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Estimating the Welfare Costs of Reforming the Iraq Public Distribution System

A Mixed Demand Approach

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Abstract

The Iraqi Public Distribution System is the largest universal, in-kind subsidy system in the world. In 2012, the Public Distribution System transfers accounted for as much as 30 percent of incomes of the poorest 10 percent of the Iraqi population and provided 70 percent of the calories of the poorest 40 percent. In effect, the Public Distribution System remains the only safety net program that covers all the poor and vulnerable in the country. Yet, it is a very inefficient and expensive means to deliver transfers to the poor and creates distortions in the economy as well as an unsustainable fiscal burden. The fiscal crisis since mid-2014 has put reform of the Public Distribution System back on the agenda. This paper employs a mixed demand approach to analyze the consumption patterns of Iraqi households and quantify the welfare impact of a potential reform of the Public Distribution System in urban areas. The results show that household consumption of Public Distribution System items is relatively inelastic to changes in price. Consumption is more inelastic for the poorest quintiles and, for much of the population, these goods are not inferior, but rather normal goods. Cross-sectional comparisons suggest that with improvements in welfare levels, and with well-functioning markets, some segments of the population are substituting away from the Public Distribution System and increasing their consumption of market substitutes. The removal of all subsidies will require compensating poor households by 74.4 percent of their expenditures compared with nearly 40 percent for the richest households in urban areas.

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Estimating the Welfare Costs of Reforming the Iraq Public Distribution System:

A Mixed Demand Approach[1]

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1. Introduction

Subsidies are an important social protection tool used by many countries to provide economically vulnerable populations with basic needs such as food and fuel at affordable prices. Subsidies are also used to redistribute revenues and protect the population as a whole from spikes in the prices of necessities. Especially in the case of universal subsidies, the objective of protection is typically counteracted by their regressive nature, in absolute terms, and the large costs and inefficiencies associated with running these programs. The latter can be particularly acute when transfers are in-kind and involve large-scale operations for import and procurement, transportation, storage and distribution. Moreover, such large programs can also crowd out spending on health, education and productive investment, which are arguably more progressive in nature. This paper considers the largest universal, in-kind subsidy system in the world, Iraq's Public Distribution System (PDS), which exemplifies these difficult trade-offs. Using a Mixed Demand approach, we quantify the welfare impacts of alternate reform scenarios, in a context of long term dependence on the PDS for basic food needs and recurrent and unpredictable exposure of the population to economic and non-economic shocks.

Iraq's PDS has its origins in the sanctions era of the 1990s, when it began as a program to distribute domestically-produced food. In 1996, the United Nations agreed to allow food imports under the Oil for Food Programme, and since then, the PDS has been almost entirely sourced through imports. In its current form, the PDS distributes heavily subsidized food rations to almost every household in Iraq. A family's allocation is determined by the size and composition of the family as registered in their ration card and these are acquired for a negligible amount.

The value of transfers from the PDS alone accounts for 13 percent of incomes for the average Iraqi household [World Bank (2014a)]. For households in the bottom 10 percent of the distribution, PDS transfers account for as much as 16.5 percent of their total expenditure (Figure 1), 60 percent of non-labor income or 30 percent of their total income [World Bank (2014a)]. Roughly 70 percent of the calories of the bottom 40 percent of the distribution come from the PDS in 2012, but it accounted for only a third of calories consumed by the richest 20 percent of the consumption distribution (Figure 2). Likely related, food or extreme poverty rates are almost negligible in Iraq [World Bank (2014a)]. The PDS is the only safety net program that covers all the poor and vulnerable in a country where other social protection programs such as the Social Security Network, have started only recently and cover at most a fifth of the poor. It is seen to be one of the more tangible benefits delivered by the state and has increasingly become viewed as a general entitlement. As a result, any discussions of reforms or changes to the PDS are politically sensitive and contingent on the establishment of a comprehensive social protection system.

However, the need to reform the PDS is well recognized, and various proposals have been put forward for its reform since 2003. The fact remains that the PDS represents a large fiscal burden, even for oil-rich Iraq,

accounting for 1 trillion Iraqi dinars and 5% of Iraq's GDP [Silva, Levin and Morgandi (2012)]. While the PDS provides a level of broad food security to the poor and vulnerable in Iraq, it also covers more than 95 percent of the non-poor, and therefore, the cost is considerably higher than is typical for a targeted safety net. In its current form, it suffers from large inefficiencies in procurement, distribution, and management, and implies significant macro-economic distortions because of its heavy reliance on food imports and its universal nature. Due to its large scale, it distorts the market for food and discourages local production. For this and many other reasons, including the need for the introduction of a comprehensive safety net system going beyond food subsidies, the Government of Iraq is considering further reforms to the PDS.[5] The sharp decline in oil prices and the Islamic State insurgency since mid-2014 have severely constrained the fiscal environment and made PDS reform even more imperative.

In considering any reform options, it will be extremely important to quantify and understand the potential welfare impact of a change in the PDS across the distribution of consumers. This is particularly critical because of the context- a system that is universally accessed; high dependence on imports implying lack of available substitutes in the market; the large accompanying macro-economic distortions; and the recurrent exposure of households to unpredictable shocks. Moreover, incorporating the behavioral response of households to reforms is essential given that the population may have come to think of the PDS transfer as a constant, unchanging benefit that comes at almost zero cost. Finally, in designing alternatives, it is important to quantify the adverse welfare impact to be able to (a) assess whether a targeted system is feasible, and what the welfare cut-off could be; (b) estimate the size of cash transfer that would hold utility constant, at least for the lower parts of the distribution; and (c) assess the cost-effectiveness of alternatives.

Using a Mixed Demand approach, this paper simulates the impact of hypothetical reform scenarios of the PDS on consumer welfare. Using the most recently available household survey, the Iraq Household and Socio-Economic Survey (IHSES) – 2012, we estimate income and price elasticities to be able to model the behavioral response of households to these reforms. The Iraqi food subsidy system involves partial rationing, where the PDS food items are available at subsidized prices until a quantity quota is reached. For larger quantities, consumers can purchase the free market counterparts of these items at the free market price. The Mixed Demand approach allows us to explicitly take into consideration the partial rationing of the PDS and its dual price system. Such a demand system explicitly incorporates rationed quantities for a subset of goods with predetermined prices, in addition to free market goods. The estimated income and price elasticities from such a model permit us to analyze the impact of reforms on consumer consumption and therefore, welfare

[5] The Government of Iraq is currently considering moving to a 'smart card' system of delivery of PDS entitlements, and potentially a means-targeted eligibility criterion for the social protection programs.

[Houthakker and Tobin (1952), Madden (1991), Huffman and Johnson (2000), Moschini and Rizzi (2007), Ramadan and Thomas (2011)].

The paper is organized as follows. Section 2 describes the data and issues related to the valuation of subsidized and rationed goods in the Iraqi context. Section 3 details the methodological approach of the Mixed Demand Model. Section 4 discusses estimations and results including welfare analysis, and Section 5 concludes.

2. Data and valuation of ration items

The mixed demand model is estimated using the Iraq Household and Socio Economic Survey (IHSES) for 2012. IHSES covers roughly 25,000 households and is designed to be representative at the provincial or governorate level. The survey collects detailed data on all aspects of household income and expenditure and a wide variety of socio-economic indicators. These include household composition and demographic information for each individual member; housing; health; education; job search, past and current employment; wages, earnings and income; loans and assistance; consumption of food and non-food items; ownership of durable goods; time use, anthropometrics; access to justice; household shocks and coping strategies, migration; life satisfaction; and consumption and receipts of PDS or ration items.

There are 13 ration products: rice, brown wheat flour, white wheat flour, children's food, powdered milk, vegetable fat, vegetable oil, dry white beans, chick peas, lentils, sugar, salt and tea. These ration items differ in terms of their importance: for instance, 36% of total ration expenditure is spent on brown wheat flour compared to almost 0% for salt and tea. The other highly consumed ration products are: sugar (26% of total ration expenditure), vegetable oil (22% of ration expenditure) and rice (14% of ration expenditure) (Figure 3). Taken together, brown wheat flour, rice, vegetable oil and sugar represent almost 98% of total ration expenditures. Hence, our analysis focuses on the consumption of these four ration items and their free market counterparts.

Information about PDS items is collected in two separate modules: the rations module and a 7-day diary for food purchases. The former collects information about the quantity of ration items received, consumed, bartered, sold or given away by the household during the last 30 days. In the rations module, households are also asked how much they would pay in the open market to purchase each PDS or ration item. The diary records all purchases of food including ration items over the last 7 days (expenditures and quantities). To estimate a household's consumption of PDS items, we follow the methodology for the construction of the official welfare aggregate for estimating poverty [World Bank (2013)]. Any purchases of PDS items recorded in the diary over the 7-day recall period are multiplied by a factor of 30/7 to obtain 30 day equivalents, and these quantities are added to the consumption of PDS items over the last 30 days as recorded in the rations module. In practice, purchases of PDS items (recorded in the diary) are few and far between.

Next, these monthly quantities of PDS items need to be valued and two key principles guide this valuation procedure. Households who consume (or purchase) a larger quantity of PDS items must be assigned higher consumption and thereby utility. Second, in principle, goods and services ought to be valued equal to their infra-marginal benefit; i.e.; the market price faced for the marginal unit consumed. In Iraq, ration items are rarely traded in the market and a market-equivalent price is non-existent. Few transactions are recorded in the diary and there are two main reasons why market prices or in this case unit values (the ratio of expenditure to quantity) from market transactions are not used as the reference for valuing ration items. The first is the insufficient number of observations per item. For instance; the percentage of households reporting purchases of ration items in the diary questionnaire varies from less than 1 percent in the case vegetable fat, lentils, brown wheat, and sugar to a maximum of less than 3 percent in the case of rice. Furthermore, there are no transactions recorded in some geographical divisions for brown wheat, vegetable fat, vegetable oil, lentils and sugar. Secondly, there is a possibility of selection-bias. In other words, these unit values could be associated with a select few households who are quantity constrained and purchased PDS items on the market because their allocation proved insufficient.

Additionally, the unit values for the nearest free market equivalents are significantly higher for some items. For instance, a significant gap is observed in unit values between market-traded and ration rice. For instance, the difference between the median unit value of ration rice from diary and commercial local rice is 70 percent. This gap doubles when comparing with the median unit value of imported commercial rice. This could be mainly related to important quality differences between these types of goods. This implies that market prices for commercially available items cannot be used to value all ration items because they are not perfect substitutes.

Another possibility is to use official prices for ration items. Again, two main concerns are relevant: the first is that these prices are very low. Using these heavily subsidized prices would artificially suppress the value of food expenditures stemming from rations. The second is that rations should be valued at a price close to that we expect to be traded. But these official prices are not prices at which households can procure unlimited quantities (by design).

The remaining candidate to value rations is the self-reported value of ration items. IHSES asks households how much they would pay for ration-equivalent items in the market.[6] In practice, few households expressed an opinion, and enumerators approached the local ration agent in the cluster, in a manner akin to a price survey. However, there were variations in these prices that may reflect uncertainty, noise and local variations in supply, demand and quality. In order to ensure that all those who consume exactly the same amount of a ration item are assigned the same expenditure, and thereby utility; and that this expenditure increases with higher

[6] The actual question from the IHSES questionnaire is: "If you could buy this [ITEM] in the market, how much would you have to pay for it?"

consumption; the methodology followed in this paper uses the national median values of prices reported by ration agents to value ration items [World Bank (2013)].

Using the quantities and ration-agent's prices for these ration items to estimate expenditures, on average only 6% of total expenditure is allocated to this type of products by Iraqi households in 2012. This aggregate statistic hides a lot of heterogeneity throughout the consumption distribution. PDS expenditures account for 30 percent of food expenditures for the poorest 10 percent of Iraqi households, and around 17 percent of their total expenditures in 2012. The share of PDS expenditures declines as total household expenditures increase or as households get richer. For instance, it reduces to 12, 7 and 2 percent for the 2nd, 5th and top deciles of the consumption distribution respectively (Figure 1). Table 1 shows the average shares of ration expenditure with respect to total food expenditure by consumption quintile in urban and rural areas. In urban areas, the richest spend almost 9% of their total food expenditure on ration products, compared to 44% spent by the poorest quintile. These shares are slightly higher in rural areas: 9.4% and 47% for the upper and bottom 20 percent of the consumption distribution respectively.

3. Mixed Demand Model

Estimating the behavioral responses of households to changes in the availability of goods requires the estimation of the demand functions of consumers of these goods. In this setting, the most common empirical specifications involve expressing quantity demanded as a function of total expenditure and market prices, or a direct demand system [Moschini and Rizzi (2006)]. However, standard specifications rely on additional identifying assumptions, in particular, the implicit assumption that prices are predetermined, or in other words, that supply functions for these goods are perfectly elastic. This assumption is not likely to hold in the context under consideration here, where nominally priced PDS items form a significant part of expenditures on food, and are widely consumed. An alternate approach treats quantities as predetermined, with prices adjusting so that demand and supply are equalized in the aggregate. This approach, while appropriate for perishable products, is not appropriate in the scenario considered in this paper either. A third approach, first introduced by Samuelson (1965), considers mixed demand functions. In this approach, while for some goods, prices are predetermined, for others, quantities are given. This allows for more flexibility in assumptions regarding whether prices or quantities are held exogenous for each good, and this is the approach we follow in this paper.

In addition, the presence of a dual system of prices for PDS or ration goods can be incorporated into a mixed demand model specification; whereas Marshallian demand functions using flexible specifications such as the Almost Ideal Demand Systems (AIDS) may not be appropriate. The dual system is one where households have access to quotas of subsidized food products in addition to their free market counterparts. In this setting, a consumer has to simultaneously choose the subsidized consumption segment (i.e., a quantity above or below

the allocated quota) and the free market consumption level. The existence of food subsidies in the consumer demand system is associated with individual consumption quotas, which introduce nonlinearities in the demand functions. Households have access to subsidized goods up to their designated quota, but when demand exceeds this quota, households have to purchase free market goods with the same or a different quality, and of course a different price [Ramadan and Thomas (2011)].

Following Moschini and Rizzi (2007) and Ramadan and Thomas (2011), we estimate a normalized quadratic mixed demand model in order to understand consumer behavior. In a mixed demand model where there are *n* free market products and *m* subsidized products, let $X = [x_1 \ldots\ldots x_n]$ be the vector of goods whose prices are determined on the market; $Z = [z_1 \ldots z_m]$ the vector of goods whose quantities are predetermined (quotas); *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:

$$\begin{gathered} \max_{x,q} u(x,z) - v(p,q,y) \\ s.t.\ p'x + q'z = y \end{gathered} \tag{2.1}$$

where *U* and *V* are the direct and indirect utility functions respectively, and y is the consumer's income (or total expenditure). Solving the first-order conditions of the above maximization problem yields the vector of Marshallian mixed demands:

$$x^* = x(p,z,y) \text{ and } q^* = q(p,z,y) \tag{2.2}$$

These yield the following optimum direct and indirect utility functions[7]:

$$\begin{aligned} u(x^*,z) &= v(p,q^*,y) \\ &\equiv V^M(p,z,y) \end{aligned} \tag{2.3}$$

where $V^M(p,z,y)$ is the mixed utility function. The mixed demand functions $x(p,z,y)$ and $q(p,z,y)$ satisfy the adding up conditions and are homogeneous of degree zero and degree one in *p* and *y* respectively. The symmetry property applies to the compensated mixed demand functions that are the same as the compensated demand under rationing and may be characterized in terms of the restricted cost function as follows [Moschini and Rizzi (2006) and Moschini and Rizzi (2007)]:

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

[7] Given the duality between direct and indirect utility functions; the indirect utility function derived from a utility function achieves a minimum on prices such that: u(x) =min v(p,y). Hence, for each level of x, there is a level of p such that: u(x)= v(p,y).

The restricted cost function $C(p,z,u)$ is monotonic in its arguments and homogeneous of degree one and concave in p. Using Shepard's lemma, the partial derivatives of the cost function with respect to p and z yield the compensated (Hicksian) demand functions for the goods that are chosen optimally, x^h, and the compensated price-dependent functions, q^h, respectively. The latter are the prices that would have resulted in z being the cost minimizing solution [Moschini and Vissa (1993); Moschini and Rizzi (2007)].

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

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

$$\begin{aligned} \mathrm{x}(p,z,y) &= x^h(p,z,V^M(p,z,y)\,) \\ \mathrm{q}(p,z,y) &= -q^h(p,z,V^M(p,z,y)\,) \end{aligned} \tag{2.6}$$

So for achieving a given utility level u, the total cost given (p,z) can be written as:

$$C^M\big(p,z,V^M(p,z,y)\big) = C(p,z,u) - \nabla_z C(p,z,u) \equiv y \tag{2.7}$$

where $C^M(p,z,V^M(p,z,y))$ is defined as the mixed cost function. According to Moschini and Rizzi (2007), the mixed utility function, $V^M(p,z,y)$ can be derived from equation (2.7). For this, they selected a cost function from the Gorman Polar form that is affine in u, as follows:

$$C(p,z,u) = F(p,z) + G(p,z)u \tag{2.8"}$$

where F and G are continuous and differentiable in p and z. Such a specification allows deriving a closed form of the mixed utility function from the mixed cost function as follows:

$$V^M(p,z,R) = \frac{R - F(p,z) + \nabla_z F(p,z) z}{G(p,z) - \nabla_z G(p,z) z} \tag{2.9}$$

Following Diewert and Wales (1988) and Moschini and Rizzi (2007), we use a Normalized Quadratic form for the functions F and G, "to ensure that the chosen parameterization satisfies the requirements of a flexible functional form":

$$\begin{aligned} \mathrm{F}(p,z) &= \delta' p (a'p)(\mu' z) \\ \mathrm{G}(p,z) &= \beta' p + (a'p)(\gamma' z) + 0.5(a'p)(z'\Gamma z\,) + p'Lz \end{aligned} \tag{2.10}$$

Using the above specification, the mixed demand equations and the mixed utility can be written as follows:

$$\begin{aligned} x_i^* = \delta_i + (\mu' z)a_i + \{\beta_i + \sum_{j=1}^{n} \frac{\beta_{ij} p_j}{a'p} + \sum_{k=1}^{m} \lambda_{ik} z_k \\ + \; a_i \left[\gamma' z - 0.5\left(\frac{p'Bp}{(a'p)^2}\right) + 0.5(z'\Gamma z)\right]\} \; V^M \end{aligned} \tag{2.11}$$

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

$$V^M = \frac{y - \delta'p}{\beta'p + 0.5\left(\frac{p'Bp}{(a'p)^2}\right) - 0.5(a'p)(z'\Gamma z)} \tag{2.12}$$

Where *i=1,2,..n* for the free market products and *k=1,2,...m* for the quantity determined products. Finally, the structural estimation equations of the demand system can be written in terms of budget shares as follows:

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

$$-W_k = [(a'p)\mu_k + [(a'p)\gamma_k + (a'p)\sum_{s=1}^{m}\lambda_{ks}z_s + \sum_{j=1}^{n}\lambda_{jk}p_j]V^M]\frac{z_k}{y} + \xi_k \tag{2.11'}$$

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

The estimated parameters of the model will be used to compute price and income elasticities. These elasticities are used to estimate the quantity response for items with predetermined prices, and for those with pre-determined quantities, the price response. These allow us to measure the impact of hypothetical reform scenarios on consumption and therefore on welfare.

4. Results

This section presents the results of the estimation of the Mixed Demand model, including estimates of the price and income elasticities of each of the PDS items, and based on these, estimates of the welfare impacts of potential reform scenarios for the PDS. The share equations (2.10') and (2.11') of the mixed demand model, described in Section 3, are estimated using a system of nonlinear Seemingly Unrelated Regression (SUR)

criterion, by using iterated feasible generalized least squares (IFGLS).[8]. The model is estimated by 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 (Moschini and Rizzi, 2007; Poi, 2008).

The model is estimated assuming that the products with predetermined quantities, *Z*, are the four ration products: brown wheat flour, rice, sugar and vegetable oil, representing 98% of ration expenditure. These are the quantity-rationed items, i.e., items for which only a certain quota can be purchased at the associated prices. For the X group of foods with predetermined price, we choose to include the free market counterparts of these rations. These are aggregated into four groups; wheat, sweets, rice and oil.[9] The model therefore includes 8 items representing, on average, 35% of food expenditure.

Total expenditure on the eight food items is used as a proxy of income, because measurement errors may be important with the latter, and because we concentrate on consumption of these eight items only [Löfgren and El-Said (2001)]. Prices of all commodities are computed as unit values by dividing the product expenditure on its consumed quantity. All prices are included in their logarithmic form. For the aggregate free market food groups, the share-weighted Stone formula is used to compute composite price indices:

$$PI_I = \sum_{i=1}^{m \in I} w_i *. P_i$$

where PI_I is the price index for the I^{th} food group (I=Free market wheat, Free market rice, Free market sweets and Free market oil), w_i is the share of each product included in group I from the total expenditure of I, and P_i is its price in logarithmic form.

Table 2 shows the average share of each ration product in the expenditure of the four ration items included in the model. Brown wheat flour has the highest expenditure share, in both urban and rural areas for all income quintiles, followed by vegetable oil, sugar and rice. The ration expenditure share is lower in urban areas than rural areas, which is natural given the lower welfare levels and consequently higher rates of poverty in rural Iraq. And as expected, the rationed products are mainly consumed by the two lowest expenditure quintiles.

Given that consumption is very heterogeneous across commodity groups, we followed Ramadan and Thomas (2011) to solve the issue of frequent zero expenditures for some food items in the following way. We estimate

[8] The model is estimated using the nlsur command in STATA 13.
[9] For more details about the items included in each group, see Appendix I.

average shares at the stratum level for the different quintiles in urban and rural areas, instead of the household level. The choice of aggregating over the stratum level generates a loss in information in the data compared to an analysis at the household level, but it avoids the need to adopt more sophisticated procedures for dealing with multiple corner solutions in demand systems [Ramadan and Thomas (2011); Shonkwiler and Yen (1999); Millimet and Tchernis (2009)].

The share equations (2.10') and (2.11') are estimated with all explanatory variables normalized by their sample mean. The coefficients of vector (a) in the two equations (2.10') and (2.11') are set to the mean share of the different non-rationed product groups. Using the estimated parameters from the mixed demand model,[10] we compute price and income elasticities at the mean of the prices, the quantities and the total expenditure of different quintile levels in urban and rural areas.[11]

Price and income elasticities for ration items and equivalent free market products

Overall, the results suggest that except for free market oils, ration items and their closest free market counterparts are essential in the consumption basket of Iraqis. The own price elasticity of free market cereals is close to zero for Iraqi households in both urban and rural areas for all the quintiles. In other words, consumption of cereals (primarily wheat) is inelastic with respect to any changes in the price. Free market rice consumption is highly inelastic as well, and it constitutes a substitute for wheat in both urban and rural areas (Table 3).

Compared with cereals/wheat and rice, both free market sugar and oil have higher elasticities for all the quintiles in both urban and rural areas. However, in absolute terms, their consumption is inelastic with changes to their own prices. Free market oil is the least inelastic item among the three, with own price elasticity higher than 0.5 for the two lowest quintiles in both urban and rural areas. Both sweets and oil are more important for the higher income groups as the price elasticities of these two free market products fall with increasing quintiles. For instance, in urban areas, a 1-unit increase in the price of oil decreases its consumption by 0.84 for the poorest quintile, while the consumption falls 0.31 units for the richest quintile (Table 3).

Table 4 displays the own quantity mixed elasticities of rationed PDS goods in rural and urban areas, respectively. The own quantity elasticities of the price equations of the ration goods are negative and less than 1 in absolute values for all income levels in urban and rural areas. Thus, consumption of ration products is inelastic, and is more inelastic for the poorest quintiles compared with the richest, given their importance in terms of caloric

[10] The estimated parameters from the mixed demand model are available in Appendixes II and III.
[11] The elasticities formulas are presented in Appendix IV.

contribution to the diet of the less well-off. Among the four products, vegetable oil and sugar are the most inelastic.

Following the R classification (R for Rations) of 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. z_k and z_s are substitutes if $(\delta_{q_k}/\delta_{z_s})(z_s/q_k) < 0$ and complements otherwise. Let x_m be an unconstrained good with unit price p_m, z_k and x_m are substitutes (respectively complements) if $(\delta_{q_k}/\delta_{p_m})\,(p_m/q_k) > 0$ (respectively < 0) and $(\delta_{x_m}/\delta_{z_k})\,(z_k/x_m) < 0$ (respectively > 0) (Ramadan and Thomas, 2011). Thus, both ration brown (wheat) flour and ration rice are substitutes in rural and urban areas (Table 4). In addition, ration brown flour is also a substitute for free market cereals but complementary to free market rice. Rationed rice complements the consumption of free market cereals as well as free market rice. Moreover, free market sweets and rationed sugar are complements (Table 5 through Table 8). Hence, the results show that, despite the quality difference between the rations and free market goods, they are complementing each other in the diet of Iraqi households.

Expenditure (income) elasticities are presented in Table 9. Overall, most products show a positive expenditure elasticity of value less than 1 in both rural and urban areas and across quintiles. This implies that these are normal goods and necessary goods. But more expensive free market goods have relatively high expenditure elasticities for all quintiles relative to ration items. At the same time, less well-off households are more responsive than their well-off counterparts to changes in the prices of free market goods. In other words, less well-off households would increase their consumption of free market goods (except for free market oils) to a greater degree when faced with an increase in their incomes.

Free market cereals, rice and sweets are normal goods for all income levels in both urban and rural areas. Expenditure elasticities for these three products decrease with the income level. For instance, in rural areas, a one-unit increase in income increases consumption of wheat, rice and sweets by 0.086, 0.353 and 0.359 respectively for the lowest income group compared with an increase of 0.033, 0.072 and 0.166 units respectively for the highest income group. Comparing rural and urban areas, there is no significant difference in elasticities of the three items.

Surprisingly, free market oil is considered as an inferior good for all income groups in rural areas, a result that requires more investigation. Subsidized or rationed brown flour is also an inferior good for urban households, showing that an increase in income will yield to a decrease in consumption of PDS brown flour with an increase in its substitute, free market cereals. Surprisingly, it is the opposite for ration oil; an increase in income increases subsidized oil consumption and decreases the consumption of free market oil.

How would consumers adjust their consumption responses over time?

Given the lack of information of future consumer responses to changes in prices and expenditure, one way to understand behavior over time is by exploiting the spatial disparities that Iraq has. In other words, consumer behavior in better off regions may be a rough approximation of how less well-off regions today will behave in the future as their welfare levels improved, holding everything else constant. Thus, we consider how households would adjust their consumption patterns over time, as welfare levels improved, by comparing current demand responses in Kurdistan and the rest of Iraq. We take Kurdistan (i.e. three north-east governorates: Erbil, Duhok and Sulaimaniya) as the reference region because their current consumption levels of ration items are the lowest in the country and because their per capita expenditure levels are the highest on average.

Similar consumption responses to changes in own prices of ration and free market goods are seen for Kurdistan and for the rest of Iraq relative to previous findings for urban and rural areas (Table 10). Overall, most goods are ordinary goods meaning that demand for this type of goods decreases when there is an increase in their own prices. Not surprisingly, demand for ration items is much less elastic than free market goods. However, all level responses are higher in Kurdistan than in the rest of Iraq and higher than the estimates for urban areas shown above. At the same time, well-off households in Kurdistan region are much more responsive to variations in prices of ration goods and the opposite is true for their free market equivalents, compared to the rest of Iraq and urban Iraq. In other words, in line with higher welfare levels in Kurdistan relative to urban Iraq, and in urban Iraq relative to rural Iraq, the flexibility of consumer demand to changes in prices increases. Thus, as the economy grows, consumers in Iraq will likely face a larger set of options and the ability to substitute away from ration items and increase their consumption of free market goods. Similarly, if economic conditions worsen, consumer dependence on rations and their inelasticity of response will likely increase.

This pattern in consumer behavior is quite clear when inspecting demand responses for goods to variations in total household expenditure and income. In general, most ration items are marginally "inferior" goods in the Kurdistan region irrespective of the level of per capita consumption. In other words, as household expenditures increase by 10 percent, demand will fall by between 0.4 and 3.4 percent for brown flour and by around 0.7 percent for rice (Table 11). Opposite responses are obtained in the Rest of Iraq: ration items are considered "normal" goods. We speculate therefore that, as the economy evolves and the levels of income increase across the distribution, and as the rest of the country approaches the higher welfare levels of Kurdistan, these types of ration goods would be less demanded.

Welfare analysis

The elasticities estimated above permit the measurement of changes in consumer welfare induced by changes in the PDS. More precisely, these elasticities are used to compute the change in the total expenditure of the

households and the different product shares in total expenditures when faced with a removal of the PDS. The implicit assumption here is that since PDS goods have predetermined quantities, households will procure these on the market in the absence in of the PDS. Thus, the removal of any of the subsidized products will yield a change in the consumption of their free market counterpart as well as in the corresponding free market prices. Consumers will react to the removal of the subsidized quota by adjusting their consumption of the other free market products consumed. This will yield a change in their total expenditure.

Two sets of reform scenarios for the PDS are implemented to illustrate its distributional impact. Both sets consider the complete removal of the PDS only in urban households – in other words, urban households will no longer be able to purchase wheat, rice, sugar and oil up to their quota at the subsidized prices. Such a scenario, with phased implementation of reform beginning with urban areas, is plausible for logistical and implementation reasons, and for welfare considerations. We focus only on households living in urban areas because these have relatively better initial conditions than their rural counterparts, which might ease the implementation of the reform. Even though the reduction in rural poverty has been significantly higher than in urban areas between 2007 and 2012, rural poverty levels remain double those in urban areas [World Bank (2014a)]. Moreover, urban households presumably have better access to free market products than those living in rural areas. This would make the implicit assumption of being able to substitute PDS goods for their free market counterparts reasonable.

The first set of scenarios (i.e. Scenarios A) focuses on removing the rations products from the highest two income quintiles in urban areas. The implementation of such a scenario assumes the ability to relatively well-target PDS beneficiaries in urban areas and exclude the top 40% of the welfare distribution from the program. This extreme case would have no impact on rural areas or on the urban poor. In other words, we are excluding the public transfer from those segments of the population which may need them the least or who could reasonably adjust their consumption or a combination of both, given their relative better-off welfare conditions. To measure the household responses to changes in the PDS, we gradually remove the quotas in increasing order of the share of each ration item in the total expenditure. More precisely, scenarios A are defined as follows:

- Scenario A1: decrease the ration rice quota by 100% for the two highest quintiles in urban areas;
- Scenario A2: Scenario A1 in addition to the decrease of the ration vegetable oil quota by 100% for the two highest quintiles in urban areas;
- Scenario A3: Scenario A2 in addition to the decrease of the sugar quota by 100% for the two highest quintiles in urban areas;
- Scenario A4: scenario A3 in addition to the decrease of the brown flour quota by 100% for the two highest quintiles in urban areas.

Given the substitutive and complementary relations between the ration products and free market products; the prices and quantities for each product will change based on the own price and cross price elasticities estimated. According to scenarios A, the removal of the quotas of each of the subsidized products will result in an increase in the shares of the other subsidized products and free market products in total expenditures (Figures 4-7). The removal of the quotas for each subsidized product represents a decrease in its share in total expenditures by 100%, computed with respect to the initial value of expenditure on that product.

Overall, the highest increase in expenditures because of the removal of subsidies is observed for free market oil. Under scenario A1 (Figure 4), where only the rice quota was removed, the free market oil share increases by 17% and 20% for the fourth and fifth quintiles respectively. Under scenario A4 (Figure 7), where all subsidized products were removed, the shares of free market oil increase by 116% and 107%, compared with its original share, for the fourth and fifth quintiles respectively. This high impact is not surprising given the large cross price elasticities of free market oil with respect to all subsidized products.

Under scenario A1, the removal of the rice quota will increase the expenditure shares on its free market counterpart by 5% and 2% for the fourth and fifth quintile, respectively. And given the complementarity between the rationed rice and free market cereals, we find that the removal of rice quota increases free market cereals share by 1% for the fourth quintile while it deceases by 3% for the fifth quintile. At the same time, the share of expenditures on subsidized flour will increase, as it is a substitute for PDS rice (Figure 4).

The removal of the subsidized sugar (Scenario A3), in addition to the subsidized rice and oil, results in an increase in the share of its free market counterpart by 52% and 20% for the fourth and fifth income groups respectively. Eliminating the quotas for all four subsidized products (Scenario A4) results in a large increase in the share of the free market products. For the fourth quintile urban households, their share of free market cereals, rice and sweet increase by 61%, 53% and 24%, respectively. The impact is lower in the case of the fifth quintile, whose shares of free market cereals, free market rice and free market sweet increase by 31%, 27% and 11%, respectively. These results are not surprising given that households should compensate for the removal of the subsidized products through an increase in expenditures on their free market counterparts.

The second set of scenarios (Scenarios B) involves the removal of access to rations products from all income quintiles in urban areas. While for Scenarios A, only the highest income quintiles of urban areas were affected, for Scenarios B, all urban areas will be affected with no impact on rural areas. This is a strong assumption, given that markets are interlinked and may be difficult to isolate such change from affecting the rural areas. Moreover, when such policies are applied, this may result in black market and leakage if no strong targeting policies are implemented. However, this assumption is used for simplification of the analysis.

Similarly, as in Scenarios A, the different quotas will be removed gradually according to the importance of the share of each ration item. More precisely, scenarios B are:

- Scenario B1: decrease the ration rice quota by 100% in urban areas.
- Scenario B2: ScenarioA1 in addition to the decrease of the ration vegetable oil quota by 100% in urban areas.
- Scenario B3: Scenario A2 in addition to the decrease of the sugar quota by 100% in urban areas.
- Scenario B4: scenario A3 in addition to the decrease of the brown flour quota by 100% in urban areas.

Under scenarios B, the urban poor are the most affected, given the importance of the subsidized products in their diet. Eliminating rice subsidies will increase the expenditure share of its free market counterpart by 10% for the poorest households compared with only 2% for the richest (Table 13). While removing the quotas of the four subsidized products will yield an increase in the share of their free market counterparts by more than 200% for the lowest quintiles compared with an increase of less than 50% for the richest group, except for oil, whose share increases by more than 100% for the richest group.

Holding incomes constant, such increases in expenditure shares imply that affected households will likely have to cut back on other food and non-food expenditures. A more direct measure of the utility or welfare impact of the removal of the PDS can be estimated by computing the Compensating Variation (CV). The CV represents the difference between the minimum expenditure required to attend an original level of utility at the new price 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 (2009)]. As explained by Huang and Huang (2009), holding the utility level constant, 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:

$$CV = C(p_1, u_0) - C(p_0, u_0)$$

Following Ramadan and Thomas (2011), the subsidized price is the initial price p_0, while p_1 is the new price after the removal of subsidies. A negative (positive) CV means that the change in prices results in an increase (decrease) of the consumer's welfare [Ackah and Appleton (2007); Huang and Huang (2009)]. Positive change represents an increase in the expenditure with the new prices to keep the same initial utility level. This means a decrease in the consumer's welfare.

Assuming that the households will continue consuming the same quotas but the subsidized price will increase as if the quotas were removed (i.e. the quantity decreases by 100%), households will have to increase their total

expenditure to keep their utility level constant. Table 14 shows the compensating variation is positive for all households under Scenario B. This implies that the removal of subsidies will result in a decrease in their welfare.

The two lowest income quintiles are the most affected by this reform, given the importance of the subsidized products in their total expenditures. The elimination of access to subsidized rice will require compensating the poorest households by 0.10% of their total expenditures to maintain their welfare level, compared with 0.09% for the richest group. While the removal of all the subsidies will have almost the same impact on all income groups; they would need to be compensated by around 0.3% of their total expenditures. This low level of CV can be explained by the fact that the increase in the price resulting from a decrease of the quota by 100% is very low given the low own price elasticities.

However, if the previously subsidized products are only available at the prices of the free market counterparts (or at relatively similar prices, which is a reasonable assumption), this will imply an important change in the households' total expenditures (Table 14) to keep utility constant, especially for the poor households. The removal of all subsidies in this case will require compensating poor households by 74.4% of their expenditures compared with nearly 40% for the richest. This large decrease in the households' welfare reflected by the high positive value of compensating variation is due to the high price differential between the official/subsidized prices and free market prices.

5. Concluding Remarks

The poorer segments of the consumption distribution in Iraq are disproportionately dependent on public and private transfers to supplement their relatively low earnings on the labor market [World Bank (2014)]. Most of these transfers are however, small, and cover a fraction of the poor. The single exception is the Public Distribution System, which guarantees a minimum amount of caloric consumption for not just the poor, but the whole population.

Given the universality of consumption of PDS goods, the lack of a market for ration items, and the low levels of income for much of the population [World Bank (2014)], household consumption of PDS items is relatively inelastic to changes in price. The own quantity elasticities of price are negative and less than 1 in absolute values for all income levels in urban and rural areas. However, they are more inelastic for the poorest quintiles compared with the richest, given their importance in terms of caloric contribution to the diet of the less well-off. In addition, for much of the population, these goods are not inferior, but rather normal goods. Most products show a positive expenditure elasticity of value less than 1 in both rural and urban areas and across quintiles.

However, there are some signs that with improvements in welfare levels, and faced with well-functioning markets, some segments of the population are substituting away from the PDS and increasing their consumption of market substitutes. For instance, most ration items are marginally "inferior" goods in the Kurdistan region irrespective of the level of per capita consumption, while the opposite occurs in the rest of Iraq where ration items are considered "normal" goods.

Overall, our findings suggest that any one-shot reform of the PDS will have adverse and sizeable welfare impacts. The removal of all subsidies will require compensating the poor households by 74.4% of their expenditures compared with nearly 40% for the richest in urban areas. However, over time, and with increases in welfare, some households may not be as significantly affected.

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Table 1: Average share of ration expenditure in total food expenditure by consumption groups in urban and rural areas (%)

Consumption Quintiles	Poorest	2	3	4	Richest
Rural	47.3	26.5	20.1	15.1	9.4
Urban	43.8	26.9	20.3	14.9	8.8
Total	45.9	26.8	20.2	15.0	8.9

Source: Own estimations based on IHSES 2012.

Table 2: Average shares of ration items to total expenditure of the 4 food items used in the analysis (%)

	Quintile	Poorest	2	3	4	Richest
Rural	Brown Flour	32.9	28.1	24.7	21.4	16.1
	Rice	13.4	10.8	9.6	7.8	6.0
	Vegetable Oil	20.1	17.4	15.5	13.9	10.9
	Sugar	16.7	14.5	13.0	11.5	9.1
Urban	Brown Flour	30.7	26.1	22.1	18.0	12.7
	Rice	12.8	11.2	9.2	7.5	5.0
	Vegetable Oil	19.4	17.0	15.2	13.3	10.5
	Sugar	16.1	14.5	13.0	11.5	9.2

Source: Own estimations based on IHSES 2012.

Table 3: Price Elasticities of Free Market Goods

	Poorest	2	3	4	Richest
Rural Areas					
Cereals with respect to price of					
Cereals	-0.003	-0.004	-0.001	0.000	-0.004
Rice	0.022	0.011	0.011	0.011	0.006
Sweets	-0.062	-0.043	-0.037	-0.032	-0.030
Oils	-0.025	-0.007	-0.013	-0.017	-0.019
Rice with respect to price of					
Cereals	0.083	0.044	0.034	0.026	0.010
Rice	-0.019	-0.015	-0.008	-0.006	-0.005
Sweets	-0.062	-0.046	-0.031	-0.025	-0.019
Oils	-0.282	-0.162	-0.134	-0.120	-0.089
Sweets with respect to price of					
Cereals	-0.062	-0.050	-0.035	-0.028	-0.028
Rice	-0.036	-0.029	-0.020	-0.017	-0.018
Sweets	-0.035	-0.034	-0.026	-0.024	-0.032
Oils	-0.151	-0.092	-0.110	-0.124	-0.155
Oil with respect to price of					
Cereals	0.201	0.104	0.076	0.068	0.038
Rice	0.180	0.088	0.067	0.068	0.039
Sweets	0.394	0.202	0.164	0.159	0.092
Oils	-0.761	-0.378	-0.288	-0.280	-0.105
Urban Areas					
Cereals with respect to price of					
Cereals	0.003	0.002	0.002	0.001	0.001
Rice	0.023	0.017	0.015	0.012	0.011
Sweets	-0.058	-0.041	-0.036	-0.031	-0.027
Oils	-0.015	-0.016	-0.014	-0.013	-0.019
Rice with respect to price of					
Cereals	0.091	0.067	0.045	0.031	0.019
Rice	-0.017	-0.012	-0.008	-0.006	-0.002
Sweets	-0.077	-0.054	-0.039	-0.031	-0.021
Oils	-0.273	-0.222	-0.162	-0.129	-0.116
Sweets with respect to price of					
Cereals	-0.045	-0.034	-0.027	-0.023	-0.018
Rice	-0.028	-0.021	-0.017	-0.015	-0.010
Sweets	-0.035	-0.026	-0.024	-0.024	-0.023
Oils	-0.117	-0.112	-0.107	-0.108	-0.170
Oil with respect to price of					
Cereals	0.171	0.139	0.095	0.078	0.054
Rice	0.182	0.148	0.109	0.094	0.073
Sweets	0.423	0.336	0.247	0.212	0.162
Oils	-0.843	-0.696	-0.509	-0.429	-0.313

Source: Own estimations based on IHSES 2012.

Table 4: Own quantity mixed elasticities of ration items

		Poorest	2	3	4	Richest
Rural Areas						
Brown flour price with respect to:						
Ration	Brown Flour	-0.032	-0.034	-0.041	-0.047	-0.066
	Rice	-0.005	-0.001	-0.004	-0.007	0.002
	Sugar	0.034	0.033	0.043	0.051	0.062
	Vegetable Oil	0.018	0.021	0.024	0.027	0.042
Rice price with respect to:						
Ration	Brown Flour	-0.004	-0.004	-0.005	-0.006	-0.009
	Rice	-0.030	-0.030	-0.036	-0.042	-0.050
	Sugar	0.020	0.020	0.025	0.028	0.036
	Vegetable Oil	-0.043	-0.045	-0.054	-0.062	-0.082
Sugar price with respect to:						
Ration	Brown Flour	0.012	0.012	0.015	0.017	0.023
	Rice	0.010	0.010	0.012	0.014	0.018
	Sugar	-0.006	-0.006	-0.008	-0.009	-0.013
	Vegetable Oil	0.004	0.004	0.005	0.006	0.008
Vegetable Oil price with respect to:						
Ration	Brown Flour	0.004	0.004	0.005	0.006	0.008
	Rice	-0.012	-0.013	-0.016	-0.018	-0.024
	Sugar	0.002	0.002	0.002	0.002	0.003
	Vegetable Oil	-0.001	-0.001	-0.001	-0.002	-0.002
Urban Areas						
Brown Flour price with respect to:						
Ration	Brown Flour	-0.030	-0.034	-0.037	-0.042	-0.059
	Rice	-0.009	-0.011	-0.012	-0.013	-0.018
	Sugar	0.035	0.041	0.046	0.053	0.082
	Vegetable Oil	0.016	0.018	0.020	0.024	0.035
Rice price with respect to:						
Ration	Brown Flour	-0.004	-0.004	-0.005	-0.006	-0.008
	Rice	-0.028	-0.033	-0.035	-0.039	-0.051
	Sugar	0.019	0.022	0.024	0.027	0.041
	Vegetable Oil	-0.041	-0.049	-0.054	-0.061	-0.092
Sugar price with respect to:						
Ration	Brown Flour	0.011	0.013	0.014	0.016	0.023
	Rice	0.009	0.010	0.011	0.013	0.017
	Sugar	-0.006	-0.006	-0.007	-0.008	-0.013
	Vegetable Oil	0.004	0.004	0.005	0.005	0.008
Vegetable Oil price with respect to:						
Ration	Brown Flour	0.004	0.004	0.005	0.005	0.007
	Rice	-0.012	-0.014	-0.015	-0.017	-0.023
	Sugar	0.002	0.002	0.002	0.002	0.004
	Vegetable Oil	-0.001	-0.001	-0.001	-0.002	-0.003

Source: Own estimations based on IHSES 2012

Table 5: Elasticities of free market goods with respect to ration items in Rural Areas - quintiles

		Poorest	2	3	4	Richest
Cereals with respect to:						
Ration	Brown Flour	-0.034	-0.021	-0.015	-0.008	-0.003
	Rice	0.116	0.068	0.059	0.048	0.035
	Sugar	0.008	0.005	0.004	0.002	0.001
	Vegetable Oil	-0.025	-0.016	-0.013	-0.010	-0.007
Rice with respect to:						
Ration	Brown Flour	0.300	0.184	0.131	0.102	0.061
	Rice	0.085	0.051	0.035	0.027	0.015
	Sugar	-0.017	-0.010	-0.008	-0.006	-0.004
	Vegetable Oil	-0.009	-0.006	-0.004	-0.003	-0.001
Sweets with respect to:						
Ration	Brown Flour	0.245	0.162	0.139	0.120	0.100
	Rice	0.033	0.021	0.018	0.014	0.010
	Sugar	0.060	0.042	0.034	0.028	0.022
	Vegetable Oil	0.014	0.009	0.009	0.008	0.007
Oil with respect to:						
Ration	Brown Flour	-1.107	-0.532	-0.432	-0.395	-0.227
	Rice	-0.313	-0.150	-0.123	-0.116	-0.066
	Sugar	-0.086	-0.042	-0.035	-0.033	-0.018
	Vegetable Oil	-0.074	-0.037	-0.030	-0.027	-0.016

Source: Own estimations based on IHSES 2012

Table 6: Elasticities of ration item's price with respect to free markets goods' price in rural areas - quintiles

		Poorest	2	3	4	Richest
Ration Brown flour with respect to						
Free market	Cereals	0.088	0.103	0.093	0.067	0.058
	Rice	-0.408	-0.405	-0.494	-0.627	-0.866
	Sweets	-0.342	-0.360	-0.465	-0.582	-0.782
	Oils	0.976	0.989	1.211	1.477	1.910
Ration Rice with respect to						
Free market	Cereals	-0.205	-0.204	-0.239	-0.255	-0.291
	Rice	-0.064	-0.062	-0.073	-0.087	-0.111
	Sweets	-0.012	-0.012	-0.013	-0.013	-0.012
	Oils	0.235	0.230	0.275	0.306	0.364
Ration Sugar with respect to						
Free market	Cereals	-0.009	-0.009	-0.010	-0.009	-0.007
	Rice	0.001	0.001	0.002	0.003	0.006
	Sweets	-0.036	-0.039	-0.048	-0.056	-0.071
	Oils	0.020	0.021	0.029	0.036	0.045
Ration Vegetable oil with respect to						
Free market	Cereals	0.021	0.021	0.024	0.024	0.025
	Rice	0.009	0.009	0.010	0.012	0.014
	Sweets	0.000	0.000	0.000	-0.002	-0.005
	Oils	-0.015	-0.015	-0.016	-0.016	-0.018

Source: Own estimations based on IHSES 2012

Table 7: Elasticities of free market goods with respect to ration items in Urban Areas - quintiles

		Poorest	2	3	4	Richest
Cereals with respect to ration of:						
Ration	Brown Flour	-0.028	-0.017	-0.012	-0.008	-0.003
	Rice	0.092	0.067	0.053	0.043	0.033
	Sugar	0.007	0.005	0.003	0.002	0.001
	Vegetable Oil	-0.021	-0.015	-0.012	-0.010	-0.008
Rice with respect to ration of:						
Ration	Brown Flour	0.318	0.231	0.160	0.119	0.078
	Rice	0.090	0.065	0.043	0.031	0.018
	Sugar	-0.016	-0.012	-0.008	-0.006	-0.005
	Vegetable Oil	-0.011	-0.008	-0.005	-0.004	-0.002
Sweets with respect to ration of:						
Ration	Brown Flour	0.197	0.156	0.129	0.109	0.103
	Rice	0.026	0.020	0.015	0.012	0.010
	Sugar	0.051	0.040	0.032	0.027	0.025
	Vegetable Oil	0.011	0.010	0.008	0.007	0.008
Oil with respect to ration of:						
Ration	Brown Flour	-0.994	-0.778	-0.555	-0.463	-0.354
	Rice	-0.281	-0.225	-0.157	-0.133	-0.098
	Sugar	-0.082	-0.067	-0.048	-0.042	-0.035
	Vegetable Oil	-0.067	-0.053	-0.038	-0.032	-0.026

Source: Own estimations based on IHSES 2012

Table 8: Elasticities of Ration items' prices with respect to Free Market goods' prices in Urban Areas

		Poorest	2	3	4	Richest
Ration Brown flour with respect to						
Free market	Cereals	0.067	0.063	0.054	0.048	0.021
	Rice	-0.422	-0.500	-0.574	-0.667	-1.002
	Sweets	-0.393	-0.463	-0.537	-0.627	-0.932
	Oils	1.063	1.227	1.389	1.581	2.250
Ration price of rice with respect to						
Free market	Cereals	-0.181	-0.210	-0.219	-0.230	-0.296
	Rice	-0.063	-0.073	-0.080	-0.089	-0.126
	Sweets	-0.013	-0.014	-0.014	-0.013	-0.013
	Oils	0.210	0.249	0.263	0.283	0.385
Ration price of sugar with respect to						
Free market	Cereals	-0.010	-0.010	-0.010	-0.010	-0.009
	Rice	0.000	0.001	0.001	0.002	0.005
	Sweets	-0.042	-0.048	-0.054	-0.061	-0.085
	Oils	0.027	0.031	0.037	0.042	0.063
Ration price of oil with respect to						
Free market	Cereals	0.019	0.021	0.022	0.022	0.026
	Rice	0.010	0.011	0.012	0.012	0.016
	Sweets	0.001	0.000	-0.001	-0.002	-0.005
	Oils	-0.013	-0.014	-0.015	-0.015	-0.020

Source: Own estimations based on IHSES 2012

Table 9: Expenditure Elasticities by Quintile of Per Capita Consumption and Area

	Ration products				Equivalent Free Market Product			
	Brown Flour	Rice	Sugar	Vegetable Oil	Cereal	Rice	Sweets	Oils
Rural								
1	0.015	-0.024	0.005	0.021	0.086	0.353	0.359	-0.017
2	0.084	-0.005	0.006	0.023	0.054	0.227	0.259	-0.021
3	0.059	-0.009	0.005	0.027	0.045	0.155	0.213	-0.022
4	0.027	0.003	0.005	0.030	0.037	0.118	0.180	-0.013
5	0.263	0.082	0.017	0.044	0.033	0.072	0.166	-0.046
Urban								
1	-0.057	-0.008	0.000	0.019	0.060	0.359	0.292	0.087
2	-0.073	-0.014	0.000	0.022	0.044	0.256	0.224	0.085
3	-0.093	-0.004	-0.001	0.025	0.035	0.175	0.187	0.061
4	-0.088	0.012	-0.001	0.028	0.029	0.129	0.162	0.042
5	-0.146	0.035	-0.002	0.041	0.023	0.082	0.152	0.017

Source: Own estimations based on IHSES 2012

Table 10: Own-Price Elasticities of Ration Items by quintile of per-capita consumption and area, 2012

	Ration products				Equivalent Free Market Product			
	Brown Flour	Rice	Sugar	Vegetable Oil	Cereal	Rice	Sweets	Oils
Kurdistan								
1	-0.032	-0.038	-0.006	-0.005	0.010	-0.004	-0.013	-1.034
2	-0.037	-0.046	-0.007	-0.007	0.006	-0.002	-0.005	-0.941
3	-0.040	-0.044	-0.007	-0.007	0.003	-0.004	-0.013	-0.457
4	-0.048	-0.055	-0.009	-0.009	0.005	0.000	-0.011	-0.541
5	-0.076	-0.080	-0.016	-0.015	0.006	0.002	-0.010	-0.398
Rest of Iraq								
1	-0.030	-0.029	-0.005	-0.004	0.009	-0.007	-0.048	-0.533
2	-0.033	-0.032	-0.006	-0.005	0.007	-0.005	-0.035	-0.370
3	-0.038	-0.038	-0.007	-0.005	0.007	0.000	-0.028	-0.321
4	-0.043	-0.042	-0.007	-0.006	0.006	0.000	-0.026	-0.271
5	-0.058	-0.053	-0.011	-0.009	0.003	0.000	-0.029	-0.133

Source: Own estimations based on IHSES 2012

Table 11: Expenditure Elasticities by Quintile of Per Capita Consumption and Region

	Ration products				Equivalent Free Market Product			
	Brown Flour	Rice	Sugar	Vegetable Oil	Cereal	Rice	Sweets	Oils
Kurdistan								
1	-0.04	-0.07	0.00	0.03	0.04	0.29	0.21	0.16
2	-0.10	-0.11	0.00	0.03	0.04	0.18	0.20	0.17
3	-0.02	-0.07	0.00	0.04	0.03	0.12	0.18	0.06
4	-0.13	-0.07	0.00	0.04	0.03	0.09	0.15	0.08
5	-0.34	-0.07	-0.01	0.07	0.02	0.06	0.14	0.05
Rest of Iraq								
1	0.03	0.01	0.00	0.02	0.090	0.46	0.37	-0.13
2	0.05	0.02	0.00	0.03	0.06	0.35	0.25	-0.09
3	0.00	0.02	0.00	0.03	0.04	0.25	0.21	-0.07
4	-0.02	0.03	0.00	0.03	0.03	0.20	0.17	-0.06
5	0.06	0.09	0.00	0.05	0.03	0.12	0.16	-0.06

Source: Own estimations based on IHSES 2012

Table 12: Average change in subsidized products shares - Scenarios B (Urban areas -Consumption quintiles)

		Poorest	2	3	4	Richest
Scenario B1	Rice	-100%	-100%	-100%	-100%	-100%
	Oil	15%	13%	11%	10%	10%
	Sugar	13%	11%	9%	8%	6%
	Flour	14%	12%	10%	9%	8%
Scenario B2	Rice	-100%	-100%	-100%	-100%	-100%
	Oil	-100%	-100%	-100%	-100%	-100%
	Sugar	31%	25%	20%	16%	10%
	Flour	31%	25%	20%	16%	11%
Scenario B3	Rice	-100%	-100%	-100%	-100%	-100%
	Oil	-100%	-100%	-100%	-100%	-100%
	Sugar	-100%	-100%	-100%	-100%	-100%
	Flour	67%	50%	38%	30%	18%
Scenario B4	Rice	-100%	-100%	-100%	-100%	-100%
	Oil	-100%	-100%	-100%	-100%	-100%
	Sugar	-100%	-100%	-100%	-100%	-100%
	Flour	-100%	-100%	-100%	-100%	-100%
		Poorest	2	3	4	Richest
Scenario B1	Rice	-100%	-100%	-100%	-100%	-100%
	Oil	15%	13%	11%	10%	10%
	Sugar	13%	11%	9%	8%	6%
	Flour	14%	12%	10%	9%	8%

Scenario B2	Rice	-100%	-100%	-100%	-100%	-100%
	Oil	-100%	-100%	-100%	-100%	-100%
	Sugar	31%	25%	20%	16%	10%
	Flour	31%	25%	20%	16%	11%
Scenario B3	Rice	-100%	-100%	-100%	-100%	-100%
	Oil	-100%	-100%	-100%	-100%	-100%
	Sugar	-100%	-100%	-100%	-100%	-100%
	Flour	67%	50%	38%	30%	18%
Scenario B4	Rice	-100%	-100%	-100%	-100%	-100%
	Oil	-100%	-100%	-100%	-100%	-100%
	Sugar	-100%	-100%	-100%	-100%	-100%
	Flour	-100%	-100%	-100%	-100%	-100%

		Poorest	2	3	4	Richest
Scenario B1	Rice	-100%	-100%	-100%	-100%	-100%
	Oil	15%	13%	11%	10%	10%
	Sugar	13%	11%	9%	8%	6%
	Flour	14%	12%	10%	9%	8%
Scenario B2	Rice	-100%	-100%	-100%	-100%	-100%
	Oil	-100%	-100%	-100%	-100%	-100%
	Sugar	31%	25%	20%	16%	10%
	Flour	31%	25%	20%	16%	11%
Scenario B3	Rice	-100%	-100%	-100%	-100%	-100%
	Oil	-100%	-100%	-100%	-100%	-100%
	Sugar	-100%	-100%	-100%	-100%	-100%
	Flour	67%	50%	38%	30%	18%
Scenario B4	Rice	-100%	-100%	-100%	-100%	-100%
	Oil	-100%	-100%	-100%	-100%	-100%
	Sugar	-100%	-100%	-100%	-100%	-100%
	Flour	-100%	-100%	-100%	-100%	-100%

Source: Own estimations based on IHSES 2012

Table 13: Average change in free market products shares - Scenarios B (Urban areas – Consumption quintiles)

		Poorest	2	3	4	Richest
Scenario B1	Cereals	7%	5%	3%	1%	-3%
	Rice	10%	8%	7%	5%	2%
	Sweet	12%	10%	9%	7%	5%
	Oil	21%	19%	17%	17%	20%
Scenario B2	Cereals	28%	23%	18%	13%	6%
	Rice	29%	23%	19%	14%	8%
	Sweet	29%	23%	18%	14%	7%
	Oil	48%	41%	36%	34%	35%
Scenarios B3	Cereals	62%	48%	36%	27%	15%
	Rice	66%	49%	39%	30%	19%
	Sweet	59%	43%	33%	24%	11%
	Oil	94%	76%	63%	58%	57%
Scenarios B4	Cereals	220%	152%	84%	61%	31%
	Rice	212%	113%	80%	53%	27%
	Sweet	207%	106%	74%	52%	20%
	Oil	284%	180%	133%	116%	107%

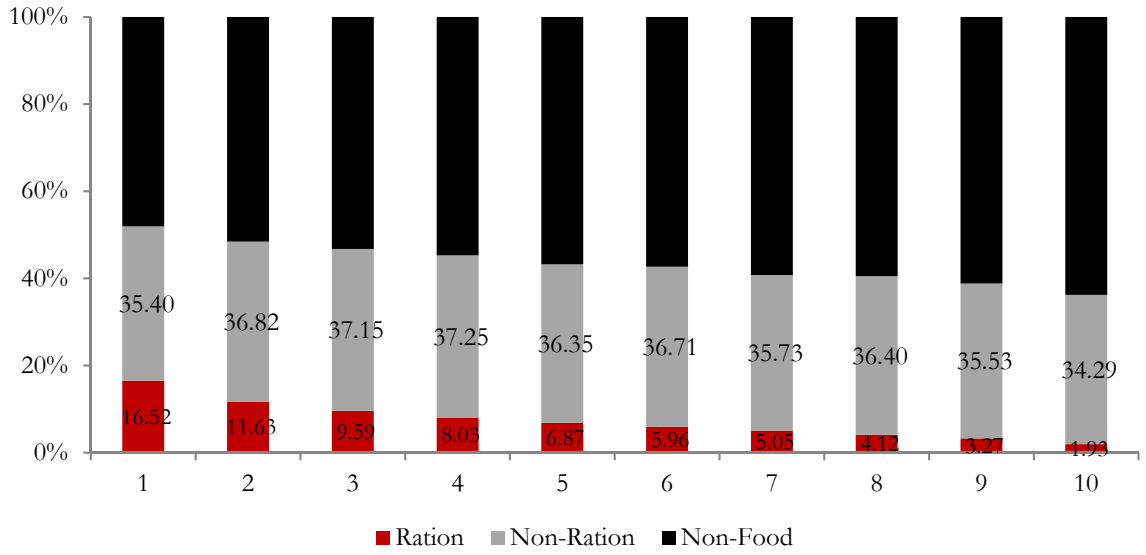
Source: Own estimations based on IHSES 2012

Table 14: Compensating Variation (%) for households in urban areas (Scenarios B)

Scenarios	Poorest	2	3	4	Richest
If subsidized prices increase due to a decrease of the subsidy quantities by 100% (based on the elasticities)					
B1	0.10	0.11	0.10	0.09	0.09
B2	0.14	0.15	0.14	0.13	0.13
B3	0.24	0.25	0.23	0.23	0.23
B4	0.29	0.30	0.29	0.28	0.29
If subsidized prices are set equal to the free market ones					
B1	7.50	7.50	7.15	6.62	5.16
B2	1.63	2.45	3.02	3.27	2.85
B3	16.96	17.03	17.30	16.44	13.47
B4	74.36	71.44	63.42	53.86	38.90

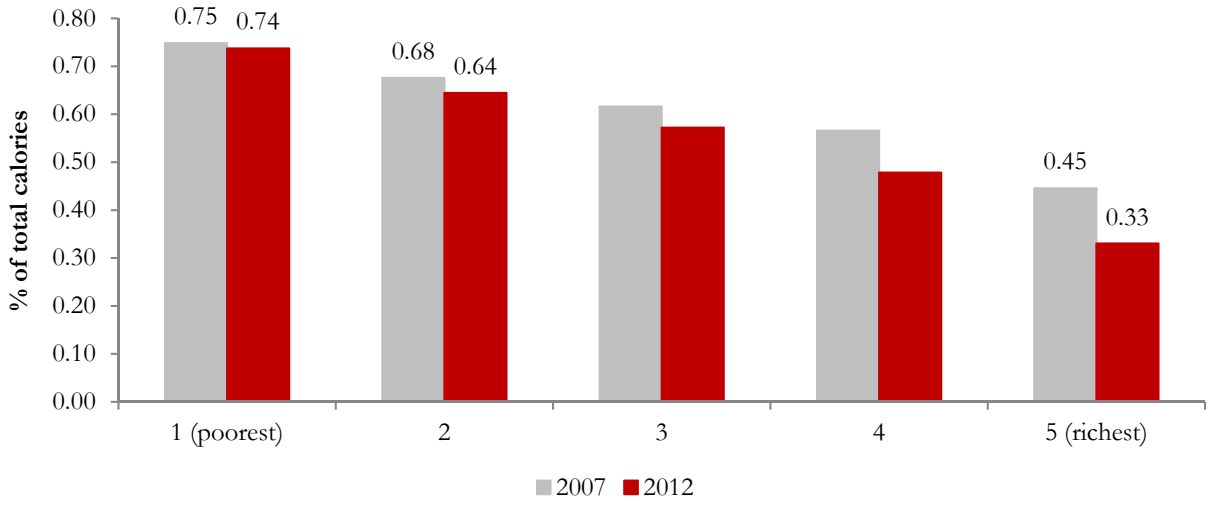
Source: Own estimations based on IHSES 2012

Figure 1: PDS Expenditures, Food and Non-Food Expenditures by Consumption Quintile, 2012



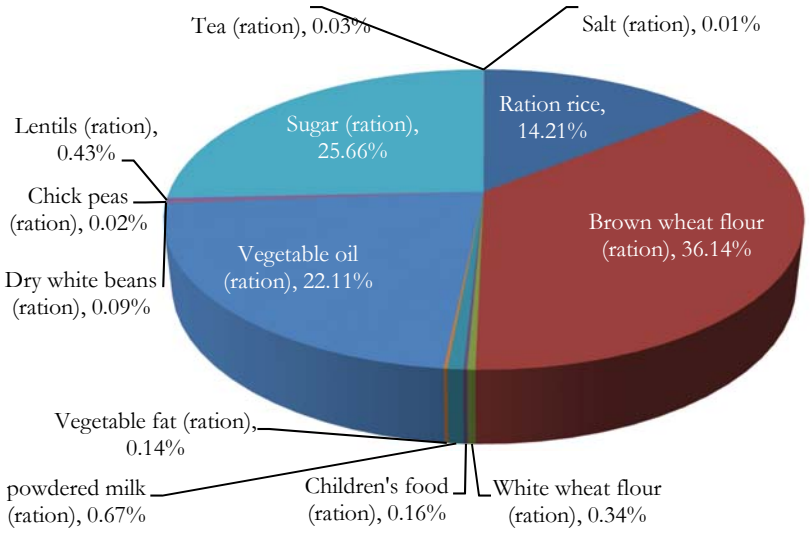
Source: Own estimations based on IHSES 2012

Figure 2: Share of Calories from the PDS, by Consumption Quintile, 2007 and 2012



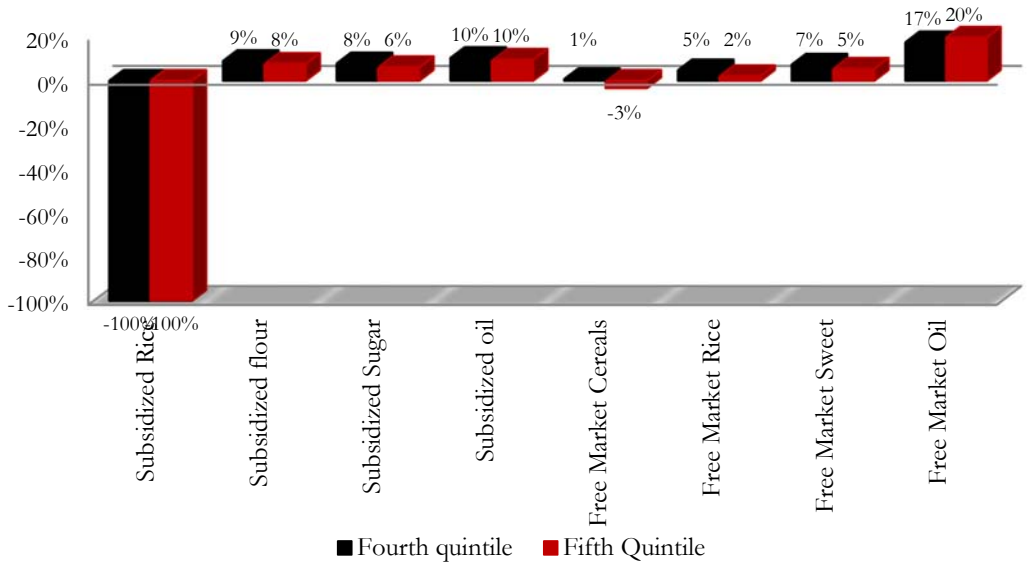
Source: Own estimations based on IHSES 2012

Figure 1: Share of different ration products in total ration expenditure (%)



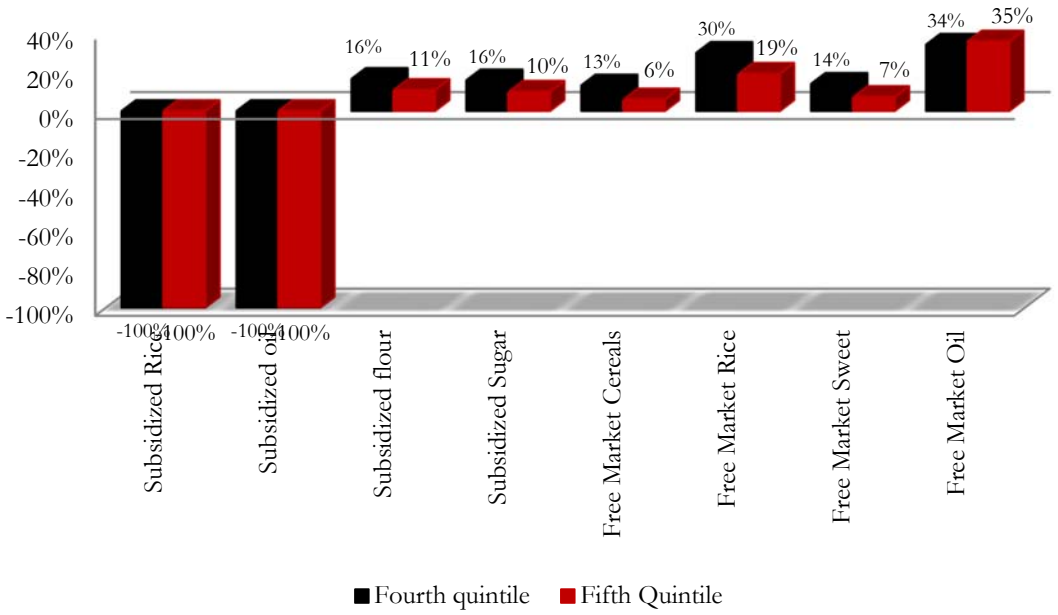
Source: Own estimations based on IHSES 2012

Figure 2: Average change in products shares - Scenario A1 (Urban areas)



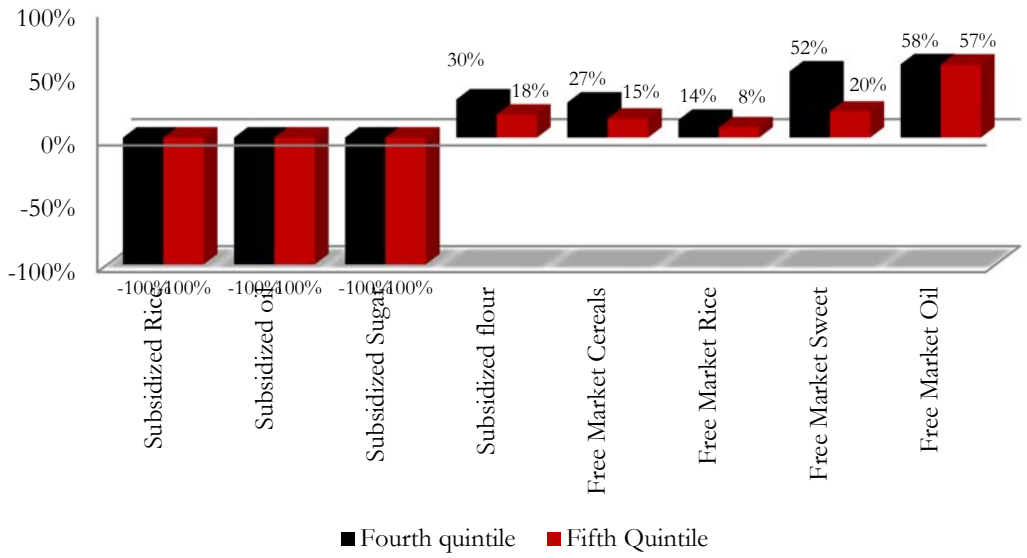
Source: Own estimations based on IHSES 2012

Figure 3: Average change in products shares - Scenario A2 (Urban areas)



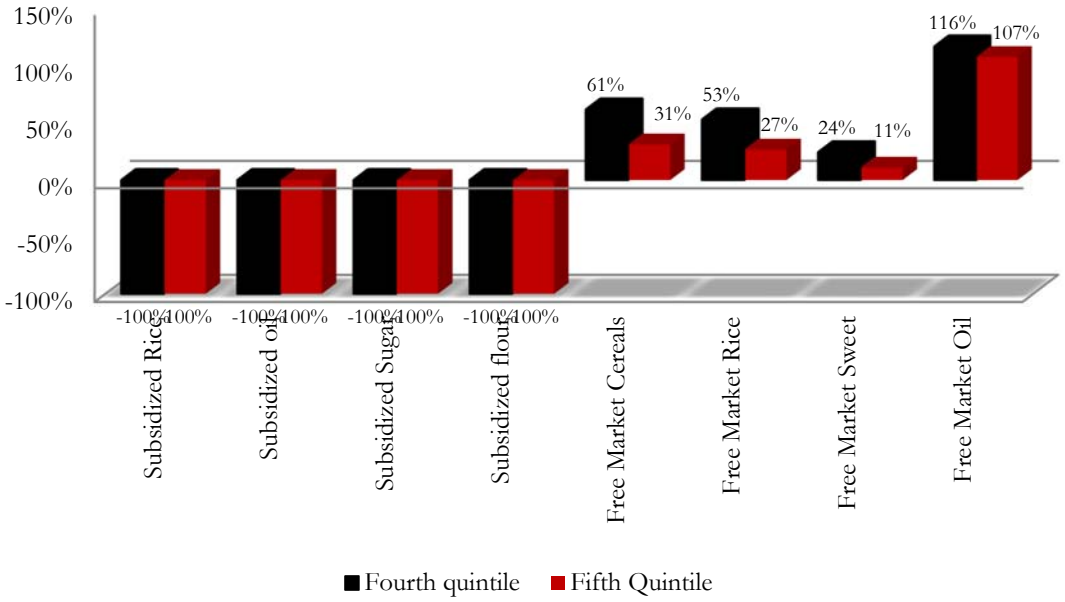
Source: Own estimations based on IHSES 2012

Figure 4: Average change in products shares - Scenario A3 (Urban areas)



Source: Own estimations based on IHSES 2012

Figure 5: Average change in products shares - Scenario A3 (Urban areas)



Source: Own estimations based on IHSES 2012

Appendix I: Items included in the four free market products

Cereals	Sweets	Oil	Rice
Wheat	Assorted sweets	Vegetable fat (commercial)	Commercial rice (imported)
Brown wheat flour (commercial)	Chocolate	Animal fat (ghee)	Commercial rice (local)
White wheat flour (commercial)	Jam	Vegetable oil (commercial)	Ground rice
Barley	Honey	Olive oil	
Barley flour	Date syrup	Sesame oil	
Maize	Artificially flavored juice	Other oils	
Burghul (cracked wheat)	Chewing gum		
Habbiya (whole roasted wheat)	Ice-cream		
Jareesh and sameed	Ice		
Maccaroni and vermicelli			
Starch			
Cornflakes			
Corn crisps			
Corn chips			
Bread, all types			
Buns, all types and sizes			
Kahi (local millefeuille)			
Klecha (local pastry)			
Cake			
Biscuits			
Rusk and zwieback			
Readymade pizza			
Other bread and bakery products			

Source: Own estimations based on IHSES 2012

Appendix II: The estimated parameters of the Normalized Quadratic Model

	Coefficient	Standard error
μ 1	-0.175***	(0.0110)
μ2	0.0360***	(0.00587)
μ 3	0.0409***	(0.00584)
μ 4	-0.0402***	(0.00413)
γ 1	0.0143***	(0.00409)
γ 2	-0.0568***	(0.00680)
γ 3	0.0345***	(0.00276)
γ 4	-0.0940***	(0.00299)
λ 5_1	0.0358***	(0.00254)
λ 6_1	0.342***	(0.00621)
λ 7_1	0.334***	(0.00593)
λ 5_2	0.160***	(0.00348)
λ 6_2	0.0549***	(0.00125)
λ 7_2	-0.000125**	(5.59e-05)
λ 5_3	0.000942***	(0.000135)
λ 6_3	-0.00950***	(0.000447)
λ 7_3	0.0753***	(0.00217)
λ 5_4	0.000413***	(0.000151)
λ 6_4	0.000187	(0.000124)
λ 7_4	0.0360***	(0.00110)
b5_5	-0.0213***	(0.000739)
b5_6	0.0254***	(0.000801)
b5_7	-0.130***	(0.00464)
b6_6	-0.0625***	(0.00246)
b6_7	-0.0944***	(0.00363)
b7_7	-0.0789***	(0.00286)
δ5	-0.115***	(0.00565)
δ6	-0.100***	(0.00374)
δ7	-0.0492***	(0.00436)
β5	-0.0275***	(0.00345)
β6	-0.0228***	(0.00362)
β 7	0.00171	(0.00283)
g1_1	0.0222***	(0.00247)
g1_2	0.00399	(0.00456)
g1_3	-0.0251***	(0.00383)
g1_4	-0.0130***	(0.00349)
g2_2	0.0280***	(0.00362)
g2_3	-0.0194***	(0.00288)
g2_4	0.0429***	(0.00263)
g3_3	0.0127***	(0.00353)
g3_4	-0.00792***	(0.00283)
g4_4	0.00544**	(0.00241)
Total Observations	1140	

*** p<0.01, ** p<0.05, * p<0.1

Note: 1=subsidize brown flour, 2=subsidized rice, 3= subsidized sugar, 4= subsidized oil, 5=Free market cereals, 6=free market rice, 7= free market sweets, 8= free market oil.

Source: Own estimations based on IHSES 2012

Appendix III: The estimated parameters of the dropped equation (8=Free market Oil) and the remained parameters from the constraints

Coefficient	Value
b 5_8	0.126366
b 6_5	0.0254108
b 6_8	0.1314652
b 7_5	-0.1304544
b 7_6	-0.0943763
b 7_8	0.3037276
b 8_5	0.126366
b 8_6	0.1314652
b 8_7	0.3037276
b 8_8	-0.5615588
δ 8	0.2642576
β 8	1.048563
γ 2_1	0.0039866
γ 3_1	-0.0250819
γ 3_2	-0.0194129
γ 4_1	-0.0129679
γ 4_2	0.0429261
γ 4_3	-0.0079164
λ 81	-0.7116576
λ 82	-0.2152323
λ 83	-0.0666918
λ 84	-0.0365806

Source: Own estimations based on IHSES 2012

Appendix IV: The formulas of the estimated elasticities

- Price elasticities of free market goods (*i, j=1,2,..n*):

$$\varepsilon_{ij} = \frac{\partial x_i^*(z,p,u)}{\partial p_j} * \frac{p_j}{x_i}$$

- Own quantity mixed elasticities of ration items (*k, s=1,2,..m*):

$$\varepsilon_{ks} = \frac{\partial q_k^*(z,p,u)}{\partial z_s} * \frac{q_k}{z_s}$$

- Elasticities of free market goods with respect to ration goods:

$$\varepsilon_{ik} = \frac{\partial x_i^*(z,p,u)}{\partial z_k} * \frac{z_k}{x_i}$$

- Elasticities of ration item's price with respect to free markets goods' price:

$$\varepsilon_{kj} = \frac{\partial q_k^*(z,p,u)}{\partial p_j} * \frac{p_j}{q_k}$$