1 Introduction

Most developing countries have a distorted price structure. While many of these distortions are due to lack of fully developed economic institutions and competitive environments, many others are direct result of government intervening with the working of the price system. This is an obvious occurrence when these countries undertake public projects that have to be financed through distortionary taxes. Less obvious is the example of countries with significant sources for public finance who engage in distortionary policies through subsidizing the various expenditures of the "masses" by following populist policies. One such example is Iran which has a huge nationalized oil industry and uses a substantial portion of these revenues to subsidize the price of such goods as bread, bread products, utilities, and transportation. While these subsidies have been controversial for many years, the government of Iran has only recently embarked on a policy to eliminate them.

Interestingly, thus far, there has been no solid economic piece of analysis that has measured the efficiency or the redistributive cost of these policies and the potential gains in reforming them. One particularly flawed aspect of this debate is its lack of consideration for the general equilibrium ramifications of subsidy elimination. Proponents and opponents of price subsidies assume that eliminating the subsidy on a particular item will simply save the government what it currently spends on that particular subsidy. This ignores the fact that eliminating a good's subsidy invariably causes consumers to spend more on the good's substitutes and less on its complements. To the extent that these other goods are also subsidized, a change in their consumption levels also affect government finances. If the subsidized goods have high cross-price elasticities with one another, the fiscal interaction effects can be huge, exceeding the direct subsidy savings.[1] Under this circumstance, reducing the rate of subsidy on one good increases the consumption of other subsidized goods leaving total subsidy costs to the government unchanged. This paper examines the importance of these effects in assessing the benefits

[1]Numerous papers, in the context of environmental taxes, have emphasized the importance of fiscal interaction effects. These papers typically focus the interaction of environmental taxes with tax-distorted factor markets. See, among others, Fullerton and Metcalf (2001), Goulder and Williams (2003), and Parry *et al.* (2009). There are also studies on fiscal interaction between federal and provincial tax authorities as in Hayashi (2001). Studies such as ours, with a focus on fiscal interaction between tax-distorted markets for consumer goods, appear to be rare.

and costs of eliminating price subsidies in Iran. In particular, it studies the implications of fiscal interaction effects for the estimates of potential welfare gains due to the elimination of price subsidies when implemented partially or sequentially.[2] Input subsidies are ignored.[3]

The paper is related, at a theoretical level, to Ahmad and Stern (1984) who discuss *marginal* commodity tax reforms. The distinguishing feature of the paper is the calculation of exact welfare measures for *non-marginal* tax/subsidy reforms without resorting to any approximation. To this end, we first estimate the pattern of consumer expenditures in Iran. The estimation enables us to derive a set of robust exact welfare measures that are consistent with consumer theory as well as optimal tax theory. Comparing the gains for non-marginal with marginal reforms, we show that the two may not necessarily recommend the same reform. This indicates that one cannot always rely on Ahmad and Stern's methods for reforms that are large.[4]

Demand functions derived from the commonly-specified utility functions, e.g. CES, impose severe a-priori restrictions on demand estimates that are unsupported by the data. Using flexible demand functions mitigates this problem. On the other hand, one wants to compute welfare gain measures that not only are consistent with consumer theory but also with optimal tax theory. Deaton and Muellbauer's (1980) Almost Ideal Demand System (AIDS) provides one estimation framework that satisfies both of these requirements. Yet this system implies, rather implausibly, that all goods have Engel curves that vary *linearly* with the log of expenditures. Empirical Engel curves, on the other hand, often indicate relationships that are nonlinear. To allow for this nonlinearity, we use Banks *et al.*'s (1997) Quadratic Almost Ideal Demand System (QUAIDS) for our estimation procedure. This

[2]Lack of space prevents us from considering specific reforms. A particular reform that the government of Iran has implemented is a policy of uniform cash rebates. Politically, it would have been extremely difficult to cut the price subsidies without providing some other type of relief to the population. Alternatively, the government could use the available funds to finance its health expenditures or to reduce other distortionary taxes in the system. However, with the abundance of oil revenues, at present, the government does not rely much on personal income or commodity taxes to lower them.

[3]This assumption simplifies our calculations. However, given that energy which is an important input into the production process, is subsidized heavily, it also biases our welfare cost estimates.

[4]This comes at the cost of having to estimate specific functional forms for the demand functions which is not needed when using Ahmad and Stern's method. See Section 8 for a fuller discussion.

framework, which is a generalization of Deaton and Muellbauer's AIDS system, enables us to estimate the parameters of the underlying indirect utility function behind the demand system.[5] Consequently, we are able to calculate welfare measures that are exact.[6] More importantly perhaps, regarding our choice of QUAIDS, is that non-parametric analyses of consumer expenditures in our data suggest that the Engel curves for many of the goods categories are nonlinear in the logarithmic of expenditure. See Figures 1–6 in the Appendix.

With the exception of the information on prices, which is from the Central Bank of Iran,[7] the data come from repeated cross sections of the Household Budget Survey of the Statistical Center of Iran on a quarterly basis for the period of the spring 1998 to the winter of 2001 (for a total of 16 seasons).[8] Expenditures are grouped into eleven categories. The pooled sample consists of 43,641 households who reside in Iran's urban areas. While the range of income variations is quite large in our data, this is not the case for price variations. Price controls have led to no variations across geographic regions, at least not according to the official data. This limitation on price variations, i.e. existence of only sixteen data points, severely limits the reliability of our price elasticity estimates.

We show that fiscal interaction effects are substantial for many of the subsidized goods. Ignoring them leads to a distorted picture of what subsidy

[5] QUAIDS is also preferable to other commonly used specifications. Log-linear models do not satisfy theory exactly; linear expenditure system is overly restrictive, and flexible functional forms lead to representations of utility functions only approximately.

[6] The flexibility of the estimated demand system notwithstanding, the magnitude of the subsidy cuts are such that our estimates are based on prices that take us well out of the sample. See Figures 7–12 in the Appendix indicating how the non-subsidized prices compare to the price range in the data.

[7] These are quarterly price indices for the country as a whole. The Central bank of Iran (CBI) reports monthly consumer price indices for a wide range of commodities. We used these reports to derive aggregate monthly consumer price indices for our eleven demand categories. In this process, we matched CBI indices with commodities included in each demand category. Then using the monthly price indices, we developed quarterly price indices for the period of the spring of 1998 to the winter of 2001.

[8] The Household Budget Survey (HBS) collects data on incomes and the breakdown of expenditures by urban and rural households of Iran. It also collects data on education, health, and housing status of the households. The survey is conducted by the Statistical Center of Iran and its branches across the country. It is the oldest and most reliable survey of its kind in the country, and the main source for conducting research on Iran. Nevertheless, there are indications that households may not report their incomes correctly.

elimination implies for the government finances and for any potential welfare gains to the society. One particularly unexpected finding concerns the elimination of price subsidies on utilities. Such a policy saves the government little by way of revenues and will lead to a reduction in welfare. The reason for this is that when the price of utilities increases, as a result of eliminating its subsidy, consumers' demand for other highly-subsidized goods increases substantially. Chief among these subsidized goods are bread, household items, and transportation.[9] This increases government subsidy payments on these other goods. The additional cost to the government due to increased demand for all other subsidized goods is so high as to exceed the benefit to the society from eliminating the subsidy on utilities.[10] Specifically, removing the subsidy on utilities saves the government 66.5 thousand Iranian rials (TIR) per household per month if one ignores the general equilibrium tax interaction effects. Including these effects lowers the savings to only 21.3 TIR which is less than what the subsidies are worth to consumers (42.0 TIR in compensating variation).[11] Consequently, eliminating the subsidy to utilities is welfare reducing unless other price subsidies too are eliminated.[12]

2 The model

The economy is populated with households with identical tastes but different income levels. Each household is endowed with one unit of time which it supplies inelastically.[13] There are n categories of consumer goods, whose

[9] In interpreting why the demand for these goods may increase, one should bear in mind that eliminating the subsidy on utilities does not increase the price of these goods in our calculations because we are ignoring input subsidies.

[10] In fact, the high-income groups increase their consumption of these substitutes so much that the government *loses* revenues from them when it eliminates the subsidy on utilities!

[11] We report all monetary figures, here and elsewhere in the paper and the tables that follow, using 1,000 Iranian rials, TIR, as our monetary unit. This translates to about $0.66 using the Purchasing Power Parity (PPP) exchange rate during the sample period, and $0.13 using the market exchange rate during the sample period.

[12] These numbers, as well as all the other subsidy numbers in the paper, are based on the subsidies in place during the sample period. The values of the subsidies have increased tremendously since then.

[13] Allowing for preferences to depend on leisure necessitates the estimation of labor supply elasticities and cross-price elasticities between goods and leisure. We do not have data to undertake such estimates.

consumption levels are denoted by $\mathbf{x} = (x_1, x_2, ..., x_n)$. All consumer goods are produced by a linear technology subject to constant returns to scale in a competitive environment. Consequently, optimal consumer prices are equal to their corresponding undistorted produce-price values. The efficiency cost of the existing price subsidies can then be measured relative to their first-best producer-price values. We carry out these calculations by directly estimating the parameters of the representative household's indirect utility function.

Assume households preferences subscribe to the Quadratic Almost Ideal Demand System introduced by Banks *et al.* (1997).[14] Thus a household's indirect utility function is of the form

$$\ln v = \left\{ \left[\frac{\ln m - \ln a(\mathbf{p})}{b(\mathbf{p})} \right]^{-1} + \lambda(\mathbf{p}) \right\}^{-1}, \tag{1}$$

with

$$\ln a(\mathbf{p}) \equiv \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln p_i \ln p_j, \tag{2}$$

$$b(\mathbf{p}) \equiv \prod_{i=1}^{n} p_i^{\beta_i}, \tag{3}$$

$$\lambda(\mathbf{p}) \equiv \sum_{i=1}^{n} \lambda_i \ln p_i, \tag{4}$$

where m denotes the household's aggregate expenditures on goods $\mathbf{x} = (x_1, x_2, \ldots, x_n)$, the price vector $\mathbf{p} = (p_1, p_2, \ \ldots, p_n)$ denotes the consumer prices, and $\alpha_0, \alpha_i, \beta_i, \lambda_i$ and γ_{ij} $(i, j = 1, 2, \ldots, n)$ are constants. Observe also that the homogeneity (of degree zero in income and prices) and adding up properties of the demand system is ensured by imposing the restrictions $\sum_{i=1}^{n} \gamma_{ij} = \sum_{j=1}^{n} \gamma_{ij} = 0$, $\sum_{i=1}^{n} \beta_i = \sum_{i=1}^{n} \lambda_i = 0$, and $\sum_{i=1}^{n} \alpha_i = 1$ on the parameters of (2)–(4). The symmetry restriction (of the Slutsky matrix) requires $\gamma_{ij} = \gamma_{ji}$, for all $i \neq j = 1, 2, \ldots, n$, and must also be imposed on the estimated parameters.[15]

[14] There are a number of studies of demand systems in the literature that follow Banks *et al.* (1997) and use QUAIDS. See, among others, Blundell and Robin (1999), Moro and Sckokai (2000), Fisher and Fleissig (2001), and Gil and Molina (2008).

[15] If $\lambda_i = 0$, for all $i = 1, 2, \ldots, n$, the indirect utility function (1) will be reduced to Deaton and Muellbauer's (1980) Almost Ideal Demand System. In this case, Engel curves will be linear in $\ln m$.

It will be simpler, however, to estimate the goods' expenditure shares rather than their demand functions. We have from Roy's identity,

$$\omega_i \equiv \frac{p_i x_i}{m} = \frac{p_i}{m}\left(\frac{-\partial v/\partial p_i}{\partial v/\partial m}\right) = -\frac{p_i}{m}\frac{\partial \ln v/\partial p_i}{\partial \ln v/\partial m},$$

where ω_i denotes the expenditure share for good $i = 1, 2, \ldots, n$. Partially differentiating (1) with respect to p_i and m, and simplifying through equations (2)–(4), one arrives at the system of equations for expenditure shares:[16]

$$\omega_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln \frac{m}{a(\mathbf{p})} + \frac{\lambda_i}{b(\mathbf{p})}\left[\ln \frac{m}{a(\mathbf{p})}\right]^2, \quad i = 1, 2, \ldots, n. \quad (5)$$

Observe that the quadratic specification allows Engel curve for good i to vary with $\ln m$ nonlinearly through λ_i. If $\lambda_i = 0$ for some good i, the relationship becomes linear through β_i. This is the property often displayed by empirical Engel curves which are linear for some goods and nonlinear for others.

On the basis of (5), one can easily calculate the income elasticity of demand for good i, η_i, and its own price and cross price elasticity with respect to good j, ε_{ij}, as

$$\begin{aligned} \eta_i \equiv \frac{\partial x_i}{\partial m}\frac{m}{x_i} &= \frac{1}{\omega_i}\frac{\partial \omega_i}{\partial \ln m} + 1, \\ &= \frac{1}{\omega_i}\left[\beta_i + \frac{2\lambda_i}{b(\mathbf{p})}\ln \frac{m}{a(\mathbf{p})}\right] + 1, \end{aligned} \quad (6)$$

$$\begin{aligned} \varepsilon_{ij} \equiv \frac{\partial x_i}{\partial p_j}\frac{p_j}{x_i} &= \frac{1}{\omega_i}\frac{\partial \omega_i}{\partial \ln p_j} - \delta_{ij}, \\ &= \frac{1}{\omega_i}\left\{\gamma_{ij} - \left[\beta_i + \frac{2\lambda_i}{b(\mathbf{p})}\ln \frac{m}{a(\mathbf{p})}\right] \times \right. \\ &\qquad \left. \left(\alpha_j + \sum_{k=1}^{n} \gamma_{jk} \ln p_k\right) - \frac{\lambda_i \beta_j}{b(\mathbf{p})}\left[\ln \frac{m}{a(\mathbf{p})}\right]^2\right\} - \delta_{ij}, \end{aligned} \quad (7)$$

for i and $j = 1, 2, \ldots, n$ where δ_{ij} is the Kronecker delta. Observe that if $\lambda_i = 0$, both the income and the own and cross price elasticity of demand for good i is independent of income.

[16] In deriving equation (5) , we have also made use of the symmetry condition $\gamma_{ij} = \gamma_{ji}$. Otherwise, the term $\sum_{j=1}^{n} \gamma_{ij} \ln p_j$ on the right-hand side of (5) must be replaced with $\sum_{j=1}^{n} (\gamma_{ij} + \gamma_{ji}) \ln p_j / 2$.

2.1 Family size

The sampled population is most likely not homogeneous. Thus, in estimating preferences, one needs data to control for "demographic factors" that account for this heterogeneity. One such source of difference in our data is family size. To allow for the impact of size variation on our estimates, we thus incorporate a variable for the family size, z, in the household in equations (2)–(3) and rewrite them as,[17]

$$\ln a(\mathbf{p}) \equiv \alpha_0 + \sum_{i=1}^{n} (\alpha_i + \theta_i z) \ln p_i + \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln p_i \ln p_j, \tag{8}$$

$$b(\mathbf{p}) \equiv \prod_{i=1}^{n} p_i^{\beta_i + \varphi_i z}. \tag{9}$$

The idea here is that for the same income level a larger family cannot buy as much, on a per person basis, and one can account for this by assuming that such a family faces a "higher price".

Given these expressions, applying Roy's identity to the indirect utility function (1) then changes the expression for w_i, for $i = 1, 2, \ldots, n$, according to

$$\omega_i = (\alpha_i + \theta_i z) + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + (\beta_i + \varphi_i z) \ln \frac{m}{a(\mathbf{p})} + \frac{\lambda_i}{b(\mathbf{p})} \left[\ln \frac{m}{a(\mathbf{p})} \right]^2, \tag{10}$$

where the expressions for $\ln a(\mathbf{p})$ and $b(\mathbf{p})$ are those in (8)–(9). The corresponding expressions for the income and cross price elasticities of demand will be the same as those in equations (6)–(7), except that β_i is replaced by $\beta_i + \varphi_i z$, and α_i is replaced by $\alpha_i + \theta_i z$, with the expressions for $\ln a(\mathbf{p})$ and $b(\mathbf{p})$ being those in (8)–(9). Observe also that to preserve the adding up properties of the demand system we must also impose the restrictions $\sum_{i=1}^{n} \varphi_i = \sum_{i=1}^{n} \theta_i = 0$.

[17] In general, the role of z arises when one estimates the parameters of the utility function with data on households who differ along some dimension. It is intended here to incorporate the impact of size of the households on the parameter estimates because the households in our data vary in size. If need be, z may also be a vector allowing for differences among households beyond size (e.g., age, race, etc.). If households are identical in all dimensions, there will be no need to include the variable z in the utility function.

3 Data and the Engel curves

With the exception of the information on prices, which is from the Central Bank of Iran,[18] the data come from repeated cross sections of the Household Budget Survey of the Statistical Center of Iran on a quarterly basis for the period of the spring 1998 to the winter of 2001 (for a total of 16 seasons). Our pooled sample consists of 43,641 households who reside in Iran's urban areas. Table 1 shows the number of families in each income category, where by "income" we mean "aggregate expenditures."[19] As also pointed out in the Introduction, we report all monetary figures in 1,000 Iranian rials, TIR. This translates to about $0.66 using the Purchasing Power Parity (PPP) exchange rate during the sample period, and $0.13 using the market exchange rate during the sample period.[20]

According to this sample, some 69% of Iranians who resided in urban areas between 1998 and 2001 lives on less than 2,000 TIR a month. Another 17% had incomes between 2,000 and 3,000 TIR, followed by 10% of the population with incomes between 3,000 to 5,000 TIR. These income groups accounted for 96% of Iranians living in urban areas. Out of the remaining 4%, only 2% had incomes exceeding 6,000 TIR a month. The average family size was the lowest for the least well-off group at about four rising to about five for other income groups (with some variations).

The data provide information on the expenditure of the households on eleven categories of goods and services. These are: (i) Grains/bread/cake, (ii) other food products, (iii) clothing, (iv) housing (rent and imputed rent), (v) utilities (water, electricity, gas, phone, etc.), (vi) household items and

[18] These are quarterly price indices for the country as a whole. The Central bank of Iran (CBI) reports monthly consumer price indices for a wide range of commodities. We used these reports to derive aggregate monthly consumer price indices for our eleven demand categories. In this process, we matched CBI indices with commodities included in each demand category. Then using the monthly price indices, we developed quarterly price indices for the period of the spring of 1998 to the winter of 2001.

[19] The two are often not the same. We have used figures for aggregate expenditures for consistency with our specification of the model in which one's income is fully spent on his current consumption.

[20] The PPP is a more appropriate exchange rate than the market rate for non-traded goods. According to the World Bank WDI data, the PPP exchange rate was 1,227 rials per dollar for 1998 and 1,727 for 2001. The market exchange rate during this period was about 8,000 rials per dollar. Currently, the PPP exchange rate is 4,056 rials per dollar (for 2008, the latest available year) and the market exchange rate is 10,000 rials per dollar.

Table 1. Number and average size of families by income groups (expressed per month and in units of 1,000 Iranian rials, TIR)

income groups	number of families	percent of total	average size
1–999	12,819	29.37	4.07
1,000–1,999	17,248	39.52	4.79
2,000–2,999	7,393	16.94	5.08
3,000–3,999	3,078	7.05	5.05
4,000–4,999	1,399	3.21	5.11
5,000–5,999	756	1.73	4.92
6,000–6,999	445	1.02	4.88
7,000–7,999	242	0.55	4.78
8,000–8,999	173	0.40	4.76
9,000–	88	0.20	4.99
Total	43,641	100.00	4.66

furnishing , (vii) health, (viii) transportation (including fuel used outside the house), (ix) education, recreation, personal hygiene, (x) durable goods including automobiles (expenditures as opposed to imputed services), and (x) other non-durable goods and services. Table 2 shows the expenditures of different goods for different income categories. Observe that households in the lowest income bracket spend about 60% of their income on housing and food (including bread), leaving them with only 40% to spend on everything else. They purchase practically no consumer durables.

The table indicates that the expenditure shares of bread, food, housing, and utilities decrease as income increases. On the other hand the expenditure shares of health (with one exception) and particularly consumer durables increase with income. These changes are consistent with one's intuition. The expenditure shares on the category named "other" seems to be constant for all households. In case of the remaining four, clothing, household items, transportation, expenditure shares first increase and then decline.

3.1 Engel curves

The first step is to examine whether or not a linear specification for Engel curves is appropriate. We thus regress the expenditure shares for each

Table 2. Expenditure shares 1998–2001 (percent)

incomes → goods ↓	**1 to 999**	**1,000 to 1,999**	**2,000 to 2,999**	**3,000 to 3,999**	**4,000 to 4,999**	**5,000 to 5,999**	**6,000 to 6,999**	**7,000 to 7,999**	**8,000 to 8,999**	**9,000 and above**
bread	9.37	8.59	7.86	7.11	6.13	5.74	4.75	4.26	3.99	4.05
food	27.30	24.18	21.30	18.51	16.00	13.35	10.81	8.73	8.74	8.02
clothing	4.19	7.15	9.47	10.39	10.03	8.95	6.81	6.30	6.76	5.06
housing	23.93	18.68	15.14	12.92	11.63	10.05	9.41	6.25	6.59	4.86
utilities	7.62	6.66	5.78	5.25	4.76	4.35	4.07	3.79	3.66	3.64
household items	5.21	5.30	5.50	5.60	5.48	5.41	4.88	4.43	4.49	3.82
health	5.27	5.95	6.59	7.19	7.25	8.39	7.46	11.01	7.41	11.51
transportation	2.68	3.71	4.31	4.37	4.42	4.27	3.90	3.08	3.36	3.83
education	1.79	2.53	3.09	3.32	3.36	3.23	2.99	2.72	2.79	2.74
durables	0.02	4.89	8.60	12.98	18.54	23.96	32.88	37.45	40.16	40.37
other	12.62	12.36	12.36	12.34	12.39	12.30	12.04	11.97	12.04	12.10

category of goods on the log income (deflated by the average consumer rice index) and log income squared. The results of these regressions are presented in Table A.1 of the Appendix. Additionally, in Figures 1–6 of the Appendix, we graph non-parametric kernel regressions and quadratic polynomial regressions for our eleven commodity groups. The regressions and the graphs support a linear relationship for bread, utilities, household items, and health but not the other seven categories of goods. It is apparent that the data support a preference specification that allows for some of the Engel curves to be nonlinear.

4 Estimation

In keeping with our finding that Engel curves for bread, utilities, household items and health are linear, we initially ran regressions using a linear relationship for these items and nonlinear relationships for the rest. However, the results did not support a nonlinear relationship for education either. The final regressions, which form the basis of our other computations and welfare analysis, are based on mix of linear and nonlinear specifications, with the coefficient of log income squared being restricted to zero in the equations for bread, utilities, household items, health, and education.

Equation (10) contains sixteen parameters ($\gamma_{i1}, \gamma_{i2}, \ldots, \gamma_{i11}, \alpha_i, \beta_i, \lambda_i, \theta_i, \varphi_i$). It represents a system of eleven nonlinear equations consisting of 176 (11×16) parameters that must be estimated. As stated earlier, however, five of these parameters (λ_i in the equations for bread, utilities, household items, health, and education) were restricted to zero, reducing the number of parameters to be estimated to 171.

We drop the equation for other goods category from the set of equations to be directly estimated, computing its parameter estimates from the adding up restriction. This reduces the number of equations to be estimated to ten. We also choose “other” good category as the numeraire, measuring all prices and incomes relative to the price of this category of goods. This reduces the number of variables in each equation to fifteen. We thus end up with a total of 145 ($10 \times 15 - 5$) parameters to be estimated.

We follow Banks *et al.* (1997) and use an estimation procedure that exploits the property that once $a(\mathbf{p})$ and $b(\mathbf{p})$ are known, the remaining parameters in (10) are linear. One chooses an initial set of variables for the parameters in $\ln a(\mathbf{p})$ and $b(\mathbf{p})$ and separately estimates each of the equations

Table 3. Demand system equations:
Second-stage estimates with t-ratios in parentheses

Expenditure share for → explanatory variables ↓	bread	food	clothing	housing	utilities	h-items	health	transport	education	durables	other
bread	0.0121	-0.0459	0.0774	-0.0543	0.0414	-0.0042	0.0507	-0.0389	0.0104	-0.0634	0.0146
price	(2.2)	(-8.1)	(9.4)	(-5.6)	(9.6)	(-0.6)	(5.6)	(-5.9)	(2.8)	(-7.9)	(-)
food	-0.0459	0.0099	-0.1021	0.0332	-0.0523	0.0458	0.0010	0.0191	-0.0280	0.0802	0.0391
price	(-8.1)	(0.8)	(-8.8)	(2.0)	(-9.1)	(4.3)	(0.1)	(1.7)	(-4.9)	(7.6)	(-)
clothing	0.0774	-0.1021	-0.1996	0.3327	-0.1731	0.1013	-0.1066	0.0925	-0.0416	0.1692	-0.1500
price	(9.4)	(-8.8)	(-8.2)	(16.1)	(-16.7)	(4.2)	(-5.4)	(5.8)	(-4.9)	(10.5)	(-)
rent	-0.0543	0.0332	0.3327	-0.0881	0.1066	-0.0906	0.0481	-0.0939	0.0186	-0.2025	-0.0097
price	(-5.6)	(2.0)	(16.1)	(-2.5)	(9.8)	(-4.9)	(1.8)	(-4.5)	(1.6)	(-10.4)	(-)
utilities	0.0414	-0.0523	-0.1731	0.1066	-0.0521	0.0299	-0.0493	0.0591	-0.0138	0.0987	0.0048
price	(9.6)	(-9.1)	(-16.7)	(9.8)	(-8.4)	(3.6)	(-4.6)	(6.9)	(-3.0)	(11.8)	(-)
h-items	-0.0042	0.0458	0.1013	-0.0906	0.0299	-0.1470	0.0597	-0.0412	0.0392	-0.0004	0.0068
price	(-0.6)	(4.3)	(4.2)	(-4.9)	(3.6)	(-4.0)	(3.5)	(-2.4)	(5.1)	(0.0)	(-)
health	0.0507	0.0010	-0.1066	0.0481	-0.0493	0.0597	0.0408	0.0008	-0.0406	0.0339	-0.0384
(price)	(5.6)	(0.1)	(-5.4)	(1.8)	(-4.6)	(3.5)	(1.2)	(0.0)	(-4.0)	(1.8)	(-)
transport	-0.0389	0.0191	0.0925	-0.0939	0.0591	-0.0412	0.0008	-0.0167	0.0115	-0.0436	0.0513
price	(-5.9)	(1.7)	(5.8)	(-4.5)	(6.9)	(-2.4)	(0.0)	(-0.8)	(1.3)	(-3.4)	(-)
education	0.0104	-0.0280	-0.0416	0.0186	-0.0138	0.0392	-0.0406	0.0115	0.0073	0.0188	0.0182
price	(2.8)	(-4.9)	(-4.9)	(1.6)	(-3.0)	(5.1)	(-4.0)	(1.3)	(1.2)	(2.6)	(-)
durables	-0.0634	0.0802	0.1692	-0.2025	0.0987	-0.0004	0.0339	-0.0436	0.0188	-0.0903	0.0014
price	(-7.9)	(7.6)	(10.5)	(-10.4)	(11.8)	(0.0)	(1.8)	(-3.4)	(2.6)	(-4.8)	(-)
other	0.0146	0.0391	-0.1500	-0.0097	0.0048	0.0068	-0.0384	0.0513	0.0182	0.0014	0.0646
price	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
ln income	-0.0074	-0.0143	0.0608	-0.0244	-0.0153	0.0004	0.0104	0.0301	0.0100	-0.0724	0.0057
	(-7.7)	(4.0)	(19.5)	(-4.8)	(-22.1)	(-0.8)	(8.1)	(18.2)	(19.9)	(-15.7)	(-)
$(\ln \text{income})^2$	0.0000	-0.0145	-0.0106	-0.0075	0.0000	0.0000	0.0000	-0.0038	0.0000	0.0356	0.02009
	(0.0)	(-21.1)	(-17.6)	(-7.5)	(0.0)	(0.0)	(0.0)	(-11.7)	(0.0)	(39.7)	(-)
size	0.0135	0.0111	-0.0119	-0.0251	0.0042	0.0007	-0.0022	-0.0006	0.0037	0.0038	0.0028
	(25.2)	(12.1)	(-14.6)	(-18.8)	(11.0)	(2.3)	(-3.1)	(-1.4)	(13.1)	(3.2)	(-)
size ×	-0.0027	0.0001	0.0057	0.0027	-0.0006	0.0001	0.0004	0.0000	-0.0007	-0.0042	-0.0008
ln income	(-13.3)	(0.2)	(18.8)	(5.4)	(-3.9)	(0.9)	(1.6)	(-0.2)	(-6.7)	(-9.4)	(-)
constant	0.0493	0.2130	0.0440	0.3884	0.0599	0.0365	0.0352	-0.0011	0.0029	0.0882	0.0837
	(16.0)	(50.2)	(2.5)	(56.3)	(24.8)	(5.2)	(3.0)	(-0.3)	(-3.6)	(12.0)	(-)

in (10). Using the resulting estimated parameter values, one then updates the parameter values initially chosen. This iterative procedure is repeated until convergence is achieved for $\ln a(\mathbf{p})$ and $b(\mathbf{p})$.

When separately estimating equations in (10), we used both OLS and TSLS procedures. The latter procedure was meant to deal with the problems of measurement errors and endogeneity of the households' aggregate expenditures. We used monthly income, family size, age of the head of household, number of years of education, homeownership dummy variables, the household's living area, number of rooms, number of cars, and dummy variables for having a telephone as instruments for cross-household differences in aggregate expenditure. Additionally, as instruments for differences in prices, we used world price indices for cereals, food, industrial commodities, crude oil, and natural gas. However, we could not reject our OLS estimates as the TSLS estimates turned out to be more imprecise in a number of instances.

Estimating the parameters of the left-out equation as residuals via the adding up restrictions ensures that adding up is satisfied. Moreover, with all prices in (10) being expressed relative to the price of other goods category, each estimated equation for expenditure shares remains invariant to proportional changes in consumer prices thus satisfying the homogeneity restrictions. However, the procedure outlined above does not guarantee symmetry for γ_{ij}'s. Thus, after achieving convergence, we embark on a second round of estimation to ensure symmetry.

The procedure we follow is based on the method suggested by Rothenberg (1973) for estimation under constraints. Write the 15 parameters contained in each of the ten equations in (10) as one 15×1 column vector and stack the resulting 10 vectors (for $i = 1, 2, \ldots, 10$) into a 150×1 column vector, denoted by $\mathbf{b}$. Then choose the elements of a 45×150 matrix $\mathbf{G}$ (consisting of zero's and one's only) such that $\mathbf{Gb} = \gamma$, where γ is a 45×1 column vector whose elements are $\gamma_{ij} - \gamma_{ji}$ for $i \neq j = 1, 2, \ldots, 10$. The restrictions that must be imposed on our first-stage estimates are then $\mathbf{Gb} - \gamma = \mathbf{0}$. Denoting the first-stage estimate of $\mathbf{b}$ by $\hat{\mathbf{b}}_1$, and the covariance matrix of the error terms in the first stage by $\mathbf{V}_1$, the second-stage estimate of $\mathbf{b}$ will be given by $\hat{\mathbf{b}}_2$, and the second-stage covariance matrix of the error terms by $\mathbf{V}_2$, such that

$$\begin{aligned} \hat{\mathbf{b}}_2 &= \hat{\mathbf{b}}_1 - \mathbf{V}_1\mathbf{G}' \left(\mathbf{G}\mathbf{V}_1\mathbf{G}'\right)^{-1} \mathbf{G}\hat{\mathbf{b}}_1, \\ \mathbf{V}_2 &= \mathbf{V}_1 - \mathbf{V}_1\mathbf{G}' \left(\mathbf{G}\mathbf{V}_1\mathbf{G}'\right)^{-1} \mathbf{G}\mathbf{V}_1. \end{aligned}$$

The results of the second-stage estimates are given in Table 3 (and the first-stage estimates in Table A2 in the Appendix).[21] Observe that the coefficient of log income squared is statistically significant in all the equations with a quadratic specification (food, clothing, housing, transportation, durables, other). Observe that the own-price coefficients are positive in the equations for bread, food, health, education, and other indicating a positive relationship between expenditure shares of these goods and their prices. What this means is that the own-price elasticities for these goods are less than one (in absolute value). Expenditure shares for the other goods—clothing, housing, utilities, household items, transportation, and durables—move negatively with price indicating an elastic demand.

Table 4 reports the values of own-price elasticity, income elasticity, and compensated price elasticity of demand for the eleven categories of goods for a household with average income. As far as price elasticity is concerned, bread, food, health, education, and other have inelastic demands, while clothing, housing, utilities, household items, transportation, and durables have elastic demands. The demand curves for household items and clothing are in particular highly elastic.

Turning to income elasticities, bread, food, housing, and utilities have income elasticities smaller than one; clothing, health, transportation, education, and durables have income elasticities greater than one; and household items and other have approximately a unitary elasticity. Observe that the goods are all normal. This implies that their compensated price are, in absolute value, smaller than non-compensated elasticities. The compensated demand curves are inelastic for bread, food, health, education, and other, and elastic for the remaining goods. Household items, clothing, and durables have highly elastic demands. The demand for household items is highly elastic at all income levels, while clothing and durables have compensated elasticities that decrease with income. Utilities, on the other hand, has an elastic demand which increases with income. These elasticities indicate that, everything else equal, subsidizing bread, food, health, education, and other entail less loss in welfare. At the same time, the worst candidates for subsidies are clothing and household items. However, as we will see later, while these elasticities do matter, they ignore what is a more important con-

[21] Comparing the estimated coefficients in the two stages indicates a number of sign reversals. This occurrence is common in these types of estimation; see, e.g., Banks et al. (1997). Rothenberg (1973) explains this by suggesting that in the second stage one corrects the first stage results to account for one's prior information (i.e. a theoretically consistent demand structure). He refers to this as the "value of prior information".

sideration in general equilibrium; namely, cross-price elasticities.

Table 4. Income and price elasticities
(for a household with average income)

	price	income	compensated price
bread	–0.83	0.73	–0.77
food	–0.90	0.77	–0.73
clothing	–3.20	1.46	–3.07
housing	–1.40	0.75	–1.26
utilities	–1.84	0.70	–1.80
household items	–3.74	1.00	–3.69
health	–0.38	1.19	–0.30
transportation	–1.38	1.31	–1.33
education	–0.73	1.24	–0.70
durables	–2.42	2.23	–2.30
other	–0.49	0.96	–0.36

5 Existing subsidies

There are, broadly speaking, two types of subsidies on goods and services consumed in Iran: direct and indirect (or hidden). Direct subsidies are on the books and appear in various government publications. Dividing these figures by the corresponding aggregate consumer expenditures thus yields the direct subsidy rates on these goods. Indirect subsidies are the implicit subsidies provided to certain category of goods by reducing their consumer prices via subsidies given to the producers or importers of these goods. These subsidies take three forms. One is through selling fuel and other oil products, produced in the public sector, to domestic producers at highly below world-market prices; the second is the public sector's provision of loans and credits to the private sector at very low interest rates; and the third is selling foreign exchange to importers at less than the market rate of exchange.

Esfahani and Taheripour (2002) estimate the three indirect subsidies amount to 9.4%, 7%, and 13.6% of the (producer) price of the subsidized good. Of course, not all aspects of production of a good are subjected to

Table 5. Percentage increase in consumer prices if their sample-period subsidies are eliminated*

	direct	indirect	total
bread	40	30	70
food	4	30	34
clothing	0	16	16
housing	0	0	0
utilities	40	21	61
household items	0	30	30
health	6	30	36
transportation	97	21	118
education	0	9	9
durables	0	10	10
other	0	9	9

*Authors' calculations.

these rates. Different goods used different amounts of energy in production, goods are not produced totally on credit, and nor totally imported on subsidized exchange rate. We thus adjust these rates on the basis of the share of their value added that can be attributed to these factors. Table 5 reports by what percentage consumer prices increase if the current subsidies are eliminated. Of the five goods with inelastic compensated demand—bread, food, health, education, other—only the first three are heavily subsidized (leading to price increases of 70%, 34%, 36%). Education and other have the lowest subsidy rate (leading to a price increase of 9%). The highest subsidized sector is by far transportation (leading to a price increase of 118%) despite the fact that its compensated demand is elastic. The same is true of utilities which has an elastic compensated demand but the third highest subsidy rate (leading to a price increase of 61%). Household items, clothing, and durables, have elastic demands with subsidy rates whose elimination leads to price increases of 30%, 16%, and 10%. There is no subsidy to housing.[22]

[22]Nor are there any direct *price* subsidies on clothing, household items, education, consumer durables and other good category. Transfers in kind are not included in the numbers reported in Table 5. In the case of education, the expenditures in survey refer to out of pocket expenses; primary, secondary, and higher education are provided publicly and for free. There are also many free health clinics.

Finally, given the magnitude of the price increases in Table 5, it is useful to gauge how far out of the sample one is going when estimating the welfare effects of eliminating the subsidies. Clearly, the closer one stays within the range of prices during the sample period, the more confident one is that the demand after the subsidy removal can be read off the estimated demand curve. Figures 12–19 in the Appendix depict the estimated demand curves and indicate where one ends up on them after the subsidy removal. Admittedly, in some cases, subsidy elimination takes us too far out.

5.1 Subsidy expenditures by income groups and good categories

Relative to lump-sum rebates, price subsidies benefit the rich more than the poor. Consider the monthly subsidy transfers to households in different income brackets via their consumption of the eleven categories of goods. One can calculate these on the basis of the statutory subsidy rates and the quantities of goods consumed by consumers in the groups. Let x_j^h denote the consumption of good $j = 1, 2, \cdots, n$ by household $h = 1, 2, \cdots, H$, s_j denote the statutory subsidy rate on good j, and $\mathbf{s} = (s_1, s_2, \ldots, s_n)$ be the vector of subsidy rates. It is expositionally simpler to denote the vector of consumer prices *without* the subsidies by $\mathbf{p} = (p_1, p_2, \ldots, p_n)$, so that the current subsidy-inclusive prices are given by $\mathbf{p} - \mathbf{s} = (p_1 - s_1, p_2 - s_2, \ldots, p_n - s_n)$. One can then calculate the subsidy an h-household implicitly receives for consuming good j as[23]

$$S_j^h = s_j x_j^h \left(\mathbf{p} - \mathbf{s}, m^h\right), \tag{11}$$

where m^h denotes the money income (aggregate expenditures) of a household in the income category h. The *total* subsidies family h receives is thus measured by

$$S^h = \sum_j S_j^h. \tag{12}$$

The monetary value of the subsidies are given in Table 6. The total amount of subsidies amounts to 144.1 TIR per month for a family in the lowest income group and increased to 2,394.9 TIR per month for a family

[23] By an h-household, we mean a household in the income group h. Observe also that in our data, h takes values of 500 up to 9,500 TIR in increments of 1000 TIR.

Table 6. Cost of current subsidies to the government
(1,000 rials, per family, per month)

incomes → **goods ↓**	**1 to 999**	**1,000 to 1,999**	**2,000 to 2,999**	**3,000 to 3,999**	**4,000 to 4,999**	**5,000 to 5,999**	**6,000 to 6,999**	**7,000 to 7,999**	**8,000 to 8,999**	**9,000 and above**	**average income**
bread	36.7	86.2	125.1	158.0	186.8	212.3	235.1	255.7	274.3	291.3	99.5
food	44.3	116.6	171.4	213.8	246.4	270.9	288.3	299.5	305.1	305.7	135.8
clothing	1.4	19.5	40.8	62.9	85.3	107.7	130.0	152.1	173.9	195.4	26.2
housing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
utilities	25.3	57.9	82.5	102.6	119.5	134.0	146.4	157.2	166.4	174.4	66.5
household items	8.0	23.9	39.9	55.9	71.9	88.0	104.0	120.0	136.0	152.1	29.1
health	8.7	33.4	61.4	91.2	122.3	154.5	187.4	221.0	255.3	290.0	42.1
transportation	11.1	69.4	134.1	200.3	266.8	332.4	397.4	461.6	524.9	587.2	89.8
education	0.8	3.4	6.5	9.8	13.2	16.8	20.5	24.3	28.1	32.1	4.4
durables	1.5	6.7	20.6	41.2	67.5	98.5	133.6	172.4	214.5	259.8	10.3
other	6.4	18.0	29.4	40.6	51.8	62.9	73.9	85.0	96.0	107.0	21.7
all goods	144.1	435.1	711.7	976.6	1,231.5	1,477.8	1,716.7	1,948.7	2,174.6	2,394.9	525.3
all goods $\times \pi^h$	42.3	172.0	120.6	68.8	39.5	25.6	17.5	10.7	8.7	4.8	**Total** = 510.5

π^h denotes the proportion of households in the income group h .

in the highest income group. Subsidy expenditures on bread, food, utilities, and transportation, are high at all income levels. Households in the lowest income group do not benefit much from other subsidies. Households in the income bracket 1,000–1,999 TIR benefit also from the subsidies on clothing, household items, health, transportation, and other (but not education and durables). Subsidies on durables become important for households with incomes above 2,000 TIR, but subsidies on education do not amount to much until very high income levels.

Finally, expressed as a percentage of a family's expenditures, subsidies constitute 41% of its expenditures on bread, 25% of its expenditures on food, 14% of its expenditures on clothing, 0% of its expenditures on housing, 38% of its expenditures on utilities, 23% of its expenditures on household items, 26% of its expenditures on (out of pocket) health, 54% of its expenditures on transportation, 8% of its expenditures on (out of pocket) education, 9% of its expenditures on consumer durables, and 9% of its expenditures on other good categories. When it comes to the family's total expenditures, subsidies amount to about 22% for families with incomes below 4,000 TIR per month, to about 21% for families with incomes between 4,000 and 8,000 TIR per month, and to about 20% for families whose incomes exceed 8,000 TIR per month.

6 Subsidy elimination and fiscal interactions

It will be a mistake to identify the gain to the government, when it eliminates a subsidy on a particular good, by what it currently spends on subsidizing that good. We denoted these latter expenditures on each consumer type by S_j^h (and S^h for government expenditures on all goods) and reported them in Table 6. The difference arises because of the general equilibrium effects of changing the consumer price of one good on the consumption of all other goods. Given that these other goods also receive price subsidies, an increase (a reduction) in their consumption will increase (decrease) the subsidies paid on account of other goods. The *net* savings in the total cost of subsidies to the government will then be less (more) than the subsidies that will no longer be paid on the good whose subsidy is eliminated. Denote the government's net savings due to the elimination of the subsidy on good j by $\widehat{S}_j^h$. Let $\overline{\mathbf{p}}_j$ denote the vector of producer prices of all goods except good j and $\overline{\mathbf{s}}_j$ denote the vector of subsidies on all goods except good j. Then

$$\widehat{S}_j^h = S_j^h - \sum_{i \neq j} s_i \left[x_i^h \left(p_j, \overline{\mathbf{p}}_j - \overline{\mathbf{s}}_j, m^h \right) - x_i^h (\mathbf{p} - \mathbf{s}, m^h) \right]. \tag{13}$$

Observe, however, that if subsidy rates on all goods are eliminated, the general equilibrium changes in consumer demands will not have any impact on government subsidy costs (all s_i's in the above formula will be zero).[24] Under this circumstance, net government savings, $\widehat{S}^h$, will be identical to its initial expenditures on subsidies, S^h. We report the figures for $\widehat{S}_j^h$ and $\widehat{S}^h$ in Table 7.

The reported values in Table 7 are different from their counterparts in Table 6 (except for $\widehat{S}^h$ and S^h in the last rows of the two tables which are indeed equal). The differences are particularly substantial for bread and food, which entail higher net government savings than the cost of subsidies, and for utilities, transportation, and to a lesser degree for household items and other, which entail lower net government savings than the cost of subsidies. This tells us that non-bread and non-food good categories are on average complements to bread and food respectively; while non-utilities, non-transportation, non-household items, and non-other good categories are on average substitutes to utilities, transportation, household items, and other respectively. With complements, eliminating the subsidy on a good, which increases its price, implies a reduction in average consumption for other goods and thus a reduction in the total subsidy the government pays on these other goods. In consequence, net government savings will be more than what it saves from the subsidy elimination. The reverse is the case for substitutes. Eliminating the subsidy on such a good, increases the average consumption for, and the subsidy paid on, the remaining goods. Consequently, net savings to the government will be less than what it saves from the subsidy elimination.

It is also interesting to point out that the substitution property is so high in the case of utilities and for high-income groups, that the government *loses* revenues from high income groups if it cuts the subsidy on utilities. In this case, the additional cost to the government due to increased demand for all other subsidized goods is so high as to exceed the gain to the government by not paying the subsidy on utilities.

Table 8 illustrates this point by reporting the cross-price elasticity of demand for utilities with respect to every other good category for a family

[24] As defined, $\widehat{S}^h$ is not equal to $\sum_j \widehat{S}_j^h$.

Table 7. Net government savings (net monetary losses to households) when eliminating the subsidy on a single item

(1,000 rials, per family, per month)

incomes → goods ↓	1 to 999	1,000 to 1,999	2,000 to 2,999	3,000 to 3,999	4,000 to 4,999	5,000 to 5,999	6,000 to 6,999	7,000 to 7,999	8,000 to 8,999	9,000 and above	average income
bread	40.4	96.1	140.8	179.3	213.5	244.4	272.6	298.5	322.4	344.6	111.3
food	49.9	132.7	197.7	250.1	292.6	326.8	353.9	374.7	389.8	399.9	155.2
clothing	0.2	15.9	34.4	53.6	73.0	92.2	111.2	129.9	148.3	166.3	21.7
housing	–	–	–	–	–	–	–	–	–	–	–
utilities	13.2	20.8	20.3	15.1	6.8	-4.1	-16.9	-31.5	-47.6	-64.9	21.3
household items	4.8	14.3	23.7	33.1	42.5	51.8	61.1	70.3	79.6	88.9	17.4
health	8.1	31.3	57.5	85.4	114.4	144.3	175.0	206.3	238.2	270.5	39.5
transportation	3.6	46.6	96.0	146.5	197.0	246.9	295.9	344.0	391.1	437.2	62.2
education	1.0	3.8	7.0	10.5	14.1	17.8	21.6	25.6	29.5	33.6	4.8
durables	0.00	2.4	13.8	32.3	56.5	85.5	118.9	156.0	196.6	240.4	5.2
other	4.1	11.0	17.4	23.6	29.7	35.8	41.7	47.7	53.5	59.4	13.1
all goods	144.1	435.1	711.7	976.6	1,231.5	1,477.8	1,716.7	1,948.7	2,174.6	2,394.9	525.3

Table 8. Uncompensated average cross price elasticity of utilities with respect to other good categories (95% confidence intervals in parentheses)*

bread	food	clothing	housing	utilities	h-items	health	transport	education	durables	other
0.708	-0.800	-2.878	1.878	-1.841	0.515	-0.808	0.981	-0.230	1.659	0.119
(0.695, 0.730)	(-0.835, -0.776)	(-2.979, -2.778)	(1.780, 1.935)	(-1.894, -1.788)	(0.463, 0.567)	(-0.811, -0.755)	(0.927, 1.034)	(-0.281, -0.179)	(1.554, 1.714)	(0.113, 0.205)

* The confidence intervals are calculated using a bootstrapping procedure on 16 clusters of time observations.

with average income. The table also contains the 95% confidence intervals for these estimates derived using a bootstrapping procedure on 16 clusters of time observations. All our elasticity estimates fall within their corresponding confidence intervals. The elasticity is positive for bread, housing, household items, transportation, durables and other categories (at 0.71, 0.51, 0.98, 1.66, and 0.12); it is negative for food, clothing, health, and education (at –0.80, –2.87, –0.80, and –0.23).[25] Thus eliminating the subsidy on utilities, which increases its price, increases the demand for the first set of goods and reduces the demand for the second set of goods. The demand increases raise the subsidies that the government pays on these goods (subsidized at 70%, 30%, 118%, 10%, and 9%) and the demand reductions decrease the subsidies the government pays on them (subsidized at 34%, 16%, 36%, 9%). That the net cost to the government increases substantially stems from the fact that the first set of goods are the more heavily subsidized ones including transportation and bread which have the highest subsidy rates (along with utilities). Note that housing is also a substitute to utilities but its higher demand does not affect government subsidies.

7 Welfare gains in general equilibrium

These general equilibrium effects influence the welfare gains associated with subsidy elimination. The most interesting result that emerges is that while eliminating *all* subsidies is a good thing, eliminating subsidies on utilities, which the government of Iran wants to do is not.

To derive the efficiency gain in eliminating the subsidy on a particular good, we have two compute each consumer type's loss and subtract it from what the government gains from this type of consumer. To calculate how much a subsidy recipient values the subsidy, we resort to the Hicksian concept of compensating variation, CV. Let $v(.)$ denote the household's indirect

[25] To examine the reliability of our cross-price estimates we also re-estimated our demand system with TSLS using world price indices for cereals, food, industrial commodities, crude oil, and natural gas as instruments for differences in prices. We recalculated all cross-price elasticities based on these new estimates. The results are very similar to our original estimates. In particular, the cross-price elasticity of demand for utilities are

bread	food	clothing	housing	utilities	h-items	health	transport	education	durables	other
0.708	-0.800	-2.878	1.878	-1.841	0.515	-0.808	0.981	-0.230	1.659	0.119

utility function and $\overline{\mathbf{p}}_j$ denote the vector of prices that is formed from $\mathbf{p}$ by eliminating p_j. Define $\overline{\mathbf{s}}_j$ similarly from $\mathbf{s}$ by eliminating s_j. The compensating variation of eliminating s_j for an h-household, for all $j = 1, 2, \cdots, n$, and $h = 1, 2, \cdots, H$, is found according to

$$v(\overline{\mathbf{p}}_j - \overline{\mathbf{s}}_j, p_j, m^h + CV_j^h) = v(\mathbf{p} - \mathbf{s}, m^h). \tag{14}$$

In words, CV_j^h measures the amount of money one has to give an h-household in order to enable it to have the same utility level as it did with the subsidy on good j. Observe that CV_j^h is defined such that it is positive for a change which makes the household worse off (elimination of a subsidy). Similarly, one can define the compensating variation for price subsidies on *all* goods for an h-household, CV^h. This is defined by $v(\mathbf{p}, m^h + CV^h) = v(\mathbf{p} - \mathbf{s}, m^h)$.

Turning to the measurement of the efficiency gain, EG, associated with the elimination of price subsidies, one must subtract the loss to the consumer CV_j^h, from the net government savings, $\widehat{S}_j^h$. We have

$$EG_j^h = \widehat{S}_j^h - CV_j^h. \tag{15}$$

When all subsidies are eliminated, the efficiency gain is given by $EG^h = \widehat{S}^h - CV^h$.

The welfare gain values are reported in Table 9. The highest gains are generated by eliminating the subsidies on bread and food. These are due to general equilibrium effects as the goods in question have inelastic demands. Cutting the subsidy on transportation also leads to substantial efficiency gains, though not to the same extent as bread and food. This is mainly due to the high rate of subsidy on this good. On the other hand, eliminating the subsidy on utilities generate a substantial efficiency loss. This follows naturally when the subsidy reduction increases the government budgetary costs. The other effects are rather small in magnitude. However, it is interesting to note that, as with utilities, eliminating the subsidy on the durables and other categories lead to a welfare loss to the economy at all income brackets. The same is true for health except at high income brackets and clothing and transportation at the lowest income bracket. These households value the subsidies they get on account of these goods by more than what the government saves from eliminating them.

The most unexpected finding is that the elimination of price subsidies on utilities, other, durables, and, to some extent, health result in efficiency losses to the economy rather than efficiency gains. This is due to the general

Table 9. Welfare gain of partial reforms: Excess of government savings over compensating variation when eliminating the subsidy on a single item

(1,000 rials, per family, per month)

incomes → goods ↓	1 to 999	1,000 to 1,999	2,000 to 2,999	3,000 to 3,999	4,000 to 4,999	5,000 to 5,999	6,000 to 6,999	7,000 to 7,999	8,000 to 8,999	9,000 and above	average income
bread	10.9	26.5	39.3	50.6	60.9	70.4	79.1	87.3	95.1	102.3	30.8
food	10.0	28.0	43.9	58.3	71.3	83.1	93.8	103.6	112.5	120.6	33.3
clothing	-0.5	0.9	1.7	2.4	2.9	3.3	3.6	3.7	3.8	3.8	1.2
housing	–	–	–	–	–	–	–	–	–	–	–
utilities	-4.0	-16.3	-30.4	-45.6	-61.5	-77.9	-94.9	-112.1	-129.8	-147.6	-20.7
household items	0.5	0.8	1.2	1.5	1.8	2.0	2.2	2.4	2.6	2.8	0.9
health	-0.3	-0.4	-0.5	-0.4	-0.3	-0.2	-0.1	0.1	0.3	0.4	-0.4
transportation	-2.1	7.4	17.7	28.3	38.8	48.9	58.6	68.0	77.0	85.6	10.6
education	0.2	0.5	0.7	1.0	1.3	1.6	1.8	2.1	2.3	2.6	0.5
durables	-1.2	-3.4	-5.0	-6.2	-7.2	-8.0	-8.6	-9.2	-9.6	-10.0	-4.0
other	-2.1	-6.8	-11.5	-16.3	-21.2	-26.1	-31.0	-36.0	-41.0	-46.0	-8.3

equilibrium effects in other markets. Observe also that the bulk of efficiency gain in eliminating price subsidies on bread and food arise from the general equilibrium effects. Ignoring these would severely under-estimate the calculated efficiency gains (19.0 and 13.9 TIR rather than the correct values of 30.8 and 33.3 TIR). In case of utilities, transportation, household items and other, ignoring the general equilibrium effects would over-estimate the efficiency gains (at 24.5, 38.2, 12.7, and 0.4 TIR in place of the correct values of -20.7, 10.6, 0.9, and -8.3 TIR). Eliminating all subsidies entails an efficiency gain of 44.1 TIR.

8 Which subsidy should be cut first?

This section studies the order in which the subsidies are to be eliminated if this is to be phased in over a period of time (as the Iranian government plans to do). To address this question we need a procedure that gauges the welfare gain to the *society as a whole* due to the elimination of the subsidy on each category of goods. To pass judgment on the welfare implication of such a phase-in procedure we must resort to a social welfare function.

The iso-elastic welfare function introduced by Atkinson (1973) is a particularly useful for this purpose one as it allows for a wide range of attitudes towards inequality in the society. It is defined by

$$\begin{aligned} W &= \frac{1}{1-\eta}\sum_{h=1}^{H}\pi^h\left(v^h\right)^{1-\eta} \quad \eta\neq 1 \quad \text{and} \quad 0\leq\eta<\infty, \qquad (16)\\ &= \sum_{h=1}^{H}\pi^h \ln\ v^h, \quad \eta=1, \end{aligned}$$

where $\eta \geqq 0$ denotes the inequality aversion index and v^h is the utility of a household in income bracket h (h = 1–999, 1,000–1,999,. . . , 9,000– , TIR). As is well-known, this social welfare function reduces to the utilitarian function for $\eta = 0$ and to the Rawlsian function when $\eta \to \infty$. The functional form of v^h is given by (1) with parameters specified by (2)–(4) and estimated through our QUAIDS procedure.

8.1 Eliminating a subsidy in full

To make welfare comparisons for the society, we use the concept of the "social compensating variation", CV_j^s. We define this analogously to the compensating variation of eliminating a particular subsidy for an h-household as in equation (14). Thus define CV_j^s implicitly from

$$\sum_{h=1}^{H} \pi^h \left[v^h \left(\overline{\mathbf{p}}_j - \overline{\mathbf{s}}_j, p_j, m^h + CV_j^s \right) \right]^{1-\eta} = \sum_{h=1}^{H} \pi^h \left[v^h \left(\mathbf{p} - \mathbf{s}, m^h \right) \right]^{1-\eta}. \quad (17)$$

It measures how much one has to compensate every household in the society, as a result of eliminating the subsidy on good j, such that the level of social welfare remains the same as what it was under the current subsidy. Put differently, it measures the society's valuation of the subsidy in terms of identical compensation to all households. Similarly, when all subsidies are eliminated, the social compensating variation, CV^s, is defined according to

$$\sum_{h=1}^{H} \pi^h \left[v^h \left(\mathbf{p}, m^h + CV^s \right) \right]^{1-\eta} = \sum_{h=1}^{H} \pi^h \left[v^h \left(\mathbf{p} - \mathbf{s}, m^h \right) \right]^{1-\eta}. \quad (18)$$

Observe that CV_j^s and CV^s are positive when the subsidy elimination lowers the welfare of the society.

Table 10 reports the values of CV_j^s and CV^s for different values of η. The social compensating variation associated with all the subsidies is, for a utilitarian social welfare function, 481.4 TIR per month for every household. It decreases to 294.0 TIR for $\eta = 1$ and levels off to about 132.8 TIR when η reaches 10. That these valuations decrease with η reflects the adverse redistributional implications of price subsidies. With the rich receiving more subsidies than the poor, the society values price subsidies less when it cares more about equality.

To determine which price subsidy should be eliminated first, one has to also find the gain to the society when a particular subsidy is cut. One can calculate the gains from Table 7. There, we have reported net gains to the government for families at different income levels. A weighted average of these numbers, with the weights being equal to π^h (the proportion of family types in each income category), provides us with an estimate of the gains per family. This calculation gives us 103.8 TIR for bread, 141.3 TIR for food, 22.7 TIR for clothing, 0.0 TIR for housing, 16.1 TIR for utilities, 17.2 TIR

Table 10. Social compensating variation of price subsidies
(1,000 rials per family, per month)

inequality aversion index → **goods ↓**	0.0	0.5	1.0	2.0	5.0	10.0
bread	76.6	62.2	50.5	36.7	29.8	29.5
food	112.7	91.5	73.5	51.7	40.2	39.9
clothing	22.3	14.6	8.9	3.0	0.3	0.2
housing	–	–	–	–	–	–
utilities	38.5	32.3	27.0	20.6	17.3	17.2
household items	16.7	12.6	9.5	6.2	4.5	4.5
health	42.6	30.8	22.1	12.8	8.6	8.4
transportation	54.5	37.7	25.0	11.4	5.1	5.0
education	4.6	3.3	2.3	1.3	0.8	0.8
durables	16.2	9.8	5.8	2.4	1.2	1.2
other	21.6	16.5	12.6	8.3	6.3	6.3
all goods	481.4	378.4	294.0	190.8	134.9	132.8

for household items, 41.1 TIR for health, 64.0 TIR for transportation, 5.0 TIR for education, 12.2 TIR for durables, 12.7 TIR for other, and 510.6 TIR for all subsidies combined. Subtracting the entries in Table 10 from theses numbers gives us the net gain to the society, for each value of η, when a particular subsidy is eliminated. A positive number implies a net gain and a negative number a net loss. These numbers are reported in Table 11.

The main lesson of Table 11 is that if price subsidies are to be eliminated in full but not all at the same time, the top three candidates are food, bread, and transportation. This is true for all values of η. Health, clothing, household items, and durables come in at number 4 to 7 but only for positive values of η. Second, eliminating the subsidy on utilities is welfare-reducing for all reported values of η. The loss is estimated to be 22.4 TIR per family when $\eta = 0$ but it is reduced to 1.1 TIR when $\eta = 10$. Third, all the entries increase with η. That is, the more the society abhors inequality the higher it will be its gains from cutting the price subsidies. The net gain from cutting all subsidies is 29.1 TIR per family for a utilitarian social welfare function ($\eta = 0$) and increases to 377.8 when $\eta = 10$.[26]

8.2 Marginally cutting a subsidy

The previous subsection tells us which subsidy is to be *eliminated* first if elimination is total. We now discuss which subsidy should be *cut* first if the cut is a "marginal" cut in the subsidy rate. This idea mirrors the commodity tax reform problem of Ahmad and Stern (1984); see also Stern (1987). The methodology we have developed above for gauging the benefit of a tax/subsidy reform, does not rely on any approximation. As such, if one has an estimate of demand system for different income groups, and a utility function behind them, as we do, it yields a more accurate picture of welfare changes than Ahmad and Stern's methodology. The advantage of Ahmad and Stern's method is that one can use it without a full knowledge of the individual demand curves (assuming fixed welfare weights for individuals of

[26] Other interesting observations about the reported numbers in Table 11 include: Fourth, at low values of η, education subsidy should be eliminated before the subsidy on other category; this ranking changes for $\eta = 2$ and higher. Fifth, eliminating the price subsidy on health and durables are welfare-reducing at $\eta = 0$ but turn welfare-improving for $\eta = 0.5$ and higher. Sixth, the entry for the other category is negative for $\eta = 0$ and $\eta = 0.5$ but turns positive when η reaches one. Seventh, in all other cases, eliminating price subsidies is welfare improving (and the welfare gains increase with the size of η).

Table 11. Society's net gain in eliminating price subsidies
(1000 rials per family, per month)

inequality aversion index → **goods ↓**	0.0	0.5	1.0	2.0	5.0	10.0
bread	27.2	41.6	53.3	67.1	74.1	74.3
food	28.6	49.9	67.8	89.6	101.1	101.4
clothing	0.3	8.0	13.7	19.7	22.4	22.5
housing	–	–	–	–	–	–
utilities	-22.4	-16.2	-10.9	-4.5	-1.2	-1.1
household items	0.5	4.6	7.7	11.0	12.7	12.7
health	-1.5	10.3	19.0	28.3	32.6	32.7
transportation	9.5	26.4	39.0	52.6	58.9	59.1
education	0.4	1.8	2.7	3.7	4.2	4.2
durables	-4.1	2.4	6.4	9.8	11.0	11.0
other	-8.8	-3.7	0.2	4.4	6.4	6.5
all goods	29.1	132.2	216.6	319.8	375.7	377.8

different income groups).

Consider the social welfare function (16). Increasing the rate of subsidy on any good $j = 1, 2, \ldots, n$, from the existing price subsidies $\mathbf{s}$, by a "small amount," will affect the social welfare by

$$\begin{aligned}\frac{\partial W}{\partial s_j} &= \sum_{h=1}^{H} \pi^h \left(v^h\right)^{-\eta} \frac{\partial v^h}{\partial s_j} \\ &= \sum_{h=1}^{H} \pi^h \left(v^h\right)^{-\eta} \frac{\partial v^h(\mathbf{p}-\mathbf{s}, m^h)}{\partial m^h} x_j^h(\mathbf{p}-\mathbf{s}, m^h),\end{aligned}$$

where the last step follows from Roy's identity. This measures the value of the last "dollar" spent on the subsidy on good j; it is measured in units of the utility function. To translate it to dollar units, one should divide this by the social welfare value of a dollar. This latter concept is given by

$$\beta \equiv \frac{\partial W}{\partial m^h} = \sum_{h=1}^{H} \pi^h \left(v^h\right)^{-\eta} \frac{\partial v^h(\mathbf{p}-\mathbf{s}, m^h)}{\partial m^h}.$$

Next consider the expression for the total subsidy costs to the government at the existing price subsidies $\mathbf{s}$,

$$S = \sum_{i=1}^{n} \sum_{h=1}^{H} s_i \pi^h x_i^h \left(\mathbf{p}-\mathbf{s}, m^h\right), \tag{19}$$

Increasing the rate of subsidy on good $j = 1, 2, \ldots, n$, by a "small amount," will affect the subsidy costs to the government by

$$\frac{\partial S}{\partial s_j} = \sum_{h=1}^{H} \pi^h x_j^h \left(\mathbf{p}-\mathbf{s}, m^h\right) - \sum_{i=1}^{n} \sum_{h=1}^{H} s_i \pi^h \frac{\partial x_i^h \left(\mathbf{p}-\mathbf{s}, m^h\right)}{\partial p_j}.$$

It follows from these expressions that marginal social benefit of the last "dollar" spent on subsidizing the price of good j, $j = 1, 2, \ldots, n$, is[27]

$$\begin{aligned}
\mu_j &\equiv \frac{(\partial W/\partial s_j)/\beta}{\partial S/\partial s_j} \\
&= \frac{\sum_{h=1}^{H} \pi^h \left(v^h\right)^{-\eta} \frac{\partial v^h(\mathbf{p}-\mathbf{s},m^h)}{\partial m^h} x_j^h(\mathbf{p}-\mathbf{s},m^h)}{\sum_{h=1}^{H} \pi^h \left(v^h\right)^{-\eta} \frac{\partial v^h(\mathbf{p}-\mathbf{s},m^h)}{\partial m^h} \left[\sum_{h=1}^{H} \pi^h x_j^h\left(\mathbf{p}-\mathbf{s},m^h\right) - \sum_{i=1}^{n}\sum_{h=1}^{H} s_i \pi^h \frac{\partial x_i^h\left(\mathbf{p}-\mathbf{s},m^h\right)}{\partial p_j}\right]} \\
&= \sum_{h=1}^{H} \pi^h \left[\frac{\left(v^h\right)^{-\eta} \frac{\partial v^h(\mathbf{p}-\mathbf{s},m^h)}{\partial m^h}}{\sum_{h=1}^{H} \pi^h \left(v^h\right)^{-\eta} \frac{\partial v^h(\mathbf{p}-\mathbf{s},m^h)}{\partial m^h}}\right] \left\{\frac{x_j^h(\mathbf{p}-\mathbf{s},m^h)}{\sum_{h=1}^{H} \pi^h \left[x_j^h\left(\mathbf{p}-\mathbf{s},m^h\right) - \sum_{i=1}^{n} s_i \frac{\partial x_i^h\left(\mathbf{p}-\mathbf{s},m^h\right)}{\partial p_j}\right]}\right\}.
\end{aligned} \tag{20}$$

Equivalently, μ_j shows the marginal social loss due to reducing the subsidy cost on good j by one dollar (by cutting its subsidy rate).

Redistributive and efficiency considerations determine the value of μ_j. Redistribution is represented by the first bracketed expression, and efficiency by the second bracketed expression, that appear on the right-hand side of (20).[28] If the structure of existing subsidies are optimal, μ_j takes the same value for all goods. On the other hand, $\mu_j > \mu_i$ tells us that saving one dollar in subsidy costs if achieved via lowering the subsidy rate on good j entails a higher marginal social welfare cost than if it is done through lowering the subsidy rate on good i. Put differently the lower is μ_j the earlier good j should be cut.

Table 12 reports the values of $\mu_1, \mu_2, \ldots, \mu_{11}$ for different values of η. Observe that the ranking of μ_j's change with the value of η. For example, bread and food have the second and the fourth lowest μ at $\eta = 0$. On the other hand, they assume the fourth and third highest values when η increases to 10. Put differently, these are the goods whose subsidy should be cut earlier at low values of η but later at high values of η. The reason for this is that

[27] Using calculus, Ahmad and Stern (1984) employ a first-order approximation to measuring the changes in welfare and government budget, ΔW and ΔS, due to a change in the tax/subsidy rate. More recently, Urzúa (2005) has extended the Ahmad-Stern approach by using a second-order approximation to the changes in ΔW and ΔS.

[28] If the social marginal utility of income, $\left(v^h\right)^{-\eta}\left(\partial v^h/\partial m^h\right)$, is the same for all households, the first bracketed expression collapses to one and equity will play no role in determining μ_j.

Table 12. The marginal social benefit of the last TIR spent on a price subsidy in TIR

inequality aversion index → **goods** ↓	0.0	0.5	1.0	2.0	5.0	10.0
bread	0.5875	0.4758	0.3859	0.2825	0.2308	0.2293
food	0.6897	0.5554	0.4443	0.3136	0.2473	0.2453
clothing	0.7938	0.5307	0.3374	0.1339	0.0415	0.0389
housing	–	–	–	–	–	–
utilities	0.8394	0.6866	0.5622	0.4174	0.3444	0.3422
household items	0.6223	0.4687	0.3530	0.2277	0.1689	0.1672
health	0.9621	0.6902	0.4913	0.2822	0.1873	0.1846
transportation	0.4802	0.3344	0.2261	0.1109	0.0579	0.0564
education	0.8860	0.6281	0.4405	0.2446	0.1563	0.1538
durables	1.1754	0.7131	0.4271	0.1825	0.0981	0.0963
other	1.9045	1.4517	1.1085	0.7348	0.5581	0.5530

these goods are consumed proportionately more by the poor.[29] Consequently, it becomes less desirable to cut their subsidies when the society cares more about inequality.

Most interestingly, the ranking of subsidy cuts differs for marginal cuts as compared to the total elimination of subsidies. In particular, the important message that we have thus far conveyed is that the subsidies on utilities should not be eliminated first. However, the same message does not come through with a marginal cut in subsidies. At $\eta = 0$, each of the good categories other, durables, health, and education has a higher μ than utilities. The same is true for other, durables, and health at $\eta = 0.5$, and for other at all higher values of η. Consequently, if the subsidy cut is to be marginal, they are better candidates for keeping their subsidies (as compared to utilities).

The above finding appears, at least at first, rather puzzling. After all, large changes are simply sum of marginal changes. However, one should note that lowering the subsidy rate on a good successively might very well change its ranking in terms of μ. This occurs because the value of μ_j depends on the initial values of the subsidies from which the subsidy is to be cut. To see this point clearly, Table 13 reports the values for $\mu_1, \mu_2, \ldots, \mu_{11}$ under three different scenarios: when the subsidy on utilities is at its current full value, and when the subsidy has been reduced to 80% and 60% of its current value. The Table also reports, for the purpose of comparison, the counterpart of μ_j for the full subsidy elimination. This is the loss in social welfare per one unit of currency saved in subsidy costs. It is derived by dividing the social compensating variation for the subsidy as reported in Table 10 by the corresponding net savings in subsidy expenditures reported in Table 7. All the numbers are calculated for $\eta = 0.5$.[30] As expected, under full subsidy elimination, utilities has the highest μ. And, as reported earlier, calculating $\mu_1, \mu_2, \ldots, \mu_{11}$ at the current values for all subsidies indicates that the value of μ is higher for health, durables, and other as compared to utilities. However, when μ_j is calculated from an initial subsidy on utilities that is 80% of its existing value, keeping all the other subsidies at their current values, the ranking changes and utilities becomes only second to other. Finally, when the subsidy on utilities falls to 60% of its current value, utilities has the highest μ.

[29] The lowest two income groups spend 8.8% of their income on bread and 23.8% on food; while these shares for the highest two income groups are only 4.5% and 10.0%.

[30] One can make the same point by fixing η at another value; no purpose is served by carrying out this exercise for different values of η.

9 Conclusion

This paper has estimated a Quadratic Almost Ideal Demand System for Iranian Economy that consists of eleven broad categories of goods. It has used the estimated model to calculate the welfare gains due to the elimination of current price subsidies in Iran, and to gauge the efficiency and distributional implications of replacing the price subsidies with a policy of uniform cash rebates. The data for estimation has come from repeated cross sections of the Household Budget Survey of the Statistical Center of Iran for the period of the spring 1998 to the winter of 2001 consisting of 43,641 households.

We have found that eliminating *all* price subsidies is welfare enhancing and that the welfare improvements increase in value the more the society cares about inequality. The theory behind this is well known. Price subsidies are inefficient and, because of this, their elimination should enhance welfare. Moreover, price subsidies benefit all income groups proportionately to their expenditures on the subsidized goods. Thus, as a rule, price subsidies accords the rich more purchasing power. Consequently, the more the society is concerned about income inequality, the less it values the benefits of price subsidies and the more it values the benefits of replacing them with uniform rebates. Still, the magnitudes of the changes we have found have been quite astounding.[31]

The paper's second main finding has come to us as something of a surprise. While we had expected that fiscal interactions play an important role in determining the welfare gains of price subsidy eliminations in Iran, we did not expect it to be this strong. Eliminating price subsidies on utilities, for example, will not save the government much by way of revenues and entails substantial welfare losses. We explained this by noting that utilities have high cross-price elasticities with most other highly-subsidized goods. The specifics of these findings apply, obviously, only to the Iranian economy. However, the

[31]The disparities between price subsidy benefits to the rich and the poor in Iran are extremely huge. The most well-off households receive approximately seventeen times the benefits that the least well-off households get. When it comes to particular subsidy items, the very poor in Iran benefit only from subsidies on bread, food, utilities, and transportation. And one has to be in the second lowest income bracket for subsidies on clothing, household items, and health to kick in.

Table 13. Loss in social welfare per one TIR saved in subsidy costs
(inequality aversion index $\eta = 0.5$)

	Subsidy elimination in full	**Subsidy elimination at the margin:** Initial utilities' subsidy at its		
		current value	80% current value	60% current value
bread	0.60	0.48	0.45	0.43
food	0.65	0.56	0.57	0.59
clothing	0.65	0.53	0.72	1.55
housing	–	–	–	–
utilities	2.00	0.69	1.02	1.87
household items	0.73	0.47	0.45	0.44
health	0.75	0.69	0.81	0.98
transportation	0.59	0.33	0.31	0.29
education	0.65	0.63	0.67	0.72
durables	0.80	0.71	0.60	0.55
other	1.29	1.45	1.42	1.40

importance of fiscal interaction effects is a general lesson with applications to all economies, developing and developed.

Our third main finding is that one cannot recommend a large tax/subsidy reform based on the results derived for marginal changes pioneered by Ahmad and Stern (1984). The two approaches may lead to different policy recommendations. This is not to diminish the power and the usefulness of Ahmad and Stern's contribution. The advantage of their method is that it can be used without a full knowledge of the individual demand curves (while the method we have espoused in this paper cannot). However, when one is able to gather such information, as we have done in this paper, one should judge a policy reform based on a full accounting of its costs and benefits rather than using a shortcut via Ahmad and Stern's (1984) methodology.

We conclude by pointing out a number of caveats that should be borne in mind when interpreting the specific numbers we have reported. First, while the range of income variations is quite large in our data, this is not the case for price variations. Price controls have led to no variations across geographic regions, at least not according to the official data. We have only 16 price data points which severely limits the reliability of our price elasticity estimates.

Second, input subsidies have been ignored in this study. This assumption has simplified our calculations but it must have also biased our welfare cost estimates. Energy is an important input into the production process and is being subsidized heavily.

Third, economies of developing countries are marred by a myriad of distortions due to lack of fully developed economic institutions and competitive environments. In the absence of precise information on the nature of such distortions, it is difficult to speculate how price distortions might affect them. If a particular good is "under-produced" relative to its first-best level, as it will be when prices exceed marginal production costs, its subsidization will likely alleviate the existing distortion. On the other hand, if a good is "over-produced," its subsidization will likely exacerbate the existing distortion.[32]

Fourth, the paper ignores the environmental distortions— local emissions, carbon emissions, congestion, and accidents—associated with the consumption of such subsidized goods as utilities and transportation. To the extent that subsidization of these goods have increased their consumption, removal of their subsidies leads to greater overall welfare gains than our numbers suggest. In the same vein, when we find that partially removing the subsidy on

[32]Not all goods can be under-produced.

utilities might not be welfare enhancing, we are ignoring the gains associated with the reduction of pollution.

Fifth, lack of data on skills distribution (a problem that exists in all developing countries and not just Iran), has forced us to ignore income taxes altogether. To the extent that removal of price subsidies would allow the government to reduce distortionary income taxes, welfare would likely be enhanced further. In the case of Iran, however, our procedure is not that problematic. Because of the availability of oil revenues, income taxes in Iran are not well developed and do not constitute an important source of revenue for the government.[33] Nevertheless incorporating income taxes in the study will be a worthwhile exercise for the future. This is particularly relevant for similar studies on other developing countries which do rely on income taxation.

[33]Only about 4% of the annual budget of the government of Iran comes income taxes, and these revenues constitute only about 13% of total government tax revenues.

Appendix A

Table A1. Quadratic Engel curve regressions

	constant	t-ratio	ln income	t-ratio	(ln income)^2	t-ratio
bread	0.4376	4.08	–0.0573	–2.49	0.0019	1.53
food	– 0.3474	–2.19	0.1992	5.84	–0.0143	–7.83
clothing	–1.2702	–8.54	0.2580	8.06	–0.0122	–7.10
housing	–0.4440	–1.96	0.2043	4.23	–0.0138	–5.34
utilities	0.2084	2.95	–0.0164	–1.08	–0.0001	–0.18
h- items	0.0896	1.60	–0.0123	–1.02	0.0006	0.98
health	–0.0061	–0.05	–.0004	–0.01	0.0007	0.42
transportation	–0.5638	–7.41	0.1241	7.58	–0.0062	–7.08
education	–0.2180	–4.02	0.0443	3.80	–0.0019	–3.10
durables	2.8980	13.11	–0.7035	–14.80	0.0435	17.04
other	0.2123	7.56	–0.0400	–6.62	0.0020	6.17

Table A2. Demand system equations:
First-stage estimates with standard errors in parentheses*

Expenditure share for → explanatory variables ↓	bread	food	clothing	housing	utilities	h-items	health	transport	education	durables
bread	0.0345	-0.0201	0.1966	0.0121	0.0023	-0.0011	-0.0156	-0.0387	-0.0121	-0.1592
price	(0.0166)	(0.0198)	(0.0558)	(0.0289)	(0.0092)	(0.0041)	(0.0173)	(0.0128)	(0.0088)	(0.0470)
food	-0.0959	0.0196	-0.3174	0.0983	-0.0372	0.0186	0.0277	0.0269	-0.0227	0.2859
price	(0.0231)	(0.0477)	(0.1049)	(0.0565)	(0.0194)	(0.0133)	(0.0269)	(0.0160)	(0.0142)	(0.0782)
clothing	-0.2632	-0.2063	-0.5141	0.4623	-0.1090	0.0635	-0.0475	0.1025	-0.0321	0.5096
price	(0.0591)	(0.0904)	(0.2118)	(0.1477)	(0.0426)	(0.0274)	(0.0604)	(0.0426)	(0.0347)	(0.1640)
rent	-0.0099	0.0250	0.9959	-0.1826	0.0304	-0.0222	-0.0825	-0.1071	-0.0180	-0.6443
price	(0.0625)	(0.1125)	(0.2233)	(0.0932)	(0.0358)	(0.0157)	(0.0529)	(0.0378)	(0.0292)	(0.1556)
utilities	-0.0667	-0.0753	-0.4196	0.1219	0.0084	0.0084	0.0302	0.0688	0.0081	0.3152
price	(0.0210)	(0.0334)	(0.1151)	(0.0443)	(0.0172)	(0.0132)	(0.0318)	(0.0140)	(0.0176)	(0.0835)
h-items	0.3343	0.1183	0.1782	-0.5964	0.0388	-0.1177	0.1475	-0.0356	0.1240	-0.1324
price	(0.0927)	(0.1344)	(0.2631)	(0.2840)	(0.0578)	(0.0481)	(0.0871)	(0.0575)	(0.0466)	(0.2493)
health	0.0307	0.0100	-0.2524	-0.0296	-0.0828	0.0348	0.0336	0.0101	-0.0178	0.2536
(price)	(0.0633)	(0.0558)	(0.1109)	(0.0989)	(0.0291)	(0.0169)	(0.0646)	(0.0386)	(0.0347)	(0.1151)
transport	0.0077	0.0209	0.4284	-0.1799	0.2089	0.0029	-0.0511	-0.0326	-0.0265	-0.2091
price	(0.0644)	(0.0581)	(0.1672)	(0.0867)	(0.0354)	(0.0231)	(0.0619)	(0.0269)	(0.0392)	(0.0880)
education	0.0367	0.0233	-0.3226	0.0601	0.0241	0.0113	-0.0047	0.0284	0.0163	0.1392
price	(0.0172)	(0.0268)	(0.0757)	(0.0403)	(0.0112)	(0.0094)	(0.0239)	(0.0141)	(0.0081)	(0.0466)
durables	-0.0594	0.0609	0.4134	0.0993	0.0389	0.0133	-0.0805	-0.0630	-0.0429	-0.3893
price	(0.0280)	(0.0520)	(0.1332)	(0.0851)	(0.0147)	(0.0164)	(0.0413)	(0.0292)	(0.0159)	(0.1233)
ln income	-0.0076	0.0145	0.0601	-0.0238	-0.0153	-0.0004	0.0103	0.0302	0.0100	-0.0714
	(0.0012)	(0.0036)	(0.0034)	(0.0102)	(0.0007)	(0.0006)	(0.0013)	(0.0026)	(0.0019)	(0.0081)
(ln income)^2	0.0000	-0.0146	-0.0105	-0.0077	0.0000	0.0000	0.0000	-0.0038	0.0000	0.0354
	(0.0000)	(0.0013)	(0.0012)	(0.0018)	(0.0000)	(0.0000)	(0.0000)	(0.0005)	(0.0000)	(0.0014)
size	0.0137	0.0113	-0.0116	-0.0248	0.0042	0.0007	-0.0022	-0.0006	0.0037	0.0035
	(0.0024)	(0.0012)	(0.0011)	(0.0074)	(0.0007)	(0.0003)	(0.0009)	(0.0003)	(0.0005)	(0.0013)
size ×	-0.0027	0.0000	0.0056	0.0026	-0.0006	0.0001	0.0004	0.0000	-0.0007	-0.0041
ln income	(0.0003)	(0.0004)	(0.0004)	(0.0005)	(0.0002)	(0.0001)	(0.0003)	(0.0001)	(0.0002)	(0.0005)
constant	0.0619	0.2050	0.0608	0.3680	0.0622	0.0402	0.0378	-0.0029	0.0064	0.0434
	(0.0115)	(0.0256)	(0.0140)	(0.0383)	(0.0058)	(0.0046)	(0.0082)	(0.0101)	(0.0033)	(0.0204)

*Standard errors are calculated using a bootstrapping procedure on 16 clusters of time observations.

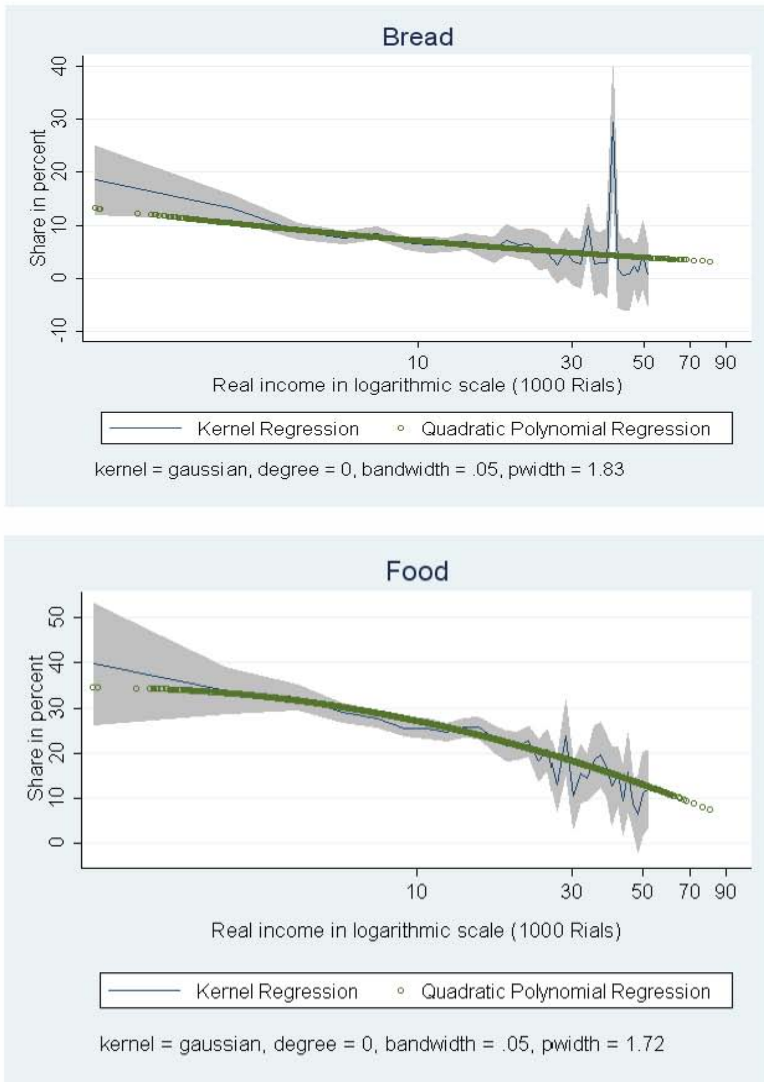


Figure 1: Estimated Engel curves for bread and food; evaluated at average income for a family of size five.

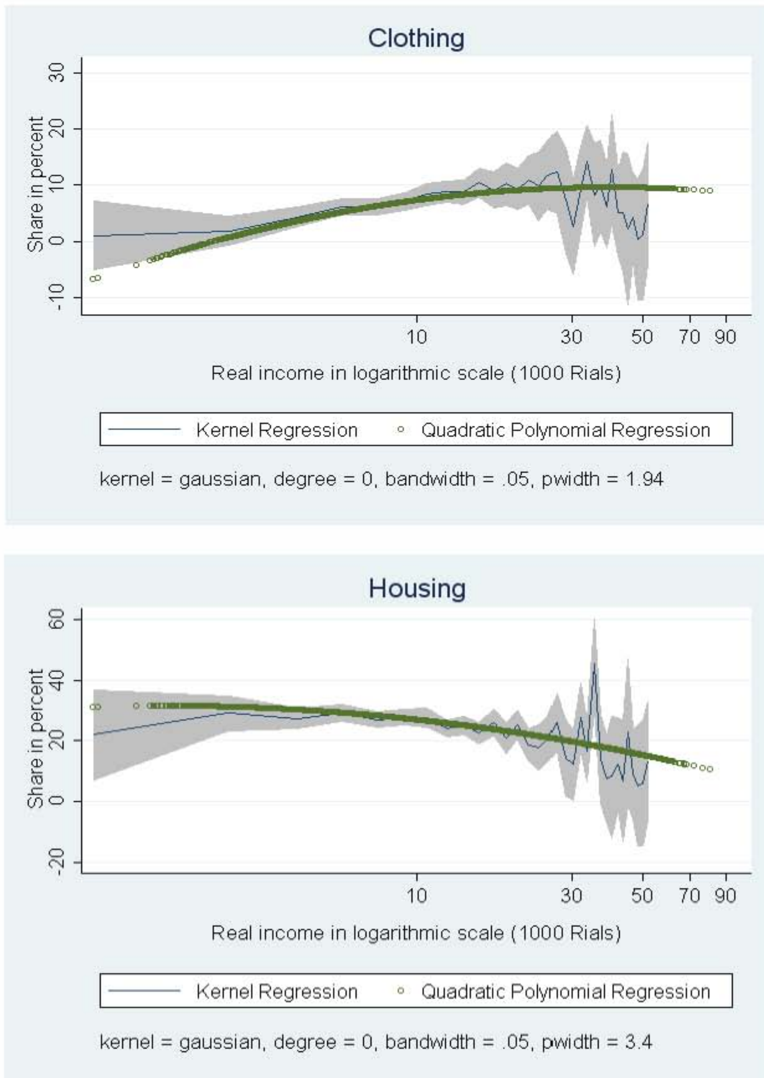


Figure 2: Estimated Engel curves for clothing and housing; evaluated at average income for a family of size five.

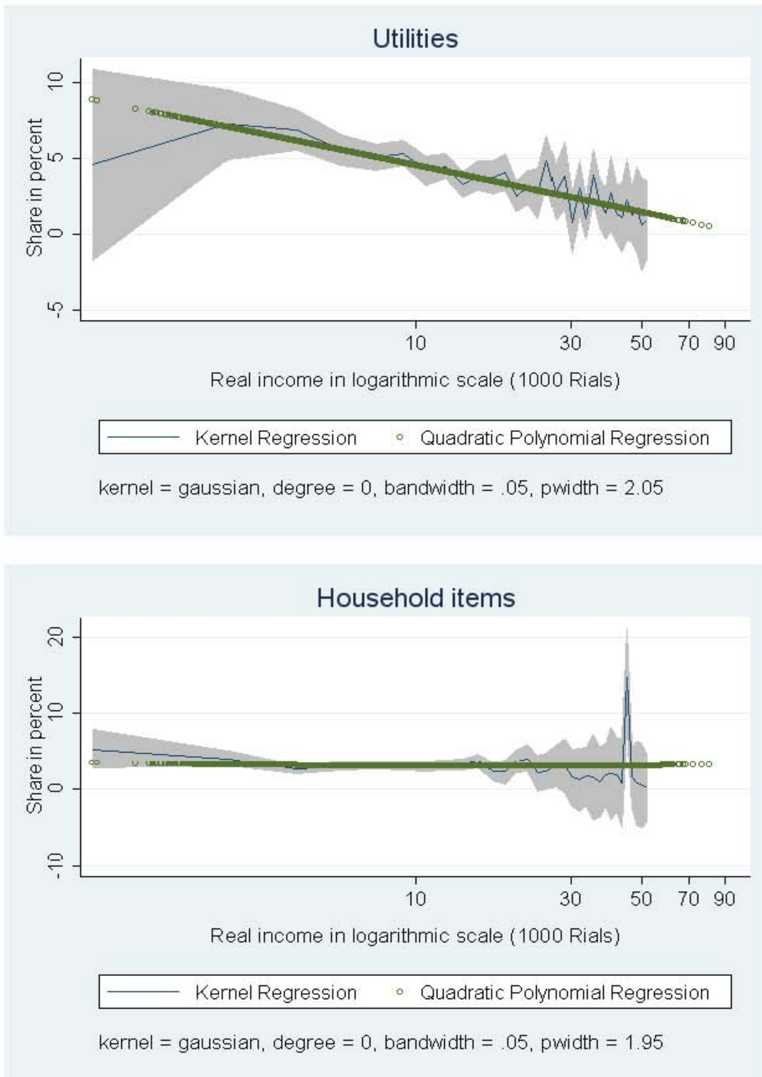


Figure 3: Estimated Engel curves for utilities and household items; evaluated at average income for a family of size five.

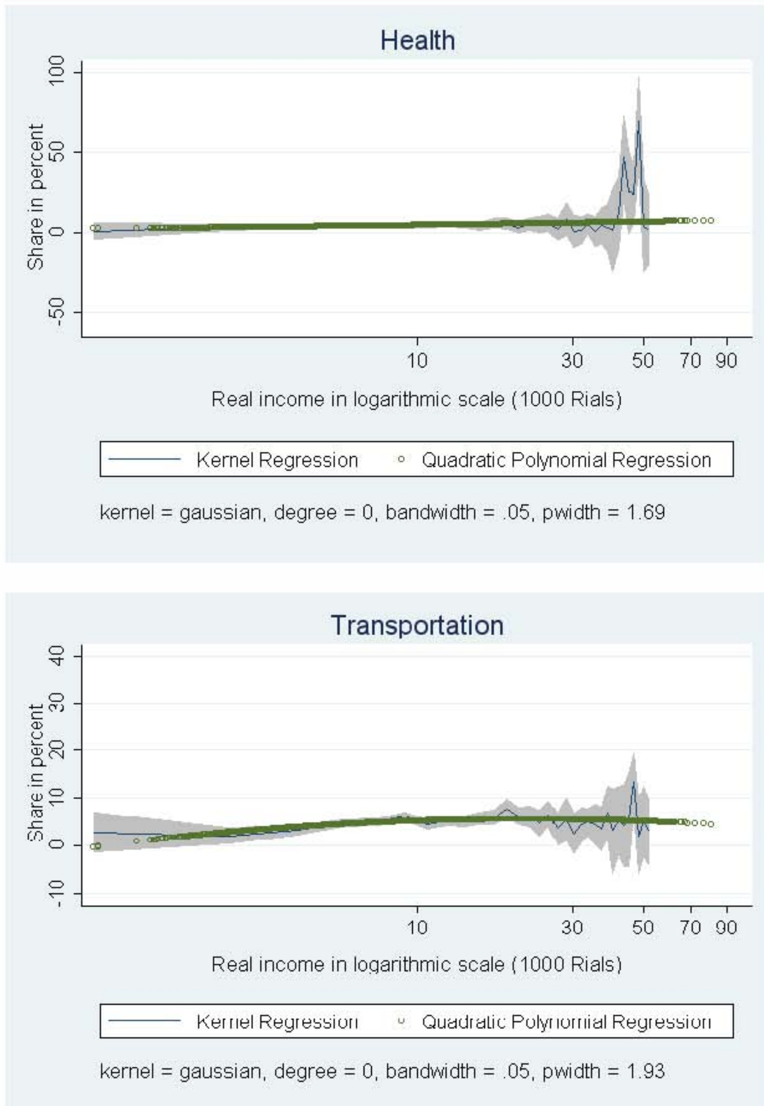
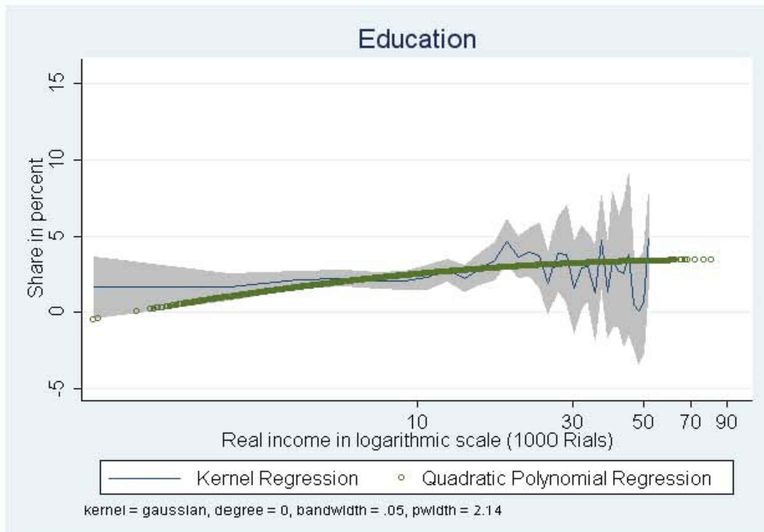


Figure 4: Estimated Engel curves for health and transportation; evaluated at average income for a family of size five.



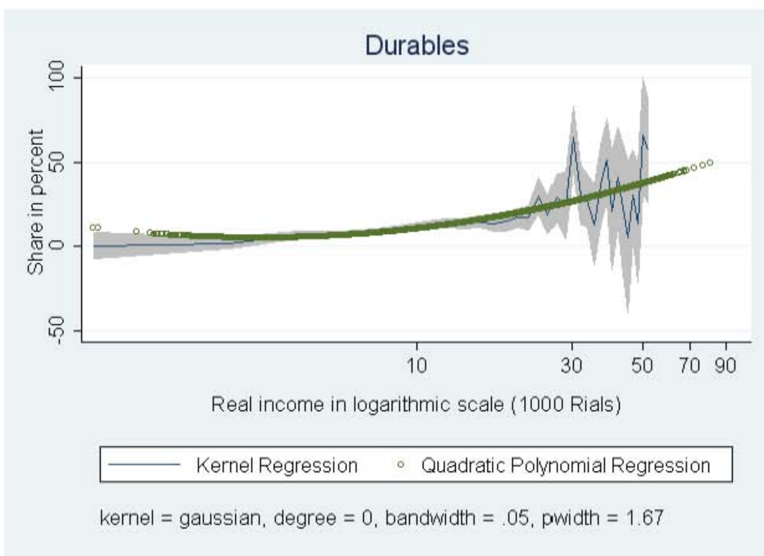


Figure 5: Estimated Engel curves for education and durables; evaluated at average income for a family of size five.

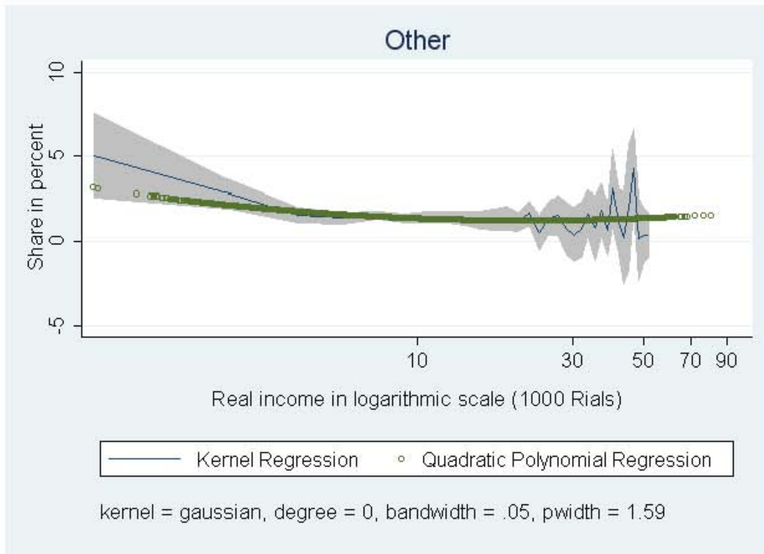


Figure 6: Estimated Engel curve for "other"; evaluated at average income for a family of size five.

Demand curves for 11 categories of goods and services (Family Size=5)
These demands are evaluated at average income.

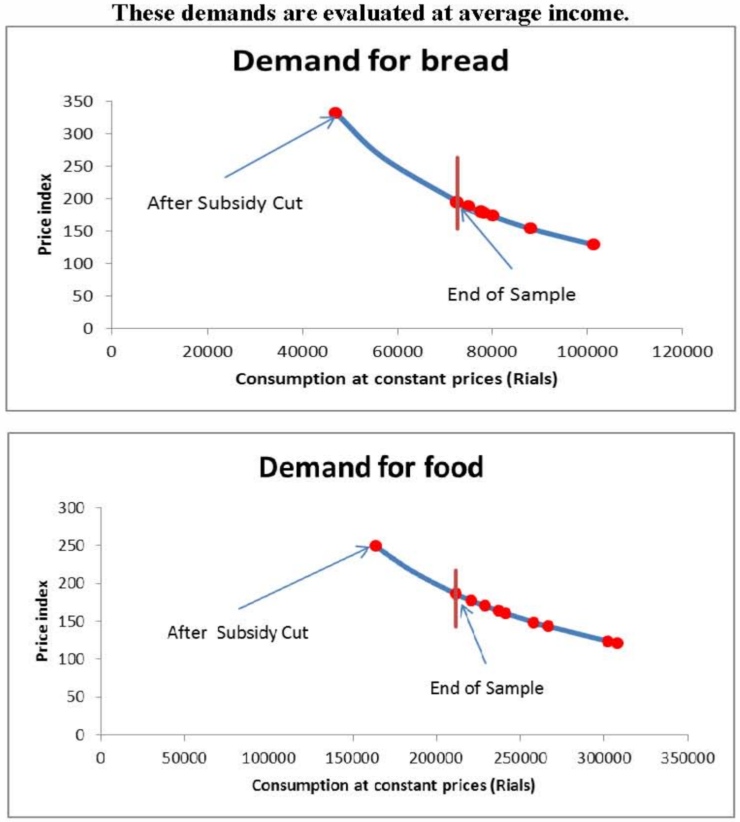


Figure 7: Demand curves for bread and food; evaluated at average income for a family of size five.

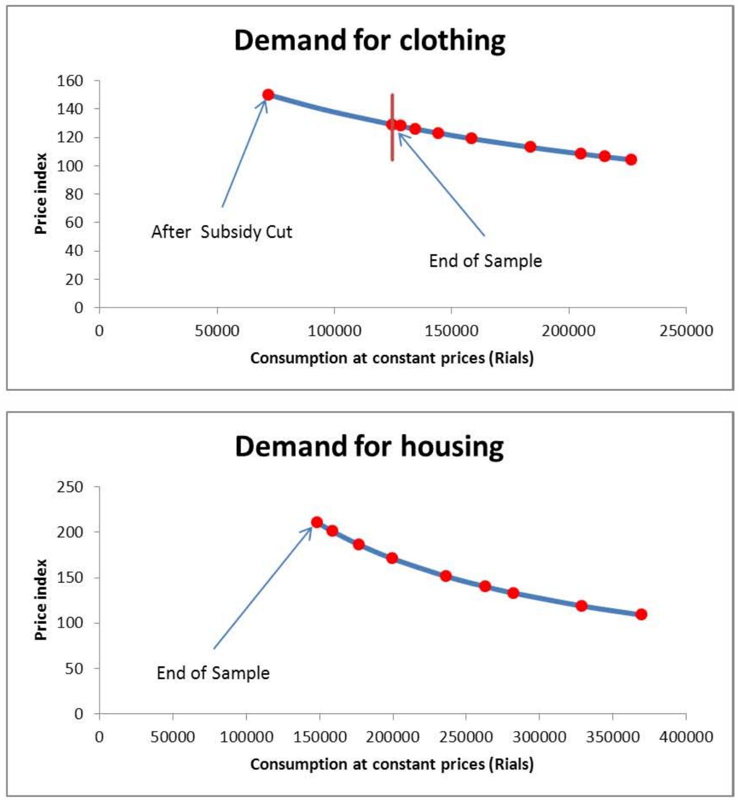


Figure 8: Demand curves for clothing and housing; evaluated at average income for a family of size five.

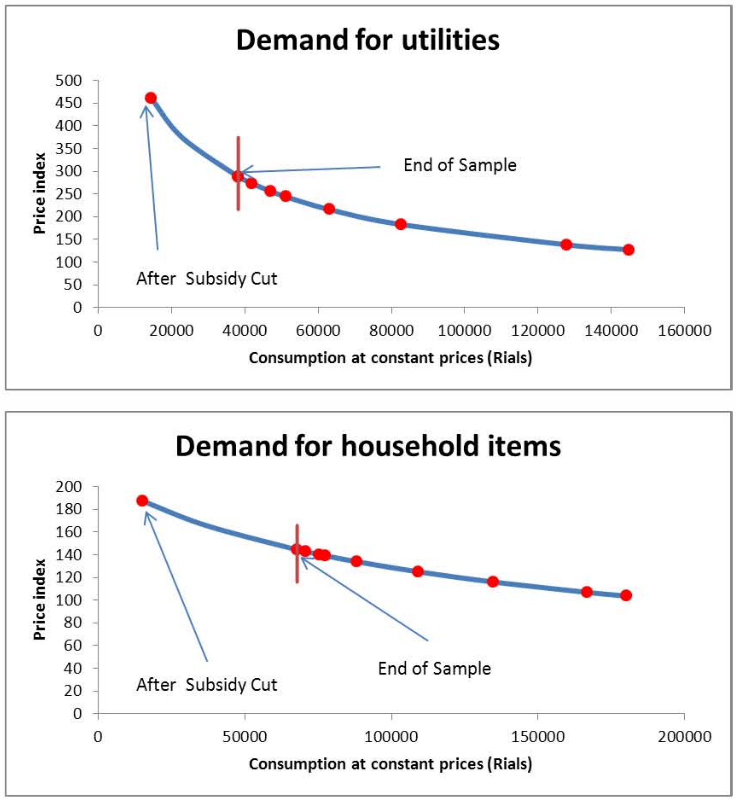


Figure 9: Demand curves for utilities and household items; evaluated at average income for a family of size five.

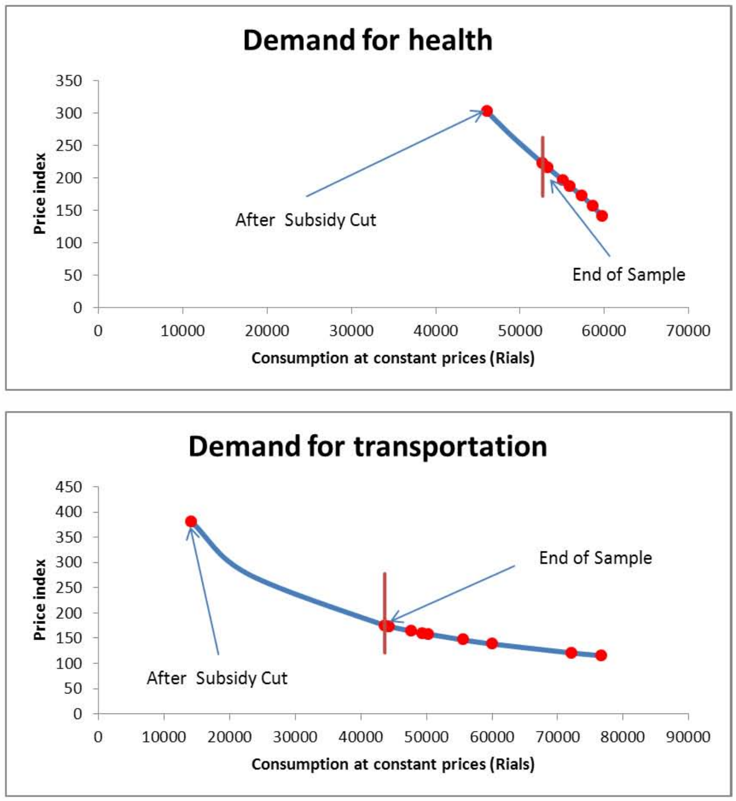


Figure 10: Demand curves for health and transportation; evaluated at average income for a family of size five.

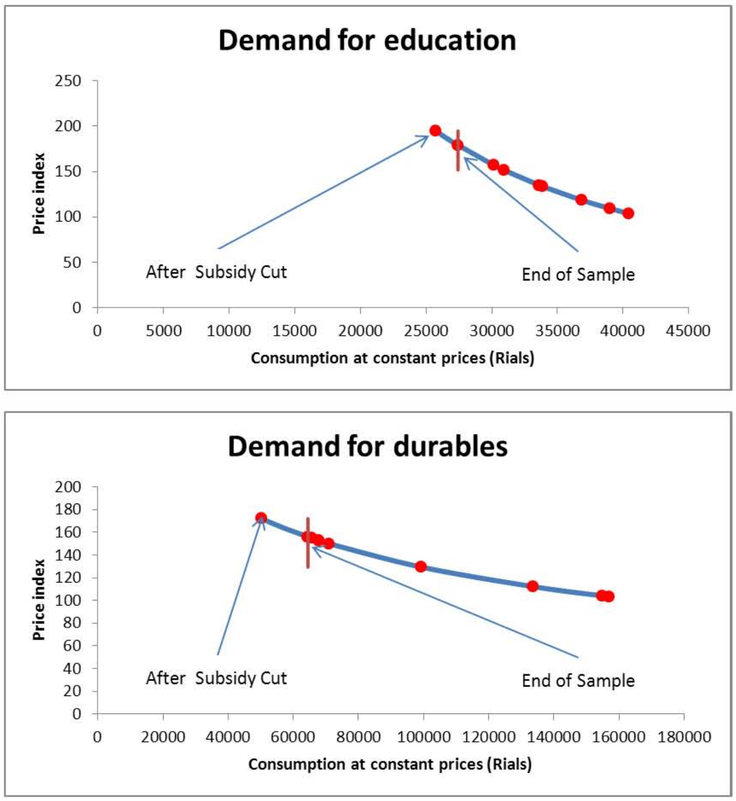


Figure 11: Demand curves for education and durables; evaluated at average income for a family of size five.

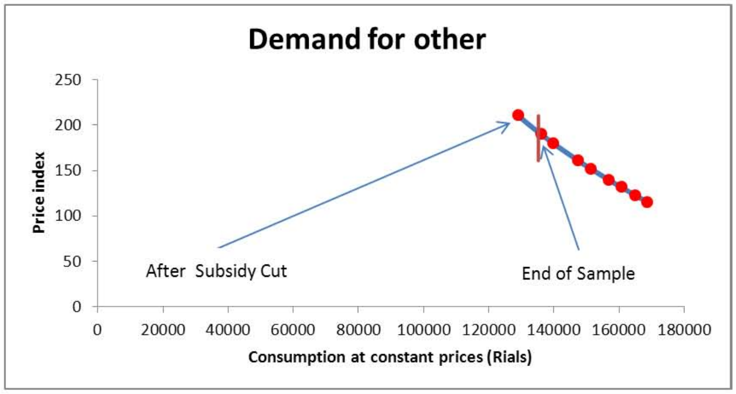


Figure 12: Demand curve for "other"; evaluated at average income for a family of size five.

References

[1] Ahmad, Ehtesham, Stern, Nicholas, 1984. The theory of reform and Indian indirect taxes. Journal of Public Economics 25, 259–298.

[2] Atkinson, Anthony B., 1977. Optimal taxation and the direct versus indirect tax controversy. Canadian Journal of Economics 10, 590–606.

[3] Banks, James, Blundell, Richard, Lewbel, Arthur, 1997. Quadratic Engel curves and consumer demand. The Review of Economics and Statistics 79, 527–539.

[4] Banks, James, Blundell, Richard, Lewbel, Arthur, 1997. Tax reform and welfare measurement: Do we need demand system estimation? The Economic Journal 106, 1227–1241.

[5] Blundell, Richard, Robin, Jean Marc, 1999. Estimation in large and disaggregated demand systems: an estimator for conditionally linear systems. Journal of Applied Econometrics 14, 209—232.

[6] Esfahani, Hadi S., Taheripour, Farzad, 2002. Hidden public expenditures and the economy in Iran. International Journal of Middle Eastern Studies 34, 691–718.

[7] Fisher, Douglas, Fleissig, Adrian R., 2001. An empirical comparison of flexible demand system functional forms. Journal of Applied Econometrics 16, 59–80.

[8] Fullerton, Don, Metcalf, Gib, 2001. Environmental controls, scarcity rents, and pre-existing distortions. Journal of Public Economics 80: 249–68.

[9] Gil, Ana Isabel, Molina, José Alberto, 2008. Alcohol demand among young people in Spain: an addictive QUAIDS. Empirical Economics 36, 515–530.

[10] Goulder, Lawrence H., Williams III, Roberton C., 2003. The substantial bias from ignoring general equilibrium effects in estimating excess burden, and a Practical Solution. Journal of Political Economy 111, 898–927.

[11] Hayashi, Masayoshi, Boadway, Robin, 2001. An empirical analysis of intergovernmental tax interaction: the case of business income taxes in Canada. Canadian Journal of Economics 34, 481–503.

[12] Jorgenson, Dale W., Lau, Lawrence J., Stoker, Thomas M., 1982. The transcendental logarithmic model of aggregate consumer behavior. In Advance in Econometrics, vol 1, ed. R. Basmann and G. Rhodes. Greenwich, Connecticut: JAI Press.

[13] Deaton, Angus, Muellbauer, John, 1980. An almost ideal demand system. The American Economic Review 70, 312–326.

[14] Moro, Daniele, Sckokai, Paolo, 2000. Heterogeneous preferences in household food consumption in Italy. European Review of Agricultural Economics 27, 305–323.

[15] Muellbauer, John, 1975. Aggregation, income distribution and consumer demand. Review of Economic Studies 62, 525–43.

[16] Parry, Ian W. H., West, Sarah E., Laxminarayan, Ramanan, 2009. Fiscal and externality rationales for alcohol policies. The B.E. Journal of Economic Analysis & Policy 9, Iss. 1 (Contributions).

[17] Rothenberg, Thomas J., 1973. Efficient estimation with a priori information. Cowels Foundation for Research in Economics. New haven: Yale University Press.

[18] Stern, Nicholas, 1987. The theory of optimal commodity and income taxation: an introduction; Aspects of the general theory of tax reform. In The Theory of Taxation for Developing Countries ed. David Newbery and Nicholas Stern. Oxford University Press.

[19] Stone, Richard, 1954. Linear Expenditure Systems and Demand Analysis: An Application to the Pattern of British Demand. The Economic Journal 64, 511–527.

[20] Theil, Henri, 1965. The Information Approach to Demand Analysis. Econometrica 33, 67–87.

[21] Urzúa, Carlos M., 2005. The Ahmad-Stern approach revisited. Economics Bulletin 8, 1–8.