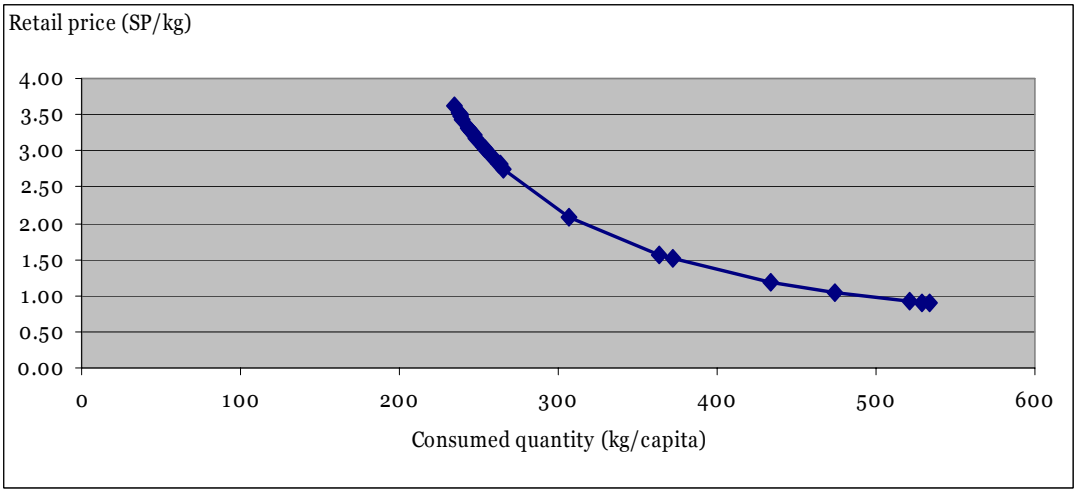
Figure 3.1. Evolution of the actual and estimated demand for cereals & legumes, 1982-2005 (kg/capita)



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Figure 3.2 traces the relationship between the quantity consumed and the retail price of cereals & legumes (inverse demand) from 1982-2005 holding all other factors affecting demand constant. The figure shows an inverse relationship between the retail price and quantity consumed coinciding with economic theory.

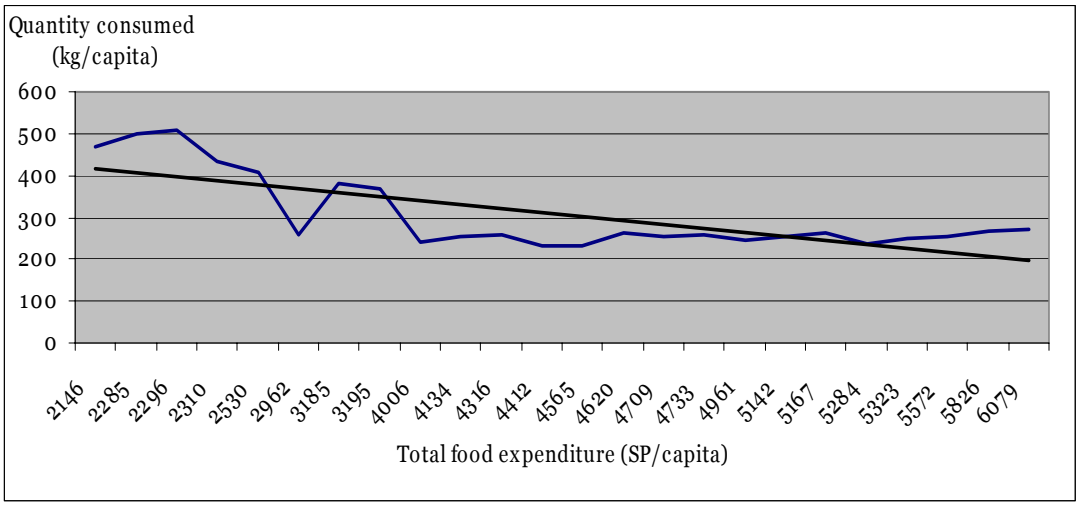
Figure 3.2. The demand for cereals & legumes with respect to its retail price (kg/capita)



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Holding all factors affecting demand constant except income leads to Engel curves. Figure 3.3 depicts the linear Engel curve related to cereals & legumes for the period 1982-2005 considering total food expenditures. It shows an inverse relationship between consumption level and income coinciding with economic theory and indicating a dominating price effect.

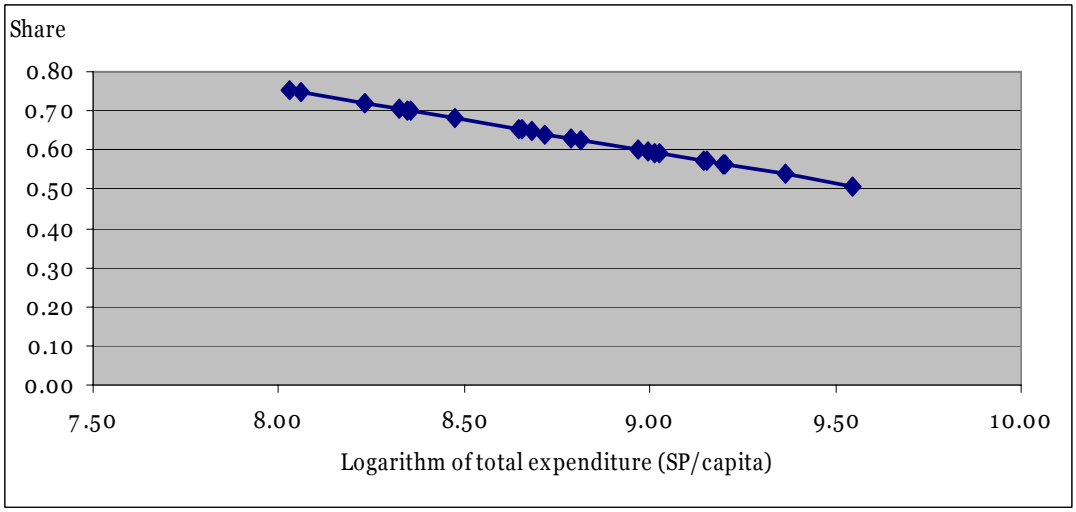
Figure 3.3. Linear Engel curve for cereals & legumes, 1982-2005 (kg/capita)



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Figure 3.4 depicts a Working-Lesser Engel curve (semi-log) for cereals & legumes over the period 1982-2005 illustrating the relationship between the share of this group and the logarithm of income (total expenditure). The figure indicates that as the logarithm of income increases the share devoted to cereals & legumes decreases, which coincides with the first Engel Law. The income elasticity is equal to -0.53. The regression coefficients are highly significant at the 5 % level, but accompanied with a low explanation of the demand equation (low adjusted R-Square.

Figure 3.4. Working-Leser Engel curve for cereals & legumes, 1982-2005



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Vegetables

Table 3.3 encompasses the results of applying the vegetables demand equation of the LES to Syrian data comprising the estimates of the regression parameters, testing results and the Marshallian and compensated elasticities with respect to total food expenditure. As depicted in Table 3.3, all regression coefficients are statically significant at either the 5% level of significance or the 10% level of significance. Adjusted R-Square denotes that 79% of the variations in vegetables expenditure are explained by the demand equation. The signs and magnitudes of the Marshallian elasticities comply with economic theory. The compensated elasticities can be

higher or less than the Marshallian elasticities. The own-price elasticity implies an inverse relationship between the consumption level and the retail price of vegetables and a rigid demand. The cross-price elasticities denote that vegetables are gross complement with all groups excluding milk, which is gross substitute with vegetables. The income elasticity of demand shows a positive relationship between consumption level and expenditure indicating a luxury good.

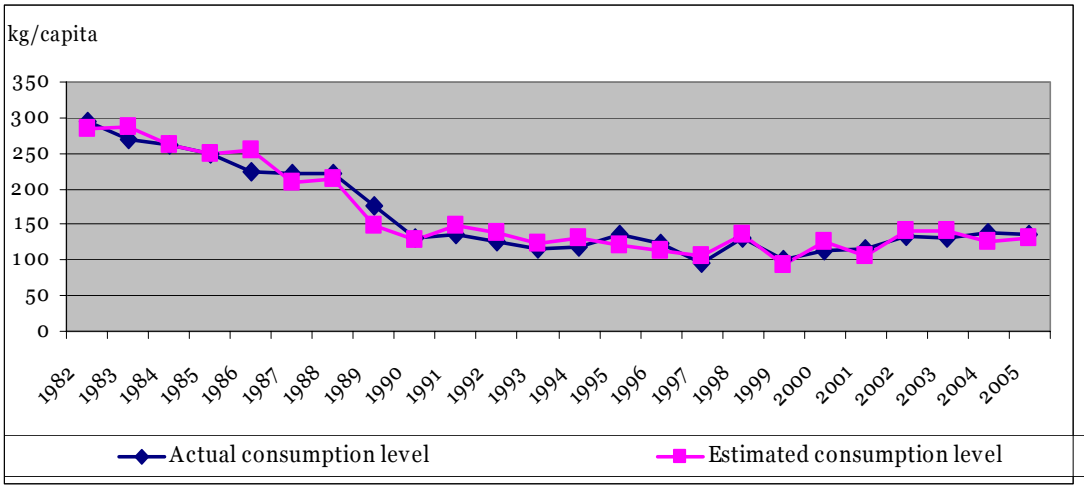
Table 3.3. LES estimates for vegetables with respect to total food expenditure, 1982-2005

Variable	Coefficient	Standard Error	P-Value	Elasticities	
				M	H
Intercept	165.33	85.95	0.07		
Retail price of vegetables	157.43	26.77	0.00	-0.03	0.18
Retail price of cereals & legumes	-343.73	91.21	0.00	-1.43	-1.22
Retail price of meats & eggs	-12.92	4.23	0.01	-0.66	-0.41
Retail price of fruits	-29.84	16.51	0.09	-0.36	0.01
Retail price of milk	175.54	84.77	0.06	0.93	1.05
Retail price of vegetable oils & fats	-16.86	8.60	0.07	-0.52	-0.40
Total food expenditure	0.21	0.06	0.00	1.28	
Time trend	14.21	7.92	0.09	0.29	

Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Figure 3.5 depicts the evolution of the actual and estimated aggregate demand for vegetables over the period 1982-2005. The figure indicates a decreasing trend for the consumption of vegetables.

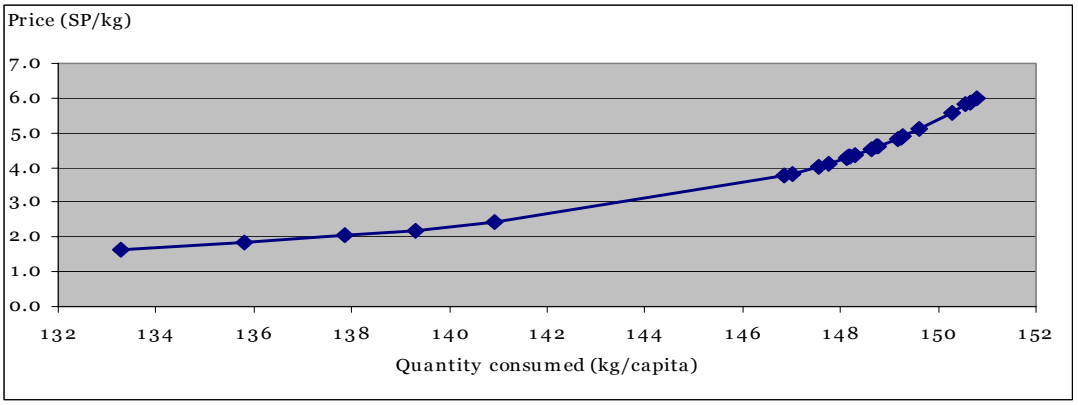
Figure 3.5. Evolution of the actual and estimated demand for vegetables, 1982-2005 (kg/capita)



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

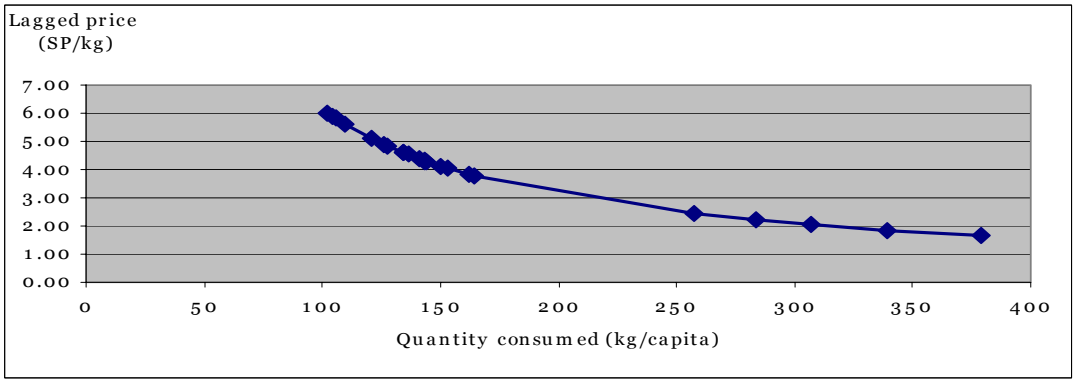
Figure 3.6 depicts the relationship between the quantity consumed and the retail price of vegetables from 1982 to 2005 holding all other factors affecting demand constant. The figure indicates a positive relationship between the retail price and quantity consumed implying a dominating income effect. However, performing the relationship with the lagged price of vegetables indicates an inverse relationship between the retail price and consumed quantity because past consumption patterns have substantial impact on current consumption behaviors (Figure 3.7).

Figure 3.6. The demand for vegetables with respect to its retail price (kg/capita)



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

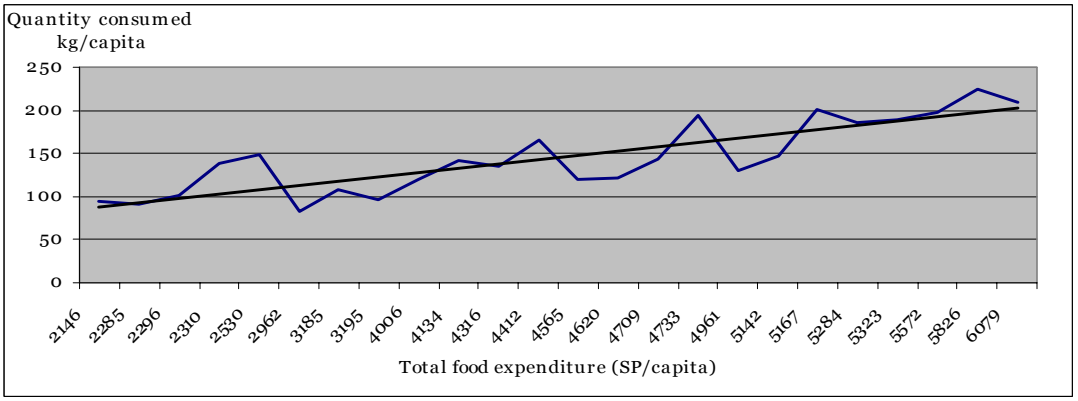
Figure 3.7. The demand for vegetables with respect to its lagged retail price (kg/capita)



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Tracing the relationship between consumption level and income leads to Engel curves. Figure 3.8 depicts a linear Engel curve related to vegetables for the period 1982-2005 considering total food expenditures. It shows a positive relationship between consumption level and income coinciding with economic theory. This means as income increases, the share of expenditure devoted to vegetables also increases.

Figure 3.8. Linear Engel curve for vegetables, 1982-2005 (kg/capita)



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Fruits

Table 3.4 includes the results of applying the fruits demand equation of the LES to Syrian data comprising the estimates of the regression parameters, testing results and the Marshallian and compensated elasticities with respect to total food expenditure.

Table 3.4. LES estimates for fruits with respect to total food expenditure, 1982-2005

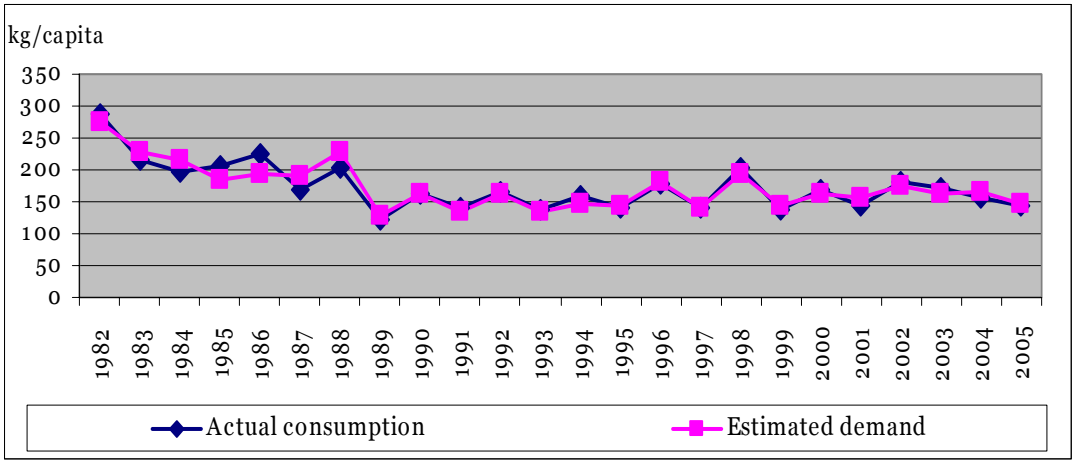
Variable	Coefficient	Standard Error	P-Value	Elasticities	
				M	H
Intercept	29.75	113.60	0.80		
Retail price of fruits	96.49	21.82	0.00	-0.44	0.01
Retail price of cereals & legumes	220.47	120.55	0.09	0.30	0.73
Retail price of meats & eggs	-21.19	5.60	0.00	-0.47	-0.23
Retail price of vegetables	-87.59	35.38	0.03	-0.55	-0.04
Retail price of milk	-334.63	112.04	0.01	-0.91	-0.75
Retail price of vegetable oils & fats	27.15	11.37	0.03	0.43	0.58
Total food expenditure	0.45	0.08	0.00	1.61	
Time trend	-30.33	10.47	0.01	-0.31	

Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

As depicted in Table 3.4, all regression coefficients are statically significant at either the 5% level of significance or the 10% level of significance. Adjusted R-Square indicates that 97% of the variations in fruit expenditure are explained by the demand equation. The signs and magnitudes of the Marshallian elasticities coincide with economic theory. The compensated elasticities can be higher or less than the Marshallian elasticities. The own-price elasticity implies an inverse relationship between the consumption level and the retail price of fruits and a rigid demand. The cross-price elasticities denote that fruits are gross complement with all groups with the exception cereals & legumes and vegetable oils & fats, which are gross substitute with fruits. The income elasticity of demand indicates a positive relationship between consumption level and expenditure pointing out to a luxury good.

Figure 3.9 traces the evolution of the actual and estimated aggregate demand for fruits over the period 1982-2005. The figure points out to a decreasing trend for the consumption of fruits.

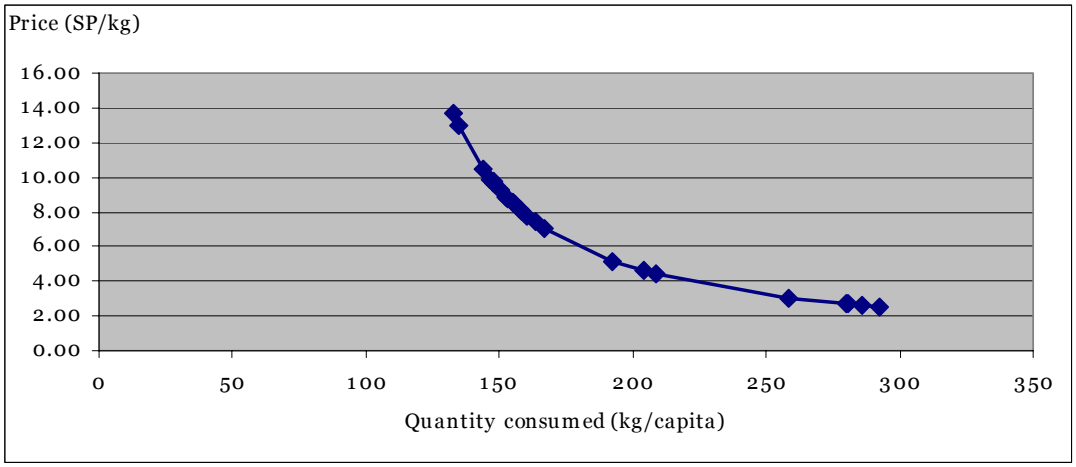
Figure 3.9. Evolution of the actual and estimated demand for fruits, 1982-2005 (kg/capita)



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Figure 3.10 depicts the relationship between the quantity consumed and the retail price of fruits from 1982 to 2005 holding all other factors affecting demand constant. The figure indicates an inverse relationship between the retail price and quantity consumed complying with economic theory.

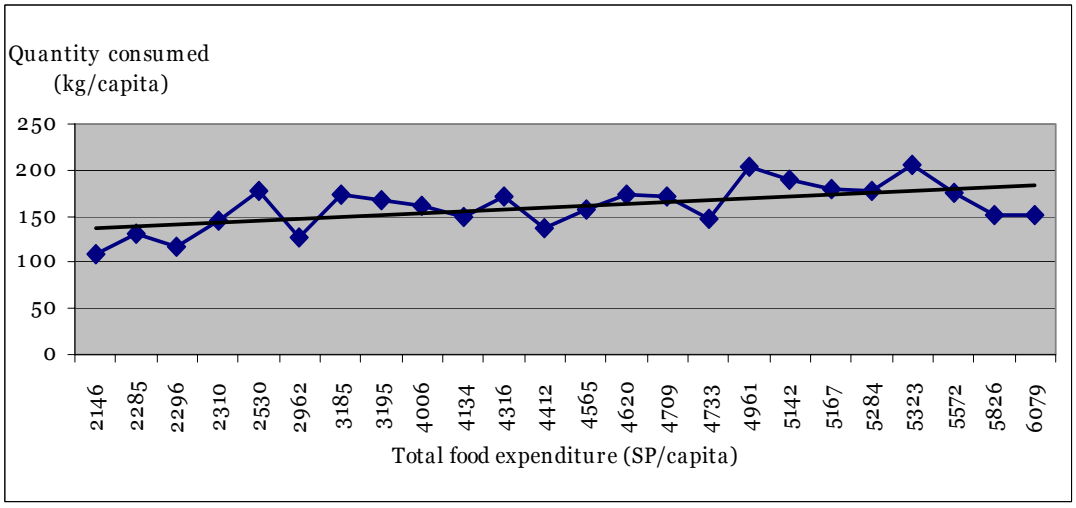
Figure 3.10. The demand for fruits with respect to its retail price (kg/capita)



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Figure 3.11 shows a linear Engel curve related to fruits, which depicts the association between the quantity consumed and the level of income holding all other factors affecting demand constant, for the period 1982-2005 considering total food expenditures. It shows a positive relationship between the consumption level and income coinciding with economic theory. This means as income increases, the share of expenditure devoted to fruits also increases.

Figure 3.11. Linear Engel curve for fruits, 1982-2005 (kg/capita)



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Meats & eggs

Table 3.5 includes the results of applying the meats & eggs demand equation of the LES to Syrian data comprising the estimates of the regression parameters, testing results and the Marshallian and compensated elasticities with respect to total food expenditure.

Table 3.5. LES estimates for meats & eggs with respect to total food expenditure, 1982-2005

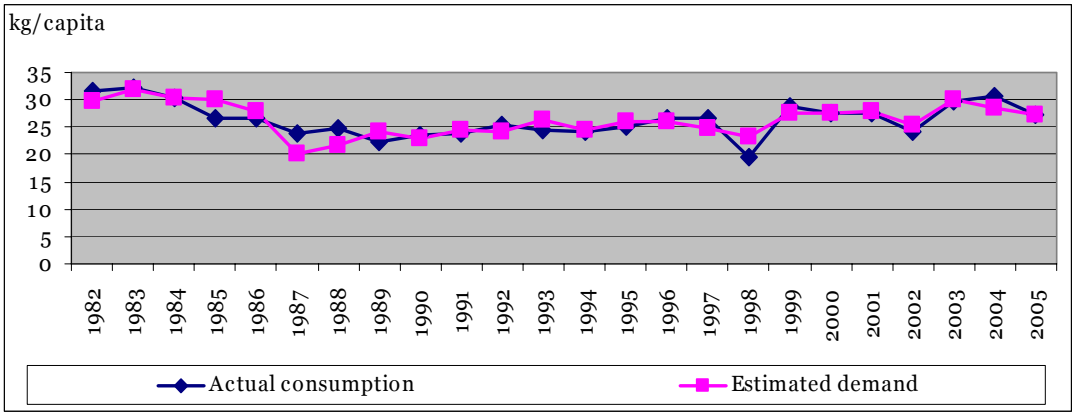
Variable	Coefficient	Standard Error	P-Value	Elasticities	
				M	H
Intercept	124.44	87.11	0.17		
Retail price of meats & eggs	32.58	4.29	0.00	0.23	0.25
Retail price of cereals & legumes	-30.67	92.44	0.74	-0.09	-0.08
Retail price of vegetables	-43.14	27.13	0.13	-0.22	-0.21
Retail price of fruits	-27.99	16.73	0.12	-0.25	-0.23
Retail price of milk	27.05	85.91	0.76	0.11	0.11
Retail price of vegetable oils & fats	-12.39	8.72	0.18	-0.29	-0.28
Total food expenditure	0.01	0.06	0.82	0.07	
Time trend	18.56	8.03	0.04	0.28	

Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

As depicted in Table 3.5, all regression coefficients are statistically insignificant at the 5% level of significance excluding the price of meats & eggs and the time trend. Adjusted R-Square implies that 96% of the variations in meats & eggs expenditure are explained by the demand equation. The signs and magnitudes of the Marshallian elasticities coincide with economic theory except the own-price elasticity because of its positive sign. The compensated elasticities are approximately equal to the Marshallian. The own-price elasticity implies a positive relationship between the consumption level and the retail price of meats & eggs and a rigid demand. The cross-price elasticities denote that meats & eggs are gross complement with all groups except for milk, which is gross substitute with meats & eggs. The income elasticity of demand indicates a positive relationship between the consumption level and expenditure pointing out to a necessity good.

Figure 3.12 traces the evolution of the actual and estimated aggregate demand for meats & eggs over the period 1982-2005. The figure points out to a decreasing trend for the consumption of meats & eggs until 1990 and to an increasing one thereafter.

Figure 3.12. Evolution of the actual and estimated demand for meats & eggs, 1982-2005 (kg/capita)

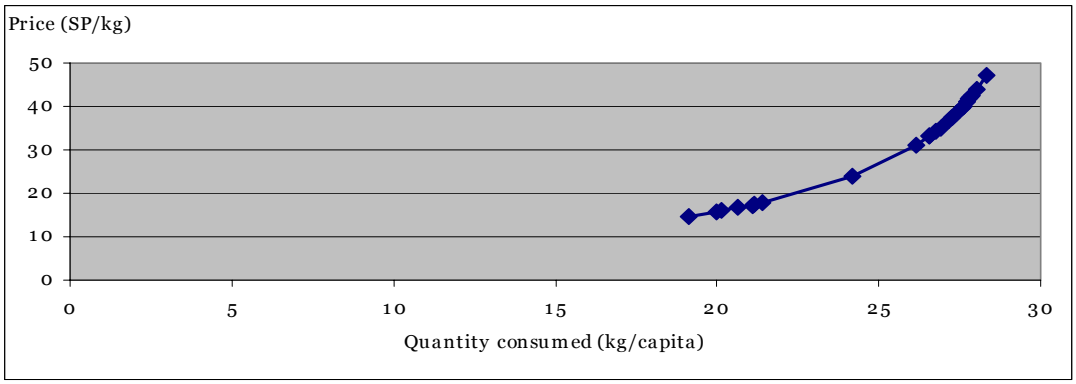


Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Figure 3.13 depicts the relationship between the quantity consumed and the retail price of meats & eggs from 1982 to 2005 holding all other factors affecting demand constant. The figure indicates a positive relationship between the retail price and quantity consumed.

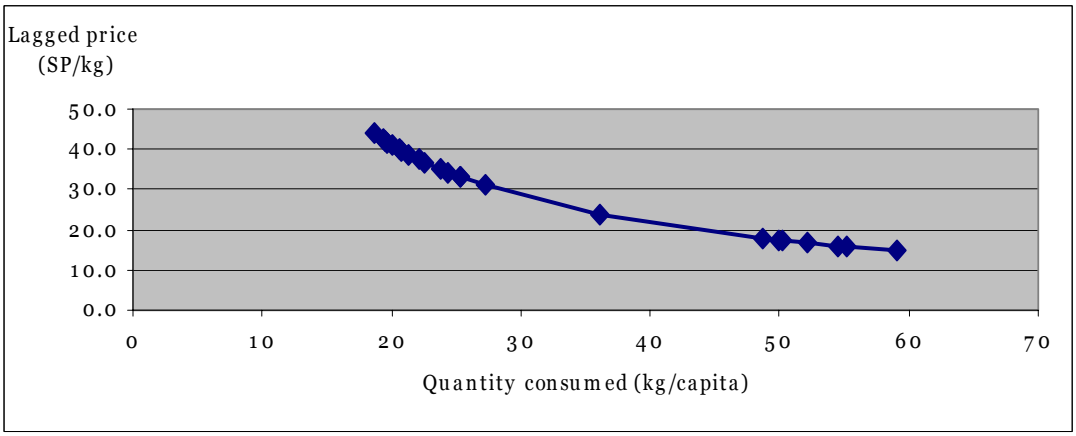
Tracing, however, the relationship between the quantity consumed of meats & eggs with its corresponding lagged (past price) retail price shows an inverse relationship between the quantity consumed of meats & eggs and the retail price (Figure 3.14).

Figure 3.13. The demand for meats & eggs with respect to its retail price (kg/capita)



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

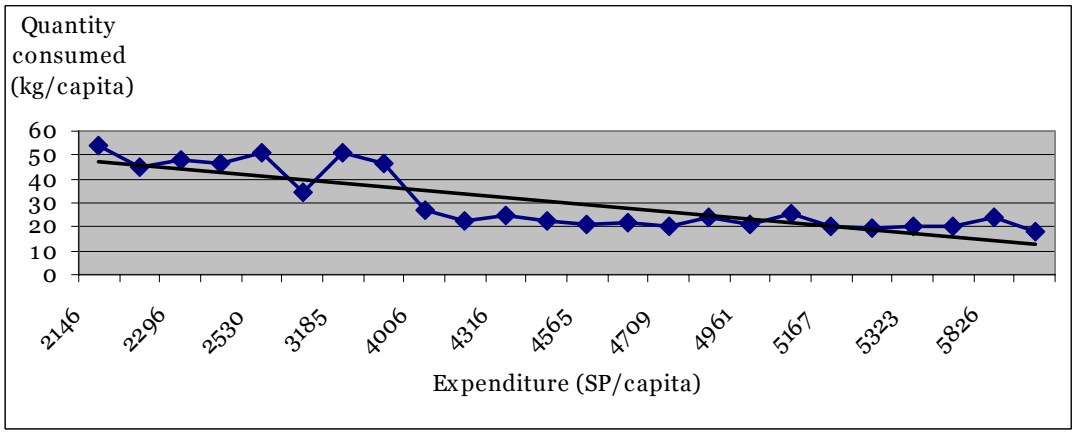
Figure 3.14. The demand for meats & eggs with respect to its lagged retail price (kg/capita)



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Figure 3.15 traces a linear Engel curve related to meats & eggs, which depicts the association between the level of consumption and income holding all other factors affecting demand constant, for the period 1982-2005 considering total food expenditures. It shows a negative relationship between consumption level and income indicating a dominating price effect.

Figure 3.15. Linear Engel curve for meats & eggs, 1982-2005 (kg/capita)



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various.

Milk & its products

Table 3.6 includes the results of applying the milk & its products demand equation of the LES to Syrian data comprising the estimates of the regression parameters, testing results and the Marshallian and compensated elasticities with respect to total food expenditure.

Table 3.6. LES estimates for milk with respect to total food expenditure, 1982-2005

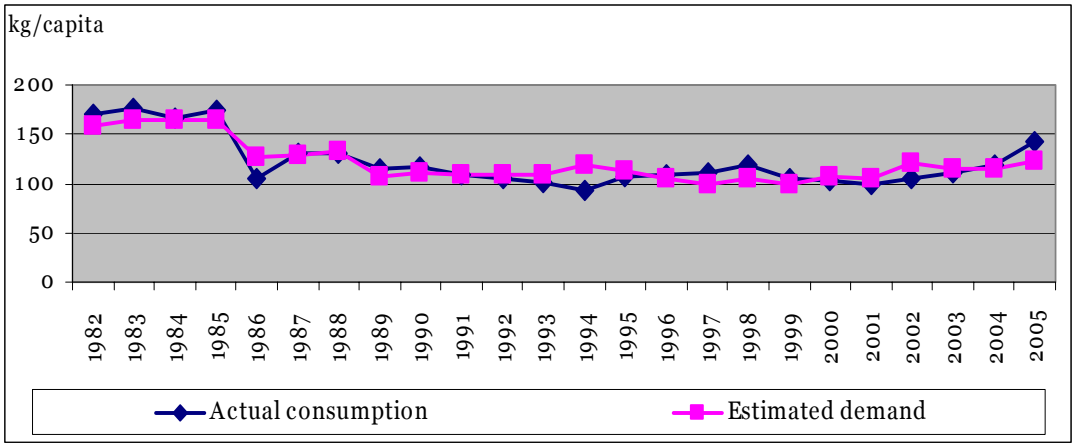
Variable	Coefficient	Standard Error	P-Value	Elasticities	
				M	H
Intercept	17.20	62.42	0.79		
Retail price of milk	113.24	61.56	0.09	-0.06	0.03
Retail price of fruits	-0.91	11.99	0.94	-0.02	0.27
Retail price of vegetables	16.60	19.44	0.41	0.18	0.35
Retail price of cereals & legumes	-105.66	66.23	0.13	-0.71	-0.55
Retail price of meats & eggs	0.24	3.07	0.94	0.02	0.22
Retail price of vegetable oils & fats	-11.51	6.25	0.09	-0.58	-0.48
Total food expenditure	0.10	0.04	0.04	1.0008	
Time trend	1.47	5.75	0.80	0.05	

Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

As depicted in Table 3.6, all regression coefficients are statistically insignificant at the 10% level of significance excluding the price of milk, the price of vegetable oils & fats and the total food expenditure. Adjusted R-Square implies that 72% of the variations in milk expenditure are explained by the demand equation. The signs and magnitudes of the Marshallian elasticities coincide with economic theory. The compensated elasticities are lower or greater than the Marshallians. The own-price elasticity indicates a negative relationship between the consumption level and the retail price of milk and a rigid demand. The cross-price elasticities denote that milk is gross complement with all groups except for meats & eggs, which are gross substitute. The income elasticity of demand implies a positive relationship between consumption level and expenditure pointing out to a luxury good.

Figure 3.16 traces the evolution of the actual and estimated aggregate demand for milk over the period 1982-2005. The figure points out to a decreasing trend for the consumption of milk until 1994 and to an increasing one thereafter.

Figure 3.16. Evolution of the actual and estimated demand for milk, 1982-2005 (kg/capita)

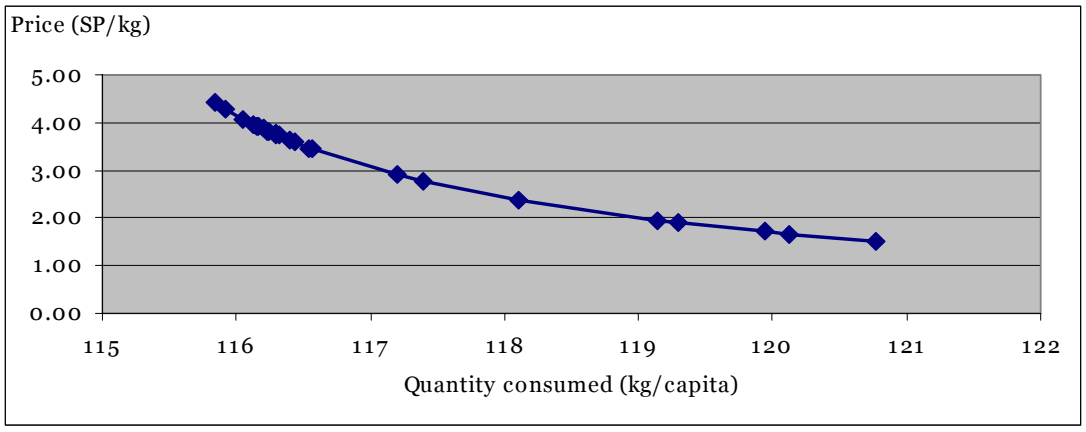


Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Figure 3.17 depicts the relationship between the quantity consumed and the retail price of milk from 1982 to 2005 holding all other factors affecting demand constant. The figure indicates an

inverse relationship between the retail price and quantity consumed complying with economic theory.

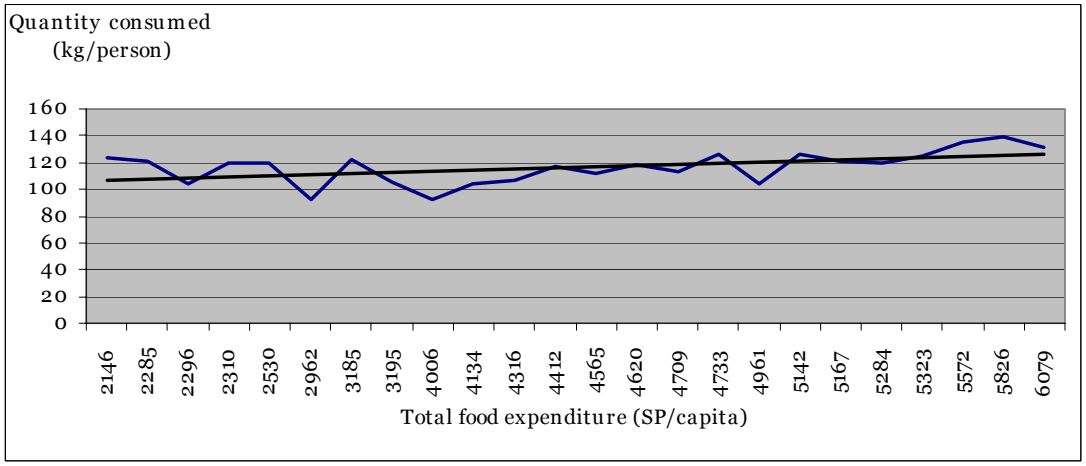
Figure 3.17. The demand for milk with respect to its retail price (kg/capita)



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Figure 3.18 traces a linear Engel curve related to milk, which depicts the association between the quantity consumed and income holding all other factors affecting demand constant, for the period 1982-2005 considering total food expenditures. It shows a positive relationship between the consumption level and income.

Figure 3.18. Linear Engel curve for milk, 1982-2005 (kg/capita)



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various

Vegetable oils & fats

Table 3.7 includes the results of applying the vegetable oils & fats demand equation of the LES to Syrian data comprising the estimates of the regression parameters, testing results and the Marshallian and compensated elasticities with respect to total food expenditure. As depicted in Table 3.7, all regression coefficients are statistically significant at the 5% level of significance excluding the intercept and the retail price of fruits (Annex Table 15). Adjusted R-Square indicates that 99.5% of the variations in vegetable oils & fats expenditure are explained by the demand equation. The signs and magnitudes of the Marshallian elasticities coincide with economic theory except the own price elasticity because of its positive sign. The compensated elasticities are lower or greater than the Marshallians. The own-price elasticity indicates a

positive relationship between the consumption level and the retail price of vegetable oils & fats and a rigid demand. The cross-price elasticities denote that vegetable oils & fats are gross complement with all groups except for cereals & legumes, which are gross substitute. The income elasticity of demand implies a positive relationship between consumption level and expenditure pointing out to a necessity good.

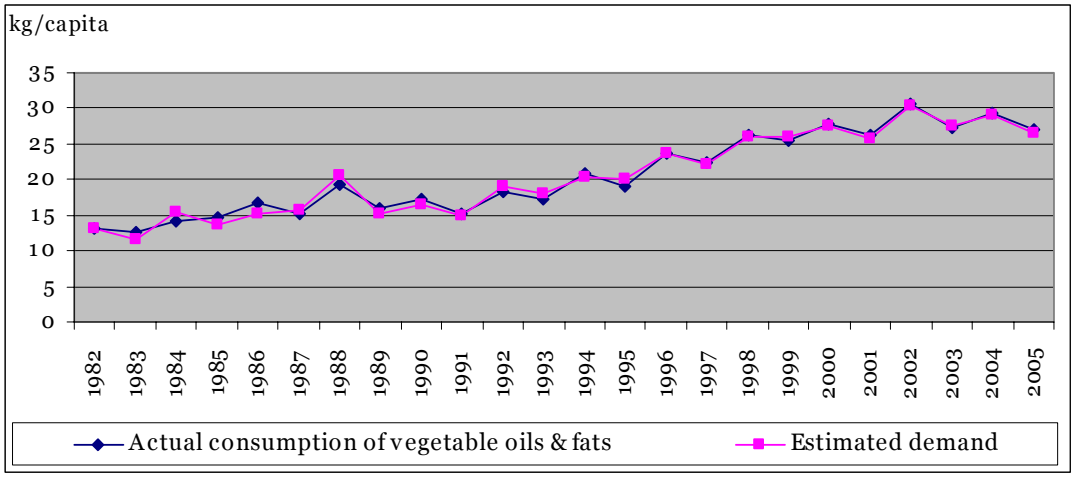
Table 3.7. LES estimates for vegetable oils & fats with respect to total food expenditure, 1982-2005

Variable	Coefficient	Standard Error	P-Value	Elasticities	
				M	H
Intercept	-16.53	21.91	0.46		
Retail price of vegetable oils and fats	24.23	2.19	0.00	0.17	0.26
Retail price of milk	-165.54	21.61	0.00	-1.28	-1.19
Retail price of fruits	-4.26	4.21	0.33	-0.07	0.20
Retail price of vegetables	-22.97	6.82	0.00	-0.23	-0.07
Retail price of cereals & legumes	122.57	23.25	0.00	0.74	0.90
Retail price of meats & eggs	-4.96	1.08	0.00	-0.37	-0.18
Total food expenditure	0.09	0.01	0.00	0.96	
Time trend	8.37	2.02	0.00	0.25	

Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Figure 3.19 traces the evolution of the actual and estimated aggregate demand for vegetable oils & fats over the period 1982-2005. The figure indicates an increasing trend.

Figure 3.19. Evolution of the actual and estimated demand for vegetable oils & fats, 1982-2005 (kg/capita)



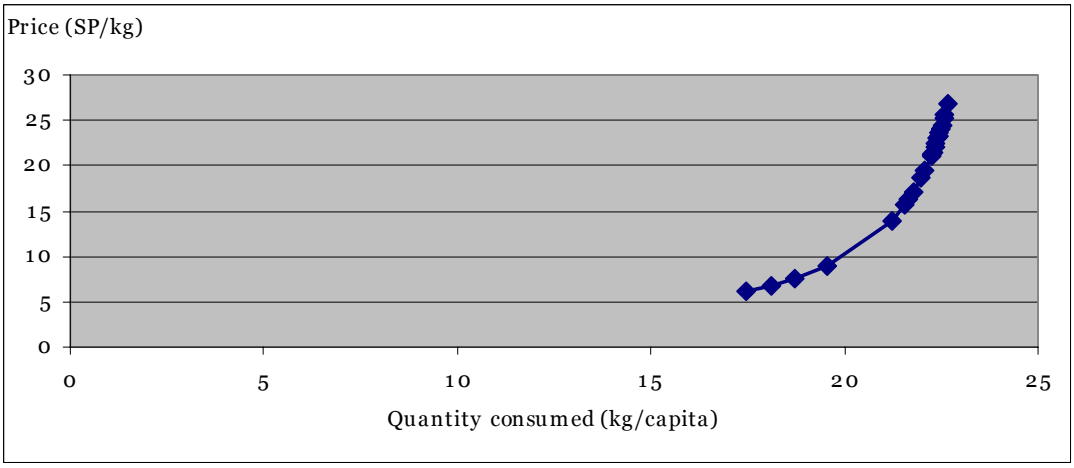
Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Figure 3.20 depicts the relationship between the quantity consumed and the retail price of vegetable oils & fats from 1982 to 2005 holding all other factors affecting demand constant. The figure indicates a positive relationship between the retail price and quantity consumed.

Tracing, however, the relationship between the quantity consumed of vegetable oils & fats with its corresponding lagged (past price) retail price shows an inverse relationship between the quantity consumed of vegetable oils & fats and the retail price (Figure 3.21).

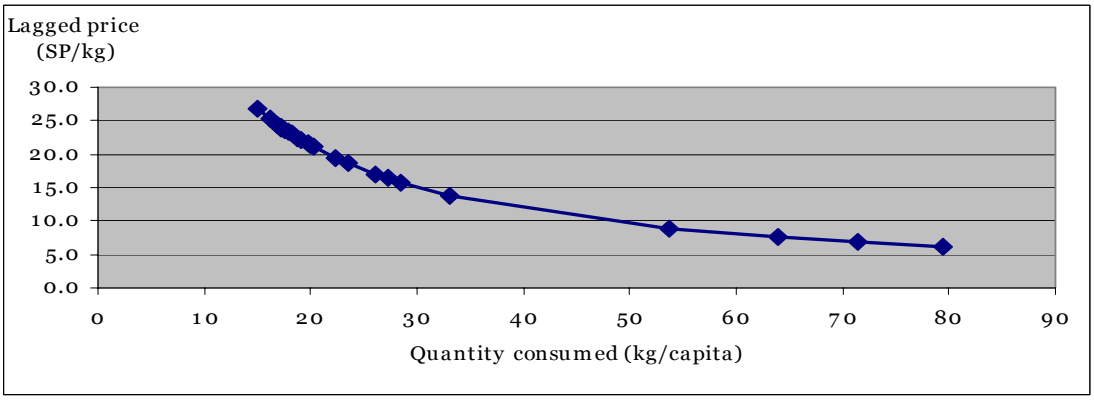
Figure 3.22 traces a linear Engel curve related to vegetable oils & fats, which depicts the relationship between the level of consumption and income holding all other factors affecting demand constant, for the period 1982-2005 considering total food expenditures. It shows a decreasing trend for the consumed quantity.

Figure 3.20. The demand for vegetable oils & fats with respect to its retail price (kg/capita)



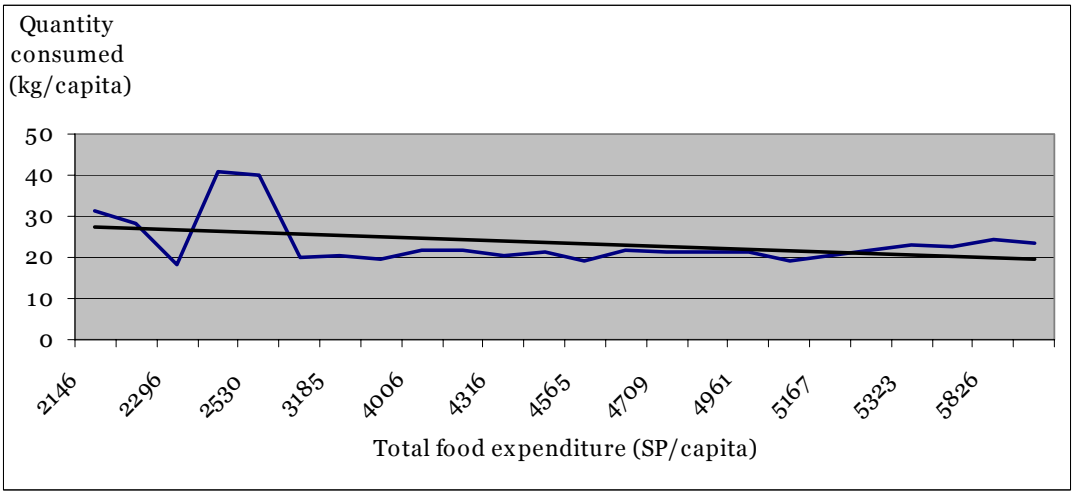
Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Figure 3.21. The demand for vegetable oils & fats with respect to its lagged retail price (kg/capita)



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

Figure 3.22. Linear Engel curve for vegetable oils & fats, 1982-2005 (kg/capita)



Source: Elaborated from NAPC database; MAAR, AASA, Various issues and CBS, ASA, Various issues.

3.2.2.2 Results of the demand systems approach

The equations of the aforementioned single equation approach were solved simultaneously using the Seemingly Unrelated Regression (SUR) technique, but without imposing the restrictions of the demand theory. There was a substantial improvement in the significance of the regression parameters. Because the regressors are identical across equations, the correction was performed only for the standard errors. This means that the regression coefficients of the explanatory variables have the same values by both estimation techniques.

After imposing the restriction of the demand system, the following interpretations are from great importance:

Estimates of cereals & legumes

The signs and magnitudes of the own- price elasticities coincide with economic theory and very close to international estimates. This conclusion applies also for expenditure and cross-price elasticities. The income elasticity indicates that cereals & legumes are necessity goods. The own-price elasticity of cereals & legumes is estimated at -0.51 reaching the highest value among the food groups and ranging between -0.51 and -2.075. While at international level the smallest own-price elasticity was in West Pakistan (-0.1) and the highest was in Ghana (-2.32). Canadian estimates of the AIDS model in 2005 show that the own- price elasticity is -0.70 for cereals & pasta and -0.43 for bakery[5]. The income elasticity of this group equals to 0.89 ranging from 0.83 to 0.94, which is smaller than the income elasticities of the other food groups except for meats & eggs. At international level on the other hand, the income elasticity was smallest in Argentina (0.16) and highest in India (1.06). Canadian estimates of the AIDS present an income elasticity of 0.89 for cereals and 0.94 for bakery.

Estimates of vegetables

The estimates coincide with economic theory and with international estimates. The income elasticity implies that vegetables are luxury goods. The own-price elasticity of this group is the smallest one (-0.03) among those of the other groups excluding that of the vegetable oils & fats and ranges between -0.03 and -1.02. International estimates show that the own-price elasticity varies between -0.13 (Argentina) and -1.11 (Java). Canadian assessment of the AIDS for the own-price elasticity is -0.65. The income elasticity of vegetables is about 1.33 and fluctuates between 1.28 and 1.37, which is smaller than the income elasticity of fruits and higher than the income elasticities of the remaining groups. At international level the income elasticity of vegetables varies between 0.04 (Argentina) and 0.67 (Java). Canadian estimation of the AIDS for the income elasticity of vegetables is 1.31.

Estimates of fruits

The estimates comply with economic theory and international estimates. The income elasticity implies that fruits are luxury goods. The own-price elasticity of this group is about -0.44 and varies between -0.44 and -1.01, which is smaller than the own-price elasticity of cereals & legumes and greater than the elasticities of the remaining groups. Internationally, the own-price elasticity of fruits is about -0.95. Canadian estimates of the AIDS show an own-price elasticity of -0.84 for fruits. The income elasticity of fruits is about 1.47 and ranges between 1.41 and 1.61, which is the greatest elasticity compared with those of the other groups. International estimate of the income elasticity of fruits is about 1.39. Canadian assessment of the AIDS presents an income elasticity of 1.28 for fruits.

[5] Pombosa and Mbaga (2007).

Estimates of meats & eggs

The own-price elasticity of this group is about 0.23 and varies between -1.06 and 0.23, which doesn't comply with economic theory, but it complies with international estimates of the own-price elasticities. At international level, the own-price elasticity of meats & eggs varies between -2.16 and 6.33. Canadian estimates of the AIDS show an own-price elasticity ranging from -0.81 to -0.1 for meats & eggs. The income elasticity of meats & eggs is about 0.11 and fluctuates between 0.07 and 0.15 implying a necessity good, which is the smallest elasticity compared with those of the other groups and much lower than international estimates, which vary between 0.57 and 1.62 . Canadian assessment of the AIDS presents an income elasticity ranging from 0.61 to 0.90.

Estimates of milk & its products

The estimates comply with economic theory and international estimates. The income elasticity implies that milk is a luxury good. The own-price elasticity of this group is about -0.06 and varies between -0.06 and -0.33 representing the smallest own-price elasticity of the studied groups after vegetables. Internationally, the own-price elasticity of milk & its products differ between -1.37 and 1.58. Canadian estimates of the AIDS show an own-price elasticity of -0.88 for dairies. The income elasticity of milk is about 1.00 and fluctuates between 0.88 and 1.08, which is ranked fourth among the studied groups. International estimates of the income elasticity of milk & its products vary between 0.17 and 1.16. Canadian assessment of the AIDS presents an income elasticity of 1.08 for dairies.

Estimates of vegetable oils & fats

The own-price elasticity of this group is about -0.01 and varies between -1.20 and 0.17 representing the smallest own-price elasticity of the studied groups. Internationally, the own-price elasticity of vegetable oils & fats fluctuates between -0.05 and -0.08. Canadian estimates of the AIDS show an own-price elasticity of -0.22 for fats & oils. The income elasticity is about 1.04 and differs between 0.96 and 1.08, which is ranked third among the studied groups and representing a luxury good. International estimates of the income elasticity of milk & its products have values between 0.50 and 1.16. Canadian assessment of the AIDS presents an income elasticity of 0.68 for fats & oils.

3.3. Concluding remarks

This working paper focuses on presenting the results of applying a dynamic model of a demand systems estimation using the LES and Syrian aggregate consumption data. The model is used to measure quantitatively the relationships between consumer demand, prices and food expenditure taking into consideration 6 food groups namely: cereals & legumes, vegetables, fruits, meats & eggs, milk & its products and vegetable oils & fats.

The own-price elasticies are consistent with economic theory excluding meat & eggs. Their magnitudes and signs are reasonable compared with international estimates. They are negative and less than one with the exception of meats & eggs. The estimates of the expenditure elasticities are also complying with economic theory and international assessments of various countries. The expenditure elasticities for vegetables, fruits and vegetable oils & fats are greater than one. Milk & its products have an expenditure elasticity of one. The other groups have expenditure elasticities less than one.

The result of this study can be considered as useful information for policy analysis such as tax reforms, trade restrictions, nutrition requirements, other regulations that may lead to higher prices, forecast demand and establishment of policy scenarios.

Finally, this study is the first of its kind to investigate consumer demand and to assess the demand elasticities. It's considered also a base for conducting detailed demand studies in the near future to describe the structure of Syrian agriculture and agri-food system and to determine the impact of changes in policies and programs, regulations, prices and income on the agricultural sector and its related agro-industry.

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