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Price opinion data in subsidized economies: Empirical evidence from Iraq

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Title: Price Opinion Data in Subsidized Economies: Empirical Evidence from Iraq.

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Abstract:

Distortions resulting from consumption subsidies or rationing systems often lead welfare analysts to use market price opinions, where household budget survey respondents are asked to provide their opinions of equivalent market prices of subsidized or rationed goods, to value consumption of the rationed goods. This is because prices paid by households for rationed goods do not represent the true marginal utility from consumption of these goods. This is the case in household budget surveys undertaken in Iraq, for example, where rationed food items received through the Public Distribution System are valued at market prices using price opinion data rather than at official prices facing households.

Despite the fact that most Living Standards Measurement Surveys conducted in countries that maintain consumption subsidies collect market price opinions, little evidence exists to support the notion that respondent opinions on market prices adequately approximate shadow prices of subsidized or rationed commodities.

This paper explores the adequacy of market price opinions of subsidized food commodities using data from Iraq. The evidence presented here suggests that price opinions of subsidized food commodities are influenced by the importance of the subsidy in the household economy – a reflection of household welfare levels and preferences. This leads to the conclusion that price opinion data for subsidized goods distorts the estimated transfer value of the PDS food subsidy and biases welfare analysis, particularly affecting the ability to monitor trends over time.

JEL Codes: I32, D63, D45, D41, H23

Key words: Subsidies, rationing, prices, welfare, poverty analysis

1. Introduction

Many developing countries maintain food consumption subsidies. Although, their rationale may vary by context, these subsidy regimes are invariably described as costly, wasteful systems and are often associated with concerns of corruption and rent seeking (Adams, 2000). Motivated by the need to alleviate fiscal burden of maintaining food consumption subsidies, international financial institutions often support national governments in undertaking policy reforms aiming to eliminate the subsidy regimes through undertaking policy impact analysis that identify the distributional impacts of policy reform.
Conducting welfare analysis and assessing the distributional impact of policies is, however, often complicated by the presence of commodity rationing and consumer subsidies, particularly where prices paid by consumers do not reflect true marginal utility of consumption (Hentschel & Lanjouw, 1996). In such contexts, virtual prices of the rationed or subsidized good should be used to value household consumption of the good rather than paid prices (Rothbarth, 1941; Neary & Roberts, 1980; Deaton A., 1981; Lee & Pitt, 1987).

As calculating virtual prices for subsidized goods can be computationally involved – see for example Dréze and Stern (1990) – welfare analysts sometimes resort to using market price opinions, where household budget survey respondents are asked to provide their opinions of equivalent market prices of subsidized or rationed goods, in place of shadow prices. A review of household surveys on the World Bank Living Standards Measurement Study (LSMS) project website shows that one of every six LSMS surveys collects price opinion data and that two thirds of the countries where this data is collected maintained food subsidies or food rationing regimes – suggesting that price opinions on equivalent market prices are often be taken to represent shadow prices.
The body of literature on price opinion data is very sparse, with the work of Gibson and Rozelle (2002) in the context of Papua New Guinea, being the only systematic review of the performance of price opinion data. No published work has been found that examines the performance of price opinion data in the approximation of virtual prices of subsidized or rationed commodities.

Drawing on existing knowledge on money metric utility (Samuelson, 1974) and its drawbacks in welfare analysis, particularly sensitivity to heterogeneity of consumer preferences (Blackorby and Donaldson (1988); Ravallion (1998); Deaton and Zaidi (2002)), this paper addresses the gap in literature on the performance of price opinion data as shadow prices for rationed food commodities, drawing specifically on the Iraqi experience with the national food rationing regime – the Public Distribution System. Using data collected in Iraq, this paper explores the possibility that the implicit income transfer value of food acquired at subsidized prices – and varying consumer preferences across income – bias price opinions offered by survey respondents. The implications of biased price opinions on welfare analysis are also explored.

The format of the remainder of this paper is as follows. Section 2 reviews the main types of price data commonly used in welfare analysis, exploring the importance of price data in constructing welfare aggregates. Section 3 develops the analytical approach adopted in this paper and section 4 summarizes the country context, including the management and functioning of the Public Distribution System and presents the various sources of data used in the analysis.

Section 5 presents the main model results and diagnostics whereas section 6 explores the implications of utilizing price opinion data in welfare analysis. Section 7 presents the final concluding remarks.

2. Price data in the welfare analysis literature

Data on prices of consumed commodities and services is a critical component of household and welfare measurement. While the underlying interest is the measurement of consumption, welfare analysts often rely upon consumption expenditures – aided by price data – to facilitate aggregation of the diverse units of consumption into a single welfare measure. Price data facilitates the conversion of quantities consumed into a common numeraire, or equivalently the measurement of consumed quantities from expenditures made (Hentschel and Lanjouw, 1996). As such, prices directly influence how quantities consumed translate into welfare.

The relevance of price data in current welfare analysis practices becomes apparent when referring to earlier economic theory literature, such as Houthakker's (1952) use of the indirect utility function and McKenzie's (1957) specification of the expenditure function in terms of quantitities and prices. This was further developed by Samuelson (1974), who argued that for fixed prices, the expenditure function specified by McKenzie is an exact representation of consumer preferences, which is known as money metric utility.

The conception of the consumer as a rational economic agent that seeks to maximize utility when faced with a budget constraint and a set of prevailing prices is, accordingly, the current practice in welfare analysis and is the "basic measure of welfare in market situations" (Deaton, 1980). Specifically, consumer demands for goods are represented by the cost function $c(u,p)$ representing the minimum cost of achieving utility level (u) when faced with a vector of prices (p). The function $c(u,p)$ is equal to total expenditure (x) when the consumer maximizes utility (u) by maximizing consumption of quantity vector (q), constrained by the equality $x = p \cdot q$ and represents the indirect utility function of achieving utility level (u) given the vector of prices (p) and a budget constraint (x).

This implies that estimation of money metric utility requires full information on consumer preferences – normally estimated through demand modeling. However, Deaton and Zaidi (2002) show that money metric utility (u_m^i) can be approximated through a first-order expansion of $c(u,p^r)$ in prices around the vector of prices paid by the household (p^i) such that, for the i^{th} household,

$$u_m^i = c\left(u^i, p^r\right) \approx c\left(u^i, p^i\right) + (p^r - p^i) \cdot q^i \qquad \text{(Eq. 1)}$$

Accordingly, if the prices paid by the household (p^i) are higher than the reference prices (p^r), the value $p^r \cdot q^i$ would be less than the value $p^i \cdot q^i$, thus households expenditure is "deflated"

by the value $(p^r \cdot q^i)$-$(p^i \cdot q^i)$. Similarly, if the prices paid by the household (p^i) are lower than the reference prices (p^r), households expenditure is "inflated" by the value $(p^r \cdot q^i)$-$(p^i \cdot q^i)$.

Since it is rare to observe a complete set of quantities for each household and – sometimes of reference prices – in practice, the Paasche price index (P_P^i) is relied upon to compare the reference price vector with the vector of prices paid by the i^{th} household $(P_P^i = p^i \cdot q^i / p^r \cdot q^i)$. It follows that the money metric utility of the i^{th} household (u_m^i) is approximated by:

$$u_m^i \approx p^i \cdot q^i / P_P^i = x^i / P_P^i \qquad \text{(Eq. 2)}$$

Where, $x^i$is total expenditure and P^i is the Paasche (current-weighted) price index comparing paid prices (p^i) with reference prices (p^r).

However, unless preferences are strictly homothetic or semi-homothetic, where household preferences over bundles of goods are constant across different income groups, money metric utility is not guaranteed to be a concave function of income (Blackorby and Donaldson, 1988), thereby violating the decreasing marginal utility of wealth property of utility functions. Accordingly, money metric utility performs poorly in the context of assessing the distributional effects of policies (Deaton and Zaidi, 2002).

To address this drawback in welfare analysis, Blackorby and Donaldson (1987) proposed the welfare ratio as a more distributionally-sensitive measure of welfare. The welfare ratio is simply the ratio of expenditures to the level of expenditures needed to reach a minimally acceptable level of utility – i.e. the poverty line. Thus, the i^{th} household (or individual) welfare ratio (wr^i) is given by,

$$wr^i = \frac{c(u^i, p^i)}{c(u^z, p^i)} \qquad \text{(Eq. 3)}$$

Where (u^z) is the "utility poverty line". To represent welfare ratio in monetary terms, the ratio in Equation 3 is multiplied by the poverty line valued at reference prices (p^r), such that the transformed welfare ratio measure for the i^{th} household (u_r^i) is given by,

$$u_r^i = \frac{c(u^i, p^i)}{c(u^z, p^i)} \times c(u^z, p^r) \qquad \text{(Eq. 4)}$$

This is equivalent to normalizing expenditures by a true cost of living index, $c(u^z, p^i)/c(u^z, p^r)$ which is the poverty line valued at prices faced by the household divided by the poverty line

valued at reference prices (Ravallion, 1998). In practice, the cost of living index is approximated by the Laspeyres price index (P_L^i) (Deaton and Zaidi, 2002), which is calculated by,

$$P_L^i = \sum_{k=1}^{n} w_k^{zr} \left(\frac{p_k^i}{p_k^r} \right) \qquad \text{(Eq. 5)}$$

where w_k^{zr} is the budget share at the poverty line indifference curve. Thus, similar to money metric utility, the welfare ratio expressed in monetary terms is the product of dividing expenditures by the Laspeyres price index $u_r^i = x^i / P_L^i$. However, while the welfare ratio provides a solution to the poor curvature properties of money metric utility, thereby allowing distributional analysis, it is also the case that the welfare ratio is an inexact indicator of welfare unless preferences are strictly homothetic – essentially distorting the welfare of households whose consumption level is far from the poverty line (Blackorby and Donaldson, 1987).

It is evident from equations 1 – 5 and the surrounding discussion that obtaining accurate price data bears significant influence on the ability to accurately assess both welfare levels and the distributional impacts of policies. It is therefore understandable that welfare analysts often exert significant effort to obtain reliable price data during household budget surveys that can then be utilized to adjust nominal expenditures to produce what is commonly referred to as real consumption expenditure – the main building block of the welfare aggregate employed in welfare analysis (Deaton, 1997).

Typical approaches to acquiring price data include market surveys, direct estimation from available data in the form of unit values or respondent price opinions. Standard LSMS survey guidelines recommend the administration of a market survey in communities included in the household sample to collect market price data for a pre-determined selection of food and non-food commodities normally consumed by individuals in the country (Grosh and Glewwe, 1995). However, not all LSMS surveys actually conduct community market surveys (Frankenberg, 2000) and it is often the case that these surveys have quality problems such as price data collected from markets other than those frequented by the household survey respondents or that the list of goods in the price survey are different from those consumed by the survey respondents (Deaton and Grosh, 2000) or that markets are set up sporadically, especially in rural areas, leading to incomplete price data (Gibson and Rozelle, 2005).

In the absence of community market surveys, or when they are found to be of low quality, researchers frequently revert to using unit values as quasi-price measures (Deaton, 1988). Unit values are the ratio of expenditure on an acquired item to the quantity of the item acquired. The popularity of unit values among researchers can be explained by the fact that household budget surveys collect data on quantities acquired and expenditures on them and that no particular effort is required to estimate unit values.

Unit values are utilized in estimating spatial price indices that are used to deflate consumption expenditures and enable comparisons between geographic areas (Deaton, 1988). However, as Deaton and Tarozzi (2000) note, even though unit values have price-like characteristics, they are not prices and may deviate from indicators of market conditions, particularly when goods included in surveys are heterogeneous or poorly defined. Accordingly, unit values reflect the

prices of a variety goods, this adding variation due to differences in the variety of consumer choices and – importantly – the quality of the acquired goods.

Other disadvantages of unit values include the fact that they typically cannot be estimated for items where quantity data is not collected or is not well defined (Deaton and Tarozzi, 2000). Moreover, unit values are available only for purchasers as opposed to market prices where the data would exist regardless of whether surveyed household procured them or not during the reference period (Gibson, 2007). Since unit values are derived from expenditure and the quantity acquired, measurement error in either factor is transmitted to the unit value (Deaton, 1997).

Reliance on unit values have been reported to lead to overestimation of poverty lines and poverty rates (Gibson and Rozelle, 2005; Capeau and Dercon, 2006). To minimize this, Deaton proposed careful graphical and analytical review of unit value data (Deaton and Tarozzi, 2000), including the replacement of household level unit values with their cluster or locality median values (Deaton and Zaidi, 2002)

In addition, Deaton (1989; 1997) derived a method for consistent estimation of demand elasticities using unit value, even with the presence of measurement error and quality effects. With continued reliance on unit values as price measures, the method remains widely utilized in the applied demand measurement literature (McKelvey, 2011), despite having been the subject of some critique (See Niimi, 2005 or McKelvey, 2011).

One proposed alternative to conducting community market surveys, or the use of unit values, is asking community informants or household survey respondents to report market prices for a list of commodities regardless of whether the household acquired the commodity or not (Frankenberg, 2000), although Frankenberg suggests that this method may be unreliable, particularly considering how little is known about such price data collection methods and among concerns that such 'price opinions' would not be representative of suffer from other biases such as differences in bargaining skills and uncertainty about reference periods (Gibson and Rozelle, 2005).

Motivated to find a plausible solution to this problem, Gibson and Rozelle (2002) devised an experiment to test the merits of different sources of food price data. Through the experiment, information on price data collected through unit values and price opinions of respondents that were shown pictures of a selection of food items was compared to price data collected through a market price survey. The different price measures were used to calculate poverty lines and demand system estimates which were compared to those calculated using market prices.

Through this experiment, Gibson and Rozelle (2002, 2005) illustrated that price opinion data for select food items, collected with the help of visual aids, reduced quality effects and performed better as market price proxies than unit values in both poverty measurement and demand system estimation. This experiment was the "only systematic attempt" to test the reliability of price opinion data (Gibson and Rozelle, 2005) while others considering the merits of price opinion data have concluded that "further research would be necessary to recommend this method more broadly" (Gaddis, 2016)

Yet, to gain an appreciation of the extent to which price opinion data is actually relied upon, we perform a thorough review of the questionnaires of LSMS surveys included in the World Bank's

LSMS website[1]. Of the 107 LSMS surveys included in the "LSMS Data Finder" site, 102 surveys conducted in 36 countries between 1985 and 2017 were found to include expenditure data that can be used in building a consumption aggregate for use in welfare analysis. These are surveys.

The review of the questionnaires reveals that unit values and market surveys are, indeed, the two main sources of food price information for LSMS surveys. Nonetheless, one out of every six surveys was found to collect price opinion data from either household survey respondents or community key informants in a quarter of the countries (nine out of thirty-five countries). Table 1 presents the main results of the review.

Table 1: Type of food price data frequently collected in LSMS surveys

	Proportion	Number
Price Data from Community Market Survey	62.7%	64
Unit Values - Purchased Food	69.6%	71
Unit Values - Own Produced food	39.2%	49
Unit Values - Other food sources	30.4%	31
Price Opinion	17.6%	18

Source: Authors calculation from a review of all questionnaires in the World Bank's "LSMS Data Finder" site

Interestingly, most of the countries[2] (six of the nine countries) that collected price opinion data either maintained or were in the process for reforming food subsidy or rationing regimes – implying preference for price opinion data in contexts where regulations distort market prices.

This, it appears, is not without reason. In a World Bank Living Standards Measurement Study (LSMS) Working Paper, Jesko Hentschel and Peter Lanjouw (1996) stress that, under a system of rationing, prices paid by households for rationed goods do not represent the true marginal utility from consumption of these goods as prices are artificially kept from rising despite the restrictions on quantities. Accordingly, shadow prices should be used to value consumption of rationed goods instead of paid prices.

Following this recommendation, for example, the World Bank and the Iraqi Central Statistical Organization sought to value rationed food items received through the Public Distribution System at market prices using price opinion data rather than valuing the food items at paid official prices (Amendola and Vecchi, 2011).

3. Analytical Approach and Model Specification

[1] http://iresearch.worldbank.org/lsms/lsmssurveyFinder.htm

[2] Albania, Bulgaria, China, Ecuador, Ghana and Iraq

The difference between paid prices for rationed goods and open market prices for the same goods, coupled with the ability of consumers to acquire the rationed good through both the Public Distribution System and commercially at market prices introduces significant complications to the process of constructing welfare indicators.

In the context of consumer subsidies and rationing, the difference between paid prices and market prices for subsidized commodities represents – quite literally – the value of income transferred to the household by virtue of the subsidy. A number of studies conducted within the similar context of the Public Distribution System in India (see Kaul, 2014; GSI, 2010; Kochar, 2005 and George, 1979) have defined the value of subsidy, or the ith household's subsidy income transfer value from acquiring the kth commodity (V_i^k) as:

$$V_i^k = (p_r^k - p_i^k) \cdot q_i^k \qquad \text{(Eq. 6)}$$

Where:

V_i^k is the value of transfer income for the ith household from the kth subsidized food commodity,
p_r^k is the reference market price of the kth food commodity,
p_i^k is the official prices paid by the ith household for the kth rationed food commodity,
q_i^k is the quantity acquired by the ith household of the kth food commodity included in the PDS food basket.
In the Iraqi context, where information on reference market prices for a rationed commodity is retrieved through requesting respondent opinions on the market value of the rationed goods, Equation 6 is modified to replace reference market prices (p_r^k) with the respondent's price opinion (po_i^k) such that $V_i^k = (po_i^k - p_i^k) \cdot q_i^k$. In other words, the subsidy income transfer received by a household is a function of the actual prices they face – i.e. paid prices – and their perception of the market value of subsidized goods – i.e. price opinion.

Literature from the marketing and product pricing fields often distinguishes between objective prices and perceived prices. Consumer's awareness of prices is reported to be influenced by demographic factors such as gender, marital status, age and employment (Zeithaml, 1988) as well as by commodity specific attributes such as durability, and by price dispersion for the same good in the market (Maynes and Assum, 1982).

Since price opinions are – in effect – price perceptions, they may be influenced by demographic factors and by the ease of acquisition of the commodities in question. In the context of food consumption subsidies or food rationing systems such as that in Iraq, it is possible that influences, such as the relevance of the implicit transfer to the overall household budget, may introduce bias in the valuation of the quantities acquired from the PDS.

The existing literature on sources of reporting error in household budget surveys is narrowly focused on issues such as recall versus diary taking, level of aggregation in the commodity list and length of reference period. A number of studies have established that greater cognitive demand is placed on respondents in instances where the recall period is too long or when respondents are requested to respond to hypothetical questions such as average expenditures or consumption during 'typical' months – leading to biased estimates caused by reporting error (Beegle *et al*, 2010). In the study conducted by Beegle et al., the effects of the extent of

cognitive demand on survey respondents due to various data collection methods as well as household characteristics were tested using multiple regression models.

A prerequisite for regression analysis is ascertaining the presence of sufficient variation in the price data. Table 2 lists mean prices and dispersion ratios for five commodities distributed through the PDS from price information collected through market surveys and respondent price opinions for the same commodities. The dispersion ratios reveal significant price variation for all items. Commodities with the least variation have a dispersion ratio of 2 – meaning the highest recorded price is twice that of the lowest price.

Table 2: Comparing market prices and price opinion data for rationed items

	Market Prices		Price Opinion	
	Mean (Iraqi Dinars)	Dispersion	Mean (Iraqi Dinars)	Dispersion*
Brown Wheat Flour	493	2.7	459	2.5
Rice	1,290	5.8	474	3.8
Sugar	1,337	2.1	1,355	3.0
Vegetable Oil	2,187	2.0	2,170	2.5
Vegetable Fat	2,241	2.0	1,792	2.0

Sources: Market prices - Average of 2011-Q1 market price bulletin; Price opinion - Authors calculation using 2011 IKN survey data.

** 99^{th} percentile divided by the 1^{st} percentile*

Remembering that the price opinion data for the subsidized PDS commodities serves as a proxy for their shadow prices. These prices therefore should reflect the marginal utility from the consumption of these goods. It follows, therefore, that the comparison of the price opinions for PDS goods and the market prices for their commercial equivalents (Table 2) provides insight into the respondents' preferences over these goods. For example, that the price opinion for PDS wheat flour being slightly lower than the market price of its commercial equivalent can be taken to indicate that respondents consider their PDS wheat flour ration to be extra marginal. This is also true for vegetable fat and oil, and for rice to a far greater extent to a greater extent. The opposite can be said for PDS sugar, which is valued at higher than prevailing market prices. However, this comparison would hold only if little differences exist in the quality of the goods, a proposition that could not be explored with the data at hand.

Poor infrastructure, high levels of violence and barriers to free movement between the different areas of Iraq led to poor market linkages and explains the presence of high spatial variation in market prices. Spatial variation in prices is not only present in the commodities listed in table 2 and spans across a wider range of goods. For example, the Consumer Price Index for Diyala – a district only 50 kilometers north east of Baghdad – is 40 percent higher than the CPI for Baghdad during the first quarter of 2011[3]. The extent of spatial variation in price opinion data is highlighted in table 3.

[3] Authors calculations from the January through March CPI reports in 2011 (CSO, 2011)

Table 3: Spatial variation across Governorates in price opinion data for rationed items

Price Opinion (Iraqi Dinar/ Kg)

	Rice	Wheat Flour	Vegetable Fat	Vegetable Oil	Sugar
Dohuk	690	356	1634	2183	1127
Mosul	500	478	1737	2281	1437
Sulaimaniya	348	377	1543	1898	1347
Kirkuk	499	500	---	2250	---
Erbil	286	291	1526	2243	1345
Diyala	493	495	1845	2397	1375
Anbar	493	482	1791	2282	1160
Baghdad	488	488	1936	2370	1258
Babylon	499	495	1828	2256	1395
Kerbala	447	485	1845	2285	1426
Wassit	499	479	1660	2304	1373
Salah Al Din	498	498	1898	1864	1430
Najaf	454	464	1627	2344	1337
Qadisiya	500	499	1890	2473	1424
Muthanna	499	499	1996	2160	1255
Thi-Qar	499	499	1702	2500	1284
Maysan	499	500	1861	2368	1495
Basrah	496	492	1781	2347	1374
Dispersion (high/low)	2.4	1.7	1.3	1.3	1.3

Source: Authors calculation using 2011 IKN survey data.

Model Specification

Given the structure of the data where the available market price data is collected at the sub-district level for the monthly consumer price index series, a multilevel modelling approach is required. Accordingly, the reference market price data is constant within the sub-district and only varies between districts. Such an approach models households to be nested within markets and all households within the same sub-district face the same prevailing market prices.

A log-log hierarchical linear model fitted for each of the five rationed items, with households nested within sub districts, would allow the observation of any statistically significant association between the income transfer value of the food subsidy and household specific socio economic and demographic indicators while holding constant local market prices. The log-log specification is followed in order to transform log-normally distributed variables to follow a normal distribution as well as to allow the interpretation of coefficients as percent deviations.

The choice of the hierarchical model specification is motivated by the fact that the market price data is constant within sub districts and varies only between sub districts. Moreover, the choice of the hierarchical model specification, where households are nested within markets, allows the analysis of the variance in the value of subsidy (V_k^i) due to local market conditions separately from the variance due to household level conditions.

With the dependent variable as the transfer value of the subsidy (V_k^i) from the k[th] food commodity for the i[th] household in the j[th] sub district, the generic hierarchical model would be specified as:

$$\ln(V_{ij}^k) = \gamma_{00} + \gamma_{01} \ln \overline{p_j^k} + \gamma_{10} \ln(y_{ij}) + \gamma_{20} \ln(q_{ij}^k) + \gamma_{30} \ln(q_{ij}^k)^2 + \gamma_{40} z_{ij}^k + \sum_1^n \boldsymbol{\gamma}_{50}^{n0} \boldsymbol{\zeta_{ij}} + u_j^k + \varepsilon_{ij}^k \quad \text{(Eq. 7)}$$

Where,

V_{ij}^k is the transfer value from the k[th] subsidized commodity received by the i[th] household in the j[th] sub-district;

p_j^k is the mean market price of commodity k in the j[th] sub-district;

q_{ij}^k is the quantity of the kth rationed commodity acquired through the PDS, and $q_{ij}^{k\,2}$ is its quadratic term;

y_{ij} is total per capita consumption expenditures for the i[th] household in the jth sub-district;

z_{ij}^k is a binary variable indicating whether the household has purchased the rationed commodity from the market during the 7 day period of the diary; and

ζ_{ij} is a vector of household demographic variables including household size and the age and sex of the head of household.

The subscript notation in Eq. 7 follows the typical mixed model notation where ($\gamma_{\mathbf{n}0}$) represents the coefficient for the n[th] independent variable in the household level model (level 1) and where ($\gamma_{0\boldsymbol{n}}$) represents the coefficient for the n[th] independent variable in the level 2 model.

Building on the equality presented in Eq. 6, the specification in Eq. 7 would model the value of the subsidy to the household (V_{ij}^k) from the k[th] subsidized commodity received by the i[th] household in the j[th] sub-district as a function of the quantity of the subsidized commodity acquired by the household (q_{ij}^k) and market prices (p_j^k) of equivalent commodities[4]. From Eq. 6, it is apparent that the coefficients for the q_{ij}^k and p_j^k should be significant and positive. In other words, the value of the subsidy to a household is expected to be higher with greater quantities and higher market prices.

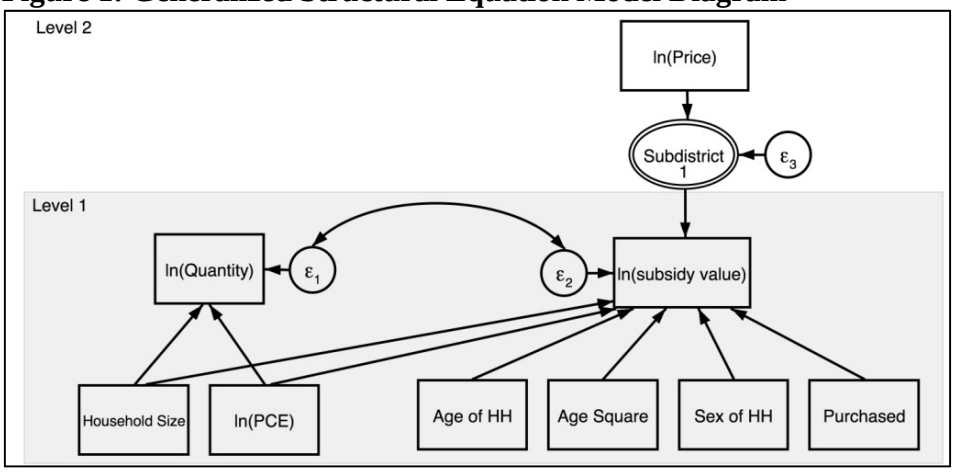
[4] This is equivalent to the reference prices (p_k^r) specified in Eq. 6.

The remaining independent variables in Eq. 7 are included to explicitly test for potential sources of biases in the price opinion data. Gibson and Rozelle (2005) contend that significant covariance with observable household characteristics ($\boldsymbol{\zeta_{ij}}$) would suggest the presence of bias due to differences in bargaining skills or the sort of quality and variety bias that are typically associated with unit values. If, after controlling for market prices and quantities acquired, the coefficient for per capita expenditure (y_{ij}) is significant, it can be concluded that the underlying price opinion data is influenced by the respondent's perception of the value of the transfer within the household budget. In addition, the coefficient for the binary variable (z_{ij}^{k}), which indicates whether the household had actually purchased from the market a quantity of the same subsidized commodity during the 7 day period of the diary is included to control for the possibility that respondents that have not recently purchased the commodity in the market may not know enough about either prices or the quality of the rationed commodity to provide reliable information.

However, it is also apparent that the model specified in Eq. 7 may suffer from endogeneity. Specifically, it is likely that the quantity of acquired subsidized goods (q_{ij}^{k}) and the value of the subsidy to the household (V_{ij}^{k}) are jointly determined. Such simultaneity in the model can lead to significant correlation between the error term (ε_{ij}^{k}) and quantity (q_{ij}^{k}), thus biasing the estimated coefficients.
A typical solution for this would be to apply instrumental variable regression techniques. However, instrumental variables that are simultaneously strongly correlated with the endogenous independent variable and uncorrelated with the model error term are famously difficult to find (Crown et al., 2011) while simply opting to exclude the endogenous variable would lead to omitted variable bias.

To address this concern, we opt to estimate the model as a generalized structural equation where the model for the value of the subsidy to the household (V_{ij}^{k}) is simultaneously estimated alongside a second model for the quantity of the subsidized commodity acquired by the household (q_{ij}^{k}). While the use of structural equation modeling remains somewhat uncommon in the economic literature, it is increasingly used in the food security literature (for example, Mohamed et al. (2017) or Deny et al., (2017)). Estimation of instrumental variable models, such as 2 Stage Least Squares (2SLS) or Latent Instrumental Variable, is also rather common in the structural equation modeling literature (for example, Hermida (2015) or Hueter (2016)). The flexibility of structural equation modeling makes it a natural choice for estimation of multilevel models (Kline, 2011). The system of equations estimated in this paper is illustrated in the diagram below.

Figure 1: Generalized Structural Equation Model Diagram



From the diagram it is apparent that the model for the value of the subsidy (V_{ij}^k) is identical to that specified in Eq. 7 with the exception of the quantity variable (q_{ij}^k) and its quadratic term, which are now excluded. Omitted variable bias due to the exclusion of (q_{ij}^k) is addressed by explicitly modelling the covariance of the error terms of both endogenous variables, represented by the curved double headed path between ε_1 and ε_2. Inclusion of covariance in the error terms is a common treatment applied in structural equation modeling when both endogenous variables share a common omitted cause (Kline, 2012). Since this is the assessed case for quantity and subsidy value, the above represents is a suitable approach to address potential endogeneity.

The double oval for the sub-district variable included in the diagram represents a multilevel component of the model. This is a feature of the generalized structural equation model function in Stata[5], which is the program used in the present estimation. The double oval indicates that sub-district is a latent multilevel variable whose hierarchical structure is defined by the sub-district variable in the data and market price data, which is constant within sub-districts, is the single predictor of this latent multilevel variable. Accordingly, this allows the estimation of the desired random intercept multilevel model. The shaded area in the diagram represents the household level components (level 1), while the non-shaded area of the diagram represents the sub-district level component (level 2).

$$\ln\left(V_{ij}^k\right) = \gamma_{00} + \gamma_{01} X^k + \gamma_{10} \ln\left(y_{ij}\right) + \gamma_{10} z_{ij}^k + \sum_1^n \boldsymbol{\gamma_{30}^{n0}}\, \boldsymbol{\zeta_{ij}} + \varepsilon_{ij}^k \qquad \text{(Eq. 8)}$$

$$X^k = \beta_{01} \ln(p_j^k) + u_j^k \qquad \text{(Eq. 9)}$$

[5] Stata 13.1 is used to estimate the model. Although it is the flexibility of the generalized structural equation model (gsem) functions within Stata that enables this estimation, this comes at a cost. The gsem function does not include goodness of fit estimates such as those found in the regular structural equation model function. It also does not allow the use of sample weights.

$$\ln(q^{ki}) = \upsilon_0^k + \upsilon_1^k \ln(y_i) + \upsilon_2^k s_i + e_i^k \quad \text{(Eq. 10)}$$

which follows the approach and notation specified in Eq. 7, though with the inclusion of the latent multilevel variable (X^k), which is simultaneously estimated in Eq. 9 as a function of sub-district level market prices. In addition, Eq. 10 models the quantity of kth subsidized good acquired by the ith household as a function of total per capita consumption expenditures y_i and total household size for the ith household. The estimation of the system of equations is subject to the constraint that the covariance of the error terms from Eqs. 8 and 9 and from Eqs. 9 and 10 is equal to zero
($\sigma_{\varepsilon_{ij}^k, u_j^k} = \sigma_{u_j^k, e_i^k} = 0$), and no such restriction is placed on the covariance of the error terms from Eqs. 8 and 10 so as to minimize omitted variable bias in Eq. 8 as discussed earlier.

4. Country Context and Data Sources

The Iraqi Public Distribution System (PDS) is a food rationing system that was established by the Government of Iraq in 1990 as a response to the crippling sanctions facing the country following the Iraqi invasion of Kuwait. Under the PDS, all residents of Iraq are entitled to a rationed monthly basket including food and non food items. The initial design of the food basket was altered in 1998 with the establishment of the Oil For Food Programme (OFFP) managed by the United Nations where the monthly food package for each adult individual included wheat flour (9 kilos), rice (3 kilos), sugar (2 kilos), tea (200 grams), vegetable oil (1.25 kilo), pulses (250 grams) and adult milk (250 grams). Infants under the age of 2 years received infant formula (1.8 kilo). The non food package included detergent (500 grams) and soap (250 grams) per person per month.

In 2010, the Government of Iraq decided to reduce the items distributed through the PDS down to 5 basic items including wheat flour, rice, sugar, vegetable oil or fat and infant formula for infants only (GOI, 2009). The same Government decree also stipulated the introduction of targeting – whereby households with income higher than 1.5 million Iraqi Dinars would be excluded from the PDS system. However, in practice, this step was never fully implemented as only 60,000 public sector employee families were removed from the PDS – approximately 1% of Iraqi households.

The supply chain of the PDS is managed by the Ministry of Trade whereas distribution of the food items to the general public is administered by a network of (approximately) 50,000 food and flour agents distributed throughout Iraq. Each family receives annually from the Ministry of Trade a paper coupon indicating the name of eligible individuals and their monthly package which can only be redeemed from a specific food/flour agent. To receive the entitled quantities, recipients pay the PDS agents the subsidized, official price. These are listed below in table 4.

Table 4: Official Rationed Prices and Open Market Prices for PDS commodities

	Official Price (Iraqi Dinars)	Market Price (Iraqi Dinars)
Brown Wheat Flour (1 kg)	6	493
Rice (1 kg)	10	1,290
Sugar (1 kg)	12	1,337
Vegetable Oil (1 ltr)	6	2,187
Vegetable Fat (1 kg)	6	2,241

Source: Average of 2011-Q1 market price bulletin.

Considering the official ration size, the average Iraqi above the age of 2 years should pay 114 ID monthly to receive a food package, the value of which is 13,207 ID. Families with infants pay 208 ID monthly for infant formula valued at 24,116 ID per infant. That is to say that the market value of the rationed commodities is approximately 115 times the official price.

Equivalent food commodities as those received through the PDS are also available on the Iraqi markets. Households are free to purchase any quantity of these food items from the market at normal market prices.

Moreover, as wealthier Iraqi households seeking higher quality commercial food commodities often sell their rationed food items to their PDS agents, the rationed food items are also frequently found on the market. Therefore, while officially a rationing system, the PDS imposes no effective limits on quantities acquired outside of the rationed food basket as no restrictions exist on the private sector to trade the same food commodities. Iraqis frequently purchase equivalent food items from the commercial food retail sector at prices set by market forces rather than officially set prices. Considering the lack of effective rationing of consumption, the PDS is best described as a consumer subsidy.

Inefficiencies in the PDS supply chain further undermine its role as a rationing tool. As shown in table 5, only a small proportion of households actually are able to acquire their sugar and vegetable oil/fat rations. The responsibilities for the procurement and distribution of the commodities in the PDS ration are divided between two state owned companies. The State Company for Grain Trade, responsible for the procurement and distribution of wheat flour and rice, manages a more efficient supply chain than the State Company for Food Stuff Trade, which is responsible for the sugar and vegetable oil/fat supply chains. Accordingly, Iraqi households often procure their basic food commodities, including those within their PDS ration, in the market.

Table 5: Percent of Households acquiring their PDS ration items by item and month

	Jul-2010	Aug-2010	Sep-2010	Oct-2010	Nov-2010	Dec-2010	Jan-2011
Wheat Flour	71.7%	75.1%	75.7%	75.7%	71.4%	66.4%	62.2%
Rice	61.2%	66.0%	67.0%	67.0%	64.1%	62.1%	62.7%
Sugar	4.7%	11.0%	8.1%	4.8%	2.4%	1.5%	2.4%
Oil	21.4%	28.0%	27.4%	25.3%	21.9%	17.0%	14.6%
Fat	6.4%	7.0%	7.6%	8.4%	10.4%	15.6%	20.0%

Source: IKN Tabulation Report (IKN 2011)

Data Sources

Two main sources of data are utilized in the analysis. Micro data on household consumption expenditures – including actual expenditures and quantity of acquired food and non food items – is provided through a survey on a representative sample during the first quarter of 2011. Data on market prices are also utilized.

The survey, called the Iraq Knowledge Network (IKN) survey was administered by the Iraqi Central Statistical Organization (CSO) to approximately 30,000 households distributed in all districts of Iraq and provides detailed information on the quantity of food acquired during a 7 day period and registered in a household diary maintained by the household. Information on detailed non-food expenditures during variable periods ranging from 1 month for recurrent non-food expenditures up to 12 months on education and durable goods are collected during the first household visit.
The data collectors visited each household a total of 3 times where the basic questionnaire was administered in the first visit and the method to fill the diary was explained to the household. The second visit occurred 3 days after the first household visit and the progress in filling the diary is reviewed. During the second visit, quantities of food received from the PDS were recorded and respondents provided price opinion data on a list of commodities normally received through the PDS. The third visit occured 8 days after the first household visit and included a revision of the diary for the whole 7-day reference period and the diary is then taken from the household and sent for quality check and data entry.

Data from the 2007 Iraq Household Socio Economic Survey (IHSES) is also utilized in this study. The survey sample consists of 17,822 households distributed over the course of 12 months of the year. The expenditure diary and PDS questionnaires from the IHSES survey are virtually the same as those from the IKN 2011 survey.
The main types of food price data used in this paper include: (a) market prices represent prevailing prices for food commodities at commercial retail outlets. This data is collected through a monthly survey of a sample of retail outlets for the purpose of updating Consumer Price Index estimates; (b) food price opinions are estimates of equivalent market prices of the subsidized, rationed food commodities included in the Public Distribution System; (c) official prices represent the nominal prices for the rationed food commodities included in the Public Distribution System as set by the Government of Iraq, and are invariant across regions and households, and (d) paid prices represent unit values for all rationed and non-rationed food commodities. For rationed food items, paid prices represent effective subsidized prices and are a reflection of official prices set by the Government but may differ from official prices in instances where additional transaction costs are added by the PDS agents.

The Iraqi Central Statistical Organization (CSO) relies upon both unit values and price opinions in the calculation of the welfare aggregate – real consumption expenditure – utilized in measuring the welfare of Iraqi households. In the context of Iraq, price opinions are utilized to approximate free market prices of the rationed PDS food commodities and unit values are utilized for all non-rationed goods and services.

In the 2011 IKN 2007 IHSES surveys, respondents are requested to provide an estimate of the price of a unit of the received food item, either a kilogram or liter, in the local market. The respondent is specifically requested to provide the market price of a commodity of equal quality to that received through the PDS. The relevant portion of the questionnaire is included in Appendix A.

A couple of concerns with the questionnaire design arise when accounting for the acquisition of the PDS food items: The first being that the reference period for the acquisition of the PDS food commodities is for 30 days, whereas the diary, which covers a period of 7 days, includes all other commodities purchased from the market on a regular basis. The second concern is that actual paid prices for the PDS commodities are not specified per item. Instead, total expenditures for the acquisition of the available commodities within the PDS food basket are grouped, preventing the direct calculation of unit values. The standard practice applied by the Iraqi Central Statistical Organization to impute paid prices for each PDS commodity is to estimate the proportional difference between the actual paid amount for the package received and the expected amount under official prices. This proportion is then used to inflate or deflate the estimated paid prices for each commodity. This imputation is also applied to the data used in the analysis performed for this paper.

Data on market prices for 446 food and non-food items collected monthly from urban centers for the purpose of updating the national and regional Consumer Price Index (CPI) is provided by the Iraqi CSO. The data is collected from 38 sub districts; 2 from each governorate, where each governorate capital is included as well as the second most populous sub district. Accordingly, the data originates from markets servicing approximately 67 percent of the Iraq population in the base year of 2007. Although the IKN micro data set is collected from all districts in Iraq and covers both urban and rural populations, the data utilized in fitting the estimation models originates only from households within the 38 sub districts included in the market price survey sample. The IKN sample from these sub districts is 3,785 households.

For the purpose of this analysis, market price data was utilized for the following items: local brown wheat flour, Thai rice, Brazilian sugar, Turkish and U.A.E vegetable fat, Turkish and U.A.E vegetable oil and French infant formula. The items were selected for their comparability to the commodities rationed through the PDS.

Special attention is necessary when utilizing the consumer price indices produced by the Iraqi CSO given the unique approach adopted in dealing with the PDS rationed food items. The food price index in Iraq is based upon the Laspeyres formula with commodity weights estimated using unit values for all food items, except the rationed food items, which are valued using price opinion data. However, official prices are used in producing relative price growth per PDS commodity. Accordingly, the CSO applies price opinion data to estimate the commodity weights and official prices to estimate relative price growth per commodity, which is an inconsistent use of price data.

Moreover, given the changes in the PDS system occurring in 2010 – namely the reduction of the PDS food basket – and the resultant changes in consumption patterns, it is expected that the Laspeyres price index which relies on base year commodity weights would over estimate

inflation during the period in question as it does not account for substitutions made by consumers.

To address these concerns, two new food price indices are calculated and used in this paper. First, a price index using official prices for rationed food items to measure item weights is calculated based upon the Fisher price index formula, which accounts for substitution of goods. The second price index is the same, though calculated using price opinion data for rationed food items to measure item weights. The market price data for 2007 and 2011 for the included food items is provided by the Iraqi CSO. Official prices are equal to those listed in table 4. The final price indices valued with both paid prices and price opinion data are presented in table 6 below.

Table 6: Food Price Indices with official prices and price opinions for Q1-2011 (2007=100)

	Official Price Weights	Price Opinion Weights
Laspeyres Index	140.97	134.86
Paasche Index	129.01	126.31
Fisher Index	134.86	130.51

Source: Authors calculations

5. Model Results and Diagnosis

Five multilevel models estimating fixed effects allowing random slopes are fitted – one for each of the following rationed food items: Wheat Flour, Rice, Vegetable Oil, Vegetable Fat and Sugar. The generalized structural equation models followed the specification set out in Eqs. 8 through 10, with the main hypothesis being that for Price Opinion data to be considered as unbiased reflections of market prices, the parameter estimates for market prices and quantities acquired on the value of subsidy (V_i^j) should be significant and positive while other significant parameters would be considered sources of bias. Table 7 presents the relevant parameter estimates with the full list of results included in Appendix B.

Table 7: Estimated parameters for the value of subsidy from wheat flour, rice, vegetable oil, vegetable fat and sugar (2011)

	Rice	Wheat Flour	Veg. Oil	Veg. Fat	Sugar
Intercept, (γ_{00})	2.423	-3.601**	1.600	0.721	2.673
	(1.655)	(1.408)	(1.762)	(1.012)	(2.115)
Ln(Price), (β_{01})	-0.284	0.759***	-0.117	0.056	-0.234
	(0.229)	(0.200)	(0.227)	(0.135)	(0.284)
Ln(Expenditure), (γ_{10})	-0.046**	-0.059***	-0.024	-0.083**	-0.032**
	(0.020)	(0.016)	(0.017)	(0.028)	(0.013)
household size, (γ_{30})	0.140***	0.133***	0.153***	0.115***	0.155***
	(0.008)	(0.006)	(0.020)	(0.010)	(0.009)
Sex of Household head, (γ_{40})	0.018	0.015	0.025	0.007	0.006
	(0.023)	(0.010)	(0.016)	(0.022)	(0.029)
Age of Household head, (γ_{50})	-0.000	0.003	-0.003	0.001	-0.005***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Age of Household head squared, (γ_{60})	0.000	0.000	0.000	0.000	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Purchased, (γ_{20})	-0.023	-0.020	-0.123	-0.057	0.048***
	(0.023)	(0.024)	(0.129)	(0.069)	(0.016)
$Cov(\varepsilon_{ij}^k, e_i^k)$	0.078***	0.058***	0.073***	0.049***	0.038***
	(0.015)	(0.007)	(0.012)	(0.007)	(0.004)
Sample Size (N)	*2,769*	*3,094*	*846*	*1,064*	*559*

*Source: Authors Calculations using IKN 2011 data. Robust Std. Errors in parentheses. *** signifies over 99% confidence; ** signifies over 95% confidence; * signifies over 90% confidence.*

Focusing on the estimated coefficients, as expected, covariance of the error terms from the model for the value of subsidy and the model for the quantity of acquired subsidized goods ($Cov(\varepsilon_{ij}^k, e_i^k)$) are all positive and significant. This indicates that the value of the subsidy is positively and significantly associated with the quantity of the rationed commodities acquired by the households. However, the model results do not appear to be so well behaved when considering the coefficients for market prices.

Normally, it would be expected that the transfer value of subsidy increases with market prices. Yet, this expectation holds only for wheat flour with a positive and significant coefficient for market price (0.759). For the remaining goods, the coefficients are not significant and for rice, vegetable oil and sugar, the coefficients are negative.

The coefficients for per capita consumption expenditure are significant and negative for all but vegetable oil. This is a particularly important result to note as it bears significance on the reliability of welfare analysis performed with price opinion data. In effect, this implies that as

the level of welfare improves over time, the estimated income transfer due to the subsidy would diminish regardless of whether this is accompanied by a reduction in reliance on the subsidy.

The coefficients for household size are all positive and significant, implying that larger households place a higher value for the subsidy even when holding constant per capita consumption expenditure. The remaining demographic variables (age and sex of household head) are insignificant across the models except for sugar, where the coefficient for the age of household head and its quadratic term are significant – albeit with rather small magnitude.

The coefficients for the binary variable indicating whether the household had actually purchased quantities of the rationed commodity in the market within 7 days of the survey are insignificant, the only exception being sugar where households that have purchased this commodity within the reference period of the survey value it 5 percent more, on average, than the remaining households.

Overall, the results indicate that price opinion data produce counter-intuitive valuations of the income transfer value of the food subsidy. Referring back to Eq. 6, it is evident that the value of subsidy from the kth food commodity (V_i^k) should be increasing in quantity q_i^k and reference market prices. This holds for quantity, as expressed in the significant and positive covariance of the error terms from the value of subsidy model and the quantity model ($Cov(\varepsilon_{ij}^k, e_i^k)$). However, the model results indicate that value of the food subsidy – and by extension price opinion data – is independent of prevailing market prices. The exception being wheat flour where the estimated coefficient is both positive and significant, as it should be.

To estimate the ratio of variance in the dependent variable – the value of subsidy – that is explained by differences between geographic areas a random effects ANOVA is fitted for each commodity and the intra-class correlation ($\hat{\rho}$) is computed as:

$$\hat{\rho} = \frac{\hat{\tau}_{00}}{\hat{\tau}_{00} + \hat{\sigma}^2} \qquad \text{Eq. 11}$$

Where $\hat{\tau}_{00}$ represents the variance of level 2 intercept and $\hat{\sigma}^2$ is the error variance. These are presented in table 8 below for each of the five commodities.

Table 8: Variance in value of subsidy due to differences across sub-districts

	Rice	Wheat Flour	Veg. Oil	Veg. Fat	Sugar
Variance(Constant) - $\hat{\tau}_{00}$	0.0516	0.0516	0.0582	0.0326	0.0825
Variance(Residual) - $\hat{\sigma}^2$	0.5100	0.4931	0.4903	0.4186	0.4406
ICC - $\hat{\rho}$	0.0919	0.0947	0.1060	0.0722	0.1577

Source: Authors Calculations using IKN 2011 data.

Differences across sub-districts explain as much as 15.77% of the variance for the value of subsidy from rationed sugar to as little as 7.2% for vegetable fat. Naturally, the remaining

variance can be expected to be due to individual household factors. For the full model, a "reduction in error variance" pseudo R^2 is estimated using

$$R^2 = 1 - \frac{\tau_{00}^{new}}{\tau_{00}^{old}} \quad \text{Eq. 9}$$

Where τ_{00}^{new} is the total variance from the full fixed effects-random slopes model and τ_{00}^{old} is the variance from the random effects ANOVA.

Table 9: Variance in value of subsidy due to differences across sub-districts

	Rice	Wheat Flour	Veg. Oil	Veg. Fat	Sugar
Variance(ANOVA) - τ_{00}^{old}	0.304	0.274	0.283	0.265	0.245
Variance(Full) - τ_{00}^{new}	0.118	0.079	0.102	0.079	0.050
Pseudo R^2	0.613	0.713	0.637	0.702	0.795

Source: Authors Calculations using IKN 2011 data.

As evident in the pseudo R^2, accounting for both fixed and random effects explains as much as 79.5% of the variance in the subsidy transfer value from sugar and only 61.3% from rice. Compared to the explained variance from the random effects model, variation between sub-districts in market prices and individual household attributes contribute a great deal to explaining the variance in the value of subsidy from the rationed goods.

6. Implications for welfare analysis in Iraq

The results of the models presented in section 2.8 indicate that individual responses to price opinion questions are not strongly influenced by actual market prices of equivalent commercial commodities and are negatively influenced by general welfare levels.

The implication of this result is illustrated by comparing real growth achieved from 2007 to 2011 in per capita food expenditures – and the prevalence of poverty – valued at actual paid prices with per capita expenditures – and the prevalence of poverty – valued using the price opinions for rationed food commodities.

Expenditure on food

Comparing real growth in expenditure on food valued with paid prices with food valued with price opinions reveals significant differences in estimated growth (see table 10). Compared to 2007, real expenditure on food increase by 3.98 percent in 2011 when valued with paid prices. In comparison, real food expenditures valued with price opinions decreased by 0.47 percent during the same period.

Table 10: Growth in total food consumption valued by source of price data among urban households

	Paid prices (1000 ID/person/day)	Price opinions (1000 ID/person/day)	Dietary Energy Consumption (kcal/person/day)
2007	1.44	1.65 ID	2,588 kcal
2011 (Q1)	2.01	2.15 ID	2,738 kcal
Nominal Change 2011	40.23%	29.89%	---
Real Change 2011*	3.98%	-0.47%	5.80%

*Source: Authors Calculations. * Food price inflation in 2011 (Q1) is set at 34.86% for paid prices and 30.51% for price opinions compared to 2007 in line with the fisher index estimates presented in table 6.*

The fact that price opinion data is only applied to rationed food commodities suggests that biases in respondent estimates of price opinion data, as highlighted by the model results presented in section 2.8, accounts for the difference in food expenditure growth rates. During the same period, Dietary Energy Consumption (DEC) increased by 5.8 percent.

Food Price Index estimated with paid prices item weights provides an estimate of inflation (34.86%) between 2007 and 2011 (Q1), which is fairly close to food price inflation measured by the growth in dietary energy unit values (32.54%) that are also estimated with paid prices. The difference between the two measures for paid prices reflects calorie efficient substitutions made by the Iraqi consumer as a result of changing prices.

Table 11: Dietary Energy Unit Values and Food Price Indices for urban households

	2007	2011 (Q1)	Growth (%)
Dietary Energy Unit Value (ID/1000 kcal) – Paid Prices	555	735	32.54%
Food Price Index (2007=100) – Paid Price	100	134.86	34.86%
Dietary Energy Unit Value (ID/1000 kcal) – Price Opinion	639	784	22.78%
Food Price Index (2007=100) – Price Opinion	100	130.51	30.51%

Source: Authors Calculations

In contrast, significant differences between inflation measured by the Food Price Index calculated with price opinion item weights (30.51%) and the inflation measured by the growth in dietary energy unit values (22.78%) that are estimated using price opinions. The discrepancies in inflation measured in paid prices and price opinions can be explained through examining the unit values of dietary energy from direct purchases and from the PDS rationed items. These are listed for urban households in table 12.

Table 12: Unit Values of Dietary Energy acquired from direct purchases and the PDS by urban households.

	2007	2011 (Q1)	Growth (%)
Dietary Energy Unit Value of purchased food (ID/1000 kcal)	1,154	1,100	- 4.62%
Dietary Energy Unit Value of PDS rationed food – **Paid Price** (ID/1000 kcal)	0.015	0.002	- 84.82%
Dietary Energy Unit Value of PDS rationed food – **Price Opinions** (ID/1000 kcal)	0.175	0.160	- 8.66%
Contribution of PDS rations to total calorie consumption (%)	51%	32%	- 37.19%

Source: Authors Calculations

When evaluated independently, the cost of dietary energy from direct purchases and from the PDS ration have declined in the period between 2007 and the first quarter of 2011 (table 12). On average, unit values of dietary energy acquired by urban households decreased by 4.62% for direct food purchases from the market[6] and by 84.82% for food acquired from the PDS. When valued with price opinions, unit values of dietary energy from the PDS also decreased – although only by 8.66%.

With unit values falling for both purchased food and rationed food, it is apparent that the main driver of inflation in food prices faced by the Iraqi consumer is the shift from reliance on the PDS as the major source of dietary energy consumed in Iraq, which provided half of the calories consumed by urban households in 2007, towards the reliance on food purchased on the marketplace.

Following the above, a variation in the estimated growth in overall consumption expenditure can be expected. Growth in per capita monthly expenditures valued with both paid prices and price opinions reveals contradictory trends. When valued with paid prices, average consumption appears to increase slightly in real terms – up by 1.2 percent in 2011. When valued with price opinions, however, average consumption decreases significantly in real terms – down by 4.8 percent in 2011.

Table 13: Real growth in overall consumption expenditures by source of price data (2007-2011)

	Paid prices (1000 ID/person/month)	Market prices (1000 ID/person/month)
2007	132.2	145.8
2011 (nominal)	174.2	180.7
Real growth* (%)	1.2%	-4.8%

Source: Authors Calculations. Overall inflation between 2007 and Q1-2011 as measured by the national CPI is 30.2%

[6] As this reflects direct purchases, no this figure is only estimated with paid prices.

Poverty line and prevalence

Setting of the poverty line and estimating the prevalence of poverty using both official prices and price opinions provides further evidence that price opinion data and actual paid prices may lead to different results when focusing on change over time. The poverty line and headcount index is estimated using welfare aggregates calculated with paid prices for commercial goods and price opinions for rationed goods, compared with another welfare aggregate calculated with paid prices for both commercial and rationed goods. These are calculated in 2007 and 2011 to compare the evolution of poverty over time using different price measures for rationed goods.

The poverty line is estimated using the Cost of Basic Needs approach where a food poverty line is set to be equal to the minimum cost of acquiring a balanced diet[7] offering 2,100 kilocalories. The cost of 1000 kilocalories in 2007 for the second expenditure decile[8] was estimated at 389.5 Iraqi Dinars in paid prices and 488.2 Iraqi Dinars when using price opinion data.

The non-food component of the poverty line is defined as the empirical average per capita monthly expenditure on non-food consumption items for those with food expenditures equal to the food poverty line, estimated using the regression method[9]. Spatial price deflators are calculated for each set of price data to deflate the welfare aggregate in both years.

Table 14: Poverty Line and Headcount Index using official prices and price opinion 2007 and Q1-2011

	Paid Prices		Price Opinions	
	2007	2011*	2007	2011
Food Poverty Line (Dinar/Person/Month)	24,878	---	31,184	---
Non Food Poverty Line (Dinar/Person/Month)	40,986	---	40,525	---
Poverty Line (Dinar/Person/Month)	65,864	86,451	71,709	93,365
Poverty Headcount Index (Standard Error in Brackets)	25.87% (0.00599)	24.09% (0.00414)	25.28% (0.00591)	24.99% (0.00419)

Source: Authors Calculations. ***** *Published national inflation figures for the period between 2007 and Q1 2011 is 30.2%*

[7] A balanced diet here is taken to mean that the contribution of energy-yielding nutrients to total energy ranges from 10 to 15 percent for proteins, from 15 to 30 percent for fats and from 55 to 75 percent for carbohydrates.

[8] Dietary energy unit values for the second decile were used as this is the lowest income group with a balanced diet and where the average dietary energy consumption is at least 2,100 kilocalories per person per day. In this case, average dietary energy consumption for the second poorest decile was 2,120 in 2007.

[9] This approach measures the average Engel ratio for households at or near the poverty line, here ±25% the poverty line, and the non food component of the poverty line is calculated by multiplying the food poverty line by the inverse of the average Engel ratio.

The choice of price data influences the overall poverty line – with the only difference being in the value of the food poverty line component – although the choice of price data does not significantly affect the poverty prevalence at the base year (2007). As is evident in Table 14, the 2007 poverty headcount index is estimated at 25.87 percent when measured using paid prices and 25.28 percent when measured using price opinion data[10] – virtually equal.

However, it is also apparent that the trend in the evolution in the prevalence of poverty over time deviates depending on the choice of price data. After adjusting the poverty line by accounting for inflation, the prevalence of poverty using paid prices falls to 24.09 percent in 2011, a statistically significant reduction (t=2.44; P=0.0146). In contrast, the prevalence of poverty using price opinion data remains in 2011 statistically equivalent to the 2007 prevalence (t=0.402; P=0.688).

Recognizing the problem of valuing subsidized PDS items, particularly in light of the difficulty faced in collecting price opinion data, the World Bank (2014) argued in favor of valuing PDS items at the national median of the price opinion data for the estimation of poverty in 2012. Although it is typical to estimate the income transfer value of the subsidy using average prices of substitutes, the benefit of applying this to the welfare aggregate used in poverty measurement is questionable. In the decision to value PDS commodities using the national median of the price opinion data or with official paid prices, it is clear that both would produce the same rank order of households as both the median price opinion data and the official paid prices are constant for all households.
To answer the question of which choice of price data produces more accurate trends of welfare, trends in other indicators of socio economic wellbeing are compared with the poverty trends produced by paid prices and price opinions.

Table 15: Trends in food deprivation, daily wages and unemployment rate between 2007 and 2011

	Food Deprivation (Paid Prices)	Food Deprivation (Price Opinions)	Avg. Daily Wages (ID/day)	Unemployment rate*
2007	7.05%	7.32%	12,000	15%
2011	5.67%	5.71%	20,200	11%
Growth (%)	-19.57%	-21.99%	29.3%	-26.7%

Source: Authors calculation using published inflation rate between 2007 and Q1-2011 of 30.2%. * Relaxed ILO definition which includes discouraged workers.

As highlighted by the figures in table 15, a number of indicators display an improvement in the standard of living of the Iraqi population between 2007 and 2011. During this period a sizable

[10] It should be noted that the estimation of the food and non food poverty lines as well as the prevalence of poverty in this paper differs significantly from that estimated and published by the Government of Iraq, with assistance from the World Bank. The main reason for this difference is the lack of sufficient data in the 2011 IKN data set to estimate consumption flow from durable goods. The measure of per capita consumption expenditures used by the Government of Iraq accounted for durable goods. Accordingly, the poverty line was set at 76,896 ID per person per month and the prevalence of poverty was estimated at 22.9 percent. For the purpose of this study, and only to ensure comparability between the 2007 and 2011 measures of welfare, per capita consumption expenditures measured in both 2007 and 2011 did not account for durable goods. As such, these results are not comparable to those estimated by the Government of Iraq.

reduction in violent incidents and insecurity occurred. Statistics on the number of security incidents leading to civilian deaths show an improvement with the average number of recorded civilian deaths falling from 747 civilians per month in 2007 down to 129 civilians per month in 2011 due to the conflict[11]. The reduction in violent incidents had a positive impact on the labour market as witnessed by the reduction in overall unemployment rates (-26.7%) and the increase in daily wages (29.3%).

In addition, the prevalence of food deprivation[12] (undernourishment) is estimated to have fallen between 2007 and 2011. Table 15 lists the prevalence of food deprivation for both years estimated using paid official prices and price opinions. Although measuring food deprivation relies primarily on kilocalorie consumption, data on consumption expenditures is used to estimate inequality in access to food due to income. Therefore, it is conceivable that the choice of price data could lead to varying estimates of food deprivation. However, the results of food deprivation analysis presented in table 15 suggest that the estimated prevalence of food deprivation is fairly robust to the choice of price data (7.05% and 7.32% in 2007 or 5.67% and 5.71% in 2011). It follows that the reduction in food deprivation witnessed between 2007 and 2011, along with the reduction in unemployment, increased daily wages and the near six-fold reduction in violence levels during the same period offer greater credibility to the trend in poverty prevalence measured using paid prices.

7. Conclusion

The choice of price data used in the construction of the welfare aggregate is known, both in theory and in practice, to bear consequences on the validity of welfare analysis.

In theory, market price data and prices actually faced by consumers are important inputs in the process of creating 'real' welfare measures that allow the ranking of households according to their welfare level (Samuelson, 1974). The problem of the choice of price data arises in the theoretical development of the concept of money metric utility, which is shown to be very sensitive to the choice of reference prices (Blackorby and Donaldson, 1988).

Moreover, the problem of the choice of price data is further complicated where selective consumption subsidies or rationing exist. In such contexts, the policy environment specifically prevents prices from reflecting the market conditions of supply and demand so that prices faced by households could be significantly different depending on the coverage of the policy and strictness of the rationing regime (Hentschel and Lanjouw, 1996).

In practice, welfare analysts invest little effort in considering the source of price data when designing consumption surveys, often leading them to spend precious time 'cleaning' the data after the field work has concluded. Much effort has been invested in developing methods that

[11] According to Iraq Body Count. https://www.iraqbodycount.org

[12] Food deprivation, or the prevalence of undernourishment, reflects the proportion of the population whose consumption of kilocalories is less than the minimum dietary energy requirements for that population (FAO, 2006). For technical details, see Section 5.3.

cope with the drawbacks of the widely used quasi-price measures – unit values (Capéau and Dercon, 2006).

However, little attention has been given to the performance of price opinion data, which is commonly collected in countries with food consumption subsidies. The evidence presented in this paper leads to the conclusion that requesting consumers to directly provide their opinion of the market price of subsidized or rationed food commodities elicits biased responses.

Instead of reflecting market conditions, price opinions of subsidized food commodities are influenced by the importance of the subsidy in the household economy – a reflection of household welfare levels and preferences. The transfer value of the subsidy, estimated as the difference between market price opinions and actual paid, official, prices decreases with rising welfare and is unaffected by prevailing market prices.

Evidence presented in this paper suggests that this bias has implications on welfare analysis. While estimation of the poverty headcount in any given year may be equal when estimated using paid official prices or price opinion data, the choice of price data leads to different trends in the growth of consumption expenditure and poverty over time. The results of the estimation models indicate that the transfer value from subsidized commodities, on the whole, decreases with rise welfare, thus counteracting the effect of rising welfare by artificially deflating consumption expenditure.

Observed against the backdrop of other indicators, all of which indicate an improvement in welfare levels between 2007 and 2011, per capita food consumption expenditures and overall consumption expenditures constructed using price opinion data for the subsidized food commodities indicate deterioration in welfare levels. The poverty headcount index estimated using price opinion data shows no improvement in the period between 2007 and 2011 despite the increase in real wages, reduction in unemployment and food deprivation during the same period.

In contrast, using paid prices in constructing consumption expenditures produces a trend that is free of the biases affecting price opinion data and which is consistent with the picture painted by other indicators of wellbeing and standard of living. Consequently, in the context of consumption subsidies and imperfectly imposed rationing, such as that in Iraq, the use of paid prices to value subsidized commodities in constructing a welfare aggregate is preferable to using price opinion data.

This paper contributes to a deeper understanding of the drawbacks associated with the use of respondent price opinions of subsidized or rationed food commodities as proxies for virtual prices. The analysis shows that though price opinions are influenced – as they should be – by the quantity of the subsidized good consumed by the respondents, they are also not associated with the market prices of their unsubsidized, free market equivalents. The implication of this in the context of Iraq is the tendency to underestimate the income transfer value of food subsidies and biasing poverty measurement.

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9. Appendices

Appendix A: IKN Ration Module including price opinion question

ITEM CODE	When was the last time the house hold received the [**ITEM**] from the agent? Enter number of months below * Enter 0 if within past 30 days * Enter 99 if never received	What is the quantity of the [**ITEM**] that you have received the last time?	How many months are covered by this quantity?	What price would you pay to purchase the quality of the [**ITEM**]?	What was the quantity that you gave away (donated)? Write "zero" if nothing	What was the quantity that you sold or traded of the [**ITEM**] that was received?	To whom did you sell or trade this [**ITEM**]? 1. Relative or friend 2. Supply agent 3. Restaurant /workshop 4. Person buying rations 5. others
	Item	**Quantity**	**Months**	**Dinar**	**Quantity**	**Quantity**	**Code**
1	Wheat flour						
2	Rice						
3	Sugar						
4	Vegetable Oil						
5	Vegetable fat						
6	Powder milk						

Appendix B: Full Structural Equation Model Results

	Rice	Wheat Flour	Veg. Oil	Veg. Fat	Sugar
Value of Subsidy Model (Eq. 8)					
Intercept, (γ_{00})	2.423 (1.655)	-3.601** (1.408)	1.600 (1.762)	0.721 (1.012)	2.673 (2.115)
X, (β_{01})			Constrained = 1.000		
Ln(Expenditure), (γ_{10})	-0.046** (0.020)	-0.059*** (0.016)	-0.024 (0.017)	-0.083** (0.028)	-0.032** (0.013)
household size, (γ_{30})	0.140*** (0.008)	0.133*** (0.006)	0.153*** (0.020)	0.115*** (0.010)	0.155*** (0.009)
Sex of Household head, (γ_{40})	0.018 (0.023)	0.015 (0.010)	0.025 (0.016)	0.007 (0.022)	0.006 (0.029)
Age of Household head, (γ_{50})	-0.000 (0.002)	0.003 (0.002)	-0.003 (0.003)	0.001 (0.002)	-0.005*** (0.002)
Age of Household head squared, (γ_{60})	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000** (0.000)
Purchased, (γ_{20})	-0.023 (0.023)	-0.020 (0.024)	-0.123 (0.129)	-0.057 (0.069)	0.048*** (0.016)
$Cov(\varepsilon_{ij}^k, e_i^k)$	0.078*** (0.015)	0.058*** (0.007)	0.073*** (0.012)	0.049*** (0.007)	0.038*** (0.004)
Quantity Model (Eq. 10)					
Intercept, (υ_0^k)	2.249*** (1.109)	-3.340*** (0.094)	0.835*** (0.167)	1.573*** (1.012)	1.602*** (0.095)
Ln(Expenditure), (υ_1^k)	-0.057*** (0.015)	-0.056*** (0.013)	-0.017 (0.018)	-0.076*** (0.018)	-0.035*** (0.011)
household size, (υ_2^k)	0.137*** (0.007)	0.133*** (0.006)	0.156*** (0.019)	0.117*** (0.008)	0.152*** (0.009)
Latent Multilevel Model (Eq. 9)					
Ln(Price), (β_{01})	-0.284 (0.229)	0.759*** (0.200)	-0.117 (0.227)	0.056 (0.135)	-0.234 (0.284)
Error Variances					
$\sigma_{e_{ij}^k}$	0.118 (0.020)	0.079 (0.012)	0.102 (0.019)	0.079 (0.007)	0.05 (0.006)
$\sigma_{u_j^k}$	0.054 (0.024)	0.025 (0.008)	0.014 (0.005)	0.015 (0.004)	0.005 (0.002)
$\sigma_{e_i^k}$	0.077 (0.015)	0.058 (0.007)	0.072 (0.011)	0.049 (0.007)	0.037 (0.003)
Sample Size (N)	*2,769*	*3,094*	*846*	*1,064*	*559*
Log Pseudolikelihood	*-2337.8*	*1547.3*	*210.5*	*-819.0*	*591.9*

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