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Estimating the Welfare Costs of Reforming the Iraq Public Distribution System: 
A Mixed Demand Approach

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Abstract
Iraq’s public distribution system (PDS) is the only universal non-contributory social transfer system in the world. Through three decades of conflict and fragility, food rations delivered through the PDS have remained the single largest safety net among Iraq’s population. Reforming the PDS continues to be politically challenging, notwithstanding its heavy dependence on imports and associated economic distortions as well as an unsustainable fiscal burden. The fiscal crisis since mid-2014 has, however, put PDS reform back on the agenda. In this context, this paper employs a mixed demand approach to analyse consumption patterns in Iraqi households and quantify the welfare impact of a potential reform of the PDS in urban areas. The results of the ex ante simulations show that household consumption of PDS items is relatively inelastic to changes in price, particularly among the poorest quintiles, and that these goods are normal goods. Cross-sectional comparisons suggest that, with improvements in welfare, and with well-functioning markets, some segments of the population are substituting away from the PDS and increasing their consumption of market substitutes. Overall, the results suggest that any one-shot reform will have adverse and sizeable welfare impacts. The removal of all subsidies in urban areas will require compensating poor households by 74 per cent of their expenditures and the richest households by nearly 40 per cent to keep welfare constant. However, a targeted removal of the top 4 deciles from PDS eligibility in urban areas will leave poverty rates unaffected and generate cost savings, but will need to be carefully communicated and managed to counter public discontent.

Keywords: Public Distribution System, Iraq, quota, demand analysis, Mixed Demand Approach, food subsidy, welfare, reform

JEL: D12, D39, H53, I38, O12, O53

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1. **Introduction**

Globally, countries with high social safety net spending are often characterized by fragility and conflict and run universal programmes in the social safety net portfolio (World Bank, 2018). Iraq is an example, spending 2.6 per cent of gross domestic product (GDP) (2011 purchasing power parity) on social safety nets, more than double the Middle East and North Africa average and twice the average of upper-middle-income countries. The bulk of this social safety net spending goes towards Iraq’s public distribution system (PDS), the largest universal, non-contributory social transfer programme in the world.\(^5\) The PDS provides in-kind transfers through food rations to nearly every household in Iraq at negligible cost.\(^6\) There are large costs and inefficiencies associated with such in-kind transfer programmes, which typically involve large-scale operations in imports and procurement, transportation, storage and distribution and allocate resources to the more well off as well as the poor. Moreover, such large programmes can also crowd out spending on health care, education and productive investment, which are arguably more progressive. Despite these shortcomings, the PDS has remained the one nationwide social transfer that has been in place through three decades of conflict and insecurity, although the post-2014 fiscal constraints have created growing pressure for reform. In this context of long-term dependence on the PDS for basic food needs and recurrent and unpredictable exposure to shocks, this paper deploys an ex ante simulation to quantify the welfare impacts of alternate reform scenarios using a mixed demand approach.

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\(^5\) The origin of the PDS is in the sanctions era of the 1990s, when the programme was launched 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.

\(^6\) A household’s allocation is determined by the size and composition of the family as registered on the respective ration card, which is acquired against payment of a negligible fee.
The PDS has long been seen as one of the few tangible benefits delivered by the state and has increasingly become viewed as a general entitlement. The PDS is the only safety net programme that covers all the poor and vulnerable in a country where other social protection programmes, such as the social security network, cover at most one fifth of the poor. The value of transfers from the PDS alone accounts for 13 per cent of the income of the average Iraqi household (World Bank, 2014). Among households in the bottom 10 per cent of the distribution, PDS transfers account for as much as 16.5 per cent of total expenditure, 60 per cent of non-labour income, and 30 per cent of total income (figure 1) (World Bank, 2014). Roughly 70 per cent of the calories of the bottom 40 per cent of the distribution were derived from the PDS in 2012, but the PDS accounted for only one third of the calories consumed by the richest 20 per cent of the consumption distribution as well (figure 2). Likely related, food shortages and extreme poverty rates are almost negligible in Iraq (World Bank, 2014).

The sharp decline in oil prices and the insurgency of the Islamic State in Iraq and the Levant since mid-2014 have severely constrained the fiscal environment and strengthened the imperative of reforming the PDS. While politically sensitive, the need to reform the PDS is well recognized, and various reform proposals have been put forward since 2003. Even for oil-rich Iraq, the PDS represents a large fiscal burden, accounting for IQD 1 trillion and 5 per cent of the country’s GDP (Silva, Levin, and Morgandi, 2012). While the PDS provides broad food security to the poor and vulnerable, it also covers more than 95 per cent of the non-poor and costs considerably more than a targeted safety net. In its current form, it suffers from large inefficiencies in procurement, distribution, and management and implies significant macroeconomic distortions because of its heavy reliance on food imports and its universal nature. In this context, the Government of Iraq is
considering options for a broader safety net system, the establishment of which would likely be a precondition for any major reforms of the PDS.\(^7\)

Understanding and quantifying the potential welfare impact of a change in the PDS across the distribution of consumers are necessary in carrying out the reform agenda. This is critical because of the context, including the recurrent exposure of households to violent and unpredictable shocks and displacement; the lack of a system that can be universally accessed; the substantial dependence on imports, implying the lack of available substitutes in the market, and the large accompanying macroeconomic distortions. Incorporating the behavioural response of households to reforms is essential given that the population may think of the PDS transfer as a constant, assured benefit that is provided at almost zero cost. The design of alternatives should involve the quantification of the adverse welfare impact to be able to (1) assess whether a targeted system is feasible and what the welfare cut-off might be; (2) estimate the size of cash transfers that would hold utility constant, at least for the lower parts of the distribution; and (3) assess cost-effectiveness.

Relying on a mixed demand approach, this paper simulates the ex ante impact of hypothetical, but plausible reform scenarios of the PDS on consumer welfare. The scenarios have been identified based on discussions with the Government. Using the most recently available household survey, the Iraq Household Socio-Economic Survey (IHSES) 2012, we estimate income and price elasticities to be able to model the behavioural responses of households to the reforms. The Iraqi food subsidy system involves partial rationing, through which PDS food items are made available at subsidized prices until a quantity quota is reached. For larger quantities, consumers

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\(^7\) These options include the establishment of a social fund programme and the expansion of a means-targeted cash transfer programme.
can purchase the free market counterparts of the items at the free market price. The mixed demand approach allows us explicitly to take into consideration the partial rationing of the PDS and the associated dual price system. Such a demand system incorporates rationed quantities for a subset of goods at predetermined prices, in addition to free market goods, and has been applied to similar contexts, including Egypt (Hosni and Ramadan, 2018; Ramadan and Thomas, 2011). The estimated income and price elasticities in such a model permit us to analyse the impact of reforms on consumer consumption and, thus, welfare (Houthakker and Tobin, 1952; Huffman and Johnson, 2004; Madden, 1991; Moschini and Rizzi, 2007; Ramadan and Thomas, 2011).

The paper is organized as follows. The next section describes the data and issues related to the valuation of subsidized and rationed goods in the Iraqi context. The subsequent section details the methodological approach of the mixed demand model. The section thereafter discusses estimates and results. The penultimate section presents the welfare analysis. The final section concludes.

2. **Data and the valuation of ration items**

The mixed demand model is estimated using the IHSES, 2012. The IHSES covers roughly 25,000 households and is designed to be representative at the governorate (provincial) level. The survey collected detailed data on all aspects of household income and expenditure and a wide variety of socioeconomic indicators (World Bank, 2013). 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 importance. For instance, 36 per cent of total ration expenditure is spent on brown wheat flour, compared with almost 0 per cent on salt and tea. The other highly consumed ration products are
sugar (26 per cent of total ration expenditure), vegetable oil (22 per cent) and rice (14 per cent) (figure 3). Taken together, brown wheat flour, rice, vegetable oil and sugar account for almost 98 per cent 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 seven-day diary of food purchases among respondents. The former collects information about the quantity of ration items received, consumed, bartered, sold, or given away by the household during the 30 days previous to the survey. 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 (expenditures and quantities), including ration items, over the first seven days of the interview period. To estimate a household’s consumption of PDS items, we follow the methodology for the construction of the official welfare aggregate in estimating poverty rates (World Bank, 2013). Any purchases of PDS items recorded in the diary over the seven-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.

Next, the monthly quantities of PDS items need to be valued. Two key principles guide the valuation procedure. First, households that consume (or purchase) a larger quantity of PDS items must be assigned higher consumption and, thereby, utility. Second, in theory, goods and services ought to be valued equal to the market price of the marginal unit consumed. In Iraq, ration items are rarely traded in the market, and a market-equivalent price is non-existent. Thus, few transactions are recorded in the diaries. There are two main reasons why market prices or, in this case, unit values (the ratio of expenditure to quantity) derived from market transactions are not used as the reference for valuing ration items. The first reason is the insufficient number of
observations per item. For instance; the share of households reporting purchases of ration items in the diary questionnaire varies from less than 1 per cent in the case of vegetable fat, lentils, brown wheat, and sugar to a maximum of less than 3 per cent in the case of rice. Furthermore, there are no transactions recorded in some geographical divisions for some items. Second, there is a possibility that these unit values may be associated with a select few households that are quantity constrained and purchase PDS items on the market because their allocation has proven insufficient.

Additionally, the unit values for the nearest free market equivalents are significantly higher for some items. For instance, the difference between the median unit value of ration rice from diary and commercial local rice is 70 per cent. This gap doubles if the comparison is with the median unit value of imported commercial rice. This could be mainly related to important quality differences across 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. Two main concerns are relevant. The first is that official prices are low. Using these heavily subsidized prices would artificially suppress the value of food expenditures stemming from rations. The second concern is that rations should be valued at a price close to the price at which we expect the item to be traded. Moreover, by design, the official prices are not the prices at which households can procure unlimited quantities.

The remaining candidate to value rations is the self-reported value of ration items. The IHSES includes a question on how much household respondents would pay for ration-equivalent items in the market. In practice, few households expressed an opinion, and enumerators

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8 The question on the IHSES questionnaire is “If you could buy this [ITEM] in the market, how much would you have to pay for it?”
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. To ensure that all households that consume exactly the same amount of a ration item are assigned the same expenditure and, thereby, utility, and that this expenditure increases with more consumption of the item, the methodology followed in this paper uses the national median values of the prices reported by ration agents to value ration items (World Bank, 2013).

Reliance on the quantities and ration-agent prices for the ration items to estimate expenditures reveals that an average of only 6 per cent of total household expenditure was allocated to this type of product by Iraqi households in 2012. This aggregate statistic hides a lot of heterogeneity throughout the consumption distribution. PDS expenditures account for 30 per cent of food expenditures among the poorest 10 per cent of Iraqi households and around 17 per cent of the total expenditures of these households in 2012. The share of PDS expenditures declines as total household expenditures increase or as households grow richer. For instance, the share falls to 12, 7 and 2 per cent among the 2nd, 5th and top decile 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 households spend almost 9 per cent of their total food expenditure on ration products, compared with the 44 per cent spent by the poorest quintile. These shares are slightly higher in rural areas: 9.4 per cent and 47 per cent for the upper and bottom 20 per cent of the consumption distribution, respectively (table 1).
3. **Mixed Demand Model**

Estimating the behavioural responses of households to changes in the availability of goods requires the estimation of the demand functions of these goods. In this setting, the most common empirical specifications involve expressing a quantity demanded as a function of total expenditure (as a proxy for income) and market prices, or a direct demand system (Moschini and Rizzi, 2006). However, standard specifications rely on additional identifying assumptions, particularly the implicit assumption that prices are predetermined or, in other words, that the 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 portion of the expenditures on food and are widely consumed. An alternate approach treats quantities as predetermined, and prices are adjusted so that demand and supply are equalized in the aggregate. This approach, while appropriate for perishable and rationed products, is not appropriate in the scenario considered in this paper. A third approach, first introduced by Samuelson (1965), considers mixed demand functions. In this approach, while prices are predetermined for some goods, quantities are given for others. This allows more flexibility in the assumptions on whether prices or quantities are held exogenous for each good. This is the approach we follow in this paper.

In this dual system, households have access to subsidized goods up to their designated quota, but, if the demand exceeds this quota, households have to purchase free market goods of the same or different quality and, of course, at a different price. A consumer must thus simultaneously choose the consumption segment (that is, a quantity above or below the allocated subsidized quota) and the free market consumption level, and this introduces nonlinearities in the demand functions (Ramadan and Thomas, 2011).
Following Moschini and Rizzi (2007) and Ramadan and Thomas (2011), we estimate a normalized quadratic mixed demand model where there are $n$ free market products and $m$ subsidized products. Let $X = [x_1 .... x_n]$ be the vector of goods the prices of which are determined on the market (that is, free market goods in our case), $Z = [z_1 ... z_m]$ the vector of goods the quantities of which are predetermined (that is, quotas of rationed products in our case), and $p$ and $q$ the price vectors associated with $X$ and $Z$, respectively. The structural estimation equations of the mixed demand system can be written in terms of budget shares as follows:

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

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

where $i = 1,2,...n$ for the free market products and $k = 1,2,...m$ for the quantity-determined products. The $W_i$’s and the $W_k$’s are the budget shares of the free market goods and rationed goods, respectively; $y$ is the income, and $V_M(p, z, y)$ is the mixed utility function such that:

$$ u(x^*, z) = v(p, q^*, y) \equiv V_M(p, z, y), $$

where $u$ and $v$ are the optimum direct and indirect utility functions, respectively; $\gamma$ and $\mu$ 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.
matrix of parameters; $\beta_i$ and $\delta_i$ are parameters to be estimated; $a = [a_1, a_2, \ldots, a_n]'$ is a vector of arbitrarily chosen coefficients to ensure the homogeneity property, and $\epsilon_i$ and $\xi_k$ are error terms.

The share of equations (1) and (2) in the mixed demand model are estimated using a system of non-linear, seemingly unrelated regression criteria by applying iterated feasible generalized least squares. The model is estimated by imposing cross-equation restrictions such as symmetry, adding up and homogeneity constraints. Given that the share equations sum to one, we dropped an 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 predetermined quantities, $Z$, included in our regression consist of the four ration products: brown wheat flour, rice, sugar and vegetable oil, which represent 98 per cent of ration expenditure. Among the $X$ group of foods with predetermined prices, we choose to include the free market counterparts of these rations. These are aggregated into four groups: wheat, sweets, rice and oil. The model therefore includes eight items, representing, on average, 35 per cent of food expenditures.

Total expenditure on the eight food items is used as a proxy for income because measurement errors may be important in the case of the latter and because we concentrate on the consumption of these eight items only (Löfgren and El-Said, 2001). All prices are included in the logarithmic form. For the aggregate free market food groups, the share-weighted Stone formula is used to compute composite price indices, as follows:

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9 The model is estimated using the \textit{nlsur} command in Stata 13.
10 The average share of each ration product in the expenditure of the four ration items included in the model is presented in annex B.
11 For more details about the items included in each group, see annex C.
\[ PI_I = \sum_{i=1}^{m \in I} w_i \cdot P_i, \quad (4) \]

where \( PI_I \) is the price index for the \( Ith \) 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 \( I \) in the total expenditure of \( I \), and \( P_i \) is the price in logarithmic form.

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

All explanatory variables are normalized by the sample mean. The coefficients of vector \( a \) in equations (1) and (2) are set to the mean share of the non-rationed product groups. Using the estimated parameters in the mixed demand model, we compute price and income elasticities at the mean of the prices, the quantities and the total expenditures of the various quintiles in urban and rural areas.\(^{12}\) These elasticities are used to estimate the quantity response for the items at predetermined prices and the price response for the items at pre-determined quantities. This allows us to measure the impact of hypothetical reform scenarios on consumption and therefore on welfare.

\(^{12}\) The estimated parameters from the mixed demand model are shown in annexes D and E. The elasticities formulas are presented in annex F.
4. Results

Overall, the results suggest that, with the exception of 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 among Iraqi households in urban and rural areas across all the quintiles. Thus, the 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 urban and rural areas at all income levels (table 2).

Compared with cereals (or wheat) and rice, both free market sugar and oil have higher elasticities across all the quintiles in urban and rural areas. However, in absolute terms, their consumption is inelastic with changes to the 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 urban and rural areas. Sweets and oil are more important among the higher income groups because the price elasticities of these two free market products fall among more well off quintiles. For instance, in urban areas, a 1 unit increase in the price of oil decreases the respective consumption by 0.84 among the poorest quintile, while, among the richest quintile, the price falls by 0.31 units (table 2).

For the rationed PDS goods, table 3 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 across all income levels in urban and rural areas. Thus, the consumption of ration products is inelastic and is more inelastic among the poorest quintiles compared with the richest, given their importance in terms of caloric contribution to the diet of the less well off. Among the four products, vegetable oil and sugar are the most inelastic.
According to the rations classification of Madden (1991), both ration brown (wheat) flour and ration rice are substitutes in rural and urban areas. In rural and urban areas, 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 (tables 4–7). Hence, the results show that, despite the quality difference between the ration goods and the free market goods, some are substitutes for each other in the diet of Iraqi households. Moreover, if consumption increases, Iraqi households complement their consumption of ration goods by consuming free market products.

Expenditure (income) elasticities are presented in table 9. Overall, most products show a positive expenditure elasticity of value at less than 1 in rural and urban areas and across quintiles. This implies that these are normal goods and necessary goods. However, the more expensive free market goods have relatively high expenditure elasticities for all quintiles relative to ration items.

Free market cereals, rice and sweets are normal goods at all income levels in urban and rural areas. The expenditure elasticities for these three products decrease with income level. In other words, less well off households would increase their consumption of these three free market goods to a greater degree if their incomes rise. For instance, in rural areas, a 1 unit increase in income raises the consumption of wheat, rice and sweets by 0.086, 0.353 and 0.359, respectively, among the lowest income group, compared with an increase of 0.033, 0.072 and 0.166 units, respectively, among the highest income group.

\(^{13}\) According to the rations classification of Madden (1991), one may define complementary or substitute rationed goods, depending on the price elasticities, as follows. Let \(z_k\) and \(z_s\) denote two quantity-constrained goods at respective prices \(q_k\) and \(q_s\). \(z_k\) and \(z_s\) are substitutes if 
\[
\left(\frac{\delta q_k}{\delta z_s}\right) \left(\frac{z_s}{q_k}\right) < 0
\]
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 
\[
\left(\frac{\delta q_k}{\delta p_m}\right) \left(\frac{p_m}{q_k}\right) > 0
\]
(respectively < 0) and 
\[
\left(\frac{\delta x_m}{\delta z_k}\right) \left(\frac{z_k}{x_m}\right) < 0
\]
(respectively > 0) (Ramadan and Thomas, 2011).
Free market oil is considered an inferior good among all income groups in rural areas; an increase in income raises subsidized oil consumption and reduces the consumption of free market oil, a result that requires more investigation. Subsidized or rationed brown flour is also an inferior good among urban households, showing that a rise in income will yield a decline in consumption of PDS brown flour and an expansion in the consumption of the substitute, free market cereals.

Given the lack of information on future consumer responses to changes in prices and expenditure, one way to understand behaviour over time is by exploiting cross-sectional spatial variation. Consumer behaviour in more well off regions may therefore be a rough approximation of how less well off regions today will behave in the future as welfare levels improve, while we hold all else constant. We thus consider how households would adjust their consumption patterns as welfare improves by comparing current demand responses in Kurdistan – the three north-east governorates, Erbil, Duhok and Sulaimaniya – and in the rest of Iraq. We take Kurdistan as the reference region because the current consumption of ration items there is the lowest in the country and because per capita expenditure there is the highest on average.

Similar consumption responses to changes in the own prices of ration and free market goods are seen in Kurdistan and the rest of Iraq relative to previous findings on urban and rural areas (annex G). Overall, most goods are ordinary goods. The demand is much less elastic for ration items than for free market goods. However, all levels of responses are higher in Kurdistan than in the rest of Iraq and also higher than the estimates for urban areas shown above. At the same time, well-off households in Kurdistan are much more responsive to variations in the prices of ration goods, while the opposite is true for the free market equivalents, compared with the rest of Iraq and urban Iraq. In line with the 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 encounter a larger set of options and acquire a greater 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 the inelasticity of the relevant response will likely rise.

Inspections of demand responses for goods and variations in total household expenditure and income reveal patterns in consumer behaviour that are quite clear. In general, most ration items are marginally inferior in Kurdistan irrespective of the level of per capita consumption. As household expenditures rise by 10 per cent, demand falls by between 0.4 per cent and 3.4 per cent for brown flour and by around 0.7 per cent for rice (annex G). Different responses obtain in the rest of Iraq: ration items are considered normal goods. We therefore speculate 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 become less sought.

5. 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 potential changes in the total expenditures of households and in the product shares in total expenditures in the face of the removal of the PDS. The implicit assumption is that the removal of any of the subsidized products will yield a change in the consumption of the free market counterparts of these products as well as in the corresponding free market prices. Consumers will react to the removal of the subsidized quota by adjusting their consumption of other free market products. This will yield a change in the total expenditures of the consumers.
Two sets of PDS reform scenarios are examined to illustrate the distributional impact of the reform. Both sets reflect the complete removal of the PDS only among urban households, that is, urban households will no longer be able to purchase rationed products. Such an outcome, based on a phased schedule of reform beginning in urban areas, is plausible given the logistical and implementation requirements, but also because of welfare considerations. We focus only on households in urban areas because these enjoy relatively favourable initial conditions relative to their rural counterparts, which might ease the implementation of the reform in urban areas.\textsuperscript{14} Moreover, relative to rural households, urban households presumably have better access to free market products. This makes the implicit assumption reasonable that urban households would be able to substitute PDS goods for the free market counterparts.

The first set of scenarios (the A scenarios) focuses on removing ration products from the highest two income quintiles in urban areas. The implementation of such a scenario assumes the ability to target PDS beneficiaries in urban areas relatively well and exclude the top 40 per cent of the welfare distribution from the programme. This extreme case would have no impact in rural areas or on the urban poor. We would be excluding the public transfer only from those segments of the population that may need them the least, that could reasonably adjust their consumption, or that feature a combination of these two characteristics because of their relatively better welfare status. To measure household responses to changes in the PDS, we gradually remove the quotas in increasing order of the share of each ration item in total expenditure. The A scenarios are as follows:

\textsuperscript{14} Even though the reduction in poverty was significantly greater in rural areas than in urban areas between 2007 and 2012, rural poverty rates are still double those in urban areas (World Bank, 2014).
• Scenario A1: decrease the ration rice quota by 100 per cent among the two highest quintiles in urban areas.

• Scenario A2: decrease the ration rice and vegetable oil quotas by 100 per cent among the two highest quintiles in urban areas.

• Scenario A3: decrease the ration rice, vegetable oil and sugar quotas by 100 per cent among the two highest quintiles in urban areas.

• Scenario A4: decrease the ration rice, vegetable oil, sugar and brown flour quotas by 100 per cent among 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 estimated elasticities. According to the A set of scenarios, the removal of the quotas on 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 the share of this product in total expenditures by 100 per cent, computed with respect to the initial value of the expenditure on the product.

Overall, the most substantial rise in expenditures as a result of the removal of subsidies occurs in the case of free market oil. Under scenario A1 (figure 4), in which only the rice quota is removed, the share of free market oil expands by 17 per cent and 20 per cent among the fourth and fifth quintiles, respectively. Under scenario A4 (figure 7), whereby all subsidized products are removed, the share of free market oil increases by 116 per cent and 107 per cent relative to the original share among the fourth and fifth quintiles, respectively. This 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 increases the expenditure shares on the free market counterpart by 5 per cent and 2 per cent among the fourth and fifth quintile, respectively. Given the complementarity between ration rice and free market cereals, we find that the removal of the rice quota boosts the share of free market cereals by 1 per cent among the fourth quintile, but deceases this share by 3 per cent among the fifth quintile. At the same time, the share of expenditures on subsidized flour rises because it is a substitute for PDS rice (figure 4).

The removal of subsidized sugar (scenario A3), in addition to subsidized rice and oil, results in an enlargement of the share of the free market counterpart by 52 per cent and 20 per cent among the fourth and fifth income groups, respectively. As expected, following the elimination of the quotas on all four subsidized products (scenario A4), households must offset the removal of the subsidized products through more expenditure on the free market counterparts. Among urban households in the fourth quintile, the share of free market cereals, rice and sweets increase by 61 per cent, 53 per cent and 24 per cent, respectively. The impact is less in the case of the fifth quintile, among which the shares of free market cereals, free market rice and free market sweet increase by 31 per cent, 27 per cent and 11 per cent, respectively. This is not surprising given that households in the highest quintile consume subsidized products the least; so, the impact on their expenditures of the removal of the subsidies should be less.

The second set of scenarios (the B scenarios) involves the removal of access to ration products from all income quintiles in urban areas. According to the B scenarios, all urban areas are affected, while there is no impact on rural areas. This is a strong assumption given that urban and rural markets are linked, and isolating rural areas from the effects of the change may be difficult. Moreover, if such reforms are undertaken and if no strong targeting policies are
implemented, this may result in the emergence of a vibrant black market and leakage. However, to simplify the analysis, the removal is assumed to be successful.

As in the A scenarios, the various quotas are removed gradually according to the importance of the share of each ration item. More precisely, the B scenarios are as follows:

- Scenario B1: decrease the ration rice quota by 100 per cent in urban areas.
- Scenario B2: scenario B1, plus decrease the ration vegetable oil quota by 100 per cent in urban areas.
- Scenario B3: scenario B2, plus decrease the ration sugar quota by 100 per cent in urban areas.
- Scenario B4: scenario B3, plus decrease the ration brown flour quota by 100 per cent in urban areas.

Under the B scenarios, the urban poor are the most affected, given the importance of the subsidized products in their diets. Eliminating rice subsidies increases the expenditure share of the free market counterpart by 10 per cent among the poorest households compared with only 2 per cent among the richest (table 9). While removing the quotas on the four subsidized products yields an expansion in the share of the free market counterparts by more than 200 per cent among the lowest quintiles compared with less than 50 per cent among the richest group, except for oil, the share of which rises by more than 100 per cent among the richest group (table 10).

If we hold incomes constant, these increases in expenditure shares imply that the 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 minimum amount of new expenditure an
agent would be required to outlay to attain the original level of utility at a new price (Ackah and Appleton, 2007; Huang and Huang, 2009). As explained by Huang and Huang (2009), if the utility level is held constant, the CV reflects the change in expenditure necessary to compensate consumers for the effects of the change in prices from \( p_0 \) to \( p_1 \). The CV may be written as follows:

\[
CV = C(p_1, u_0) - C(p_0, u_0)
\]  

(5)

The advantage of such an approach is that it provides policy makers with an estimate of the size of the cash transfer needed to compensate households. In the context being considered in Iraq and other countries in the region, reforms of safety net programmes are contingent on maintaining welfare levels among the less well off households. In Iraq, the expansion of the cash transfer programme could similarly be informed by this estimate of the compensation needed to hold utility constant.

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) in consumer welfare (Ackah and Appleton, 2007; Huang and Huang, 2009). Positive change represents an increase in the expenditure because of the new prices to keep the same initial utility. This means a decrease in consumer welfare.

Assuming that households continue consuming the same quotas and that the subsidized price rises as if the quotas were removed (that is, the quantity declines by 100 per cent), households will have to raise their total expenditure to keep the utility constant. The CVs are positive among all households under the B scenarios (table 11). This implies that the removal of subsidies will result in a decrease in the welfare of the households, as expected.
The two lowest income quintiles are the most affected by this reform, given the importance of subsidized products in their total expenditures. The elimination of access to subsidized rice will require compensating the poorest households by 0.10 per cent of the total household expenditures among this group to maintain welfare constant, compared with 0.09 per cent among the richest group. While the removal of all the subsidies will have almost the same impact across all income groups, the estimated impacts are low. For instance, the poorest households would need to be compensated by around 0.3 per cent of total household expenditures. This low level of CV can be explained by the fact that the price increase resulting from a decline in the quota by 100 per cent is 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 implies an important change in total household expenditures (table 11) to keep utility constant, especially among poor households. The removal of all subsidies in this case will require compensating poor households by 74.4 per cent of their expenditures compared with nearly 40 per cent among the richest. This large decrease in household welfare reflected by the high positive value of the CV derives from the high price differential between the official and subsidized prices and free market prices.

6. **Concluding Remarks**

Iraq is among a set of fragile and conflict-affected states with relatively large social safety net programmes relative to GDP. Others include South Sudan, Timor Leste and the State of Palestine, and, in each of these, in-kind transfers make up either the bulk or substantial shares of total spending (World Bank, 2018). Many other fragile and conflict-affected states spend little on
social safety nets, including Afghanistan, Somalia and Myanmar. There is no doubt that the former set of countries are more well placed to deliver basic transfers to the poor and vulnerable. Yet, this often occurs, as in the case of Iraq, at high opportunity cost because long-standing, universal in-kind programmes such as the PDS are difficult to scale back, especially if strong fiscal constraints put pressure on the economy and on social spending and, as in fragile and conflict-affected states, if the trade-offs between security and development spending are impossible. The need to manage public sentiment often means that alternate mechanisms of social protection need to become established before major reforms to existing programmes are considered.

This paper attempts to quantify the size of the compensating transfer needed in Iraq to protect the less well off from the negative impacts of a phased removal of the PDS. Because of the long duration of the programme, the lack of widely available market substitutes at similar prices and the widespread dependence on PDS items in the Iraqi diet, we find that the size of the transfer may be substantial. The demand for food items distributed through the PDS is generally inelastic to price changes, especially in the case of the poorest segments of the population. In addition, according to the perception of much of the population, these goods are not inferior goods, but normal goods. Taken together, these findings imply that any one-shot reform of the PDS will have sizeable adverse welfare impacts. The removal of all subsidies in urban areas, for instance, would require compensating poor households by 74 per cent of household expenditures.

The feasibility of this scenario, which removes PDS transfers from all urban households, largely depends on the institution of a well-targeted, compensating safety net system prior to removal of PDS benefits. In addition, the restoration of peace, security and broad-based economic growth will likely ease the transition. Cross-sectional spatial variation suggests that, with the enhancement of welfare and well-functioning markets, some segments of the population may
substitute away from the PDS and boost 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 this is not true in the rest of Iraq, where ration items are considered normal goods.

Our findings also suggest that a targeted eligibility criterion can safeguard the less well off segments of the population, while generating savings. One of the scenarios considered here limits eligibility to the bottom 60 per cent of the distribution in urban areas, a cut-off that was set in discussions with the Government because it was considered sufficiently above the poverty line to eliminate the risk of excluding the deserving. Such a reform could be implemented even in the current context, provided it is well managed and carefully communicated given that even more well off households will experience a loss in welfare after the elimination of the PDS.
7. References


### Tables

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

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Source: Estimates based on data of IHSES 2012.
Table 2: Price Elasticities of Free Market Goods, by consumption quintiles

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Source: Estimates based on data of IHSES 2012.
Table 3: Own quantity mixed elasticities of ration items, by consumption quintiles

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<tr>
<td>Sugar</td>
<td>-0.006</td>
<td>-0.006</td>
<td>-0.007</td>
<td>-0.008</td>
<td>-0.013</td>
</tr>
<tr>
<td>Vegetable oil</td>
<td>0.004</td>
<td>0.004</td>
<td>0.005</td>
<td>0.005</td>
<td>0.008</td>
</tr>
<tr>
<td>Price of vegetable oil relative to price of Brown flour</td>
<td>0.004</td>
<td>0.004</td>
<td>0.005</td>
<td>0.005</td>
<td>0.007</td>
</tr>
<tr>
<td>Rice</td>
<td>-0.012</td>
<td>-0.014</td>
<td>-0.015</td>
<td>-0.017</td>
<td>-0.023</td>
</tr>
<tr>
<td>Sugar</td>
<td>0.002</td>
<td>0.002</td>
<td>0.002</td>
<td>0.002</td>
<td>0.004</td>
</tr>
<tr>
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<td>-0.001</td>
<td>-0.001</td>
<td>-0.001</td>
<td>-0.002</td>
<td>-0.003</td>
</tr>
</tbody>
</table>

Source: Estimates based on data of IHSES 2012.
Table 4: Elasticities of free market goods with respect to ration items in Rural Areas, quintiles

<table>
<thead>
<tr>
<th></th>
<th>Poorest</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Richest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elasticities of brown flour relative to</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown flour</td>
<td>−0.034</td>
<td>−0.021</td>
<td>−0.015</td>
<td>−0.008</td>
<td>−0.003</td>
</tr>
<tr>
<td>Rice</td>
<td>0.116</td>
<td>0.068</td>
<td>0.059</td>
<td>0.048</td>
<td>0.035</td>
</tr>
<tr>
<td>Sugar</td>
<td>0.008</td>
<td>0.005</td>
<td>0.004</td>
<td>0.002</td>
<td>0.001</td>
</tr>
<tr>
<td>Vegetable oil</td>
<td>−0.025</td>
<td>−0.016</td>
<td>−0.013</td>
<td>−0.010</td>
<td>−0.007</td>
</tr>
<tr>
<td>Elasticities of rice relative to</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown flour</td>
<td>0.300</td>
<td>0.184</td>
<td>0.131</td>
<td>0.102</td>
<td>0.061</td>
</tr>
<tr>
<td>Rice</td>
<td>0.085</td>
<td>0.051</td>
<td>0.035</td>
<td>0.027</td>
<td>0.015</td>
</tr>
<tr>
<td>Sugar</td>
<td>−0.017</td>
<td>−0.010</td>
<td>−0.008</td>
<td>−0.006</td>
<td>−0.004</td>
</tr>
<tr>
<td>Vegetable oil</td>
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<td>−0.006</td>
<td>−0.004</td>
<td>−0.003</td>
<td>−0.001</td>
</tr>
<tr>
<td>Elasticities of sweets relative to</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown flour</td>
<td>0.245</td>
<td>0.162</td>
<td>0.139</td>
<td>0.120</td>
<td>0.100</td>
</tr>
<tr>
<td>Rice</td>
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<td>0.021</td>
<td>0.018</td>
<td>0.014</td>
<td>0.010</td>
</tr>
<tr>
<td>Sugar</td>
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<td>0.042</td>
<td>0.034</td>
<td>0.028</td>
<td>0.022</td>
</tr>
<tr>
<td>Vegetable oil</td>
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<td>0.009</td>
<td>0.009</td>
<td>0.008</td>
<td>0.007</td>
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<tr>
<td>Elasticities of oil relative to</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown flour</td>
<td>−1.107</td>
<td>−0.532</td>
<td>−0.432</td>
<td>−0.395</td>
<td>−0.227</td>
</tr>
<tr>
<td>Rice</td>
<td>−0.313</td>
<td>−0.150</td>
<td>−0.123</td>
<td>−0.116</td>
<td>−0.066</td>
</tr>
<tr>
<td>Sugar</td>
<td>−0.086</td>
<td>−0.042</td>
<td>−0.035</td>
<td>−0.033</td>
<td>−0.018</td>
</tr>
<tr>
<td>Vegetable oil</td>
<td>−0.074</td>
<td>−0.037</td>
<td>−0.030</td>
<td>−0.027</td>
<td>−0.016</td>
</tr>
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Source: Estimates based on data of IHSES 2012.
Table 5: Elasticities of ration item’s price with respect to free markets goods’ price, rural areas, quintiles

<table>
<thead>
<tr>
<th></th>
<th>Poorest</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Richest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price of ration brown flour relative to price of free market Cereals</td>
<td>0.088</td>
<td>0.103</td>
<td>0.093</td>
<td>0.067</td>
<td>0.058</td>
</tr>
<tr>
<td>Rice</td>
<td>-0.408</td>
<td>-0.405</td>
<td>-0.494</td>
<td>-0.627</td>
<td>-0.866</td>
</tr>
<tr>
<td>Sweets</td>
<td>-0.342</td>
<td>-0.360</td>
<td>-0.465</td>
<td>-0.582</td>
<td>-0.782</td>
</tr>
<tr>
<td>Oils</td>
<td>0.976</td>
<td>0.989</td>
<td>1.211</td>
<td>1.477</td>
<td>1.910</td>
</tr>
<tr>
<td>Price of ration rice relative to price of free market Cereals</td>
<td>-0.205</td>
<td>-0.204</td>
<td>-0.239</td>
<td>-0.255</td>
<td>-0.291</td>
</tr>
<tr>
<td>Rice</td>
<td>-0.064</td>
<td>-0.062</td>
<td>-0.073</td>
<td>-0.087</td>
<td>-0.111</td>
</tr>
<tr>
<td>Sweets</td>
<td>-0.012</td>
<td>-0.012</td>
<td>-0.013</td>
<td>-0.013</td>
<td>-0.012</td>
</tr>
<tr>
<td>Oils</td>
<td>0.235</td>
<td>0.230</td>
<td>0.275</td>
<td>0.306</td>
<td>0.364</td>
</tr>
<tr>
<td>Price of ration sugar relative to price of free market Cereals</td>
<td>-0.009</td>
<td>-0.009</td>
<td>-0.010</td>
<td>-0.009</td>
<td>-0.007</td>
</tr>
<tr>
<td>Rice</td>
<td>0.001</td>
<td>0.001</td>
<td>0.002</td>
<td>0.003</td>
<td>0.006</td>
</tr>
<tr>
<td>Sweets</td>
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<td>-0.039</td>
<td>-0.048</td>
<td>-0.056</td>
<td>-0.071</td>
</tr>
<tr>
<td>Oils</td>
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<td>0.021</td>
<td>0.029</td>
<td>0.036</td>
<td>0.045</td>
</tr>
<tr>
<td>Price of ration vegetable oil relative to price of free market Cereals</td>
<td>0.021</td>
<td>0.021</td>
<td>0.024</td>
<td>0.024</td>
<td>0.025</td>
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<tr>
<td>Rice</td>
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<td>0.009</td>
<td>0.010</td>
<td>0.012</td>
<td>0.014</td>
</tr>
<tr>
<td>Sweets</td>
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<td>0.000</td>
<td>0.000</td>
<td>-0.002</td>
<td>-0.005</td>
</tr>
<tr>
<td>Oils</td>
<td>-0.015</td>
<td>-0.015</td>
<td>-0.016</td>
<td>-0.016</td>
<td>-0.018</td>
</tr>
</tbody>
</table>

Source: Estimates based on data of IHSES 2012.
Table 6: Elasticities of free market goods with respect to ration items, Urban Areas, quintiles

<table>
<thead>
<tr>
<th>Ration</th>
<th>Poorest</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Richest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elasticities of cereals with respect to ration of</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown flour</td>
<td>−0.028</td>
<td>−0.017</td>
<td>−0.012</td>
<td>−0.008</td>
<td>−0.003</td>
</tr>
<tr>
<td>Rice</td>
<td>0.092</td>
<td>0.067</td>
<td>0.053</td>
<td>0.043</td>
<td>0.033</td>
</tr>
<tr>
<td>Sugar</td>
<td>0.007</td>
<td>0.005</td>
<td>0.003</td>
<td>0.002</td>
<td>0.001</td>
</tr>
<tr>
<td>Vegetable oil</td>
<td>−0.021</td>
<td>−0.015</td>
<td>−0.012</td>
<td>−0.010</td>
<td>−0.008</td>
</tr>
<tr>
<td>Elasticities of rice with respect to ration of</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown flour</td>
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<td>0.231</td>
<td>0.160</td>
<td>0.119</td>
<td>0.078</td>
</tr>
<tr>
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<td>0.043</td>
<td>0.031</td>
<td>0.018</td>
</tr>
<tr>
<td>Sugar</td>
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<td>−0.012</td>
<td>−0.008</td>
<td>−0.006</td>
<td>−0.005</td>
</tr>
<tr>
<td>Vegetable oil</td>
<td>−0.011</td>
<td>−0.008</td>
<td>−0.005</td>
<td>−0.004</td>
<td>−0.002</td>
</tr>
<tr>
<td>Elasticities of sweets with respect to ration of</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown flour</td>
<td>0.197</td>
<td>0.156</td>
<td>0.129</td>
<td>0.109</td>
<td>0.103</td>
</tr>
<tr>
<td>Rice</td>
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<td>0.020</td>
<td>0.015</td>
<td>0.012</td>
<td>0.010</td>
</tr>
<tr>
<td>Sugar</td>
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<td>0.040</td>
<td>0.032</td>
<td>0.027</td>
<td>0.025</td>
</tr>
<tr>
<td>Vegetable oil</td>
<td>0.011</td>
<td>0.010</td>
<td>0.008</td>
<td>0.007</td>
<td>0.008</td>
</tr>
<tr>
<td>Elasticities of oil with respect to ration of</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown flour</td>
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<td>−0.778</td>
<td>−0.555</td>
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<td>−0.354</td>
</tr>
<tr>
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</tr>
<tr>
<td>Sugar</td>
<td>−0.082</td>
<td>−0.067</td>
<td>−0.048</td>
<td>−0.042</td>
<td>−0.035</td>
</tr>
<tr>
<td>Vegetable oil</td>
<td>−0.067</td>
<td>−0.053</td>
<td>−0.038</td>
<td>−0.032</td>
<td>−0.026</td>
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</tbody>
</table>

Source: Estimates based on data of IHSES 2012.
Table 7: Price Elasticities of Ration items with respect to Free Market goods, by quintiles, Urban Areas

<table>
<thead>
<tr>
<th></th>
<th>Poorest</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Richest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elasticities of ration price of brown flour with respect to Free market Cereals</td>
<td>0.067</td>
<td>0.063</td>
<td>0.054</td>
<td>0.048</td>
<td>0.021</td>
</tr>
<tr>
<td></td>
<td>Rice</td>
<td>−0.422</td>
<td>−0.500</td>
<td>−0.574</td>
<td>−0.667</td>
</tr>
<tr>
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<td>Sweets</td>
<td>−0.393</td>
<td>−0.463</td>
<td>−0.537</td>
<td>−0.627</td>
</tr>
<tr>
<td></td>
<td>Oils</td>
<td>1.063</td>
<td>1.227</td>
<td>1.389</td>
<td>1.581</td>
</tr>
<tr>
<td>Elasticities of ration price of rice with respect to Free market Cereals</td>
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<td>−0.219</td>
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<td>−0.089</td>
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<tr>
<td></td>
<td>Sweets</td>
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<td>−0.014</td>
<td>−0.014</td>
<td>−0.013</td>
</tr>
<tr>
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<td>Oils</td>
<td>0.210</td>
<td>0.249</td>
<td>0.263</td>
<td>0.283</td>
</tr>
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<td>Elasticities of ration price of sugar with respect to Free market Cereals</td>
<td>−0.010</td>
<td>−0.010</td>
<td>−0.010</td>
<td>−0.010</td>
<td>−0.009</td>
</tr>
<tr>
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<td>Rice</td>
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<td>0.001</td>
<td>0.001</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>Sweets</td>
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<td>−0.054</td>
<td>−0.061</td>
</tr>
<tr>
<td></td>
<td>Oils</td>
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<td>0.031</td>
<td>0.037</td>
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</tr>
<tr>
<td>Elasticities of ration price of oil with respect to Free market Cereals</td>
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<td>0.022</td>
<td>0.026</td>
</tr>
<tr>
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<td>0.000</td>
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<tr>
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</table>

Source: Estimates based on data of IHSES 2012.
Table 8: Expenditure Elasticities by Quintile of Per Capita Consumption and Area

<table>
<thead>
<tr>
<th></th>
<th>Ration products</th>
<th>Equivalent free market product</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Brown flour</td>
<td>Rice</td>
<td>Sugar</td>
</tr>
<tr>
<td>Rural</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.015</td>
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<td>0.005</td>
</tr>
<tr>
<td>2</td>
<td>0.084</td>
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<td>0.006</td>
</tr>
<tr>
<td>3</td>
<td>0.059</td>
<td>−0.009</td>
<td>0.005</td>
</tr>
<tr>
<td>4</td>
<td>0.027</td>
<td>0.003</td>
<td>0.005</td>
</tr>
<tr>
<td>5</td>
<td>0.263</td>
<td>0.082</td>
<td>0.017</td>
</tr>
<tr>
<td>Urban</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
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<td>−0.008</td>
<td>0.000</td>
</tr>
<tr>
<td>2</td>
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<td>−0.014</td>
<td>0.000</td>
</tr>
<tr>
<td>3</td>
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<td>−0.004</td>
<td>−0.001</td>
</tr>
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<td>4</td>
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<td>−0.001</td>
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<tr>
<td>5</td>
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</table>

Source: Estimates based on data of IHSES 2012.

Table 9: Average change in subsidized product shares, B Scenarios, Urban areas, Consumption quintiles (%)

<table>
<thead>
<tr>
<th></th>
<th>Poorest</th>
<th>2</th>
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<th>4</th>
<th>Richest</th>
</tr>
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<td>−100</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
</tr>
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<td>Oil</td>
<td>15</td>
<td>13</td>
<td>11</td>
<td>10</td>
<td>10</td>
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<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Flour</td>
<td>14</td>
<td>12</td>
<td>10</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Scenario B2</td>
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<td></td>
<td></td>
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<td>−100</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
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<td>Oil</td>
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<td>−100</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
</tr>
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<td>25</td>
<td>20</td>
<td>16</td>
<td>10</td>
</tr>
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<td>20</td>
<td>16</td>
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<td>−100</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
</tr>
<tr>
<td>Oil</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
</tr>
<tr>
<td>Sugar</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
</tr>
<tr>
<td>Flour</td>
<td>67</td>
<td>50</td>
<td>38</td>
<td>30</td>
<td>18</td>
</tr>
<tr>
<td>Scenario B4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
</tr>
<tr>
<td>Oil</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
</tr>
<tr>
<td>Sugar</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
</tr>
<tr>
<td>Flour</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
<td>−100</td>
</tr>
</tbody>
</table>

Source: Estimates based on data of IHSES 2012.
Table 10: Average change in free market products shares, B Scenarios, Urban areas, Consumption quintiles (%)

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

Source: Estimates based on data of IHSES 2012.

Table 11: Compensating Variation, households in urban areas, B Scenarios (%)

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

Source: Estimates based on data of IHSES 2012.
Figure 1: PDS Expenditures, Food and Non-Food Expenditures, by Consumption Quintile, 2012

Source: Estimates based on data of IHSES 2012.
**Figure 2: Share of Calories from the PDS, by Consumption Quintile, 2007 and 2012**

![Graph showing share of calories from PDS by consumption quintile from 2007 to 2012.]

Source: Estimates based on data of IHSES 2012.

**Figure 3: Share of different ration products in total ration expenditure (%)**

![Pie chart showing the percentage of different ration products in total ration expenditure.]

- Ration rice, 36.14%
- Brown wheat flour (ration), 14.21%
- Vegetable oil (ration), 22.11%
- Sugar (ration), 25.66%
- Lentils (ration), 0.43%
- Chick peas (ration), 0.02%
- Dry white beans (ration), 0.09%
- Vegetable fat (ration), 0.14%
- White wheat flour (ration), 0.34%
- Children’s food (ration), 0.16%
- Powdered milk (ration), 0.67%
- Salt (ration), 0.01%
- Tea (ration), 0.03%

Source: Estimates based on data of IHSES 2012.
**Figure 4: Average change in product shares, Scenario A1 (Urban areas)**

Source: Estimates based on data of IHSES 2012.

**Figure 5: Average change in product shares, Scenario A2 (Urban areas)**

Source: Estimates based on data of IHSES 2012.
**Figure 6: Average change in product shares, Scenario A3 (Urban areas)**

Source: Estimates based on data of IHSES 2012.

**Figure 7: Average change in product shares, Scenario A3 (Urban areas)**

Source: Estimates based on data of IHSES 2012.
Annex A: The Mixed Demand Model

In a mixed demand model, there are \( n \) free market products and \( m \) subsidized products. Let \( X = [x_1, \ldots, x_n] \) be the vector of goods the prices of which are determined on the market; \( Z = [z_1, \ldots, z_m] \) be the vector of goods the quantities of which are predetermined (quotas); and \( p \) and \( q \) be 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 (Moschini and Rizzi, 2007; Ramadan and Thomas, 2011):

\[
\max_{x, q} u(x, z) - v(p, q, y)
\]

\[\text{s.t. } p'x + q'z = y,\]  

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, as follows:

\[
x^* = x(p, z, y) \text{ and } q^* = q(p, z, y)
\]  

These yield the following optimum direct and indirect utility functions:

\[
u(x^*, z) = v(p, q^*, y)
\]

\[= V^M(p, z, y),\]

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

---

15 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 \( u(x) = v(p, y) \).
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, 2007):

\[
C(p, z, u) \equiv \min_x \{p.x | u(x, z) \geq u\} \tag{A.4}
\]

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 \(z\), the cost minimizing solution (Moschini and Rizzi, 2007; Moschini and Vissa, 1993):

\[
\nabla_p C(p, z, u) = x^h(p, z, u) \tag{A.5}
\]
\[
\nabla_z C(p, z, u) = -q^h(p, z, u)
\]

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

\[
x(p, z, y) = x^h(p, z, V^M(p, z, y)) \tag{A.6}
\]
\[
q(p, z, y) = -q^h(p, z, V^M(p, z, y))
\]

So, to achieve a given utility level \(u\), the total cost given \((p, z)\) can be written as:

\[
C^M(p, z, V^M(p, z, y)) = C(p, z, u) - \nabla_z C(p, z, u) \equiv y, \tag{A.7}
\]

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 (7). They selected a cost function from the Gorman Polar form that is affine in \(u\), as follows:

\[
C(p, z, u) = F(p, z) + G(p, z)u, \tag{A.8}
\]

42
where $F$ and $G$ are continuous and differentiable in $p$ and $z$. Such a specification allows a closed form of the mixed utility function to be derived from the mixed cost function, as follows:

$$V^M(p, z, R) = \frac{R - F(p, z) + \nabla_z F(p, z)z}{G(p, z) - \nabla_z G(p, z)z}$$ (A.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”:

$$F(p, z) = \delta'p(a'p)(\mu'z)$$ (A.10)
$$G(p, z) = \beta'p + (a'p)(\gamma'z) + 0.5(a'p)(z'\Gamma z) + p'Lz$$

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

$$x_i^* = \delta_i + (\mu'z)a_i + \{\beta_i + \sum_{j=1}^n \frac{\beta_{ij}p_j}{a'p} + \sum_{k=1}^m \lambda_{ik}z_k$$
$$+ a_i \left[ \gamma'z - 0.5 \left( \frac{p'Bp}{(a'p)^2} \right) + 0.5(z'\Gamma z) \right] \} V^M$$ (A.11)

$$-q_k^* = (a'p)\mu_k + [(a'p)\gamma_k + (a'p)\sum_{s=1}^m \gamma_{ks}z_s +$$
$$\sum_{j=1}^n \lambda_{jk}p_j] V^M$$ (A.12)

$$V^M = \frac{y - \delta'p}{\beta'p + 0.5 \left( \frac{p'Bp}{(a'p)^2} \right) - 0.5(a'p)(z'\Gamma z)},$$ (A.13)
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:

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

\[
- W_k = [(a' p) \mu_k + (a' p) \gamma_k + (a' p) \sum_{s=1}^{m} \lambda_{ks} z_s + \sum_{j=1}^{n} \lambda_{jk} p_j] V^M \frac{z_k}{y} + \xi_k
\] (A.11')

(A.12')

The \( W_i \)'s and the \( W_k \)'s are the budget shares of the goods with predetermined prices and fixed quantities, respectively. \( \gamma \) and \( \mu \) 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. \( \beta_i \) and \( \delta_i \) are parameters to be estimated. \( a = [a_1, a_2, ..., a_n]' \) is a vector of arbitrarily chosen coefficients to ensure the homogeneity property. \( \epsilon_i \) and \( \xi_k \) are error terms.
Annex B: Average shares of ration items to total expenditure of the four food items used in the analysis (%) 

<table>
<thead>
<tr>
<th>Quintile</th>
<th>Poorest</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Richest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>Brown flour</td>
<td>32.9</td>
<td>28.1</td>
<td>24.7</td>
<td>21.4</td>
</tr>
<tr>
<td></td>
<td>Rice</td>
<td>13.4</td>
<td>10.8</td>
<td>9.6</td>
<td>7.8</td>
</tr>
<tr>
<td></td>
<td>Vegetable oil</td>
<td>20.1</td>
<td>17.4</td>
<td>15.5</td>
<td>13.9</td>
</tr>
<tr>
<td></td>
<td>Sugar</td>
<td>16.7</td>
<td>14.5</td>
<td>13.0</td>
<td>11.5</td>
</tr>
<tr>
<td>Urban</td>
<td>Brown flour</td>
<td>30.7</td>
<td>26.1</td>
<td>22.1</td>
<td>18.0</td>
</tr>
<tr>
<td></td>
<td>Rice</td>
<td>12.8</td>
<td>11.2</td>
<td>9.2</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>Vegetable oil</td>
<td>19.4</td>
<td>17.0</td>
<td>15.2</td>
<td>13.3</td>
</tr>
<tr>
<td></td>
<td>Sugar</td>
<td>16.1</td>
<td>14.5</td>
<td>13.0</td>
<td>11.5</td>
</tr>
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</table>

Source: Estimates based on data of IHSES 2012.
## Annex C: Items included in the four free market products

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

Source: Estimates based on data of IHSES 2012.
### Annex D: The estimated parameters of the Normalized Quadratic Model

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Coefficient</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\mu_1$</td>
<td>$-0.175^{***}$</td>
<td>(0.0110)</td>
</tr>
<tr>
<td>$\mu_2$</td>
<td>0.0360$^{***}$</td>
<td>(0.00587)</td>
</tr>
<tr>
<td>$\mu_3$</td>
<td>0.0409$^{***}$</td>
<td>(0.00584)</td>
</tr>
<tr>
<td>$\mu_4$</td>
<td>$-0.0402^{***}$</td>
<td>(0.00413)</td>
</tr>
<tr>
<td>$\gamma_1$</td>
<td>0.0143$^{***}$</td>
<td>(0.00409)</td>
</tr>
<tr>
<td>$\gamma_2$</td>
<td>$-0.0568^{***}$</td>
<td>(0.00680)</td>
</tr>
<tr>
<td>$\gamma_3$</td>
<td>0.0345$^{***}$</td>
<td>(0.00276)</td>
</tr>
<tr>
<td>$\gamma_4$</td>
<td>$-0.0940^{***}$</td>
<td>(0.00299)</td>
</tr>
<tr>
<td>$\lambda_{5,1}$</td>
<td>0.0358$^{***}$</td>
<td>(0.00254)</td>
</tr>
<tr>
<td>$\lambda_{6,1}$</td>
<td>0.342$^{***}$</td>
<td>(0.00621)</td>
</tr>
<tr>
<td>$\lambda_{7,1}$</td>
<td>0.334$^{***}$</td>
<td>(0.00593)</td>
</tr>
<tr>
<td>$\lambda_{5,2}$</td>
<td>0.160$^{***}$</td>
<td>(0.00348)</td>
</tr>
<tr>
<td>$\lambda_{6,2}$</td>
<td>0.0549$^{***}$</td>
<td>(0.00125)</td>
</tr>
<tr>
<td>$\lambda_{7,2}$</td>
<td>$-0.000125^{**}$</td>
<td>(5.59e$^{-}05$)</td>
</tr>
<tr>
<td>$\lambda_{5,3}$</td>
<td>0.000942$^{***}$</td>
<td>(0.000135)</td>
</tr>
<tr>
<td>$\lambda_{6,3}$</td>
<td>$-0.000950^{***}$</td>
<td>(0.000447)</td>
</tr>
<tr>
<td>$\lambda_{7,3}$</td>
<td>0.0753$^{***}$</td>
<td>(0.00217)</td>
</tr>
<tr>
<td>$\lambda_{5,4}$</td>
<td>0.000413$^{***}$</td>
<td>(0.000151)</td>
</tr>
<tr>
<td>$\lambda_{6,4}$</td>
<td>0.000187</td>
<td>(0.000124)</td>
</tr>
<tr>
<td>$\lambda_{7,4}$</td>
<td>0.0360$^{***}$</td>
<td>(0.00110)</td>
</tr>
<tr>
<td>$b_{5,5}$</td>
<td>$-0.0213^{***}$</td>
<td>(0.000739)</td>
</tr>
<tr>
<td>$b_{5,6}$</td>
<td>0.0254$^{***}$</td>
<td>(0.000801)</td>
</tr>
<tr>
<td>$b_{5,7}$</td>
<td>$-0.130^{***}$</td>
<td>(0.00464)</td>
</tr>
<tr>
<td>$b_{6,6}$</td>
<td>$-0.0625^{***}$</td>
<td>(0.00246)</td>
</tr>
<tr>
<td>Variable</td>
<td>Coefficient</td>
<td>Standard Error</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
<td>----------------</td>
</tr>
<tr>
<td>b6_7</td>
<td>-0.0944***</td>
<td>(0.00363)</td>
</tr>
<tr>
<td>b7_7</td>
<td>-0.0789***</td>
<td>(0.00286)</td>
</tr>
<tr>
<td>δ5</td>
<td>-0.115***</td>
<td>(0.00565)</td>
</tr>
<tr>
<td>δ6</td>
<td>-0.100***</td>
<td>(0.00374)</td>
</tr>
<tr>
<td>δ7</td>
<td>-0.0492***</td>
<td>(0.00436)</td>
</tr>
<tr>
<td>β5</td>
<td>-0.0275***</td>
<td>(0.00345)</td>
</tr>
<tr>
<td>β6</td>
<td>-0.0228***</td>
<td>(0.00362)</td>
</tr>
<tr>
<td>β7</td>
<td>0.00171</td>
<td>(0.00283)</td>
</tr>
<tr>
<td>g1_1</td>
<td>0.0222***</td>
<td>(0.00247)</td>
</tr>
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<td>g1_2</td>
<td>0.00399</td>
<td>(0.00456)</td>
</tr>
<tr>
<td>g1_3</td>
<td>-0.0251***</td>
<td>(0.00383)</td>
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<tr>
<td>g1_4</td>
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<td>(0.00349)</td>
</tr>
<tr>
<td>g2_2</td>
<td>0.0280***</td>
<td>(0.00362)</td>
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<tr>
<td>g2_3</td>
<td>-0.0194***</td>
<td>(0.00288)</td>
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<tr>
<td>g2_4</td>
<td>0.0429***</td>
<td>(0.00263)</td>
</tr>
<tr>
<td>g3_3</td>
<td>0.0127***</td>
<td>(0.00353)</td>
</tr>
<tr>
<td>g3_4</td>
<td>-0.00792***</td>
<td>(0.00283)</td>
</tr>
<tr>
<td>g4_4</td>
<td>0.00544**</td>
<td>(0.00241)</td>
</tr>
</tbody>
</table>

Total observations 1140

Source: Estimates based on data of IHSES 2012.
Note: 1 = subsidized 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.

***p < .01 **p < .05 *p < .1
Annex E: The estimated parameters of the dropped equation (8 = Free market Oil) and the remained parameters from the constraints

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

Source: Estimates based on data of IHSES 2012.
Annex F: The formulas of the estimated elasticities

- Price elasticities of free market goods \((i, j = 1, 2, \ldots n)\):
  \[
  \varepsilon_{ij} = \frac{\partial x_i^*(z, p, u)}{\partial p_j} \cdot \frac{p_j}{x_i} \quad (F.1)
  \]

- Own quantity mixed elasticities of ration items \((k, s = 1, 2, \ldots m)\):
  \[
  \varepsilon_{ks} = \frac{\partial q_k(z, p, u)}{\partial z_s} \cdot \frac{q_k}{z_s} \quad (F.2)
  \]

- Elasticities of free market goods with respect to ration goods:
  \[
  \varepsilon_{ik} = \frac{\partial x_i^*(z, p, u)}{\partial z_k} \cdot \frac{z_k}{x_i} \quad (F.3)
  \]

- Price elasticities of ration items with respect to free market goods:
  \[
  \varepsilon_{kj} = \frac{\partial q_k(z, p, u)}{\partial p_j} \cdot \frac{p_j}{q_k} \quad (F.4)
  \]
Annex G: The estimated results for Kurdistan and the rest of Iraq

Table G.1: Own Price Elasticities of Ration Items, by quintile of per-capita consumption and area, 2012

<table>
<thead>
<tr>
<th></th>
<th>Ration products</th>
<th>Equivalent free market product</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Brown Flour</td>
<td>Rice</td>
<td>Sugar</td>
<td>Vegetable oil</td>
<td>Cereal</td>
<td>Rice</td>
<td>Sweets</td>
<td>Oils</td>
</tr>
<tr>
<td>Kurdish</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>-0.032</td>
<td>-0.038</td>
<td>-0.006</td>
<td>-0.005</td>
<td>0.010</td>
<td>-0.004</td>
<td>-0.013</td>
<td>-1.034</td>
</tr>
<tr>
<td>2</td>
<td>-0.037</td>
<td>-0.046</td>
<td>-0.007</td>
<td>-0.007</td>
<td>0.006</td>
<td>-0.002</td>
<td>-0.005</td>
<td>-0.941</td>
</tr>
<tr>
<td>3</td>
<td>-0.040</td>
<td>-0.044</td>
<td>-0.007</td>
<td>-0.007</td>
<td>0.003</td>
<td>-0.004</td>
<td>-0.013</td>
<td>-0.457</td>
</tr>
<tr>
<td>4</td>
<td>-0.048</td>
<td>-0.055</td>
<td>-0.009</td>
<td>-0.009</td>
<td>0.005</td>
<td>0.000</td>
<td>-0.011</td>
<td>-0.541</td>
</tr>
<tr>
<td>5</td>
<td>-0.076</td>
<td>-0.080</td>
<td>-0.016</td>
<td>-0.015</td>
<td>0.006</td>
<td>0.002</td>
<td>-0.010</td>
<td>-0.398</td>
</tr>
<tr>
<td>Rest of Iraq</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>-0.030</td>
<td>-0.029</td>
<td>-0.005</td>
<td>-0.004</td>
<td>0.009</td>
<td>-0.007</td>
<td>-0.048</td>
<td>-0.533</td>
</tr>
<tr>
<td>2</td>
<td>-0.033</td>
<td>-0.032</td>
<td>-0.006</td>
<td>-0.005</td>
<td>0.007</td>
<td>-0.005</td>
<td>-0.035</td>
<td>-0.370</td>
</tr>
<tr>
<td>3</td>
<td>-0.038</td>
<td>-0.038</td>
<td>-0.007</td>
<td>-0.005</td>
<td>0.007</td>
<td>0.000</td>
<td>-0.028</td>
<td>-0.321</td>
</tr>
<tr>
<td>4</td>
<td>-0.043</td>
<td>-0.042</td>
<td>-0.007</td>
<td>-0.006</td>
<td>0.006</td>
<td>0.000</td>
<td>-0.026</td>
<td>-0.271</td>
</tr>
<tr>
<td>5</td>
<td>-0.058</td>
<td>-0.053</td>
<td>-0.011</td>
<td>-0.009</td>
<td>0.003</td>
<td>0.000</td>
<td>-0.029</td>
<td>-0.133</td>
</tr>
</tbody>
</table>

Source: Estimates based on data of IHSES 2012.
Table G.2: Expenditure Elasticities, by Quintile of Per Capita Consumption and Region

|          | Ration products | Equivalent free market product | Kurdistan | Kurdistan | Kurdistan | Kurdistan | Kurdistan | Kurdistan | Kurdistan |
|----------|----------------|-------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|          | Brown flour    | Rice                          | Sugar     | Vegetable | Cereal    | Rice      | Sweets    | Oils      |           |
| 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

<table>
<thead>
<tr>
<th></th>
<th>Ration products</th>
<th>Equivalent free market product</th>
<th>Kurdistan</th>
<th>Kurdistan</th>
<th>Kurdistan</th>
<th>Kurdistan</th>
<th>Kurdistan</th>
<th>Kurdistan</th>
<th>Kurdistan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.03</td>
<td>0.01</td>
<td>0.00</td>
<td>0.02</td>
<td>0.090</td>
<td>0.46</td>
<td>0.37</td>
<td>−0.13</td>
<td></td>
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<tr>
<td>2</td>
<td>0.05</td>
<td>0.02</td>
<td>0.00</td>
<td>0.03</td>
<td>0.06</td>
<td>0.35</td>
<td>0.25</td>
<td>−0.09</td>
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</tr>
<tr>
<td>3</td>
<td>0.00</td>
<td>0.02</td>
<td>0.00</td>
<td>0.03</td>
<td>0.04</td>
<td>0.25</td>
<td>0.21</td>
<td>−0.07</td>
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</tr>
<tr>
<td>4</td>
<td>−0.02</td>
<td>0.03</td>
<td>0.00</td>
<td>0.03</td>
<td>0.03</td>
<td>0.20</td>
<td>0.17</td>
<td>−0.06</td>
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<tr>
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<td>0.09</td>
<td>0.00</td>
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<td>0.03</td>
<td>0.12</td>
<td>0.16</td>
<td>−0.06</td>
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</tr>
</tbody>
</table>

Source: Estimates based on data of IHSES 2012.