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Calories, Conflict and Correlates: Redistributive Food Security in Post-Conflict Iraq

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Abstract

Availed, voluminous, consumption records; military incursion impacting social infrastructure; and the over-arching desire to quantify food intake in the presence of policy 'safeguards;' make ideal, war-torn Iraq, 2009, as a laboratory for food-policy social experimentation. Evidence (16,749 records on household calorie intake) enables formal assessment of the multifarious complexities impacting Iraqi food security. Among other findings, expenditure elasticities are negative and dramatically declining with respect to wealth; and an estimated additional US$1.89 is required, daily, in order to elevate the representative household to the national minimum recommended intake level. Policy implications are derived and extensions are discussed with reference to Bayesian inferential and predictive procedures (105 words).

Keywords: Calories, conflict, correlates, public intervention, Iraq (6 words).

Journal of Economic Literature Classifications: O12 Microeconomic Analyses of Economic Development P25 Socialist Systems and Transitional Economies, Rural, Urban and Regional Economics, Q18 Agriculture, Agricultural Policy and Food Policy.

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Abstract

Availed, voluminous, consumption records; military incursion impacting social infrastructure; and the over-arching desire to quantify food intake in the presence of policy 'safeguards;' make ideal, war-torn Iraq, 2009, as a laboratory for food-policy social experimentation. Evidence (16,749 records on household calorie intake) enables formal assessment of the multifarious complexities impacting Iraqi food security. Among other findings, expenditure elasticities are negative and dramatically declining with respect to wealth; and an estimated additional US$1.89 is required, daily, in order to elevate the representative household to the national minimum recommended intake level. Policy implications are derived and extensions are discussed with reference to Bayesian inferential and predictive procedures (105 words).

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Highlights

• Iraqi households allocate, on average more than half of their food expenditures to vegetables and meat.
• Average per capita calorie consumption is about 3.7 percent below the national minimum recommended.
• In order to meet minimum sufficient requirements, individuals need approximately US$1.89 daily a*dditional* income units.
• An economic growth policy that leads to an increase of household income, especially for those at low income levels, can eliminate inadequate caloric intake, alleviate under-nutrition, and mitigate poverty.
• Removal of the so-called *Public Distribution System* for food items and redistributing, in lump-sum transfer, the public expenditure savings is Iraq's most attractive 'food-securing intervention.'

Contents:

Introduction

As well as sustaining productivity and embellishing economic activities, access to food is considered one of the most fundamental of human rights (Sen, 1981). Entitlements versus availabilities (Sen, 1981; Bowbrick, 1986; Devereux, 1988) continue to consume considerable econometric labour; have a long and important evolution; and cause us often to ponder the existence of competing theories in the presence of significant demand shocks. These foci are over-arched and compounded, no less, by the ever-present persistence of supply shocks inherent in all agricultural and land-based systems. The new horizon, with emphasis on climate change (Bohle, Downing and Watts, 1994; Barnett and Adger, 2007), biological (Lal, 2004) and chemical (Carvalho, 2006) innovations; and a plethora of attentions surrounding what we produce, how we produce, and who gets what we produce; continue to belie methodological concerns. Notwithstanding, the problem of prediction inevitably arises (Lobell *et al.*, 2008). In these and other contexts, the investigator confronts inevitable uncertainty. There is uncertainty about the form of an appropriate specification in order to circumscribe food-security detail; there is inevitable uncertainty confronting covariate selection; and there is also uncertainty surrounding the 'choice' of appropriate paradigm within which to enact empirical work.

This paper presents ideas employing exclusively the Bayesian inferential paradigm, with a justification, along with one significant, over-arching criticisms, supported toward the end of the exercise. Bayesian inference, while in widespread use elsewhere, has been slow to gain a foothold in Food Security, specifically; and in food-security debates, more generally; and so, our presentation is 'novel,' somewhat, in at least this one, paradigmatic respect. However, paradigmatic choice is quite secondary to our goals within this contribution. Our primary objective is to dissect the responsiveness of Iraqi calorie demand and assess the overall impacts of policy intervention in the face of significant instabilities arising as a result of military incursion. This interest stems primarily from prior interests forming an ever-expanding literature on food, food intake, calorie demand, and econometric evaluations of these features of the agricultural-food-systems environments. For a good introduction and expansive summary of this literature see Tiffin and Dawson (2002) and the literature cited there. Notwithstanding, a secondary motivation arises from availability of a fairly unique set of records—substantial in size, but also detailed in nuances—surrounding household consumption, food intake, and various socio-demographic factors within Iraq, 2009. During this period extraneous features of the food-security environment emngender contextual implications which make the data further unique.

One feature of the food environment likely to impact calorie demand is serendipitous; the other is non-stochastic. The first feature is the dramatic and prolonged instabilities to daily Iraqi life brought about by the war; the other is the so-called 'Public Distribution System' for food intake, which (World Bank, 2011) is alleged to be one of the single-most substantial public interventions, globally. In this paper, we estimate calorie demand across the substantial sample using a set of extant Bayesian procedures that have been applied elsewhere but—to the best of our understanding—remain hitherto un-, or, at least, under-exploited in food security analysis.

The paper is organized as follows. Section two presents background essential for understanding the complex dynamics underpinning the Iraqi calorie-demand experiment. Section three presents methodology. Section four presents the sample. Section five presents empirical results. Section six discusses limitations, presents the paradigmatic basis for the approach, a critique, and discusses one important extension of the work, which could give raise to altered inference. Section seven concludes.

Background

Evidence available from national income statistics (Central Organization for Statistics and Information Technology, Iraq, 2008) confirms that the performance of the Iraqi economy during the past four decades was ‘poor,’ and bordering on ‘dismal.’ The oil sector, which, for the past six decades, had been dominating Iraq’s economy, was sluggish, under considerable international scrutiny, and was intermittently impeded. Nevertheless, a considerable proportion, some 95 percent, of foreign exchange earnings continued to evolve from oil alone. That the Iraqi economy faces many challenges is, perhaps, an understatement. In addition to international conflict, internal pressures became highly disruptive. The war against its Kurdish people (lasting for more than four decades), the Iraq-Iran War (lasting for some eight years, 1980-1988), the first Gulf War in 1991 (due to the well-known invasion of Kuwait), and the second Gulf War (commencing within 2003), all contributed to rather dramatic cumulative impediments to transacting in private, domestic markets.

Food markets, while arguably of greater importance than other domestic markets, were not immune to major disruptions. During the late 1980’s and the early 1990’s inflation exacerbated problems. Measured in terms of US dollar equivalents, the Iraqi dinar (ID) depreciated dramatically. Between the late 1980s and the end of the twentieth century. In particular, and based on so-called ‘official-rate statistics, the rate of exchange between US dollars and Iraqi dinar subsided from US$1 = ID0.311, in 1980, to US$1 = ID2,900 in 2000 (Food and Agriculture Organization-Iraq and World Food Programme-Iraq, 1997). Presently, based on World Bank (2011) classifications, Iraq is considered a ‘lower middle income’ country, with an annual per-capita income of US$1,006–US$3,975. Despite its potential prosperity arising from its rich natural-resource base, concerns about food security, food securities relations with income generation, and the ongoing, ever-present desire for mitigating poverty and alleviating the burdens brought about by conflict, and mismanagement of social infrastructure abound.

Relatively speaking, but especially in consideration of neighbouring, middle-eastern states, Iraq is fairly richly endowed with natural and human resources, but also agricultural resources. By most quantifiable measures, Iraq should be able to a sustain food supply for its population. For example, historically, Iraq was deemed self-sufficient in producing cereal grains during the middle part of the previous century. As recently as the late 1950s (Edirisinghe, 2004) Iraq was deemed able to amount surpluses. However, this situation endured dramatic erosion. Agricultural output decreased substantially between 2000 and 2010. This subsidence, while rapid, was all the more surprising due to the fact that farm prices more than doubled between the years 2001 and 2008 (Central Organization for Statistics and Information Technology-Iraq, 2009). Conflict and the instabilities it engendered, has had one dramatic impact on the agricultural and rural landscapes. But, viewed, historically, this downwards trend and decline was set in place considerably prior to the 2000-2010 decade. There were many contributing factors.

Perhaps the most important factors, among others, are the failures of several of the macroeconomic and agricultural policies enacted by the former regime (1968-2003). One key consideration is the likely detrimental impacts of various policies upon agricultural infrastructure; its destruction of tranquillity and stability of village and rural life; its displacement of its populace; compulsory relocations; and inevitable rural-urban segregations of some key components of social and human-capital-relevant resources. This problem was particularly contentious if the region known as ‘Kurdistan’ (Cordesman and Hashim, 1997). In addition, contemporaneous drought; aridity; and scarcity of irrigation water and irrigation resource bases exacerbated decline. The ongoing rural-urban resettlement served to magnify rather than mitigate basic infrastructural vagaries.

Iraq's dependencies on foreign-produced food stuffs grew dramatically throughout the 1980's and the 1990's. During 2008, Iraq's 'import dependency ratio' was computed to be approximately, 75 percent. One obvious and important implication is that, only about 24 percent the national food requirements are met by locally produced supplies; the residual 76 percent being subject to the vagaries and inconsistencies that are inevitable within international food markets. More problematic, however, is the fact that growth in Iraq food production lags significantly behind its growth in human population. Whereas population grew 3.2 percent from 1971 to 1990, cereal production grew by only about 1.2 percent for the same period (Schnepf, 2004). Quantification of such deficiencies can be stated alternately. The recommended daily per capita calories suggested by the World Health Organisation amount to, approximately 2,210 kilojoules in Iraq (Edirisinghe, 2004). Estimated proportions of the population failing to meet this minimum standard (World Food Programme-Iraq, 2004) range from as low as 7 to as high as 13.9 percent. This proportion translates to a deficiency befalling approximately 2.1 to 4.17 million persons (Central Organization for Statistics and Information Technology-Iraq *et al.*, 2010; and Food and Agriculture Organization-Iraq, 2009). Put another way, concerns surrounding food security in Iraq during the study period arise from the fact that a population about the size of the *New Zealand's total population*, are *calorie deficient*. Inter-temporal and inter-regional fluctuations in deficiencies make more problematic the issue of getting food to the needy at the right time and in the right place. In short, age-old concerns about famine-early warning systems, availabilities and entitlements to food (in the genre of an extensive literature evolving from Sen (1981); his critics, most notably, Bowbrick (1986); and his advocates, most notably during the naissance of this literature, Devereux (1988)) are no less relevant in Iraq as they are elsewhere and, moreover, make the study of Iraqi calorie demand and the study of Iraqi food policy, interesting and potentially insightful. In short, considerable scope exists for nuanced empirical analysis.

One very important component of daily infrastructure confronting its population's day-to-day food-market transactions is the so-called *Public Distribution System*. The Public Distribution System is a substantial redistributive policy mechanism which distributes both food and non-food items to households on a, primarily, monthly basis. The significance of the Public Distribution System mechanism is large and encompassing, comprising almost ten percent of Iraqi GDP (World Bank, 2011). With respect to foodstuffs, food commodities, and food-related household items, '*The System*' makes essential quantities of staple commodities available at 'nominal' prices. Approximately, and based on figures collected privately, transfers ranging from between US$3.41 and $US8.00 are enacted during the 2002-2003 consumption year (Edirisinghe, 2004). The entire population of adult citizens are registered and eligible to participate in this redistributive scheme and The World Bank (2005) has described the *Public Distribution System* as the single, largest intervention programme in the world. Approximately 21 percent of public income is allocated to the programme. The near 10 percent of gross domestic product allocated to The System exceeds the amounts devoted to education (approximately 6 percent) and health (approximately 3.4 percent) (World Bank, 2011). It is believed that this scheme protects more than half of Iraq's population from severe food shortage (Edirisinghe, 2004).

With reference to calorie intake, The Central Organization for Statistics and Information Technology-Iraq (2010) suggests that average cost of provision of adequate calorie intake at a level sustaining one thousand kilojoules is approximately ID520. And it is also estimated that the differential—the difference between the actual prices transacted within the programme and those prevailing in its absence—would be in the vicinity of about ID90.

Thus, the 'normative' aspects of the scheme are considerable; however, its 'positive' impacts are perhaps more significant and arise from at least two aspects of the programme.

First, the programme can be conceived as having a considerably distortionary impact on pricing, market allocations, and the inherent 'directives' that farm-gate and food-retail prices determine in competitive market environments would receive in its absence. We consider these aspects noteworthy, know of no study that analyses these distortionary features, previously, but note, additionally, that a potentially, more significant impact arises with respect to and within the context of studying calorie intake, food security, and the correlates of intake within the Iraq, conflict-ridden food system. This issue—the second, potentially, far-reaching significance of the *Public Distribution System's* existence—is the likelihood that its presence considerably impacts the 'normal-qua-programme-absent' aspects focussed upon so frequently by previous contributors to the so-called 'calorie-demand literature.' This facet, of course, is non-other than the relationship between calorie intake and changes in disposable income. And, Iraq's conflict-recurrent infrastructure, the presence of the The System for food redistribution, and the ever-present concerns that food security should be but may not be highly correlated with changes in income, raise considerable scope for empirical investigation. Additional detail concerning background and further nuances concerning historical Iraqi infrastructure change, of particular relevance to food security and the present endeavour, are documented in San Ahmed (2013).

Method

In a thematic dating at least to Lancaster (1966), it is sometimes argued that food commodities are demanded for their characteristics (for example, nutritional content, taste, appearance, and odour) rather than for their selves directly (Bhargava, 1991; Gorman 1980). Thus, an increase in demand for calories leads to an increase in demand for food, especially calorie-intensive commodities (Hendler, 1975). We follow some fairly well-traversed terrain (see, for example, Tiffin and Dawson (2002) and the literature cited there) in approaching inference about calorie demand from the so-called 'direct method' for imputing responses. In this context a small notational digression proves helpful.

We commence inference in the confines of a standard set-up, which is the normal-linear regression model $\mathbf{y} = \mathbf{X\beta} + \mathbf{u}$, where the N-vector $\mathbf{y} \equiv (y_1, y_2, .., y_N)^T$ denotes observations on calorie intake; '^{T}' denotes 'transpose'; $\mathbf{X} \equiv (\mathbf{x_1}, \mathbf{x_2}, .., \mathbf{x_N})^T$, $\mathbf{x_1} \equiv (x_{11}, x_{12}, .., x_{1K})^T$, $\mathbf{x_2} \equiv (x_{21}, x_{22}, .., x_{2K})^T$, .., $\mathbf{x_N} \equiv (x_{N1}, x_{N2}, .., x_{NK})^T$ denotes observations on a set of N×K arbitrarily chosen correlates of calorie intake response, also termed 'covariates;' $\boldsymbol{\beta} \equiv (\beta_1, \beta_2, .., \beta_K)^T$ denotes a K vector of corresponding 'coefficients' relating each corresponding N-vector of correlates to its appropriate calorie intake response; and $\mathbf{u} \equiv (u_1, u_2, .., u_N)^T$ denotes a vector of unobserved random shocks. Because the shocks are random, we assemble them within the usual structure when formalizing randomness, which is a probability density function, which we denote, generically, $f(\cdot)$. Thus, $f(\mathbf{u})$ denotes the randomness within the modelling exercise, deemed necessary because—prior to experiment—the shocks are unobserved. Similarly, and because observations on the coefficients are unobtainable, we use $f(\boldsymbol{\beta})$ to denote randomness in these unobserved coefficients. If we make the usual assumption about the random shocks confounding inference about coefficients, then $f(\mathbf{u})$ denotes the product of N independent normal probability density functions $f(u_1) \times f(u_2) \times .. \times f(u_N)$, each with the same mean, zero, and variance given by another parameter, σ. Accordingly, the 'modelling exercise' presents the investigator with the problem of conducting inference about the unknowns in the K+1-vector $\boldsymbol{\theta} \equiv (\beta_1, \beta_2, .., \beta_K, \sigma)^T$. Stated another way, we wish to infer the 'locations' and 'scales' of each of the elements contained within $\boldsymbol{\theta}$. One procedure, which seems altogether 'natural,' if not, perhaps, 'complicated;' is to make these inferences by constructing another set of probability density functions, $f(\beta_1|\mathbf{y})$, $f(\beta_1|\mathbf{y})$, $f(\beta_2|\mathbf{y})$, …, $f(\beta_K|\mathbf{y})$,

$f(\sigma|\mathbf{y})$, which depict the 'locations' and 'scales' of each unknown parameter, upon observing the data, $\mathbf{y} \equiv (y_1, y_2, .., y_N)^T$, which, symbolically in this part of the exercise, includes the observed $\mathbf{X} \equiv (\mathbf{x_1}, \mathbf{x_2}, .., \mathbf{x_N})^T$, $\mathbf{x_1} \equiv (x_{11}, x_{12}, .., x_{1K})^T$, $\mathbf{x_2} \equiv (x_{21}, x_{22}, .., x_{2K})^T$, .., $\mathbf{x_N} \equiv (x_{N1}, x_{N2}, .., x_{NK})^T$. Well-known procedures exist for this purpose and are articulated cogently and clearly in a set of important, basic contributions on Bayesian regression (see, for examples, Zellner, 1996; Koop, 2003; and Koop, Poirier and Tobias, 2007). The over-arching mathematical relationship motivating the inferential process, is the well-known property of the joint probability density function for partitions of the uncertainty space—in this case, and on the one hand, the data, $\mathbf{y}$, which, recall are derived from 'experiment;' and on the other hand, the unknown parameters, $\boldsymbol{\theta}$, which condition the observed responses—namely that, given the joint 'probability density function for the data' and the parameters, $f(\mathbf{y},\boldsymbol{\theta})$, this joint probability density function produces the two, intimately related, but distinct relationships $f(\mathbf{y},\boldsymbol{\theta}) \equiv f(\mathbf{y}|\boldsymbol{\theta}) \times f(\boldsymbol{\theta}) \equiv f(\boldsymbol{\theta}|\mathbf{y}) \times f(\mathbf{y})$. Within this convolution, $f(\mathbf{y}|\boldsymbol{\theta})$ denotes the data generating distribution, also referred to as the likelihood function when viewed as a function of $\boldsymbol{\theta}$ rather than $\mathbf{y}$; $f(\boldsymbol{\theta})$ denotes 'distribution' assigned by the investigator, which is most often termed 'the prior probability density function for the unknown parameters;' $f(\boldsymbol{\theta}|\mathbf{y})$ denotes 'distribution' for the parameters, $\boldsymbol{\theta}$, upon processing the data, $\mathbf{y}$, which is most often termed 'the posterior probability density function for the unknown parameters;' and $f(\mathbf{y})$, which is a marginal distribution for the data, $\mathbf{y}$, and which is sometimes referred to as 'the marginal likelihood.' Paradoxically, because it enables inference about 'model assumptions,' the most important quantity in the convolution is the latter quantity, $f(\mathbf{y})$. However, in a step that we also enact in present analysis, conventional Bayesian procedures proceed by focussing attentions on the 'posterior' $f(\boldsymbol{\theta}|\mathbf{y})$ and deriving the individual posterior marginal probability density functions for each of the unknown parameters. We relegate discussion of

$f(\mathbf{y})$ towards the end of the empirical exercise enacting procedure, together with a discussion of its historical significance in Bayesian inference and its relationship with one theorem of fundamental importance to 'inference' in general, 'empirical work' in particular and the 'scientific method' most specifically. Additional detail concerning the Bayesian methodology, as applied to the Iraqi sample, is documented in San Ahmed (2013).

In summary, availed with response data from experiment, we formalize relationships between responses and covariates using the familiar tool of 'regression' and the normal-linear model, specifically. Inferences about important parameters, proposed to influence the calorie-demand experiment can be summarized by deriving so-called marginal posterior densities for each of the parameters of interest, for which a set of standard mathematical tools exist. These inferences await their most important input which, arguably, are the data, consisting of the observations on calorie intake, $\mathbf{y} \equiv (y_1, y_2, .., y_N)^T$, and the correlates of calorie demand, denoted $\mathbf{X} \equiv (\mathbf{x_1}, \mathbf{x_2}, .., \mathbf{x_N})^T$, $\mathbf{x_1} \equiv (x_{11}, x_{12}, .., x_{1K})^T$, $\mathbf{x_2} \equiv (x_{21}, x_{22}, .., x_{2K})^T$, .., $\mathbf{x_N} \equiv (x_{N1}, x_{N2}, .., x_{NK})^T$.

The Iraq Sample Setting, The 'Calorie Consumption Experiment' and 'Adjustment'

This study draws on the Iraq Household Socio-Economic Survey (IHSES), which was conducted by the Central Organization for Statistics and Information Technology (COSIT) and the Kurdistan Region Statistics Organisation (KRSO) in Iraq, in collaboration with the World Bank, in 2007. Interviews were successfully carried out for approximately 99 percent of the targeted sample of size 18,144 records. As a result, data from 17,822 households and more than 127,000 individuals were collected from each of the eighteen governorates and the capital, Baghdad. Arguably the most important part of the survey, for the purpose of this study, is the component enacted for the purpose of obtaining information on household expenditure on food and non-food products. Comprehensive information about household food and non-food consumption was collected from twenty-four-hour intake records recalled from successive, ten-day visits. Households were asked to record both the quantities and the values of their daily expenditures and to specify the units of measurement in both cases. Households were also asked to report sources of food commodities acquired from alternative domains such as purchases, gifts, food for work quantities, or self-produced food items. For products not purchased, households were asked to report the estimated values of these products based on current market prices. Significantly, the Public Distribution System food-item quantities acquired through the programme and consumed on a daily basis were also tabulated and signified separately within the sample. In addition to 260 food-related items, the survey collected information on quantities and values of non-food commodities and related services.

Household daily food is converted into calorie intakes by applying appropriate conversion factors, provided by Bishay (2003); Butrum *et al.* (1972); and Sabry and L.Rizek (1982). These are the most detailed conversion factors that are available to convert food intakes into their calorie equivalents within Iraq. For some important food products, only value data could be obtained. In these instances, the so-called ‘average price of calories’ was used to normalize the value records converting them into quantity-equivalents. The average-price-of-calories were derived by following procedures outlined by (Vu, 2008). Because meals consumed at restaurants and coffee shops, or, alternatively, consumed out of the home and consumed elsewhere do not have corresponding quantity reports, an alternative imputation is required. We followed procedures suggested by Gibson and Rozelle (2002) and Subramanian and Deaton (1996) to produce the ‘average price of calories’ from derivative food groupings. In these cases, and also because of the higher price margins associated with restaurant foods a 50 percent premium was employed in order to reflect ‘processing margins.’

Prior to estimation, an extensive search for outliers in the dataset was undertaken. The definition of ‘outlier’ is based on the per-capita intake quantities of each food product consumed by the households over the preceding 10-day period, and a standard box-plot procedure enacted in the software environment of the ‘Statistics Toolbox’ in MATLAB©. The outlier search confirmed inconsistencies in recording of value and price responses and all inconsistent records were adjusted to consistent value-equals-price-times-quantity denominations. Approximately 0.12 percent of the sample responses were treated by this adjustment procedure.

In addition to recorded inconsistencies, some extraordinarily unreasonable values of calorie per Adult Equivalent Unit (AEU) were located. In this event we enacted protocols suggested by previous calorie-intake studies and, specifically, the suggestions of Garrett and Ruel (1999); Hoddinott and Yohannes (2002); Migotto *et al*. (2005); and Skoufias *et al.* (2009). This heritage suggests exclusions whenever calorie-intake values, per adult-equivalent scales, lie outside the range 500 to 9000 kilojoules. Exclusions resulting from violations of this conventional protocol leave us with 16,749 households, (approximately 94 percent of the original sample) available for processing and inference. Additional detail concerning the data and further nuances concerning pre-estimation processing are documented in San Ahmed (2013).

In summary, conventional procedures following previous work were employed to produce the sample of calorie responses and their correlates and a total of 16,749 records, summarized in Table 1 and Table 2 are available for analysis (please insert Table 1 and Table 2 about here.)

Empirical ‘Models’ and Results

The benchmark ‘model’ presented at the outset is what we refer to as a natural-conjugate statistical model (Berger, 1985). Given proper prior input, say, $f(\boldsymbol{\theta})$, such models enable analysis of the posterior probability density function, $f(\boldsymbol{\theta}|\mathbf{y})$, without the need to resort to intractable integrations. This feature of Bayesian analysis is well-known, if not observed, at least, as frequently as might be expected. Departures from the simplified setting represented previously are required whenever any of the basic assumption fail to surpass ‘a threshold.’ We use the term ‘threshold’ because all of the assumptions can be placed on a continuum rather than an accept-reject basis, by using the marginal-likelihood, $f(\mathbf{y})$, as a determining, defining, overarching quantity. A formal evaluation of each of the assumptions implicit in the normal-linear model setting introduced above would require definition of more ‘general’ ‘model’ settings such that the ‘misdemeanours’ created by violating any key assumption could be placed explicitly upon a probability scale, with the computationally convenient feature that its range is the unit interval, [0,1], and that numbers produced close to zero are ‘models’ with little support, and those assigned indices closer to one are ‘models’ with much greater support for which ‘the evidence,’ ‘the data,’ yield greater support. One problem with such evaluation is that for every departure from the normal-linear model, because the resulting structure is no longer natural-conjugate, the quantity $f(\mathbf{y})$, now needs to be estimated rather than computed. Methodology for estimating $f(\mathbf{y})$, together, with presentation of alternative approaches, is available from Chib (1995), using Gibbs sampling techniques, and Chib and Jeliazkov (2001), using the more general Metropolis-Hastings sampling technique. User-friendly discussions of Gibbs sampling (Gelfand and Smith, 1990) and the Metropo lis-Hastings algorithm (Metropolis *et al.*, 1953; Hastings, 1970) can be found, respectively, in Casella and George (1992) and in Chib and Greenberg (1995). The complexities involved in applying this more-general methodology cause us to seek one similar, more direct, non-Bayesian approach in assessing one of the most significant assumptions applied by the normal linear model structure, that was introduced above. This assumption is, precisely, the assumption that one of the most significant conditioning variables, namely expenditure on food products, is ‘exogenous’ to the calorie-demand equation. We apply a formal classical (frequentist) test to this over-arching application implicit in the normal-linear model setup and ask whether a movement to a more general, albeit, non-conjugate, setting, is warranted.

Relegating detail to the broader work producing these empirical results (San-Ahmed, 2013) we follow a literary heritage in three directions in order to 'formalize' an acceptable departure from the benchmark setup detailed at the outset, above. First, we consider that food consumption is, in most ways, similar to other consumable structures, wherein the consumers maximizing utility model can be applied (Bodvarsson and Van den Berg 2009; Behrman and Deolalikar, 1987; Bhargava, 1991a; Garrett and Ruel, 1999; and Wolfe and Behrman, 1983). Second, we consider calorie-demand under the explicit auspices of two distinctly different approaches, namely the so-called 'direct' and the so-called 'indirect' approaches (Ayalew, 2000; Behrman and Deolalikar, 1987; Dawson and Tiffin, 1998; Grimard, 1996; Salois *et al.*, 2010; Sinha, 2005; Strauss and Thomas, 1995). Third, recognizing the limitations implicit within both approaches, we select the so-called 'direct approach' as our *modus operandi*. Fourth, we apply a familiar structure (Behrman and Deolalikar, 1987; Behrman and Deolalikar, 1988; Bouis and Haddad, 1992; Capps and Schmitz, 1991) wherein, within the 'direct-approach' setting, per-capita calorie consumption is modelled as dependent on prices and a vector of 'other' relevant factors. We emphasize at this point and also for later reference, that this assumption is purely arbitrary. The model so-derived has been termed the so-called 'unrestricted reduced model' (Bhargava, 1991; Abdulai and Aubert, 2002) and that the income elasticities derived from this methodology should, in principle, be equivalent to those derived under the alternative. This feature, however, has from time to time been contested (see, for contrasting examples, Dawson and Tiffin, 1998; Grimard, 1996; Logan, 2009; Subramanian and Deaton, 1996; Udry, 1997). We emphasize that the types of 'bias' produced in the application of so-called indirect methods can be avoided if the direct approach is applied (Abdulai and Aubert, 2002; Gibson and Rozelle, 2002; Grimard, 1996;

Strauss and Thomas, 1995). We emphasize, along with these limitations, that both methodologies suffer from the problematic feature of calorie-demand studies being conditioned by endogenous variables and, in particular, that food expenditure is naturally considered one of the endogenous variables in the exercise (Bouis and Haddad 1992). We note, too, that Bayesian analysis of this problem is altogether different, but that available methodology exists (Drèze and Richard, 1983; Zellner, 1996; Koop, 2003; Koop, Poirier and Tobias, 2007) for assessing and formalizing endogenous features of the sample setting environment. Ineveitably, these so-called remedies to the endogeneity problem manifest themselves through Markov-chain Monte Carlo (MCMC) methods and Gibbs and Metropolis-Hastings sampling in particular (Congdon 2010; Gelman et al. 2004). The problem is also remedied classically, by first assessing the evidence in the error structure of the simplified setting (Hill et al. 2008) and then applying a likelihood-based response which enables 'instrumenting' certain variables deemed themselves to be exogenous to the problematic variables in the model structure. We emphasize that the endogeneity problem within calorie demand studies has a rich literary heritage (Aromolaran 2004; Tiffin and Dawson, 2002) to which, given our Bayesian paradigmatic underpinnings, we append recent work in Bayesian instrumental variables estimation (Rossi *et al*., 2005; Karl and Lenkoski, 2012). Hence, fifth, in what follows, we apply the procedures outlined in Karl and Lenkoski (2012).

A sixth decision concerning model choice stems from the need to consider an appropriate transformation of the calorie demanded dependent quantity, in order to 'generalize' the income-elasticity effect derived within the regression. This problem is discussed, among others, by Grimard, 1996; Sahn, 1988; Skoufias *et al.*, 2009; Vu, 2008; and, perhaps, most cogently by Subramanian and Deaton (1996). Here we make two modifications in response to this discussion. We apply the logarithmic transformation of logarithmically-transformable covariates (those covariate not containing zeros) and we allow for a quadratic terms in the logarithms of 'food expenditure.'

Seventh, recognizing the likelihood that calorie demand is impacted by possibly many exogenous factors influencing consumption (Aromolaran, 2004; Wolfe and Behrman, 1983) in addition to the potentially most important, namely, food expenditures (Razzaque and Rahman, 2007; Subramanian and Deaton, 1996), we make a selection of a smaller set of covariates available for implementation. Because not all the variations in household or in individual calories can be explained by income, other socio-economic characteristics included in the analysis comprise, *inter alia*, food prices; household size; education of female adults; composition of different age groups within the household; age and sex of the household head; weekly hours of household head and spouse; location of the household; regional location of the household; distance of the household's home to the local market(s); and, finally, seasonal variables. We emphasize, once again, that this selection is purely arbitrary.

Eighth, we consider an associated problem, namely, that the vast majority of studies in this area use unadjusted unit values to approximate market prices in their estimated demand models. This means that the price of a given food commodity is computed from the ratio of its associated expenditure to its associated physical quantity (Chernichovsky and Meesook, 1984; Dong *et al.*, 1998; Grimard, 1996; Jha *et al.*, 2009). We believe that unit values cannot be treated as if they are market prices because unit values cannot reflect the quality of different commodities within the group of goods, which is selected by a household. Thus, using unit values in the demand system model could lead to a simultaneous-equations bias. Although information about prices was not explicitly asked about in the survey, this study uses quality-adjusted prices which were obtained by following an appropriate technique (Cox and Wohlgenant, 1986; Hoang, 2009).

Ninth, we adopt a fairly ‘weak’ prior (detailed in San-Ahmed, 2013) for implementation of our regression setup using the Bayesian instrumental variables technique of Karl and Lenkowski (2012). The reader is referred to various nuances surrounding preliminary analysis presented in San-Ahmed (2013), the end-product of which is the regression presented in Table 3 (please insert Table 3 about here).

The parameter estimates reported in Table 3 are derived from an MCMC sampling scheme consisting of 50,000 iterations, of which the first 10,000 iterates (the so-called ‘burn-in’) are discarded. The regression ‘explains’ approximately 65 percent of the total variation in calorie demand quantities (represented under the logarithmic transformation) and is generally ‘significantly impacted’ by prices; the arbitrarily selected demographic detail alleged to impact consumption; the binary variable recognizing the Public-Distribution-System presence in the food-market institution producing the calorie source; and, importantly, expenditures disposable for all foods consumption.

Focussing attentions on the latter two factors, we consider income elasticity ‘progression’ across the inter-decile range within the Iraqi sample—recall that the presence of the quadratic term in the logarithm of food expenditure, unlike the usual Cobb-Douglas specification, permits covariate-dependent elasticity estimates. The reports of the inter-decile expenditure elasticities are presented in Table 4 (please insert Table 4 about here).

Considerable variability is observed in the reports; and we note, significantly, the ‘progression’ in reports is monotonic. These reports are, as expected (Aromolaran, 2004; Grimard, 1996; Sahn, 1988; Skoufias *et al.*, 2009; Vu, 2008) monotonically declining in the income decile. Additionally, the range of reports in Table 4 supports ‘conventional wisdom’ that the ‘expenditure elasticity’ is closer to one than to zero and is significantly positive (Pinstrup-Andersen and Caicedo, 1978; Pitt, 1983; Strauss, 1984; Chernichovsky and

Meesook, 1984; Kumnar and Hotchkiss, 1988; Subramanian and Deaton, 1996; Abdulai and Aubert, 2002; and Sinha, 2005).

Finally, and with respect to one significant motivation, emphasized at the outset, and one over-arching feature of the sampling environment affecting the scientific questions about which the survey data is assembled, we turn to the interesting question about the impacts of *The Public Distribution System* on Iraqi calorie demand. Given the regression results presented in Table 3, we set about posterior predictive inference with respect to one important experiment. This experiment is the removal the programme from its presence within the sample. Given the regression assumption, we enact simulation both with and without the *Public-Distribution-System binary indicator* respectively, present and absent. This modification enables reporting of results, while simultaneously, allowing the Bayesian instrumental variables procedure to 'correct' for the absence of the programme, permitting each of the remaining covariates 'coherent adjustment' with respect to each individual estimated effect. Importantly, and emphasized here, the Bayesian posterior predictive procedure allows for accounting for the specific impacts of each covariate response coefficient across the full domain $(-\infty,+\infty)$ applying appropriate 'weight' across this domain. Frequentist (likelihood-based) approaches to prediction are hampered by inability to average across the parameter space. We implement the posterior prediction in several, sequential steps. First, we generate a new expenditure series for each of the represented households by deducting the fair imputed values of the Public-Distribution-System items (measured at current market prices) from the monthly per capita expenditure, multiplying the amount of calories obtained from the programme by the unit value of the total calories paid by the household on a daily basis. Second, the monthly per-capita values of calories from the programme are computed. Third, a new monthly per-capita expenditure is computed by subtracting the monthly per-capita values of the programme calories at market price from the household's monthly per-capita expenditure. Consequently, the posterior predictive methodology (see, for example, Poirier, 1995) is applied to the newly derived series. The results of the posterior inferential procedure are presented in Table 5 (please insert Table 5 about here.) from which we note that small, but significant adjustments occur. This result raises scope for removal of the programme and its replacement by a redistributive scheme for direct income transfer as a judicious alternative to the status quo.

Limitations and Extensions

The analyses, thus far, has benefited from the insightful comments of several commentators. Generally speaking, a consensus abounds. However, about one particular feature of present analysis, there exists, in contrast, a healthy and enlivened 'debate' about what we here refer to as 'paradigmatic choice.' This choice circumscribed other 'choice' concerning certain aspects of the 'modelling substructure' which inevitably results in arbitrary decision-making by the investigator. While not wishing to complicate matters, some discussion about these 'choices' seems warranted.

The empirical content of our contribution presents results employing standard so-called 'Bayesian' procedures. Bayesian procedures, collectively, distinguish themselves from 'frequentist,' so-called 'classical' procedures by a simple assumption. This simple assumption is that anything non-observable must be expressed by way of an associated probability distribution; the methodology, the mathematical interventions, and the end-product of the estimation are all an artefact of this essential probabilistic foundation. At the heart of this distinction is a fairly elongated evolution of discussion, debate and contradiction about philosophical underpinnings of science, scientific method and the interpretation of result—empirical results—produced by the differing paradigms (Jeffreys (1961) is one useful source, but the reader is also referred to Zellner (1996), especially the opening chapter, for another). The authors adopt here the Bayesian response due to the fact that considerable effort in the broader work (San-Ahmed, 2013) is based on the Bayesian assumptions. Results reported here, therefore, are subject to limitation and, perhaps surprisingly, to most readers, we suspect, the Bayesian inferential procedure is subject to one over-arching limitation which is never discussed, but always encountered, and relates to a fundamental theorem, to which Bayesians—even some of our most revered contributors—bestow only 'lip-service.'

'Bayesian models,' like 'all models,' 'classical' and 'otherwise' are based entirely upon a 'fiction.' This fiction is that a model exists. What we mean by this 'injection' is that the parameters alleged to direct responses (as, for example, those represented by the so-called regression coefficients, '$\boldsymbol{\beta} \equiv (\beta_1, \beta_2, .., \beta_K)^{T}$'); direct variability in the sample (as, for example, those represented by parameter 'σ'); or the ones we simply invoke and do not represent, (such as 'centralizing error' by assuming that the vector of random shocks, $\mathbf{u} \equiv (u_1, u_2, .., u_N)^T$ is 'mean-zero located'); are all constructs of the investigator, the scientists involved in the investigation and the investigation itself. Only the data, $\mathbf{y} \equiv (y_1, y_2, .., y_N)^T$, and the correlates $\mathbf{X} \equiv (\mathbf{x_1}, \mathbf{x_2}, .., \mathbf{x_N})^T$, $\mathbf{x_1} \equiv (x_{11}, x_{12}, .., x_{1K})^T$, $\mathbf{x_2} \equiv (x_{21}, x_{22}, .., x_{2K})^T$, .., $\mathbf{x_N} \equiv (x_{N1}, x_{N2}, .., x_{NK})^T$ are the 'real quantities' we are able to deserve. In constructing 'fiction' it is natural to consider some fictions to be better than others and arbitrary choices, such as our choice of correlates or covariates; whether the model engenders endogeneity; or, more problematic, whether simultaneous-equations bias is ignored; are artefacts of the modelling assumptions. Non-arbitrary decision-making surrounds evaluation of $f(\mathbf{y})$, which highlights the feature that choice should not involve fiction. The so-called marginal-likelihood, $f(\mathbf{y})$, contains one very important feature which *all Bayesian*, and we emphasize, *all Bayesian studies* enact. This assumption is that the data are 'exchangeable.' For an introduction to exchangeability the reader is referred to Lindley and Smith (1992), Bernardo (1996) Bernardo and Smith (2000). Superficially, 'exchangeability' refers to the notion that the 'labels' assigned to the observed data objects in the sample can be 'permuted.' But the deeper implications of exchangeability are rather more profound because they enable so-called ‘representations’ of differing modelling assumptions. The notion of ‘exchangeability’ evolves from work of the English logician Johnson (1924) and was first introduced to a statistical environment and formalized mathematically by de Finetti (1937). Not until an English translation appeared (de Finetti, 1961) has the idea gained a foothold in *theoretical* Bayesian analysis. Its significance to e*mpirical* Bayesian inference is the notion (Bernardo, 1996) that if the data are ‘exchangeable’ then a Bayesian model exists. All of the work conducted during the present investigation is, therefore, conducted under the assumption that the data objects are ‘exchangeable.’ Recently, Poirier (2010) has called for a re-examination of the importance of ‘exchangeability,’ ‘subjectivity’ and de Finetti’s (1937) ‘Representation Theorem’ noting that Kreps (1988), among others, (see, for examples, the literature cited in Zabell (2005)) consider that de Finetti’s (1937) theorem is ‘the fundamental theorem of statistics.’ Thus, all Bayesian investigations, as in the present case, make a very fundamental assumption as they set about enacting ‘routine procedures’ for inference and prediction. This assumption is that the data are ‘exchangeable’ and can, therefore, be ‘represented’ by a ‘Bayesian model.’ Thus the present contribution shares this over-arching limitation, which, no doubt, influences our findings. Empirical procedures for assessing whether subsets of the sample are ‘exchangeable’ are presently ongoing and await empirical implementation. And it remains an open question as to whether or not, or the degree to which one can assume that a Bayesian model exists. Because the conclusions about exchangeability, the existence of a Bayesian model structure, and the validity of inferential and predictive conclusions so obtained depend intimately on this assumption, we highlight this single assumption—overarching other subjective interventions such as arbitrary choice of covariates, arbitrary choice of functional form, and arbitrary choice of error distribution—as the single most important extension evolving from the exercise. Future work should seek to relax as many critical assumptions in the current effort as we are able to and assess them formally using the 'Johson-de-Finetti-Poirier admonition' that 'exchangeability' and 'representation' should be used to guide and direct arbitrary scientific choice. Until that time the results of our empirical analysis remain subject to the usual criticisms.

Concluding Comments

We have undertaken a fairly comprehensive assessment of calorie demands both within the present summary and the broader dissertation work that this contribution extends and summarizes. We find that average calorie-demand-expenditure elasticity ranges across the sample from a low of 0.41, reported for the highest expenditure decile; to a high of 0.83, reported for the lowest expenditure decile; and that, consequently, 'poorer households' may be considerably more responsive to 'income effecting' food policies in the ever-present and ongoing efforts to ensure Iraqi 'food security.' In contrast, the posterior predictive inference derived with respect to the *Iraqi Public Distribution System* for food items has a negligible effect on calorie intake. We conclude therefore, subject to the limitations outlined in the previous section, that future work investigating the more precise impacts of removal of the *Public Distribution System* expenditures and their re-allocation as fixed-income transfers may be a profitable way and welfare-enhancing, food-securing intervention. Future research should investigate this important conjecture using the present study, its background review of Iraqi agriculture, its conflict, and its correlates, as its 'benchmark basis.'

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Table 1
Descriptive Statistics

Variable Number	Label	Mean	Standard Deviation	Minimum	Maximum	Number of Unique Values
1	Consumption	2067.85	1431.29	500.01	8997.18	16710.00
2	Expenditure	18.57	12.00	1.29	144.35	9718.00
3	Rice	0.94	0.25	0.09	2.27	16729.00
4	Wheat	0.71	0.20	0.15	1.64	16742.00
5	Potatoes	0.70	0.20	0.10	1.75	16697.00
6	Meat	5.43	1.50	0.96	12.49	16709.00
7	Fish	3.20	1.16	0.41	8.93	16729.00
8	Milk	3.26	1.64	0.36	11.39	16708.00
9	Fats	2.43	1.04	0.64	7.46	16729.00
10	Fruits	1.11	0.48	0.25	4.13	16703.00
11	Persons	7.05	3.57	1.00	51.00	35.00
12	Prop-0-6	0.20	0.18	0	0.80	112.00
13	Prop-7-14	0.18	0.18	0	0.80	103.00
14	Prop-15-17	0.06	0.10	0	1.00	63.00
15	Female	0.27	0.15	0	1.00	101.00
16	Male	0.25	0.14	0	1.00	109.00
17	Aged	0.04	0.13	0	1.00	53.00
18	Head	0.30	0.46	0	1.00	2.00
19	Age	43.73	15.63	1.00	106.00	99.00
20	Distance	3.68	1.85	1.00	7.00	7.00
21	Hours-1	2.55	2.04	1.00	8.00	8.00
22	Hours-2	1.13	0.59	1.00	8.00	8.00
23	Primary	25.18	37.84	0	100.00	27.00
24	Secondary	47.02	42.18	0	100.00	27.00
25	Higher	9.44	25.88	0	100.00	20.00
26	Urban	0.30	0.46	0	1.00	2.00
27	Kurdistan	0.16	0.37	0	1.00	2.00
28	Central	0.27	0.44	0	1.00	2.00
29	Southern	0.48	0.50	0	1.00	2.00
30	Spring	0.17	0.37	0	1.00	2.00
31	Summer	0.28	0.45	0	1.00	2.00
32	Autumn	0.17	0.37	0	1.00	2.00
33	Rooms	0.63	0.43	0.06	7.00	152.00
34	Schooling	12.22	9.25	0	51.00	45.00

Note: Formal definitions of each variable are supplied in table 2.

Table 2
Descriptive Statistics Variable Definitions

Variable Number	Label	Description
1	Consumption	Calorie consumption per capita; kilojoules.
2	Expenditure	Total expenditure; Iraqi dinar.
3	Rice	Rice price; Iraqi dinar.
4	Wheat	Wheat price; Iraqi dinar.
5	Potatoes	Potatoes price; Iraqi dinar.
6	Meat	Meat price; Iraqi dinar.
7	Fish	Fish price; Iraqi dinar.
8	Milk	Milk price; Iraqi dinar.
9	Fats	Fats and oils price; Iraqi dinar.
10	Fruits	Fruits price; Iraqi dinar.
11	Persons	Household size; count.
12	Prop-0-6	Proportion of household aged 0-6; share.
13	Prop-7-14	Proportion of household aged 7-14; share.
14	Prop-15-17	Proportion of household aged 15-17; share.
15	Female	Proportion of household aged 18-65 that are female; share.
16	Male	Proportion of household aged 18-65 that are male; share
17	Aged	Proportion of household aged 18-68; share.
18	Head	Indicator (= 1 if household is female headed); integer; 0,1.
19	Age	Age of the household head; years.
20	Distance	Indicator (= distance to the nearest service); integer; 1, 2 ..,7.
21	Hours-1	Indicator (= Hours of weekly work of head); integer; 1, 2, .., 8.
22	Hours-2	Indicator (= hours of weekly work of spouse); integer; 1, 2, .., 8.
23	Primary	Percentage of female adults with primary education; share.
24	Secondary	Percentage of female adults with secondary education; share.
25	Higher	Percentage of female adults with higher education; share.
26	Urban	Indicator (= 1 if designated urban); integer; 0,1.
27	Kurdistan	Indicator (= 1 if designated Kurdistan); integer; 0,1.
28	Central	Indicator (= 1 if designated Central); integer; 0,1.
29	Southern	Indicator (= 1 if designated Southern); integer; 0,1.
30	Spring	Indicator (= 1 if designated Spring); integer; 0,1.
31	Summer	Indicator (= 1 if designated Summer); integer; 0,1.
32	Autumn	Indicator (= 1 if designated Autumn); integer; 0,1.
33	Rooms	Household size number of rooms per capita; real.
34	Schooling	Total years of schooling of household head and spouse; years.

Notes: Variable #20, ‘Distance’ contains the categorizations, with respect to the nearest service, namely: ‘1 ≡ ‘the nearest service is within 100 metres of the household;’ ‘2’ ≡ ‘within 101-300 meters;’ ‘3’ ≡ ‘within 301-500 meters;’ ‘4’ ≡ ‘within 501-1000 meters;’ ‘5’ ≡ ‘within 1-5 kilometres;’ ‘6’ ≡ ‘within 5-10 kilometres;’ and, ‘7’ ≡ ‘greater than 10 kilometres.’ Variable # 21, ‘Hours-1’ contains categorizations, with respect to working hours, of the household head, namely, ‘1’ ≡ ‘if the head worked fewer than 20 hours;’ ‘2’ ≡ ‘between 20-29 hours;’ ‘3’ ≡ ‘30-34 hours;’ ‘4’ ≡ ‘35-39 hours;’ ‘5’ ≡ ‘40-49 hours;’ ‘6’ ≡ ‘50-69 hours;’ ‘7’ ≡ ‘70-89 hours;’ and ‘8’ ≡ ‘90 hours or more.’ Variable #22, ‘Hours-2’ contains categorizations that are identical with respect to working ours, expect that the designation refers to the spouse of the household head and not the household head himself, or herself.

Table 3
Regression Results

Parameter	Value
Intercept	2.951 *** (0.19)
Logarithm of per capita expenditure	1.491 *** (0.074)
Logarithm of per capita expenditure squared	-0.088 *** (0.007)
Logarithm of rice price	-0.126 *** (0.015)
Logarithm of wheat price	-0.169 *** (0.014)
Logarithm of potatoes price	-0.056 *** (0.014)
Logarithm of meat price	-0.103 *** (0.012)
Logarithm of fish price	-0.059 *** (0.012)
Logarithm of dairy price	-0.134 *** (0.007)
Logarithm of fats and oils price	-0.106 *** (0.009)
Logarithm of fruits price	-0.018 (0.010)
Household size	-0.005 *** (0.001)
Proportion of household aged 7-14	-0.147 *** (0.024)
Proportion of household aged 15-17	-0.343 *** (0.039)
Proportion of household aged 18-65	-0.085 *** (0.031)
Proportion of household aged over 65	0.062 * (0.036)
Proportion of household females with primary education	-0.0005 *** (0.00013)
Proportion of household females with secondary education	-0.00034 *** (0.00012)
Proportion of household females with higher education	-0.001 *** (0.0002)
Age of the household head	-0.002 *** (0.0003)
Rural area	0.066 *** (0.011)
Kurdistan region	0.034 * (0.018)
Central region	-0.062 *** (0.014)
Southern region	-0.222 ***

	(0.014)
Spring	-0.063 ***
	(0.011)
Summer	-0.046 ***
	(0.010)
Standard error of the regression	0.473
R-squared	0.6422
Logarithm of the marginal likelihood	-11210
Numerical Standard error of the estimate	0.00002

Notes: The dependent variable used in the regression is the logarithm of per-capita calorie consumption. The estimates are posterior means from the Gibbs sample. Standard errors of the estimates are reported below the posterior means in parentheses and parameter 'significance' is indicated at the ten-percent, five-percent, and one-percent levels by asterisks, '*,' '**,' and '***,' respectively.

Table 4
Inter-decile estimates of calorie-intake-expenditure elasticity.

Per-capita expenditure decile	Estimate
1	0.796
2	0.742
3	0.707
4	0.680
5	0.654
6	0.627
7	0.599
8	0.566
9	0.521
10	0.411
Sample average	0.592

Table 5
Posterior predictive inference surrounding removal of the Public Distribution System

Per-capita expenditure decile	Current per-capita consumption	Predicted per-capita consumption	Percentage change over the base
1	940	921	-2.05
2	1143	1121	-1.83
3	1308	1289	-1.38
4	1461	1439	-1.36
5	1615	1596	-1.07
6	1768	1749	-1.00
7	1963	1941	-0.94
8	2183	2163	-0.84
9	2508	2490	-0.59
10	3272	3258	-0.35
Sample average	1839	1819	-1.11