Impacts of Rising Food Prices on the Egyptian Households' Welfare

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Abstract

The rising food prices in 2008, known as food crisis, threatened the food security in many countries, especially food net importing ones. Public subsidies to consumption are one of the policies considered by "victim" countries in order to protect their population welfare. Egypt, as one of these countries, is characterized by a major food subsidy system that started after WW II and experienced a series of reforms. In this paper, we use a Mixed Demand approach to analyze the consumption structure of Egyptian households. Our model specification allows us to take into consideration the specification of the Egyptian subsidies system, with some food items having predetermined quantity quotas (sugar and oil) while others (bread and flour) have predetermined (subsidized) prices. Price, income and quota elasticities are estimated from an Egyptian family expenditure survey and welfare change measures are derived for several income quintiles. Policy simulations show the negative impact of the elimination of the actual system especially in the context of soaring food prices.

Introduction

A significant increase in grain prices in 2008 alarmed policy makers of their potential impact on low income households and caused social instability in some low income countries. According to the World Bank, the world price of wheat has tripled between 2000 and 2007. From January 2007 to June 2008, the IMF's index of internationally traded food commodities

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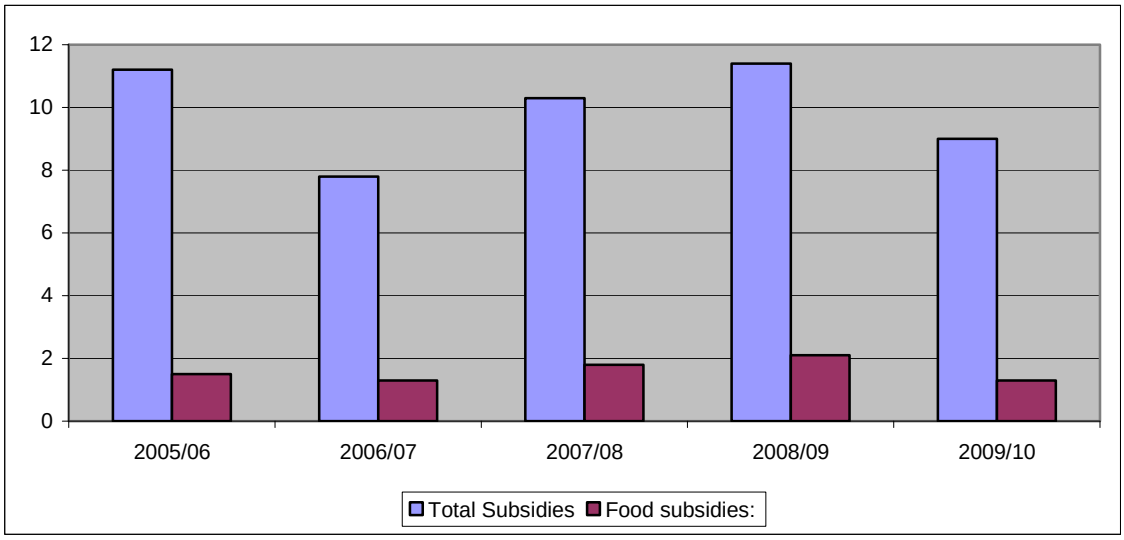
prices increased by 56 percent. The head of the World Food Program referred to this situation as "*a silent tsunami*" (Mitchell, 2008, The Economist, 2008).

The recent increase in world grain prices has been attributed to a number of reasons: increasing demand of cereals resulted from modified patterns of food consumption, especially in China and India, stronger competition among production of grain for human consumption vs. animal feeding and American and European bio-fuel programs. Other factors include increasing prices of fertilizer and energy, news of possible global recession and climate change. According to Mitchell (2008) the bio-fuel policies applied by the European Union and the U.S.A are a major factor giving rise to the food crisis. Even governmental intervention through market price ceilings, food subsidies, export quotas and import restrictions further complicated the situation. For example, such public policies often discouraged local farmers from responding to the higher global food prices, especially in developing countries, when compared with farmers in developed countries who often benefitted from higher farm gate prices. All in all, the impact of the food crisis differed across countries depending on their food trade balance.

In Egypt, cereals prices (including wheat and rice) increased by 129 percent (WFP, 2008). The rising food prices worsened the situation of the poor, causing a lot of social unrest; referred to as the *bread crisis*. The Egyptian government responded to this crisis by raising the food subsidy budget and extending its coverage area. Food subsidies increased from 1.8 percent of GDP in 2007/08 to 2.1 percent in 2008/09 (Figure 1).

Figure 1: Total subsidies and Food subsidies as a percentage of GDP (2005/06 to 2009/10)



Source: International Monetary Fund- 2008 Article IV Consultation
Note: 2009/2010 is projection.

In this paper, we investigate the influence of the Egyptian subsidy policy on consumer demand for food, and its impacts on consumers' welfare in the context of soaring food prices. To this end, we use the Egyptian Integrated Household Survey (EIHS) of 1997 to perform an econometric estimation to identify consumer demand patterns (in particular, substitution between subsidized and free-market food commodities). The estimated demand system is used to conduct a policy evaluation experiment on the actual subsidy system, by modifying prices of various food items, and computing consumers' welfare changes.

We use a Mixed Demand approach to analyze the consumption structure of Egyptian households. Our model specification allows us to take into consideration the specification of the Egyptian subsidies system that some food items are predetermined quantity quotas (rationed sugar and cooking oil) while others (bread and flour) have predetermined (subsidized) prices. To account for the rationing of some food commodities and the dual price system, we exploit the literature on mixed demand systems that explicitly incorporate rationed quantities for a subset of goods with predetermined prices, which is more adequate to the

Egyptian situation than the rationing demand system. Technical difficulties in obtaining closed-form solutions for Marshallian and Hicksian consumer demands can be alleviated by using a normalized quadratic specification, as demonstrated by Moschini and Rizzi (2007). We prefer such an estimation strategy, rather than a fully non parametric approach that would require more elaborated computation techniques for estimating consumer welfare changes (see Hausman and Newey, 1995; Foster and Hahn, 2000). An interesting aspect of the parametric specification proposed by Moschini and Rizzi (2007) is indeed the fact that consumer welfare variation is easily obtained for any change in price or income**.**

Policy simulations show the negative impact of the elimination of the present system, especially in the context of soaring food prices. Removing the baladi bread or/and the baladi flour subsidies affects negatively the low income groups. This negative impact is more important in a context of increase of the cereals price.

The paper is organized as follows. Section 1 describes the Egyptian food subsidy system. Section 2 details the consumer demand analysis in the case of rationed goods and our model specification. The empirical application with data description and estimated results are presented in Section 3. Section 4 deals with welfare analysis and the policy simulation experiment, and Section 5 concludes.

1. The Egyptian Food Subsidy Program

The Egyptian food subsidy program goes back to the Second World War (WWII). It has generally been considered an effective social safety net for protecting the poor during times of economic hardship. As it evolved, it has been regarded as an important antipoverty policy in Egypt. In 2000; it provided approximately 40 percent of the required calorie intake for low

income group. Bread subsidies kept 730 000 persons above the poverty line in the fiscal year 1999/2000 (Ahmed et al., 2001; Ahmed and Bouis, 2002, Fan et al., 2006 and IDSC, 2005). The system includes rationed subsidized goods available to consumers through ration card system, in addition to universal subsidy for wheat flour and bread.

Throughout time, a variety of problems plagued the system. Food subsidy cost increased over the years presenting a fiscal burden for the government budget. In 2007, the spending on food subsidies was 4 percent of the total public spending which represents 1.2 percent of GDP (Table1). In addition to this, the system is not well targeted and there are lacks of coverage and leakage problems. These problems ultimately make the system more costly than its benefits. For instance, the better-off households benefit from 62 percent of the food subsidies, while the poor households get benefit of just 38 percent (Table 2).

Table 1: Development of Spending on Food Subsidies

Year	Spending on food subsidies as percentage of	
	Total public spending	GDP
2002	3.3	1.2
2003	3.8	1.2
2004	4.1	1.7
2005	5.6	2.1
2006	4.6	1.5
2007	4.0	1.2

Source: Youssef (2008)

Table 2: Food subsidies distribution between the poor and the better off

items	The poor				Better off (%)	Total (%)
	Extreme poor (%)	Moderate poor (%)	Near poor (%)	Total (%)		
Baladi bread	4	14	20	38	62	100
ration cards subsidies	4	16	23	43	57	100
All food subsidies	4	14	20	38	62	100

Source: Youssef (2008)

As a result of these disadvantages; the system was about to disappear in recent years. But because of its social importance for the Egyptian population, mainly the low income groups, and its political sensitivity, its removal is difficult to consider for policy-makers. The prospect of abandoning the system became even harder after the food crisis of 2008 as its importance became more obvious with this crisis. In spite the insufficiency of the subsidized bread production and the weakness of the system, the system helps to alleviate the impacts of soaring food prices on the poor. Therefore, the food subsidy system is expected to remain in existence for the time being, and its improvement becomes necessary.

The food subsidy system can be decomposed into two sub-systems. The first one includes the rationed goods available on specific quotas per household and sold at a subsidized price in specific outlet. To get these products the households should have ration card. The list of the rationed goods varies over time. For instance, from 1981-1989 the ration system included 20 goods, in 1997 (year of the Egyptian Integrated Household Survey used in this paper) there were just the subsidized cooking oil and sugar. In 2004, new products were added to the system, such as lentils, macaroni and beans in order to provide the poor with the basic goods at lower prices (Ali and Adams, 1996; Audet et al; 2007). As a result of the food crisis, the government of Egypt increased the quotas for some commodities and removed the products without high demand. In its present form, the system includes sugar, cooking oil, rice and tea. In addition, the eligibility of the ration card has been expanded; persons born during the period (1989- 2005) were added to the ration card of their households Therefore the actual system includes 62 million beneficiaries (El Nakeeb, 2009 and WFP, 2008).

The second sub-system includes the subsidized 82 percent flour and or dark country style bread known as “baladi” bread. These are the major commodities of the system given the

importance of the wheat and its products in the Egyptians' diet. The price of *baladi* bread is very low, typically less than 1 cent a loaf in 2010 (Ahmed and Bouis, 2002; Gutner, 1999, Helmy, 2005 and IDSC, 2005). It is universal subsidy; bread is available to all consumers without any official restrictions.

The baladi bread is the major product of the subsidy system; it represents an important burden on the Egyptian government budget. In 2009/2010, the budget allocated to the bread subsidy represents 76.37 percent of the total food subsidy budget (Table 3). Bread subsidy covers third of the bread production cost (IDSC, 2005). The insufficiency local wheat production in addition to leakage and corruption at all the stages of the wheat to bread chain increase wheat imports which increases the baladi bread budget.

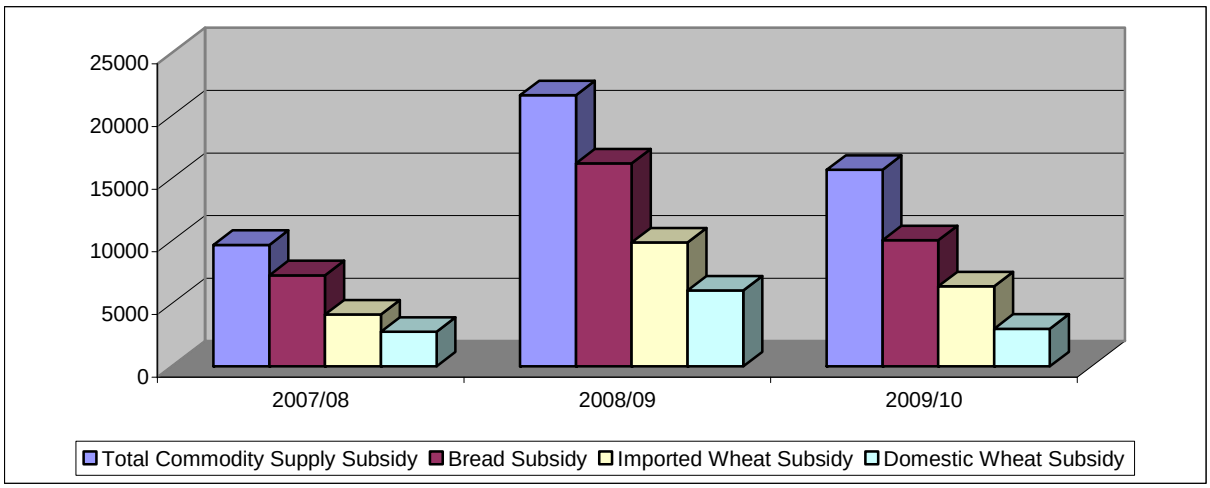
Table 3: Food Subsidy Budget by item in EGP Million for 2009/2010

Essential subsidized Commodities Budget	**EGP MILLION**	**PERCENTAGE**
Bread Subsidy		
wheat Imported	6368	48.40
Wheat Domestic	2993	22.75
Corn	688	5.23
Total	**10049**	**76.37**
Rationed Goods Subsidy		
cooking oil	1675	12.73
Sugar	1434	10.90
Total	**3109**	**23.63**
Total	**13158**	**100.00**

Source: Ministry of Finance, Government budget Statement for 2009/10.

The baladi bread high cost comes from the low wheat self sufficiency rate of Egypt. Egypt imported 54 percent of its total amount required of wheat in 2009 (El-Nakeeb, 2009) which make the bread subsidy budget vulnerable to changes in the international wheat prices (Figure 2).

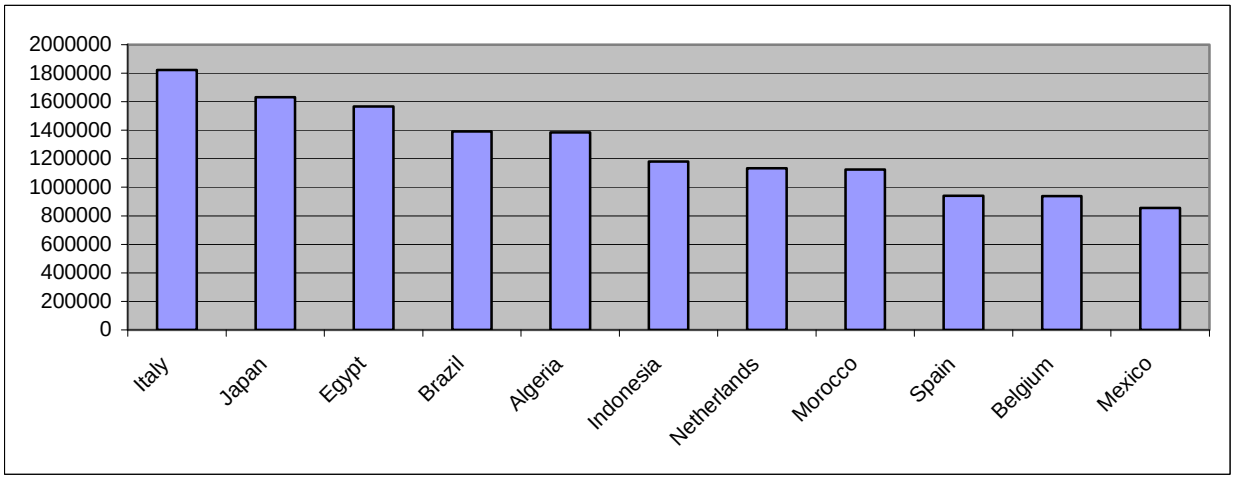
Figure 2: Total food subsidy, bread subsidy, imported wheat and domestic wheat subsidy costs in Million EGP[3]



Source: Ministry of Finance, Government budget Statement for 2007/08, 2008/09 and 2009/10.

In 2007, Egypt was the third wheat importer country after Brazil and Italy (Figure 3). In 2008, Egypt became the second largest wheat importer (WFP, 2008) and in 2009, Egypt is the world's largest wheat importer. Its wheat imports increase due to the rising demand and the decline in the domestic production (Food Outlook, June 2009). Being one of the major wheat importers, the government budget allocated to baladi bread is affected by rising international wheat prices.

Figure 3: Top 10 wheat importer countries in 2007

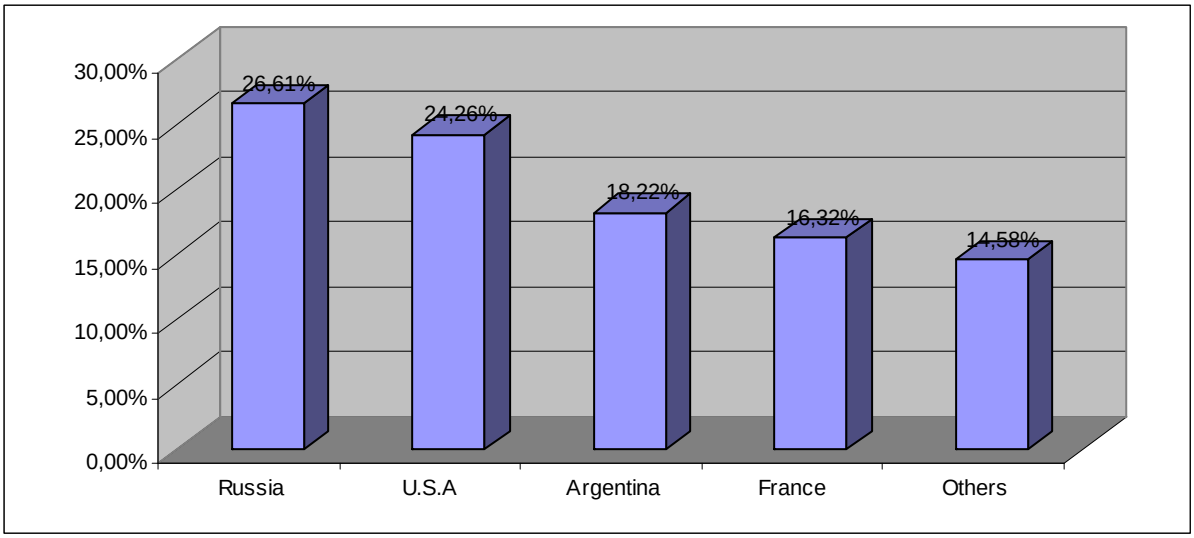


Source: FAOSTAT
Note: Imports value by (1000$).

[3] 1EGP=0.176USD

Egypt imports wheat mainly from U.S. Australia, France and Russia (Figure 4). Therefore, bread subsidy cost increases with rising international wheat price (UBIFRANCE, 2009 and USDA, 2006). This is what happened recently with the food crisis; bread production cost increased by 48 percent (WFP 2008).

Figure 4: Wheat exporting countries to Egypt in 2004/05



Source: USDA, 2006

2. Demand Analysis

In this paper, we use a mixed demand model to estimate a consumer demand system for Egypt, taking into consideration the particular features of the Egyptian food subsidy system where the quantity of some food commodities are determined (at the household level), as they can be purchased only in limited quantities from the government outlets at subsidized prices (Gao et al., 1995). In such a system, the usual empirical consumer analysis is not the best-suited approach to describe consumer behaviour, because of kinks and non-convexities in consumer budget sets. More precisely, the consumer has to choose simultaneously the consumption segment (in our case, below or above his quota) and the final consumption level within this segment. This is the same situation in fact with multi-block pricing designed by some network industries.

In this dual systems, constructing Marshallian demand functions using flexible specifications such as the Almost Ideal Demand Systems (AIDS) is not the best approach to use. This is essentially because the existence of food subsidies in the consumer demand system is associated with individual consumption quotas, which introduce nonlinearities in demand functions. Households typically have access to subsidized goods up to their designated quota, but when demand exceeds this quota, households have to turn to the free market for purchasing goods with the same or a different quality, and of course a different price. Therefore the rationing demand theory is not the best adequate to analyze such system, we use the mixed demand model developed by Samuelson (1956) to take into consideration such duality.

2.1 Rationing Demand

Rationing is a policy instrument employed by the governments to allocate a minimum level of scarce resource to the population. It is usually applied in emergency or crisis periods such as wars or famines. Rationing may also be viewed as part of a food security system that guarantees low food prices to the low income consumers, the latter however supporting indirect costs (opportunity cost of queuing, travel to the local retail outlet). It also entails large budget provisions for the government, and generally yields market distortions, discouraging local production.

Economic analysis of consumer behaviour under rationing started after WWII, when most centrally-planned economies were applying it even after the post-war reconstruction period was officially over. Interest in this literature is likely to increase in the present period, because of the increasing food price that started in 2007 and the will of many governments in developing countries to implement food rationing systems to protect their low-income population (Bhagwati and Sihag 1980 and Tobin and Houthakker 1951, 1952).

In the rationing theory, the consumption set is decomposed in two subsets, where quantity levels in one subset are imposed to the consumers. The demand of the non rationed goods in this case is function of the prices and the quantities of the rationed goods. This implicitly assumes sub-optimality of the consumption of the rationed goods. In case of rationing, the responsiveness of the non rationed goods to their prices is lower than in the absence of rationing and the increase of the quotas reduces the demand of the substitutes and increases the demand of the complements (Chavas, 1984 and Tobin and Houthakker 1951).

In this case, the consumer faces the budget constraint as well as quantity constraints for the rationed goods. For these later, the shadow price is used, which is the price level at which the consumer will choose the quotas level in case of free market. Huffman and Johnson (2000) use the German level prices as shadow prices for analyzing the demand patterns in Poland during the period of 1987 to 1992. They use the AIDS model in a rationed-good context and they found high own price elasticities for the non rationed goods after the reform, which is conform to the rationing theory.

The rationing theory is more adequate to cases where the consumers can not obtain more than the rationed amount, so the market is not cleared. In the case of Egypt, there is partial rationing. In such systems, there is a free market counterpart of the rationed commodities. Therefore consumers can consume up to the subsidized quotas and then continue with their desired consumption levels from the free markets.

In such dual price system where the markets clear, the mixed demand model, first introduced by Samuelson (1965) and analyzed by Chavas (1984), presents an alternative approach to the usual consumer demand analysis, by allowing for the possibility of limited consumption levels for a subset of commodities, at a predetermined price (GAO et al., 1995 and Matsuda, 2004). The mixed demands are functions of both the prices and quantities which provide more flexibility for empirical analysis of the consumption behavior (Chavas, 1984). This system

has an econometric appeal as it allows for different possibilities concerning the specification of the dependent and the independent variables between the two polar cases the direct and inverse demand functions. It is an intermediate case between the demand functions and the inverse demand functions (Moschini and Rizzi, 2006). Although the mixed demands are different from the rationed demands, especially that in the last case some markets do not clear, they share some similarities. The compensated mixed demands are the same as the compensated rationed ones (Chavas 1984; Moschini and Rizzi, 2006). The main difficulty with the mixed model arises from the requirement of having closed form expressions for the direct and indirect utility functions, such as the Stone-Geary utility function used by Moschini and Rizzi (2006).

2.2 Mixed Demand Model Specification

Consider $x = [x_1 \ldots\ldots x_n]$, the vector of goods whose prices are determined on the market; $z = [z_1 \ldots z_m]$ is the vector of goods whose quantities are predetermined; *p* and *q* are the price vectors associated to *x* and *z* respectively. The mixed demand of a representative consumer is derived from the solution to the following maximization problem:

$$\begin{aligned} &\max_{x,q} \; u(x,z) - v(p,q) \\ &\text{s.t.} \quad p'x + q'z = R, \end{aligned} \qquad (2.1)$$

where *u* and *v* are the direct and indirect utility functions respectively, and *R* is income (or total expenditure) of the consumer. Solving the first order conditions of the above maximization problem yields the vector of Marshallian mixed demands:

$$x^* = x(p,z,R) \quad \text{and} \quad q^* = q(p,z,R). \qquad (2.2)$$

At the optimum, we have

$$u(x^*,z) = v(p,q^*,R) = v^M(p,z,R). \qquad (2.3)$$

where $v^M(p,z,R)$ is the mixed utility function.

The mixed demand functions $x(p,z,R)$ and $q(p,z,R)$ satisfy Walras' Law and are homogeneous of degree zero and degree one in (p,R). The symmetry property applies to the compensated mixed demand functions that are the same as the compensated demand under rationing. It may be characterized in terms of the restricted cost function as (Moschini and Rizzi, 2006 and 2007):

$$C(p,z,u) \equiv \min_x \{p.x / u(x,z) \geq u\} \qquad (2.4)$$

The restricted cost function $C(p,z,u)$ is nondecreasing in *p*, nonincreasing in *z*, increasing in *u* and homogeneous of degree one. Using the Shepard's lemma, the partial derivatives of the cost function with respect to p and z yield to the compensated (Hicksian) demand functions for the goods whose quantity are chosen optimally and the compensated price-dependent functions of *z* respectively. The compensated price dependent functions are known as well as the shadow or the virtual prices of the goods in predetermined quantities (Moschini and Rizzi, 2007).

$$\begin{aligned} \nabla_p C(p,z,u) &= x^h(p,z,u) \\ \nabla_z C(p,z,u) &= -q^h(p,z,u). \end{aligned} \qquad (2.5)$$

These Hicksian demands can be related to the Marshallian one s as follows:

$$\begin{aligned} x(p,z,R) &= x^h(p,z,v^M(p,z,R)) \\ q(p,z,R) &= q^h(p,z,v^M(p,z,R)). \end{aligned} \qquad (2.6)$$

According to Moschini and Rizzi (2006), the mixed utility function, $v^M(p,z,R)$, can be derived from the restricted cost function $C(p,z,u)$ by solving for *u* in the identity:

$$C(p,z,u) - \nabla_z C(p,z,u) z \equiv R, \quad (2.7)$$

this expression had been defined by Moschini and Rizzi (2007) as the mixed cost function $C^{M}\left(p,z,v^{M}\left(p,z,R\right)\right)$.

A flexible functional form of the cost function, such as the PIGLOG cost function used in the AIDS models, will not allow one to derive a closed form of the mixed utility function. This latter is required to obtain the mixed demand functions of equation (2.6) that all together constitutent a coherent system of mixed demand equations (Moschini and Rizzi, 2006, 2007).

In a recent application of the mixed demand model**s,** Moschini and Rizzi (2007) were able to overcome this drawback of the mixed demand system by choosing a cost function from the Gorman Polar form that is affine in *u*:

$$C\left(p,z,u\right)=F\left(p,z\right)+G\left(p,z\right)u,$$

where *F* and *G* are continuous and differentiable in *p* and *z*. This yields the following form for the mixed utility function:

$$v^{M}\left(p,z,R\right)=\frac{R-F\left(p,z\right)+\nabla_{z}F\left(p,z\right)z}{G\left(p,z\right)-\nabla_{z}G\left(p,z\right)z}. \quad (2.8)$$

Then they specify a Normalized Quadratic form for the functions *F* and *G:*

$$\begin{aligned} F\left(p,z\right)&=\delta'p+\left(a'p\right)\left(\mu'z\right)\\ G\left(p,z\right)&=\beta'p+\left(a'p\right)\left(\gamma'z\right)+0.5\left(\frac{p'Bp}{a'p}\right)+0.5\left(a'p\right)\left(z'\Gamma z\right)+p'Lz \end{aligned} \quad (2.9)$$

Finally, the mixed demand equations can be derived from the above specification:

$$\begin{aligned} x_{i}^{*}=\delta_{i}+\left(\mu'z\right)a_{i}+\Bigg\{&\beta_{i}+\sum_{j=1}^{n}\frac{\beta_{ij}p_{j}}{a'p}+\sum_{k=1}^{m}\lambda_{ik}z_{k}\\ &+a_{i}\left[\gamma'z-0.5\left(\frac{p'Bp}{\left(a'p\right)^{2}}\right)+0.5\left(z'\Gamma z\right)\right]\Bigg\}v^{M} \end{aligned} \quad (2.10)$$

$$-q_k^* = (a'p)\mu_k + \left[(a'p)\gamma_k + (a'p)\sum_{s=1}^{m}\gamma_{ks}z_s + \sum_{j=1}^{n}\lambda_{jk}p_j\right]v^M \quad . \qquad (2.11)$$

For *i*= 1, 2,..n, *k*=1, 2,..m, and the mixed utility function, v^M, is defined as:

$$v^M = \frac{R - \delta'p}{\beta'p + 0.5\left(\frac{p'Bp}{(a'p)^2}\right) - 0.5(a'p)(z'\Gamma z)} . \qquad (2.12)$$

The structural estimation equations of the demand system can be written in terms of budget shares as:

$$W_i = \left[\delta_i + (\mu'z)a_i + \left\{\beta_i + \sum_{j=1}^{n}\frac{\beta_{ij}p_j}{a'p} + \sum_{k=1}^{m}\lambda_{ik}z_k + a_i\left[\gamma'z - 0.5\left(\frac{p'Bp}{(a'p)^2}\right) + 0.5(z'\Gamma z)\right]\right\}v^M\right]\frac{p_i}{R} + \varepsilon_i \qquad (2.10')$$

$$-W_k = \left[(a'p)\mu_k + \left[(a'p)\gamma_k + (a'p)\sum_{s=1}^{m}\gamma_{ks}z_s + \sum_{j=1}^{n}\lambda_{jk}p_j\right]v^M\right]\frac{z_k}{R} + \xi_k . \qquad (2.11')$$

The Wi's and the W_k's, for $i = 1,....n$ and $k = 1.....m$, are the budget shares of the goods with predetermined prices and fixed quantities respectively. β_i and δ_i for $i = 1,....n$ are parameters. γ and μ are $m \times 1$ vectors of parameters. $B = [\beta_{ij}]$ is $n \times n$ matrice of parameters. $\Gamma = [\gamma_{ks}]$ is $m \times m$ matrice of parameters. All these parameters will be estimated. $a = [a_1, a_2, ...a_n]'$ is a vector of arbitrarily chosen coefficient in order to ensure the homogeneity property. ε_i and ξ_k are error terms.

3. Empirical application

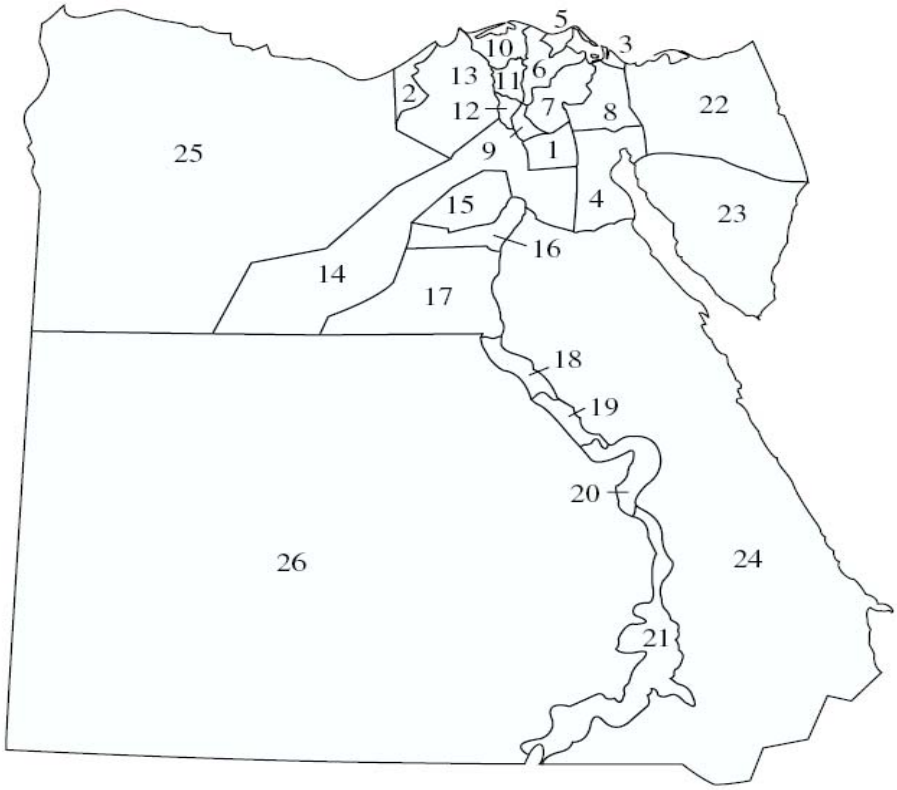
3.1 Data

We use the Egyptian Integrated Household Surveys (EIHS), 1997, for the estimation of the mixed demands developed above. This survey was conducted by the International Food Policy Research Institute (IFPRI), in collaboration with the Ministry of the Agriculture and Land Reclamation (MALR) and the Ministry of Trade and Supply (MOTS) of the Government of Egypt (GOE).

The EIHS 1997 is a nationally representative survey that consists of 2500 households (urban and rural households) selected from 20 governorates, which represent 98 percent of the Egyptian population. The choice of the household was done using a two-stage stratified selection process. In the first stage, 125 primary sampling units (PSU) were randomly selected with probability proportional to size from the master sample. In the second stage, 20 households were randomly selected from each PSU. The sample is stratified on five regions of Egypt (Figure 2.1): Metropolitan, Lower urban, Lower rural, Upper urban, and Upper rural. The PSU were selected from the five regions. The EIHS97 survey contains household- (and individual-) level variables on housing characteristics, food expenditures (subsidized and not subsidized), non-food expenditures, education, health status, wage employment, credit and savings, farming, livestock ownership, and non-farm enterprises[4].

[4] Egypt Integrated Household Survey, 1997. Overview and description of version 3 data files.

Figure 5: Administrative decomposition of Egypt



I. Metropolitan Citiesy
   1. Cairo
   2. Alexandria
   3. Port Said
   4. Suez

II. Lower Egypt :

- Eastern delta :
   5. Damietta
   6. Dakhalia
   7. Sharkia
   8. Ismailia
   9. Qalubia

- Western delta :
   10. Kafr Elsheikh
   11. Gharbia
   12. Menufia
   13. Beheira

III. Middle Egypt:
   14. Giza
   15. Fayoum
   16. Beni SUef
   17. Menya

IV. Upper Egypt:
   18. Assiut
   19. Souhag
   20. Qena
   21. Aswan

V. Frontier
   22. North Sinai
   23. South Sinai
   24. Red Sea
   25. Matruh
   26. New valley

For the present application, we use the household food expenditure section for computing prices and budget shares. Subsidized and non subsidized food commodities are all included in the household food budget, assumed to be separable from other consumer expenditures. In other terms, relative prices of non-food items will not affect the consumer's budget shares on food commodities.

As the analysis is focusing on subsidized food items, we choose to consider them together with their free-market counterparts and other products that we aggregate in broader categories. We consider twelve food commodities: cereals (includes wheat, rice, maize and other cereals), subsidized wheat flour, free-market flour (includes shami flour, fino flour and macaroni), subsidized (*baladi*) bread, free-market bread, beans *(Ful and Tamyia)*, free-market cooking oil, free-market sugar, subsidized cooking oil, subsidized sugar, meat and fish, and miscellaneous. The latter group contains all other food items such as eggs, milk, cheese, vegetables, drinks, etc.

For the subsidized products, the quantity refers to the month before whereas it concerns the past week for other food commodities, we assume that the monthly quota is used evenly by the household among the four weeks, to match observations on non-subsidized items that are consumed weekly. We use the share-weighted Stone formula to compute price indices for aggregate food groups. Finally, total expenditure on food is used instead of income.

To alleviate the problem of frequent zero expenditures for some food items, we do not consider estimation at the household level. Instead, we construct aggregate measures of consumption and prices by PSU and expenditure quartile. We first compute the three empirical quartiles (25 percent, 50 percent, and 75 percent) of the distribution of total food expenditure by PSU, denoted Q1, Q2 and Q3. We then compute the average food expenditure, budget shares and unit prices for each of the four inter-quartile ranges (minimum-Q1, Q1-Q2,

Q2-Q3, and Q3-Q4) for the 125 PSU. Two outliers were dropped, so we are left with 498 observations.

This aggregation step certainly generates a loss in information in the data because the individual level is lost, but it avoids the need to adopt more sophisticated procedures for dealing with multiple corner solutions in demand systems (Shonkwiler and Yen, 1999). Cereals, beans, meat constitute a major proportion of total food expenditure (Table 4), as they are the main components of the Egyptian households' diet. The poor groups (Q1), in both urban and rural areas, spend high percentage of their food expenditure on cheap calorie dense food such as cereals, subsidized flour, *baladi* bread and beans (Ali and Adams, 1996). The subsidized flour's share is more important in the rural areas than in the urban ones, although the subsidized bread is the opposite. This can be explained by the fact that rural households prefer to buy flour and consume homemade bread than directly buying bread. The baladi bread's share is more important than the free market bread's share, hence confirming the importance of *baladi* bread for Egyptian households. We notice as well the importance of the subsidized flour and bread for the poorest households in both urban and rural areas. The two rationed goods (subsidized cooking oil and sugar) have the lowest budget shares.

Table 4: Median expenditure shares (rural/ Urban) of food consumption categories by the expenditure groups (percent)

	Rural					Urban				
	Q1	**Q1-Q2**	**Q2-Q3**	**Q3-Q4**	**Full sample**	**Q1**	**Q1-Q2**	**Q2-Q3**	**Q3-Q4**	**Full sample**
Cereals	9.62	8.93	8.91	8.80	8.94	7.68	8.00	7.22	7.66	7.54
Subsidized flour	7.84	5.97	4.84	3.90	5.15	4.25	2.82	2.42	1.86	2.69
Free-market flour	3.61	3.80	4.12	4.33	3.93	4.02	4.14	4.31	4.53	4.27
Subsidized bread	7.25	5.29	4.58	3.55	4.76	8.62	6.19	4.83	4.31	5.41
Bread	0.63	0.74	1.06	1.00	0.94	1.59	1.16	0.89	0.71	1.03
Beans	8.67	8.31	8.08	7.74	8.13	8.16	7.71	7.43	7.04	7.45
Meat	19.96	26.22	29.30	32.34	28.02	21.67	29.89	31.66	33.09	30.90
Miscellaneous	30.32	29.74	30.25	29.51	29.90	33.70	32.43	32.78	33.41	33.13
Free-market cooking oil	3.17	2.80	2.55	2.20	2.59	3.00	2.57	2.71	2.54	2.70
Free-market sugar	6.49	6.54	5.83	5.65	6.06	5.51	5.11	4.50	4.15	4.66
Subsidized cooking oil	0.60	0.49	0.43	0.30	0.45	0.49	0.44	0.29	0.29	0.36
Subsidized sugar	0.98	0.75	0.70	0.53	0.72	0.66	0.65	0.62	0.60	0.64

Source: computed by the authors from the EIHS 1997. Q1, Q2, Q3 and Q4 respectively denote the 25 percent, 50 percent, 75 percent and 100 percent quartiles of the empirical distribution of total food expenditure.

3.2 Estimation Results

The share equations (2.9') and (2.10') are estimated with all variables normalized by their sample mean (at the PSU level). The estimation procedure consists in estimating structural parameters using a nonlinear simultaneous-equation SUR criterion, and imposing cross-equation restrictions such as symmetry, adding up and homogeneity constraints. Given that the share equations sum up to one, we dropped one equation to avoid singularity of the residual covariance matrix. Parameters of dropped equations are recovered through the homogeneity and symmetry constraints. In order to ensure the concavity of the expenditure function, the B matrix should be negative semi definite. This is imposed by computing the Cholesky decomposition of the *B* matrix, i.e., $B = -S'S$, where S is a upper triangular matrix whose parameters are estimated. Because the minimization algorithm failed to converge with all parameters initially unrestricted in matrix B, we follow Moschini (1998) and set the last two columns of this matrix to 0, resulting in 3 constrained parameters out of 45. This method destroys the original flexibility of the normalized quadratic specification but is a convenient way of achieving convergence. The coefficients of vector *a* can be chosen arbitrarily to ensure the homogeneity property (Moschini and Rizzi, 2007). We set the a_i's equal to the mean share of the different products groups. Parameters estimates are available in Appendix I. From these parameter estimates, we compute the theoretical estimates of the Marshallian (uncompensated) price and Hicksian (compensated) income elasticities at the mean of the prices, the quantities and the total expenditure ($p_i=z_k=R=1$). Empirical elasticities are then computed and used in the welfare analysis simulations.

Elasticities for the non-rationed food products

Estimated Marshallian and income elasticities of the non-rationed goods are reported in Table 5. Standard errors are computed with the Delta method at the sample mean. All the own price

elasticities are significant and have the expected sign. Free-market flour and bread are more sensitive to their own prices than their subsidized counterparts. For the income elasticities, they are all positive and significant at the 1 percent level. Subsidized flour and bread, beans, cooking oil and sugar are found to be necessary goods, as income elasticities are less than 1. Cereals and meat have the highest response with an income elasticity of 1.24 and 1.12. On the contrary, subsidized flour and bread are associated with lower income elasticity.

Table 5: Marshallian own price and income elasticities for non-rationed food products

	Own Price Elasticity	Income Elasticity
Cereals	-0.80***	1.24***
	(-9.32)	(33.07)
Subsidized flour	-0.06***	0.54***
	(-3.27)	(8.11)
Non Subsidized Flour	-0.62***	1.07***
	(-5.00)	(20.37)
Subsidized bread	-0.12***	0.63***
	(-2.96)	(12.01)
Non Subsidized bread	-1.10***	1.04***
	(-15.23)	(20.26)
Beans	-0.76***	0.92***
	(-24.61)	(35.26)
Meat	-0.58***	1.12***
	(-19.12)	(66.54)
Miscellaneous	-0.80***	1.01***
	(-23.47)	(88.29)
Cooking oil	-0.10***	0.91***
	(-3.87)	(22.73)
Sugar	-0.13***	0.78***
	(-5.40)	(25.17)

Notes: *t* statistics are in parentheses. *, ** and ***: significant at 10, 5 and 1 percent respectively. Average elasticities are computed at the sample mean. Standard errors are computed using the Delta method.

The compensated (Hicksian) elasticities are reported in Table 6. Cereals are found to be complement to subsidized flour and meat, while it is substitute to free-market bread and beans. Interestingly, free market bread and flour are not reacting to price changes of their subsidized counterparts. This shows that Egyptian households considered them as different products given the difference in qualities. Subsidized flour is complement to subsidized bread, cooking oil and sugar, and substitute to meat and miscellaneous food products. The response

of the demand of free-market bread to change in the price of cereals and its own price are highly elastic (price elasticity of 1.817 and -1.084 respectively, significant at the 1 percent level). It is also found to be complement to meat and miscellaneous food items (cross elasticity -0.396 and -0.690 respectively). Meat is a complement for cereals, subsidized flour, free-market bread and sugar, while it is substitute to beans, free-market flour and miscellaneous food products. Finally, cooking oil and sugar are weakly reacting to changes in their prices (-0.077 and -0.092 respectively).

Price elasticities for rationed food products

Estimated price elasticities for subsidized cooking oil and sugar are presented in Table 7. Only own-price elasticities are significant, subsidized sugar being much more elastic than subsidized cooking oil. Reactive to meaning that an increase in the quotas of one of these products will negatively affect its price with no impacts on the other product's price.

According to Madden (1991), one can define complementary or substitute rationed goods depending on their price elasticities, as follows. Let z_k and z_s denote two quantity-constrained goods, with respective prices q_k and q_s; x_m an unconstrained good with unit price p_m. z_k and z_s are substitutes if $(\partial q_k / \partial z_s)\ (z_s/q_k) < 0$ and complements otherwise; z_k and x_m are substitutes (resp. complements) if $(\partial q_k / \partial p_m)\ (p_m/q_k) > 0$ (resp. <0) and $(\partial x_m / \partial z_k)\ (z_k/x_m) < 0$ (resp. >0).

We found that the cereals can be considered as a substitute of the subsidized cooking oil, while the meat, miscellaneous and the cooking oil are substitute to the subsidized sugar (Tables 7 and 8). The free market flour is found to be complement to the subsidized cooking oil and the free market sugar is complement for the subsidized sugar. Surprisingly, there is no relation between the subsidized cooking oil and its free market counterpart.

Table 6: Hicksian price elasticities for non-rationed food products

	Prices									
Quantity	Cereals	Subsidized flour	Non subsidized flour	Subsidized bread	Non subsidized bread	Beans	Meat	Misc.	Cooking oil	Sugar
Cereals	-0.691***	-0.0406*	-0.046	-0.017	0.326***	0.203***	-0.125**	0.415***	-0.018	-0.021
	(-8.09)	(-1.90)	(-0.85)	(-0.54)	(12.72)	(4.19)	(-2.01)	(4.68)	(-0.96)	(-0.81)
Sub. flour	-0.097*	-0.045**	0.035	0.030	-0.008	0.2416***	-0.156**	-0.007	0.002	-0.003
	(-1.87)	(-2.36)	(0.74)	(1.47)	(-0.29)	(4.62)	(-2.20)	(-0.07)	(0.16)	(-0.17)
Non sub Flour	-0.103	0.029	-0.576***	-0.181***	0.034	0.007	0.319***	0.706***	-0.135***	-0.116**
	(-0.88)	(0.70)	(-4.67)	(-3.01)	(0.78)	(0.10)	(3.72)	(5.31)	(-4.24)	(-2.36)
Sub. bread	-0.062	0.019	-0.173***	-0.085***	0.024	-0.1093*	-0.053	0.47519***	-0.0584***	0.016
	(-1.02)	(1.14)	(-3.39)	(-2.14)	(0.82)	(-1.77)	(-0.77)	(4.65)	(-3.70)	(0.68)
Non sub. bread	1.817***	-0.016	0.095	0.083	-1.084***	0.070	-0.396***	-0.690***	-0.016	0.123*
	(10.27)	(-0.27)	(0.83)	(1.01)	(-14.93)	(0.93)	(-3.63)	(-4.45)	(-0.35)	(1.76)
Beans	0.221***	0.108***	0.005	-0.050	0.012	-0.688***	0.150***	0.149***	-0.005	0.086***
	(4.23)	(4.57)	(0.16)	(-1.48)	(0.86)	(-21.87)	(3.43)	(2.71)	(-0.31)	(4.00)
Meat	-0.038**	-0.0205**	0.0483***	0.005	-0.024***	0.042***	-0.268***	0.195***	-0.011**	0.057***
	(-1.96)	(-2.08)	(3.78)	(0.45)	(-3.79)	(3.35)	(-9.13)	(8.36)	(-2.18)	(7.23)
Misc.	0.115***	-0.002	0.0954***	0.083***	-0.039***	0.0347**	0.163***	-0.477***	0.044***	-0.0303***
	(4.44)	(-0.22)	(5.14)	(5.29)	(-5.40)	(2.35)	(7.58)	(-13.26)	(5.92)	(-2.70)
Cooking oil	-0.06	0.003	-0.225***	-0.098***	-0.011	-0.013	-0.1195**	0.577***	-0.077***	0.012
	(-0.90)	(0.18)	(-4.42)	(-3.24)	(-0.37)	(-0.27)	(-2.02)	(6.34)	(-3.02)	(0.45)
Sugar	-0.057	-0.006	-0.106**	0.020	0.037	0.133***	0.285***	-0.226***	0.002	-0.092***
	(-1.17)	(-0.41)	(2.53)	(0.88)	(1.60)	(3.64)	(6.26)	(-3.08)	(0.12)	(-3.76)

Notes. Each entry denotes elasticity of row variable with respect to column variable. *t* statistics are in parentheses. *, ** and ***: significant at 10, 5 and 1 percent respectively. Average elasticities are computed at the sample mean. Standard errors are computed using the Delta method.

Table 7: Elasticities for rationed food products

	Price of rationed good			
	Marshallian elasticity		Hicksian elasticity	
	Subsidized cooking oil	**Subsidized sugar**	**Subsidized cooking oil**	**Subsidized sugar**
Subsidized cooking oil	-0.03* (-3.61)	0.0080 0.18	-0.0299* (-3.75)	0.0093 (0.20)
Subsidized sugar	0.0127 (0.17)	-0.12* (-2.96)	0.0125 (0.17)	-0.1169* (-2.9)0
Price of non-rationed good				
Cereals	0.7894***	0.1772	0.7869***	0.1986
	(3.16)	(0.56)	(3.18)	(0.63)
Subsidized Flour	0.1252	-0.0646	0.1242	-0.0560
	(1.32)	(-0.61)	(1.33)	(-0.53)
Non subsidized Flour	-0.3704*	-0.0762	-0.3715*	-0.0667
	(-1.82)	(-0.30)	(-1.83)	(-0.26)
Subsidized Bread	-0.1574	-0.1315	-0.1590	-0.1181
	(-1.03)	(-0.66)	(-1.04)	(-0.59)
Non subsidized bread	0.1642**	0.0347	0.1638**	0.0383
	(2.05)	(0.33)	(2.04)	(0.37)
Beans	-0.0286	-0.0346	-0.0307	-0.0158
	(-0.28)	(-0.27)	(-0.30)	(-0.13)
Meat	0.1344	0.3255*	0.1268	0.3914**
	(0.98)	(1.90)	(0.95)	(2.36)
Miscellaneous	0.2817	0.7059**	0.2729	0.7817***
	(1.27)	(2.54)	(1.14)	(2.68)
Cooking oil	0.1416	0.2332**	0.1409	0.2393**
	(1.38)	(2.01)	(1.38)	(2.08)
Sugar	-0.0539	-0.3965***	-0.0553	-0.3840**
	(-0.37)	-(3.61)	(-0.38)	(-2.05)

Notes: Each entry denotes elasticity of column variable with respect to row variable.
t statistics are in parentheses. *, ** and *** indicate a parameter significant at the 10, 5 and 1 percent level respectively.

Table 8: Elasticities of non-rationed goods with respect to rationed-good quotas

	Rationed-good quota			
	Marshallian elasticity		Hicksian elasticity	
Quantity of non-rationed good	**Subsidized cooking oil**	**Subsidized sugar**	**Subsidized Cooking oil**	**Subsidized sugar**
Cereals	-0.0370***	-0.0140	-0.0304***	-0.0047
	(-3.29)	(-0.60)	(-2.72)	(-0.2)
Subsidized flour	-0.014	0.0080	-0.0111	0.0120
	(-1.33)	(0.42)	(-1.07)	(0.64)
Non subsidized flour	0.0377*	0.0093	0.0433**	0.0174
	(1.82)	(0.23)	(2.11)	(0.43)
Subsidized bread	0.0145	0.01797	0.0178	0.0226
	(1.04)	(0.63)	(1.29)	(0.79)
Non subsidized bread	-0.0422*	-0.0230	-0.0367*	-0.0152
	(-1.95)	(-0.53)	(-1.70)	(-0.35)
Beans	0.0016	0.0016	0.0065	0.0085
	(0.32)	(0.16)	(1.25)	(0.83)
Meat	-0.0018	-0.0072*	0.0040**	0.0011
	(-0.93)	(-1.85)	(2.06)	(0.3)
Miscellaneous	-0.0037	-0.0152**	0.0015	-0.0076
	(-1.20)	(-2.42)	(0.5)	(-1.21)
Cooking oil	-0.0237	-0.0688**	-0.0189	-0.0619**
	(-1.39)	(-2.28)	(-1.11)	(-2.06)
Sugar	0.0049	0.0521*	0.0091	0.0579**
	(0.40)	(2.01)	(0.73)	(2.25)

Notes: Each entry denotes elasticity of row variable with respect to column variable.
t statistics are in parentheses. *, ** and *** indicate a parameter significant at the 10, 5 and 1 percent level respectively.

4. Welfare analysis

In this section, we study the impacts of changes in taxation policies on the households' welfare, taking into consideration the soaring food prices that started in 2007. For such an analysis, the measure of the consumer surplus is required. Such a measure necessitates the specification of the demand curve. A misspecification of the demand curve yield to biased results (Hausman and Newey, 1995). Given this, sometimes nonparametric methods as Hausman and Newey (1995) and Foster and Hahn (1996), or semi parametric as Pendakur and Sperlish (2004) are used to estimate demand system and the impacts on welfare. This is not

our case given that we have the structural form of the expenditure function, precisely the mixed cost function. Therefore we estimate the change in the households' welfare using parametric methods.

The Compensating Variation (CV) is used to measure the impacts of the changes in prices on the households' expenditures. The CV represents the difference between the minimum expenditure required to attend an original level of utility at the new prices level and the initial level of expenditure that is the minimum expenditure required to achieve this original utility level at the initial prices (Ackah and Appleton**,** 2007; Huang and Huang, 2000). As explained by Huang and Huang (2000), the CV reflects the change of the expenditure necessary to compensate consumers for the effects of the change in prices from p_0 to p_1. The CV can be written as follows:

$$CV = c(p_1, u_0) - c(p_0, u_0).$$

In our case, the subsidized price is the initial price p_0 and p_1 is the new price after the subsidies removal. The variation of the CV determines if the change in price results in an increase or decrease of the consumer's welfare (Ackah and Appleton**,** 2007; Huang and Huang, 2000). Positive change represents an increase in the expenditure with the new price level in order to keep the same initial utility level. This means a decrease in the consumer's welfare.

We study the impacts of the removal of the subsidies of the non rationed goods on the households' welfare. Eliminating the subsidy system consists in increasing the price of the subsidized products by the subsidies rate; 43 and 57 percent for the subsidized flour and bread respectively (Ahmed et al, 2001). We study the impacts of two groups of taxes policies on the households' welfare measured by their expenditure. The first group of scenarios (Group A) consists of removing the baladi flour and the baladi bread subsidies separately then both of them together with no other prices change. The second group (Group B) considers the same

scenarios with an increase in the cereals price by 50 percent simultaneously. This increase in the price cereals simulates the food crisis context by a rising of the staple prices. In summary; we are studying six scenarios that can be summarized as follows:

Group A of policies: The elimination of baladi bread and flour subsidies:

- Scenario A1: The removal of the baladi flour subsidy represented by an increase of the baladi flour price by 43 percent.
- Scenario A2: The removal of the baladi bread subsidies represented by a 57 percent increase of its price
- Scenario A3: The removal of the baladi flour and baladi bread simultaneously.

Group B of policies: The elimination of baladi bread and flour subsidies in a context of rising crops prices:

- Scenario B1: A the removal of the baladi flour subsidies with a 50 percent increase of the cereals' price
- Scenario B2: the removal of the baladi bread subsidies with a 50 percent increase of the cereals' price
- Scenario B3: An increase of the subsidized flour, bread and cereals prices by 43, 57 and 50 percent respectively.

The mixed cost function is computed at $u = V^M$ using the estimated parameters of the mixed model. A new mixed cost function is estimated at the new level of prices. We compare the new mixed cost function with the original one for each case.

The change in the expenditures and the compensated variation resulting from the first three scenarios (Group A) are presented in table 9, 10 and 11 respectively. The results are decomposed by urban and rural areas as well as by food expenditure inter-quartile range.

Such decomposition is interesting as it permits to target the different groups of population and define who will gain or lose from such policy. It permits to differentiate between the low income group for whom the system is supposed to be implemented and for whom these products are necessities from the high income group.

In order to measure the impacts of a removal of the subsidies on the government budget allocated to the non rationed commodities, we simplify this later by assuming that it equals to:

$$\text{Gov\_Budget} = \sum_i \left(P_{i1} - P_{i0}\right) X_i$$

where *i*=baladi flour and baladi bread.

The government budget equals the sum of the quantities consumed of the subsidized products multiplied by the difference in prices that were paid by the government.

This is a simple measure of the subsidies budget variation, and for future research it will be interesting to model the government as a social planner that maximizes the social welfare.

Table 9: Median expenditures' changes resulted from the removal of the baladi flour subsidies by urban/rural and income quartile

	Rural					Urban				
	Q1	Q1-Q2	Q2-Q3	Q3-Q4	Full sample	Q1	Q1-Q2	Q2-Q3	Q3-Q4	Full sample
Cereals	-7.74	-5.43	-4.64	-3.72	-5.04	-4.44	-2.87	-2.51	-1.85	-2.66
Subsidized flour	39.63	38.53	38.45	38.06	38.61	40.60	40.51	40.38	40.32	40.44
Free-market flour	-1.70	-0.68	-0.43	-0.28	-0.67	-0.61	-0.19	-0.11	0.01	-0.16
Subsidized bread	-0.76	-0.45	-0.20	0.02	-0.33	-0.40	-0.12	0.00	0.06	-0.07
Bread	-3.20	-3.14	-2.37	-1.86	-2.64	-2.44	-1.78	-1.61	-1.30	-1.67
Beans	1.99	3.20	3.78	3.78	3.28	1.34	1.57	1.84	1.78	1.65
Meat	-5.57	-3.95	-3.31	-2.69	-3.55	-2.97	-1.92	-1.66	-1.29	-1.77
Miscellaneous	-3.40	-2.67	-2.10	-1.68	-2.26	-1.82	-1.25	-1.08	-0.86	-1.20
Free-market cooking oil	-2.36	-1.69	-1.41	-1.07	-1.62	-1.37	-0.89	-0.70	-0.58	-0.82
Free-market sugar	-1.94	-2.09	-1.82	-1.62	-1.90	-1.08	-0.95	-0.89	-0.77	-0.91
Subsidized cooking oil	3.45	4.46	5.73	7.96	5.03	2.49	3.46	4.17	5.60	3.82
Subsidized sugar	-0.50	-1.59	-2.21	-4.20	-1.77	-0.60	-1.12	-1.54	-2.09	-1.34
Compensating variation	3.39	2.59	2.10	1.67	2.24	1.84	1.22	1.05	0.81	1.17

Source: computed by the authors from the EIHS 1997. Q1, Q2, Q3 and Q4 respectively denote the 25 percent, 50 percent, 75 percent and 100 percent quartiles of the empirical distribution of total food expenditure.

Table 10: Median expenditures' changes resulted from the removal of the baladi bread subsidies by urban/rural and income quartile

	Rural					Urban				
	Q1	**Q1-Q2**	**Q2-Q3**	**Q3-Q4**	**Full sample**	**Q1**	**Q1-Q2**	**Q2-Q3**	**Q3-Q4**	**Full sample**
Cereals	-8.20	-5.53	-4.37	-3.28	-4.74	-9.03	-5.94	-4.33	-3.48	-5.07
Subsidized flour	-0.64	-0.23	0.07	0.24	-0.16	-0.64	0.04	0.23	0.49	0.12
Free-market flour	-17.13	-13.59	-12.91	-10.03	-13.22	-21.64	-16.37	-14.37	-12.91	-15.36
Subsidized bread	48.24	48.08	47.61	47.33	47.93	45.69	46.06	45.85	45.39	45.79
Bread	0.93	0.17	1.33	1.26	0.97	-1.82	-1.50	-1.28	-0.89	-1.30
Beans	-6.45	-5.36	-4.95	-4.51	-5.19	-8.40	-6.38	-5.66	-5.55	-6.06
Meat	-5.73	-3.61	-2.85	-2.10	-3.17	-6.42	-3.97	-3.12	-2.67	-3.50
Miscellaneous	0.02	0.71	0.88	1.20	0.73	0.44	0.95	1.20	1.51	1.05
Free-market cooking oil	-9.23	-8.01	-7.64	-7.12	-7.87	-10.85	-9.17	-8.56	-8.55	-9.07
Free-market sugar	-1.74	-1.52	-1.40	-1.01	-1.38	-1.54	-1.42	-1.09	-1.02	-1.23
Subsidized cooking oil	-2.24	-5.04	-7.54	-14.30	-5.80	-4.04	-7.52	-10.57	-18.16	-8.76
Subsidized sugar	-2.09	-4.41	-6.88	-9.75	-4.98	-3.66	-5.63	-7.09	-9.75	-6.29
Compensating Variation	4.16	3.12	2.68	2.11	2.81	4.95	3.57	2.79	2.61	3.16

Source: computed by the authors from the EIHS 1997. Q1, Q2, Q3 and Q4 respectively denote the 25 percent, 50 percent, 75 percent and 100 percent quartiles of the empirical distribution of total food expenditure.

Table 11: **Median expenditures' changes resulted from the removal of the baladi bread and baladi flour subsidies by urban/rural and income quartile**

	Rural					Urban				
	Q1	**Q1-Q2**	**Q2-Q3**	**Q3-Q4**	**Full sample**	**Q1**	**Q1-Q2**	**Q2-Q3**	**Q3-Q4**	**Full sample**
Cereals	-15.84	-10.44	-8.99	-6.70	-9.67	-13.20	-8.55	-6.69	-5.33	-7.59
Subsidized flour	38.16	38.13	38.10	38.41	38.20	39.73	40.50	40.86	41.34	40.63
Free-market flour	-17.99	-14.56	-12.87	-10.13	-13.61	-22.40	-16.46	-14.30	-12.95	-15.21
Subsidized bread	47.47	47.72	47.28	47.62	47.47	45.49	45.89	46.35	45.64	45.82
Bread	-3.99	-2.91	-1.81	-0.79	-1.83	-4.15	-3.09	-2.72	-2.19	-2.75
Beans	-4.53	-2.31	-1.33	-0.66	-2.10	-6.92	-4.69	-3.93	-4.05	-4.42
Meat	-11.64	-7.21	-6.14	-4.64	-6.69	-9.27	-5.51	-4.66	-4.00	-5.27
Miscellaneous	-3.86	-2.25	-1.33	-0.61	-1.74	-1.43	-0.53	0.09	0.66	-0.17
Free-market cooking oil	-10.49	-9.46	-8.98	-8.22	-9.31	-11.80	-10.04	-9.18	-8.94	-9.67
Free-market sugar	-4.10	-3.71	-3.27	-2.66	-3.41	-2.76	-2.41	-2.04	-1.89	-2.26
Subsidized cooking oil	1.55	0.71	-0.41	-2.98	0.14	-1.30	-4.20	-6.74	-12.58	-4.93
Subsidized sugar	-2.71	-5.83	-9.02	-14.18	-6.54	-4.19	-6.48	-8.17	-11.59	-7.41
Compensating Variation	7.68	5.45	4.84	3.80	5.10	6.86	4.72	3.90	3.38	4.34

Source: computed by the authors from the EIHS 1997. Q1, Q2, Q3 and Q4 respectively denote the 25 percent, 50 percent, 75 percent and 100 percent quartiles of the empirical distribution of total food expenditure.

The removal of the subsidy on flour tests the proposition of the Egyptian Ministry of the Social Solidarity to separate the bread production from its distribution. The idea is to sell flour to the bakeries at the market price, the government buying the produced bread from these bakeries with a price equal to the production costs. Then, the government sells the bread at subsidized price to the population in order to end the black market for this product and save government expenditure on subsidized flour for other public expenditures. Increasing the subsidized flour's price decreases the government budget by 17 percent and increases the subsidized flour expenditure by 38.6 percent and 40.44 percent for the rural and urban groups respectively. Expenditures on beans and on subsidized cooking oil increase, while the other products' expenditures decrease. This results from the cross price effects. In total, we note that the compensating variation is more important in the rural areas (2.24 percent) than the urban areas (1.17 percent) given that the rural households prefer baking bread at home using subsidized flour.

The removal of the baladi bread subsidy has an important effect on the government budget; it decreases the government budget by 82 percent. This is expected given the importance of the bread subsidy in the total food subsidies budget

The increase in the baladi bread's price affects more the urban groups than the rural ones (expenditure increases by 3.16 and 2.81 percent respectively). This is an expected result given the relatively higher weight of *baladi* bread in the urban food expenditures than in the rural ones, especially for poor households (quartile 1).

The removal of the subsidies on both goods will save the total amount spent on the subsidies but will increase the urban and rural groups' expenditures by 4.34 percent and 5.10 percent respectively. The poor group are the more affected by this policy; especially in the rural areas where the expenditure of the lowest quartile increases by 7.68.

The results of the three scenarios with the cereals' price increase (Group B) are presented in Tables 12, 13 and 14 respectively. Similarly, the results are decomposed by urban and rural areas as well as by the income groups.

Table 12: **Median expenditures' changes from the removal of the baladi flour subsidies in a context of rising cereals price by urban/rural and income quartile for scenarios of Group B (percent)**

	Rural					Urban				
	Q1	**Q1-Q2**	**Q2-Q3**	**Q3-Q4**	**Full Sample**	**Q1**	**Q1-Q2**	**Q2-Q3**	**Q3-Q4**	**Full sample**
Cereals	-20.83	-6.94	-4.73	-0.72	-6.98	-31.69	-19.82	-12.50	-8.04	-18.30
Subsidized flour	33.87	31.41	30.85	29.26	30.98	35.59	34.42	34.65	33.17	34.31
Free-market flour	-11.89	-9.12	-7.97	-7.30	-8.80	-8.10	-6.79	-6.18	-6.11	-6.50
Subsidized bread	-4.67	-4.48	-4.41	-4.32	-4.40	-3.18	-2.81	-2.61	-3.06	-2.92
Bread	88.07	72.23	75.28	66.40	74.24	57.92	48.01	44.12	45.08	47.32
Beans	8.01	7.87	9.80	9.27	8.59	9.06	8.70	9.46	9.47	9.24
Meat	-12.15	-9.61	-8.29	-7.19	-9.18	-8.37	-5.70	-4.80	-4.64	-5.30
Miscellaneous	-1.67	-1.28	-0.55	-0.71	-1.12	2.48	2.66	2.51	2.31	2.50
Free-market cooking oil	-7.68	-7.02	-6.63	-6.18	-6.93	-5.47	-4.67	-4.37	-4.39	-4.52
Free-market sugar	-6.32	-6.59	-6.44	-6.67	-6.51	-3.76	-3.94	-3.68	-4.12	-3.94
Subsidized cooking oil	22.02	29.78	38.29	59.50	34.16	29.34	38.11	51.06	73.02	44.61
Subsidized sugar	6.38	6.68	6.57	7.29	6.72	7.64	7.33	7.26	6.95	7.26
Compensating Variation	7.01	6.22	5.67	5.24	5.99	4.57	4.07	3.72	3.59	3.86

Source: computed by the authors from the EIHS 1997. Q1, Q2, Q3 and Q4 respectively denote the 25 percent, 50 percent, 75 percent and 100 percent quartiles of the empirical distribution of total food expenditure.

Table 13: Median expenditures' changes from the removal of the baladi bread subsidies in a context of rising cereals price by urban/rural and income quartile for scenarios of Group B (percent)

	Rural					Urban				
	Q1	**Q1-Q2**	**Q2-Q3**	**Q3-Q4**	**Full sample**	**Q1**	**Q1-Q2**	**Q2-Q3**	**Q3-Q4**	**Full sample**
Cereals	-21.01	-6.96	-3.49	-1.26	-6.18	-35.80	-21.20	-14.59	-9.53	-19.71
Subsidized flour	-4.96	-5.13	-5.51	-5.82	-5.26	-4.51	-4.10	-4.14	-4.66	-4.38
Free-market flour	-24.42	-20.10	-19.24	-17.21	-20.13	-27.73	-21.31	-19.40	-17.82	-20.40
Subsidized bread	43.49	42.68	42.02	41.25	42.48	43.05	43.09	43.40	41.42	42.63
Bread	87.12	74.93	78.16	68.48	77.75	54.50	45.11	42.17	43.91	45.06
Beans	0.14	0.56	0.44	0.80	0.49	-0.58	1.77	2.08	2.17	1.66
Meat	-12.09	-8.59	-7.94	-6.82	-8.53	-10.92	-7.08	-6.07	-6.06	-6.79
Miscellaneous	1.72	1.58	2.31	1.72	1.72	4.20	4.15	4.11	4.30	4.26
Free-market cooking oil	-13.28	-12.17	-12.07	-11.85	-12.19	-13.84	-12.05	-11.06	-11.87	-11.97
Free-market sugar	-5.90	-6.01	-6.10	-6.26	-6.04	-4.54	-4.12	-4.07	-4.46	-4.33
Subsidized cooking oil	16.21	20.24	25.25	40.00	22.85	21.48	27.38	34.47	48.53	31.64
Subsidized sugar	4.94	4.12	3.14	1.70	3.76	4.66	3.25	1.56	-0.13	2.60
Compensating Variation	7.82	6.45	6.25	5.55	6.40	7.75	6.09	5.44	5.45	5.87

Source: computed by the authors from the EIHS 1997. Q1, Q2, Q3 and Q4 respectively denote the 25 percent, 50 percent, 75 percent and 100 percent quartiles of the empirical distribution of total food expenditure.

Table 14: **Median expenditures' changes from the removal of the baladi bread and baladi flour subsidies in a context of rising cereals price by urban/rural and income quartile for scenarios of Group B (percent)**

	Rural					Urban				
	Q1	**Q1-Q2**	**Q2-Q3**	**Q3-Q4**	**Full sample**	**Q1**	**Q1-Q2**	**Q2-Q3**	**Q3-Q4**	**Full sample**
Cereals	-28.48	-12.12	-8.23	-3.62	-11.38	-38.97	-23.75	-17.61	-10.41	-22.50
Subsidized flour	32.89	31.44	30.92	29.50	31.19	34.43	34.82	34.85	34.24	34.50
Free-market flour	-25.61	-20.42	-19.21	-16.87	-20.40	-28.12	-21.31	-19.18	-17.85	-20.09
Subsidized bread	43.00	42.54	42.27	41.81	42.28	42.75	43.28	43.68	41.54	42.66
Bread	81.84	69.59	72.90	65.02	72.31	50.89	43.05	40.06	41.33	43.05
Beans	1.63	2.17	4.92	4.48	3.57	-0.11	2.96	3.95	3.95	2.83
Meat	-17.11	-12.95	-10.91	-9.27	-11.77	-13.19	-9.00	-7.71	-7.43	-8.39
Miscellaneous	-1.72	-1.05	0.01	0.32	-0.62	2.85	2.96	3.26	3.51	3.08
Free-market cooking cooking oil	-15.10	-13.06	-13.25	-12.76	-13.46	-15.11	-12.70	-11.59	-12.32	-12.52
Free-market sugar	-7.89	-7.83	-7.80	-7.67	-7.85	-5.45	-5.05	-4.88	-5.13	-5.10
Subsidized cooking cooking oil	18.89	24.82	29.69	47.78	28.01	24.00	30.32	38.39	53.85	35.45
Subsidized sugar	4.58	2.43	0.77	-2.27	1.86	4.12	2.27	0.14	-2.17	1.57
Compensating Variation	10.88	9.13	8.32	7.40	8.90	9.41	7.31	6.58	6.26	7.00

Source: computed by the authors from the EIHS 1997. Q1, Q2, Q3 and Q4 respectively denote the 25 percent, 50 percent, 75 percent and 100 percent quartiles of the empirical distribution of total food expenditure.

The increase in the cereals price worsens the situation of the Egyptians households, especially the rural groups. Expenditures of the rural households increase by 7.01, 7.82 and 10.88 percent for the three cases respectively. Given the high response of the demand for cereals to its own price, the cereals' expenditure decreases in the three cases. The important increase of the free market bread's expenditure results from the important cross price effect between cereals and non subsidized bread.

Although the system of food subsidy is not well targeted, the six scenarios show that the lowest income group is the most affected by such policies, especially in the rural areas (Table 15). This can be explained by the low quality of these goods and opportunity cost associated with obtaining these goods (long queues required getting it which makes the system more self selecting). These results show as well the critical role played by the subsidies system in Egypt, especially in a context of food crisis.

Table 15: Median CV with respect to total expenditure by urban/rural and income quartile for the six scenarios (percent)

	Rural					Urban				
CV/Expenditure	**Q1**	**Q1-Q2**	**Q2-Q3**	**Q3-Q4**	**Full sample**	**Q1**	**Q1-Q2**	**Q2-Q3**	**Q3-Q4**	**Full sample**
Scenario A1	3.31	2.52	2.05	1.65	2.18	1.80	1.20	1.02	0.79	1.13
Scenario A2	4.07	3.01	2.63	2.07	2.74	4.81	3.50	2.74	2.55	3.10
Scenario A3	7.50	5.36	4.70	3.71	4.98	6.65	4.62	3.83	3.32	4.23
Scenario B1	6.73	6.04	5.58	5.18	5.77	4.50	3.97	3.66	3.53	3.78
Scenario B2	7.70	6.25	6.14	5.47	6.27	7.52	5.94	5.37	5.37	5.74
Scenario B3	10.52	8.89	8.12	7.26	8.66	9.20	7.15	6.50	6.17	6.87

5. Concluding Remarks

This paper addresses a question of major concern for the Egyptian economy and its social stability, namely the impacts of the elimination of the food subsidy system on the consumers' welfare. This question had attracted the intention of economists for a long time and its importance rises again these days with the food crisis.

We estimate price and income elasticities using the mixed demand model that we found the most adequate to the representation of the Egyptian food-subsidy system. Using the estimated results for policy simulations reveals that, in spite of its drawbacks, the elimination of the food subsidies in Egypt will make all groups of the population worse off.

As other vulnerable countries, the Egyptian government should protect the low income consumers, although the actual food subsidy system may not be the most efficient way to reach this goal. A possible alternative, as has been suggested by others, is a cash transfer to poor households, so as to help them facing the food inflation. Such an alternative poverty-reduction scheme will however face administration costs and would require an effective targeting mechanism (based on population census, type of housing, other social benefits, etc.)

A major part of the subsidy problem in Egypt consists in its significant budget for the government, especially because of the insufficient local wheat production. A possible way to improve the situation would be to increase wheat production, by investing in the agricultural sector and rationalizing intermediate distribution networks. Inefficiencies in the wheat market is part of the problem of food security in Egypt, and a sustainable policy will require addressing both the consumer subsidy system and the wheat to bread chain at the same time.

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Appendix I: The estimated parameters of the Normalized Quadratic Model

Parameters	Coefficient	t-value
δ1	-0.0205	-5.69
δ2	0.0176	8.49
δ3	-0.0027	-1.19
δ4	0.0181	8.69
δ5	-0.0005	-0.58
δ6	0.0077	3.63
δ7	-0.0332	-6.64
δ8	-0.0001	-0.02
δ9	0.0025	2.63
β1	0.1156	17.30
β2	0.0199	5.84
β3	0.0430	9.46
β4	0.0275	6.90
β5	0.0178	8.47
β6	0.0754	20.21
β7	0.3262	43.55
β8	0.3148	48.67
β9	0.0247	12.56
λ11	-0.0030	-2.91
λ21	-0.0004	-0.93
λ31	0.0018	2.04
λ41	0.0009	1.42
λ51	-0.0006	-1.76
λ61	0.0005	1.08
λ71	0.0006	1.10
λ81	0.0002	0.19
λ91	-0.0005	-1.14
λ12	-0.0007	-0.35
λ22	0.0005	0.75
λ32	0.0006	0.37
λ42	0.0011	0.84
λ52	-0.0003	-0.40
λ62	0.0006	0.72
λ72	-0.0005	-0.41
λ82	-0.0027	-1.44
λ92	-0.0016	-2.06
μ1	-0.0044	-9.16
μ2	-0.0052	-6.75
γ1	0.0000	0.06
γ2	-0.0024	-2.45
N	**498**	

Source: Estimated by the author.

Note:

- For δ, β and λ: 1=cereals, 2=subsidized flour, 3= free market flour, 4= baladi bread, 5=Bread, 6=Beans (ful), 7=meat and fish, 8= Miscellaneous, 9= free market sugar and 10= free market oil.
- For μ and γ: 1=subsidize sugar and 2=subsidized oil.