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# IMPACTS OF WORLD PRICES TRANSMISSION TO DOMESTIC MARKETS AND WELFARE OF MARGINAL HOUSEHOLDS: AN EMPIRICAL APPLICATION TO RICE IN IRAN

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# Impacts of World Prices Transmission to Domestic Markets and Welfare of Marginal Households: An Empirical Application to Rice in Iran

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**Abstract**

This paper attempts to assess the degree by which Iranian households have responded to the change in price of imported rice resulting from the exchange-rate unification. In addition, it attempts to examine to which extent the policy has affected the economic welfare of various household income groups, particularly the poor. Using samples of 2472 rural households and 2900 urban households selected from the national expenditure survey data of 2002 and 2003, Armington and pass-through elasticities are calculated as two measures of substitutability, and are discussed separately for each household group in both rural and urban areas.

The findings indicate that domestic rice prices are associated differently with imported rice prices by different households. However, a price increase in imported rice, which is mainly consumed by the poor, worsens their position much more severely than rich people who prefer domestic rice. In general, the findings of this study contribute to the understanding of how price changes resulting from trade liberalization may affect various groups of households and the ways they respond to such changes in prices.

**ملخص**

تحاول هذه الورقة أن تقيم درجة رد فعل الأسر الإيرانية تجاه تغير سعر الأرز المستورد نتيجة لتوحيد سعر الصرف. كما تحاول الورقة أن تدرس مدى تأثير تلك السياسة على الأحوال الاقتصادية لمختلف القطاعات الأسرية ذات الدخول المتفاوتة، لا سيما الفقراء. وباستخدام عينات من 2472 أسرة ريفية و2900 أسرة حضرية، اختيرت من بيانات الانفاق القومي لعامي 2002 و2003 وأعدت أساليب ارمينجتون وغيرها لاجتياز الأزمات للاستخدام بصورة تبادلية.

كما نوقش كل أسلوب منها على حده بالنسبة لكل مجموعة أسرية في كل من الريف والحضر.

وتشير النتائج إلى أن أسعار الأرز المحلي ـ يتفاوت ارتباطها بأسعار الأرز المستورد وذلك بالنسبة للعائلات المختلفة إلا أنه في حالة زيادة أسعار الأرز المستورد الذي يستهلك الفقراء الجزء الأكبر منه فإن ذلك يؤدي إلى زيادة سوء الأحوال الاقتصادية، بينما لا تتأثر الأحوال الاقتصادية للأغنياء بالدرجة نفسها عند زيادة أسعار الأرز المستورد حيث أن هؤلاء الأغنياء يفضلون تناول الأرز المحلي. وتسهم نتائج هذه الدراسة عموماً في فهم تأثير تغيرات الأسعار الناجمة عن تحرير التجارة على مختلف المجوعات الأسرية، كذلك يمكن أن نعرف أيضاً ردود أفعال تلك المجموعات تجاه تغير الأسعار

## 1. Introduction

One of the objectives of policy reforms initiated in developing countries during the mid-1980s and early 1990s was the reduction of price and trade distortions by moving domestic prices closer to international ones. Although trade policies vary, most operate primarily via price changes (see Winters, 2002).

One approach to looking at the linkage between import and domestic prices is based on what is known in the literature as the exchange-rate pass-through effect and/or elasticity, and refers to the extent to which the prices of traded goods in the currency of the destination country respond to changes in the exchange rate (Baffes and Gardner, 2003). The other approach is the use of Armington elasticities, which capture the degree of substitutability between domestic and imported supplies, or, conversely, the degree to which they are differentiated (Kapuscinski and Warr, 1999). A high value for such elasticity implies that imported and domestic supplies are considered by purchasers to be virtually identical. On the other hand, a low Armington elasticity value means that the two products are dissimilar, or, equivalently, that they are weak substitutes.

The effect of changes in import prices on domestic prices is central to applied trade policy analysis; however, there are few empirical estimates of the elasticities mentioned above (Warr, 2005). Most available studies apply time-series econometric analysis, and few use cross-sectional data to estimate these elasticities. Furthermore, these effects are usually estimated for broad groups of goods and not by groups of households, who may be expected to differ in their assessment of the homogeneity of domestic and imported goods.

As stated by Hertel *et al.* (2001), marginal households, defined as those individuals that find themselves just below the poverty line prior to the policy change, are of particular interest since improvement in their well-being will mean a decrease in the poverty headcount. Moreover, lower-income households seem to be more responsive to changes in prices than higher-income households (Jones *et al.,* 1994), or exhibit higher income elasticities even if they have similar own-price elasticities (Park *et al.,* 1996).

Assuming that price and income elasticities differ across income groups, the objective of this paper is to investigate the extent by which rural and urban households in Iran, particularly marginal households, have been affected by the increase in rice prices which had occurred in recent years, mainly due to unifying previously different exchange rates. In light of this issue, the study first assesses the degree to which households have responded to the change in imported rice price evaluated in local currency. Then, it examines the extent to which the policy has affected various income household groups, with an emphasis on the poor.

This paper contributes to the literature in various ways. We present a novel way of examining price transmission using cross-sectional household survey data. The application to Iran as an important emerging Asian economy is important because of its experience of post revolutionary policy changes and its attempts to achieve the requirements to access the WTO. Moreover, this study considers diverse domestic users of rice in term of income groups of households (first to fourth income quartiles) separately in rural and urban areas that may all have different perceptions as to the degree to which domestic and imported supplies substitute for one another.

### *Iranian Background*

During the third Five-Year Development Plan (2001-05), the Iranian government undertook various economic initiatives, such as removing non-tariff barriers, in order to prepare the conditions for the country to join the global trade system, and to accelerate its development

efforts to reduce the level of poverty. Until 2002, Iran's exchange rate system was based on a multi-layered system, which prevailed from the onset of war with Iraq in 1980, where state enterprises benefited from the preferred rate (1750 Rial for $1) and the private sector had to pay the market rate of (8000 Rial for $1). In addition, there was an active informal market that was reflected in a parallel exchange rate with a significant mark-up above the market rate. As stated by Alizadeh (2003), the preferred rate was applied to the imports of essential goods, a fixed or "export" rate (3000 Rial for $1) was applied to capital goods imports for public enterprises and a variable market rate was devoted to other imports. Such a multi exchange rate system had generated implicit subsidies for state owned enterprises and revolutionary foundations as well as for importers of basic commodities. The administered setting of differentiated exchange rates was one of the characteristics of the Iranian economic policy before 2002. However, in March 2002, this system was replaced by a unified, market-driven exchange rate. Exchange-rate unification was one of the landmark reforms which eliminated the disparity between the official and market exchange rates. The removal of exchange-rate distortions could help both economic efficiency and social welfare by improving producer incentives and enhancing the growth prospects of the country. However, it may worsen the economic welfare position of households who spend a high proportion of their income on food, which was previously imported at relatively low domestic prices due to the administered exchange rate for such imports. The unification changed food consumption patterns and raised household food expenditures, which roughly increased by 30% each year in nominal terms, specifically among the poor.

Poverty figures in Iran vary according to their source. However, according to official reports, there are about 1.5 million people at the lowest levels and about 10.5 to 12 million people in Iran are at the higher levels of income. In general, more than 13 percent of Iranians are living under the poverty line. Moreover, poverty has a strong rural content in the country according to the World Bank (2004). While only 38 percent of the total population is rural, out of approximately 13 million poor people in 1998, 57 percent lived in rural areas mainly in the Eastern and Western provinces.

Despite changes in food consumption patterns due to exchange rate unification, many households across the country continued to consume staple foods in accordance with their past habits. As a major food staple in Iran, it is important to ensure that rice is available in the domestic market at reasonable prices. To do this, and also to support rice producers, the Iranian government intervenes in the rice market by controlling imports (Bakhshoodeh and Thomson, 2005).

Although the production of rice has increased in recent years, the gap between domestic production and consumption of rice has fluctuated, and a substantial share for consumption is imported into Iran each year. Imported and domestically produced rice are considered by some people as relatively close substitutes on the demand side, although rich consumers much prefer the latter type.

Between 2002 and 2003, the price of imported rice should have increased in terms of local currency as a result of the exchange-rate unification, and consequently it should have affected the price of domestic rice. However, the price impact varied greatly between different household income groups, perhaps because of the different varieties of imported rice consumed by these groups of households.

In general, the foreign prices of rice would have been expected to be differently transmitted to the domestic markets and hence to the different consumption groups. In this study, various income groups are assumed to have different perceptions and, in particular, to have been differently influenced depending on their assessment of the degree of substitutability or what is known the degree of homogeneity of domestically produced and imported rice.

The rest of the paper is structured as follows. The next section describes specifications of data and variables and the economic model considered. Section 3 illustrates the estimation of the statistical model and calculations. Presentation and interpretation of the results are in section 4 and finally, the paper concludes in section 5.

## 2. Data and Variables

We used survey panel data on household food expenditure in 2002 and 2003, collected by the official Iranian Statistical Centre. Households were removed where the unit price and expenditure information looked dubious, and where there were many missing values. The remaining observations included 2472 rural households and 2907 urban households, and covered foods including bread, chicken, eggs, fish, dairy products, pulses, red meats, imported and domestic rice and sugar, in addition to household income and demographic variables such as the number of members in various age categories.

The basic variables are specified in Table 1. As shown, four broad income groups of households in rural areas respectively spent more than 755, 1285, 1885 and 3165 thousand Rial (approximately $1=9300 rial in 2007) per person per day on food, which account for 53, 49, 45 and percent of total per capita expenditures respectively. As the budget shares reveal, poor households (1$^{st}$ quartile) in the rural areas devoted 17 percent of their food budgets to breads, and similar proportions went to red meats and dairy products. Rich households (4$^{th}$ quartile) allocated a quarter of their food expenditures to rice, much more than other groups, especially the poor whose rice share was just under 15 percent. While per capita rice consumption was much higher amongst rich households both for imported and domestic rice, they devoted more or less the same share of their food budgets to rice as households in the other groups.Nevertheless, rice consumed by different families has different qualities, as revealed by the average price paid by households in each income group; briefly, the richer the family, the higher price they paid for either imported or domestic rice in 2002 and 2003. However, the percentage changes in both domestic and imported rice prices between 2002 and 2003 were less for rich families in the rural areas. This implies that such families suffered less than others from any increase in rice price that resulted from the policy change.

Households in urban areas devoted more less the same proportion of their budget to food as in the rural areas. The previous table shows that the poor in urban areas allocated more than 16 percent of their budget to bread and its products, and almost the same proportion to red meats, while nearly 19 percent of their budget went to rice. On the other hand, while the rich devoted a lower share of their income to bread and its products, they spent somewhat more on red meats and rice. In general, people in rural areas consumed higher quantities of rice; for example, the rural poor consumed over 2.8 kg of rice per capita on average, including 2.19 kg of imported rice and 0.74 kg of domestic rice in 2002, while among the urban poor these amounts were 1.41 kg and 1.26 kg respectively. However, most people in urban areas favored domestic rice.

## 3. Methodology

### *Measurement of Armington and Pass-through Elasticities*

In this study, the two measures of substitutability, Armington ($\sigma$) and pass-through ($H_m$) elasticities, are calculated separately for different income groups of households in both rural and urban areas of the country. We apply supply and demand elasticity coefficients as well as the shares of imported and domestically produced rice in the total expenditure of household groups in order to calculate $\sigma$ as well as $H_m$, using the following formulae developed by Warr (2005):

$$\sigma = \frac{\partial \ln(X_m / X_d)}{\partial \ln(p_d / p_m)} = \frac{E_d^s P_d - \eta^D (w_m P_m + w_d P_d) - \varphi^D P_o}{w_m (P_m - P_d)}$$
$$H_m = \frac{\partial \ln p_d}{\partial \ln p_m} = \frac{w_m (\sigma + \eta^D)}{E_d^s + \sigma w_m - \eta^D w_d} \quad (1)$$

where $m$ and $d$ stand for imported and domestic rice, $X_m$ and $X_d$ denote their respective quantities, and $p_m$ and $p_d$ their respective price indices. $E_d^s$ is the supply elasticity of domestic rice taken from Bakhshoodeh and Thomson (2005), $w$ denotes expenditure share ($w_m$=1-$w_d$), $P_m$, $P_d$ and $P_o$ are the percentage changes in the real prices of imported and domestic rice and of other foods, and $\eta^D$ and $\phi^D$ are the price elasticities of a composite rice good (aggregation of imported and domestic rice) with respect to own price and to the price of other foods, proxied by pulses, which were found by Bakhshoodeh and Farajzadeh (2004) to be a close substitute for rice in Iran.

In order to calculate the price elasticities in (1), linear approximations of the almost ideal demand system (LA/AIDS) proposed initially by Deaton and Muellbauer (1980) were estimated by restricted seemingly unrelated regression for each of the four broad household groups (first to fourth income quartiles) separately in the rural and urban areas:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log \boldsymbol{P}_j + \beta_i \log \frac{Y}{P} + \varphi_i D_i \quad (2)$$

where $w_i$ represents the budget share of good $i$, $P_j$ is the price of the $j$th good, $Y$ is nominal expenditure on food, $P$ is a price aggregate (the commonly used Stone price index), and $D$ denotes some demographic dummy variables including the household proportions of active and educated members. Parameters to be estimated are represented by Greek letters.

The system of equation (2) is employed with the common parameter restrictions of standard demand theory, such as adding-up, homogeneity and symmetry.

Own-price elasticities $\xi_{ii}$ including $\eta^D$ and cross-price elasticities $\xi_{ij}$ including $\phi^D$ are respectively computed by using the formulae (3) and (4):

$$\xi_{ii} = -1 + \frac{\gamma_{ii}}{w_i} - \beta_i \quad (3)$$

$$\xi_{ij} = \frac{\gamma_{ii}}{w_i} - \beta_i \frac{w_j}{w_i} \quad (4)$$

***Measurement of Welfare Changes***

The welfare impact of price and income changes on households can be measured by using money-metric indirect utility measures. As stated by Seshan (2005), if the post-reform price level is used, the measure of net welfare gain, *WG*, is given by the difference between two expenditure functions valued at the new price level, and is the change in full income less compensating variation:

$$WG = E(p_1, u_1) - E(p_1, u_0) = \Delta y - CV \quad (5)$$

where the term $E(\boldsymbol{p},u)$ gives the minimum cost of achieving the utility level $u$ for the set of prices denoted by the vector $\boldsymbol{p}$ facing the household, and *CV* is the familiar indirect utility measure of compensating variation, which is the amount of money which the household would need to be given at the new set of prices in order to attain their initial pre-reform level

of utility. Subscripts refer to before (0) and after (1) price changes, which correspond in this study to 2002 and 2003 respectively. A positive sign indicates an improvement in welfare, and *vice versa*.

Following Hertel *et al*. (2001), we use the following expressions for calculating the change in real household income due to the price changes:

$$CV^i = -(y^i - \sum_i w_j^i p_j) \qquad (6)$$

where $wj^i$ is the *i*th group's budget share for good *j*, $p_j$ is the percentage change in the price of that good, and $y^i$ is the percentage change in income received by group *i*.

**4. Results**

Estimated LA/AIDS coefficients are shown in Table 2 for the rural areas and in Table 3 for the urban areas. With 9 equations and 12 explanatory variables per equation, the analysis generates 108 estimated coefficients for each income group and a total of 432 coefficients for each of the rural and urban areas. It can be seen from the results that many coefficients of the explanatory variables, such as the logarithms of prices and of real expenditures as well as of the two demographic variables are statistically significant at least at the 10 percent level.

For simplicity, we focus on the rice demand equations. There are several significant price coefficients ($\gamma_i$) for which a positive (negative) sign reveals positive (negative) change in the corresponding budget share with respect to a percentage change in its corresponding price, other things being held constant.

Based on the values of the coefficients of variation, $R^2$, the explanatory power of the independent variables is not very strong, except in the case of poor (marginal) households. As shown in Table 2, the rice equations in the rural areas explain 28 to 47 percent of the variation in rice budget shares. These figures are between 18 and 43 percent in urban areas.

On the other hand, the expenditure coefficient $\beta i$ is statistically significant in the rice equations of the first and the third income quartiles in rural areas, and in those of all quartiles in urban areas. A positive and statistically significant expenditure coefficient means that the budget share rises with total expenditure, implying that the expenditure elasticity is greater than one and that the commodity is a luxury good.The expenditure coefficient for the poor in rural areas is 0.066, implying that a 100 percent increase in overall household expenditure would be associated with an increase of only 6.6 percent in their rice demand, and so rice is a luxury good for them. The coefficient for the third income quartile in these areas is -0.045 and implies that budget share declines with higher total expenditure. The expenditure elasticity is less than one but positive since the rice budget share for this group is higher than 0.045 and therefore rice is a necessity good for this group of households.

The impact of economically active members in rural households on the budget share of rice ($\varphi_{i1}$) is not significant except for the third income quartile, for which the value of 0.129 implies that a larger number of 15-65 year olds in the family increases the rice budget share in this group. In the urban areas, however, the corresponding coefficients are statistically significantly different from zero and negative (-0.082) for the marginal (first quartile) and positive for the third and fourth quartiles, at 0.115 and 0.013, respectively. Thus, the rice budget share for poor households in urban areas decreases with the proportion of active family members. Educated persons in the families have a different effect on this share, as shown by the coefficient $\varphi_{i2}$. Whilst this is positive in the rice equation of the first group in the rural areas, it is negative for the third group. The coefficient was found to be insignificant in the rice equation of urban marginal households but significant in the equations of the two

middle quartiles. Although studying the reasons beyond such different responses is not the aim of this paper, varieties of consumption patterns and preferences and variation in rice quality may be why some families tilt towards easy-to prepare items such as rice.

Applying the estimated coefficients to formulae (3) and (4), price elasticities of the composite rice (aggregation of imported and domestic supplies) with respect to its own price $\eta^D$ and to the price of pulses (as other foods) $\phi^D$ were calculated, and are reported in Table 4.

As expected, demand for rice in rural areas is inelastic for all groups of households; although the coefficient of own-price elasticity in absolute terms is decreasing with level of income, meaning that it is larger for the poor than for others, and implying that the poor are more sensitive to rice price changes. In these areas, pulses are found to be a close substitute for rice regardless of the level of income, as indicated by the positive values for the cross-price elasticities. In the urban areas, rice demand is elastic for marginal households but inelastic for rich families. Contrary to the marginal rural households, pulses are recognized to be complementary to rice for such families in urban areas, as shown by the negative coefficients of -0.869 and -0.093, and indicates different consumption patterns amongst the poor households in rural and urban areas.

***Armington and Pass-through Elasticities***

The above price elasticities are used in formula (1) to calculate Armington and pass-through elasticities separately for each income group of households in both rural and urban areas of the country. The results are shown in Figure 1 and Table 5 for the rural areas.

As can be seen, with the exception of the first household group, both the Armington and pass-through elasticities are higher for lower income households. In other words, the relatively high value of the former elasticity for the second quartile, calculated at .690, means that imports and domestic supplies of rice are considered by this group of households to be virtually identical, and the degree of substitution is much closer than for rich households (the last quartile). Furthermore, as was indicated earlier, marginal households do not face the same rice prices as rich households do, and, based on the pass-through elasticities, change in the orld prices of rice is expected to be transferred to their prices much faster than for others in rural areas.

The Armington and pass-through elasticities for the urban areas are shown in Figure 2 and Table 6. With patterns similar to those for rural households but with higher values, the Armington elasticities in the urban areas are also higher among poor households, and decrease from the first to the last quartile.

Since a higher value of this parameter implies a closer degree of substitutability, imported rice and domestic supplies are considered by poor purchasers as virtually identical. On the other hand, they are considered as weak substitutes by the richer families who recognize the two products to be relatively dissimilar, since the Armington elasticity for the latter group, 0.502, is lower than those of all other groups, especially of the first quartile, at 1.569.

Since these elasticities as well as those in the rural areas are much lower than infinity, the imported and domestic rice are imperfect substitutes amongst the Iranian households in both rural and urban areas, and so, the price of the domestic good may not change by the same proportion as that of the imported rice. However, the calculated pass-through elasticities for rich families are found to be lower than those of others, and it can be concluded that domestic prices respond to world prices much faster in the low-income households.

***Welfare Gains***

As was shown in Table 1, all household income groups experienced a rice price increase from 2002 to 2003. Of course, this may be attributed to various factors and/or policy changes, but a significant part can be ascribed to exchange-rate unification. This price change implies a change in real incomes. The welfare impacts of price and income changes on households are indicated in Figure 3 and Table 7.

As was represented by equations (5) and (6), welfare gains from a price change depend on the percentage change in the price of the commodity, the percentage change in income and the compensating variation (CV) which refers to the amount of additional money an individual would need to reach the initial utility after a change in prices. In the case of our study, consumer utility decreases due to increases in the price of rice, and so the CV equals the minimum amount of money the household must be given so that it is not worse off than in the initial situation. The CV values in Table 7 reveal that the amounts of money to be paid to the marginal households are 1308 and 2776 Rial on average in rural and urban areas respectively, and are higher than for the other quartiles. This implies that the poor suffer from rice price changes much more than other households in terms of lost utility, and may react by lowering consumption or by consuming low-quality rice. In other words, the poor lose from rice price increases much more than other families classified in the second to fourth income quartiles, as shown by negative gains in the table and by negative bars in the figures. Moreover, marginal households in rural areas, whose pass-through elasticities in absolute values were calculated to be higher than corresponding households in the urban households, seem to be much more vulnerable than urban households. Whilst rural households in the first quartile lose nearly 86000 Rial, similar families in urban areas lose about 43000 Rial as the rice price increases. In sum, a price increase in imported rice, which is mainly consumed by the poor, worsens their positions much more severely than the rich people who mainly prefer domestic rice. The poor respond to world price changes faster and lose more welfare than others.

## 5. Conclusions and Policy Implications

The degrees to which Iranian households have responded to the price change in imported rice, and the extent to which the increase in rice prices has influenced various income household groups that differ in their assessment of the homogeneity of domestic and imported goods are examined in this paper.

The Armington and pass-through elasticities were found to be higher for lower income households. The relatively high value of Armington elasticities for marginal households revealed that imported and domestic supplies of rice are considered by this group of households to be virtually identical – the degree of substitution is much closer compared to rich households. Furthermore, the poor households do not face the same rice prices as rich households, and, based on the pass-through elasticities, domestic rice prices are differently associated with imported rice prices among the household groups and changes in international rice prices are expected to be transferred to domestic prices much faster than for other households in rural areas.

The findings indicate that a price increase in imported rice, which is mainly consumed by the poor, worsens their positions much more severely than rich people who prefer domestic rice. In summary, domestic users of rice, who are diverse in terms of their incomes and their rice consumption patterns, seem to have different perceptions as to how closely domestic and imported rice can be considered as substitutes. Additionally, imported and domestic rice are imperfect substitutes amongst the Iranian households in both rural and urban areas, and so, the price of domestic rice may not change by the same proportion as that of imported rice. However, the calculated pass-through elasticities for the rich families are found to be lower

than the others, and it can be concluded that domestic prices respond to world prices much faster in the low-income households.

The poor are expected to lose from rice price increases much more than other families classified as higher-income quartiles. In sum, a price increase in imported rice, which is mainly consumed by the poor, worsens their positions much more severely than the rich people.

In general, the findings of this study contribute to the understanding of how price changes resulting from trade liberalization may affect various groups of households and the ways in which they respond to such changes in prices.

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**Table 1: Means of Major Variables by Household Income Groups (quartiles) in Rural and Urban Areas of Iran**

| | Rural | | | | Urban | | | |
|---|---|---|---|---|---|---|---|---|
| | 1th | 2nd | 3rd | 4th | 1th | 2nd | 3rd | 4th |
| **Household budget shares ($w_i$)** | | | | | | | | |
| breads and other processed grain products ($w_1$) | .174 | .125 | .110 | .086 | .163 | .097 | .072 | .059 |
| chicken meats ($w_2$) | .097 | .126 | .124 | .105 | .114 | .128 | .119 | .117 |
| eggs ($w_3$) | .036 | .032 | .032 | .026 | .041 | .037 | .027 | .024 |
| fish ($w_4$) | .058 | .066 | .066 | .057 | .054 | .063 | .063 | .081 |
| dairy products ($w_5$) | .165 | .152 | .131 | .092 | .131 | .131 | .121 | .127 |
| pulses ($w_6$) | .046 | .043 | .039 | .040 | .044 | .039 | .033 | .031 |
| red meats ($w_7$) | .170 | .181 | .162 | .226 | .153 | .174 | .201 | .229 |
| rice ($w_8$) | .147 | .164 | .218 | .248 | .187 | .223 | .254 | .233 |
| sugar ($w_9$) | .107 | .110 | .118 | .120 | .113 | .108 | .109 | .101 |
| **Imported rice consumption (kg/person)** | | | | | | | | |
| in 2002 | 2.19 | 2.68 | 3.12 | 4.28 | 1.41 | 1.62 | 1.81 | 1.33 |
| in 2003 | 1.85 | 2.19 | 2.49 | 3.03 | .72 | 1.85 | 3.10 | 5.90 |
| **Domestic rice consumption (kg/person)** | | | | | | | | |
| in 2002 | .74 | 1.21 | 2.49 | 5.42 | 1.26 | 1.34 | 3.46 | 3.53 |
| in 2003 | 1.08 | 1.34 | 2.09 | 3.64 | 1.20 | 2.03 | 3.70 | 3.97 |
| **Imported rice prices (rial/kg)** | | | | | | | | |
| in 2002 | 4285 | 4661 | 4802 | 5076 | 4941 | 4933 | 4869 | 5760 |
| in 2003 | 5027 | 5366 | 5602 | 5688 | 5588 | 5482 | 5770 | 5861 |
| **Domestic rice prices (rial/kg)** | | | | | | | | |
| in 2002 | 5578 | 6883 | 7552 | 8154 | 7990 | 7948 | 8905 | 8027 |
| in 2003 | 6905 | 7366 | 8425 | 8630 | 9165 | 9329 | 9672 | 9498 |
| **Percentage change in prices 2002-2003??** | | | | | | | | |
| imported rice | 27.74 | 27.34 | 27.47 | 21.10 | 18.57 | 27.26 | 36.81 | 3.07 |
| domestic rice | 38.58 | 26.66 | 26.95 | 19.94 | 25.52 | 21.82 | 16.36 | 27.06 |
| pulses | 29.72 | 29.89 | 26.32 | 18.44 | 32.29 | 44.35 | 22.55 | 19.73 |
| **Imported rice expenditure (rial/household)** | | | | | | | | |
| in 2002 | 58627 | 69390 | 72487 | 81994 | 34456 | 49411 | 33856 | 22904 |
| in 2003 | 53299 | 64070 | 63136 | 56667 | 44701 | 52154 | 42225 | 23661 |
| **Domestic rice expenditure (rial/household)** | | | | | | | | |
| in 2002 | 25269 | 42674 | 90961 | 194708 | 45892 | 54546 | 129304 | 120533 |
| in 2003 | 36690 | 45490 | 78627 | 111546 | 47328 | 68461 | 131804 | 112446 |
| **Annual food expenditure (rial/person) 2002** | 755582 | 1285481 | 1885324 | 3165591 | 1063850 | 1844990 | 2553406 | 3821242 |
| **Annual total expenditure (rial/person) 2003** | 1403444 | 2619637 | 4180516 | 10241320 | 2793399 | 5185741 | 8333238 | 21635716 |

**Table 2: Estimated LA/AIDS Coefficients in Rural Areas by Income Quartile**

| Quartile | $w_i$ | $\alpha_i$ | $\gamma_{i1}$ | $\gamma_{i2}$ | $\gamma_{i3}$ | $\gamma_{i4}$ | $\gamma_{i5}$ | $\gamma_{i6}$ | $\gamma_{i7}$ | $\gamma_{i8}$ | $\gamma_{i9}$ | $\beta i$ | $\varphi_{i1}$ | $\varphi_{i2}$ | $R^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1st | $w_1$ | **0.302** | **0.104** | **-0.023** | -0.003 | **-0.022** | **0.052** | -0.004 | -0.023 | **-0.040** | **-0.054** | -0.008 | **-0.133** | **-0.070** | 0.83 |
| | $w_2$ | 0.204 | **-0.023** | 0.028 | **0.032** | **0.034** | **0.025** | **0.019** | **-0.102** | **-0.076** | 0.004 | 0.003 | -0.013 | 0.026 | 0.43 |
| | $w_3$ | -0.075 | -0.003 | **0.032** | -0007 | **0.031** | 0.009 | 0.001 | -0.045 | **0.078** | **-0.069** | -0.006 | 0.029 | -0.027 | 0.76 |
| | $w_4$ | **-0.438** | **-0.022** | **0.034** | **0.031** | 0.012 | 0.017 | **0.031** | 0.009 | -0.027 | **-0.074** | **-0.014** | 0.023 | 0.006 | 0.85 |
| | $w_5$ | **1.222** | **0.052** | **0.025** | 0.009 | 0.017 | **-0.157** | **0.017** | -0.010 | **0.127** | **-0.057** | **0.026** | -.0.178 | **-0.214** | 0.72 |
| | $w_6$ | 0.102 | -0.004 | **0.019** | 0.001 | **0.031** | **0.017** | **0.019** | **-0.054** | -0.009 | -0.019 | -0.001 | **-0.058** | 0.002 | 0.51 |
| | $w_7$ | -0.809 | -0.023 | **-0.102** | -0.045 | 0.009 | -0.010 | **-0.054** | 0.191 | -0.050 | **0.092** | -0.024 | -0.018 | 0.102 | 0.60 |
| | $w_8$ | -0.924 | **-0.040** | **-0.076** | **0.078** | -0.027 | **0.127** | -0.009 | -0.050 | -0.017 | -0.033 | **0.066** | -0.009 | **0.084** | 0.47 |
| | $w_9$ | **5.521** | **-0.054** | 0.004 | **-0.069** | **-0.074** | **-0.057** | -0.019 | **0.092** | -0.033 | -0.038 | **-0.025** | **0.345** | **0.106** | 0.59 |
| 2nd | $w_1$ | **0.646** | **0.018** | -0.008 | **-0.011** | **0.010** | **0.022** | -0.001 | **-0.019** | -0.001 | **-0.015** | 0.008 | **-0.137** | -0.029 | 0.30 |
| | $w_2$ | **-0.298** | -0.008 | **0.081** | 0.003 | -0.012 | 0.008 | **-0.028** | -0.021 | **-0.044** | 0.012 | -0.008 | -0.005 | -0.033 | 0.40 |
| | $w_3$ | **-0.297** | **-0.011** | 0.003 | 0.026 | **-0.010** | 0.006 | -0.009 | 0.022 | 0.004 | **-0.049** | -0.006 | **-0.032** | 0.018 | 0.22 |
| | $w_4$ | -0.158 | **0.010** | -0.012 | **-0.010** | 0.012 | -0.002 | **0.011** | 0.018 | **-0.024** | -0.020 | -0.005 | -0.012 | 0.003 | 0.20 |
| | $w_5$ | **0.840** | **0.022** | 0.008 | 0.006 | -0.002 | **-0.059** | **0.018** | **-0.032** | -0.010 | **0.028** | 0.013 | 0.009 | 0.090 | 0.24 |
| | $w_6$ | **0.313** | -0.001 | **-0.028** | -0.009 | **0.011** | **0.018** | **0.032** | -0.029 | **0.010** | 0.007 | 0.004 | 0.011 | -0.011 | 0.61 |
| | $w_7$ | -0.403 | **-0.019** | -0.021 | 0.022 | 0.018 | **-0.032** | -0.029 | 0.057 | -0.011 | **0.038** | -0.007 | **0.144** | -0.025 | 0.51 |
| | $w_8$ | **0.319** | -0.001 | **-0.044** | 0.004 | **-0.024** | -0.010 | **0.010** | -0.011 | **0.092** | 0.005 | -0.009 | 0.023 | 0.084 | 0.40 |
| | $w_9$ | 6.359 | **-0.015** | 0.012 | **-0.049** | -0.020 | **0.028** | 0.007 | **0.038** | 0.005 | 0.007 | 0.005 | -0.002 | **0.083** | 0.24 |
| 3rd | $w_1$ | **0.569** | 0.004 | **0.029** | -0.003 | 0.004 | **0.011** | 0.004 | **-0.031** | **-0.018** | **0.023** | 0.012 | -0.011 | **0.065** | 0.36 |
| | $w_2$ | **-0.865** | **0.029** | **0.208** | -0.014 | **-0.065** | 0.021 | -0.026 | **0.042** | **-0.033** | **-0.098** | -0.021 | 0.015 | -0.020 | 0.24 |
| | $w_3$ | 0.114 | -0.003 | -0.014 | **0.013** | 0.006 | -0.001 | 0.006 | -0.005 | 0.001 | -0.002 | 0.002 | 0.003 | -0.004 | 0.20 |
| | $w_4$ | 0.081 | 0.004 | **-0.065** | 0.006 | -0.002 | -0.008 | 0.004 | **0.042** | -0.013 | **0.031** | -0.001 | 0.001 | **-0.074** | 0.25 |
| | $w_5$ | 0.098 | **0.011** | 0.021 | -0.001 | -0.008 | **-0.025** | **0.034** | **0.034** | 0.004 | **-0.032** | 0.003 | 0.014 | **0.078** | 0.26 |
| | $w_6$ | 0.167 | 0.004 | -0.026 | 0.006 | 0.004 | **0.034** | **0.027** | **-0.069** | 0.001 | 0.004 | 0.002 | -0.016 | 0.013 | 0.32 |
| | $w_7$ | -0.344 | **-0.031** | **0.042** | -0.005 | **0.042** | **0.034** | **-0.069** | 0.023 | **-0.025** | -0.045 | -0.012 | 0.039 | **-0.122** | 0.32 |
| | $w_8$ | **0.736** | **-0.018** | **-0.033** | 0.001 | -0.013 | 0.004 | 0.001 | **-0.025** | 0.037 | **-0.035** | **-0.045** | **0.129** | **-0.035** | 0.31 |
| | $w_9$ | 5.834 | **0.023** | **-0.098** | -0.002 | **0.031** | **-0.032** | 0.004 | -0.045 | **-0.035** | 0.013 | -0.001 | 0.032 | **-0.066** | 0.28 |
| 4th | $w_1$ | **0.578** | **0.036** | -0.006 | -0.001 | 0.003 | **-0.011** | 0.004 | 0.006 | **-0.038** | 0.011 | **0.021** | -0.006 | -0.042 | 0.28 |
| | $w_2$ | **-0.126** | -0.006 | **0.072** | -0.004 | **-0.023** | -0.001 | **-0.030** | 0.013 | -0.008 | **-0.011** | -0.008 | 0.028 | -0.004 | 0.30 |
| | $w_3$ | 0.005 | -0.001 | -0.04 | **0.010** | -0.009 | -0.004 | -0.001 | **0.017** | -0.005 | -0.002 | -0.001 | -0.006 | 0.003 | 0.38 |
| | $w_4$ | -0.104 | 0.003 | **-0.023** | -0.009 | **0.015** | 0.010 | -0.005 | **0.026** | -0.017 | -0.003 | -0.007 | -0.034 | 0.031 | 0.26 |
| | $w_5$ | **0.121** | **-0.011** | -0.001 | -0.004 | 0.010 | -0.006 | **-0.018** | **0.035** | 0.002 | **-0.012** | 0.007 | 0.018 | 0.019 | 0.16 |
| | $w_6$ | -0.048 | 0.004 | **-0.030** | -0.001 | -0.005 | **-0.018** | **0.084** | -0.056 | -0.003 | -0.018 | -0.007 | -0.003 | 0.011 | 0.45 |
| | $w_7$ | **0.709** | 0.006 | 0.013 | **0.017** | **0.026** | **0.035** | -0.056 | -0.069 | **-0.089** | **0.080** | 0.023 | 0.086 | -0.038 | 0.24 |
| | $w_8$ | 0.225 | **-0.038** | -0.008 | -0.005 | -0.017 | 0.002 | -0.003 | **-0.089** | **0.126** | -0.002 | -0.028 | -0.095 | 0.072 | 0.28 |
| | $w_9$ | **2.645** | 0.011 | **-0.011** | -0.002 | -0.003 | **-0.012** | -0.018 | **0.080** | -0.002 | **0.027** | 0.006 | 0.012 | **-0.047** | 0.23 |

Figures in bold show coefficients significant at least at the 10% level.

**Table 3: Estimated LA/AIDS Coefficients in Urban Areas by Income Quartiles**

| Quartile | $w_i$ | αi | γi1 | γi2 | γi3 | γi4 | γi5 | γi6 | γi7 | γi8 | γi9 | βi | φi1 | φi2 | $R^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1st | $w_1$ | **0.681** | 0.034 | **-0.049** | **-0.035** | **-0.052** | -0.004 | **-0.026** | -0.022 | **0.048** | **-0.028** | **-0.045** | -0.061 | **0.058** | 0.48 |
| | $w_2$ | 0.110 | -0**.049** | 0.016 | **0.013** | 0.013 | **-0.035** | **0.027** | -0.004 | 0.014 | **-0.042** | -0.016 | **0.081** | -0.026 | 0.25 |
| | $w_3$ | **0.229** | **-0.035** | **0.013** | 0.023 | -0.007 | **0.015** | -0.001 | -0.021 | **0.032** | -0.029 | **-0.024** | -0.006 | 0.018 | 0.28 |
| | $w_4$ | 0.182 | **-0.052** | 0.013 | -0.007 | 0.005 | **-0.027** | -0.006 | **0.016** | **0.037** | **-0.023** | **-0.023** | -0.028 | -0.007 | 0.32 |
| | $w_5$ | -0.214 | -0.004 | **-0.035** | **0.015** | -0.001 | **0.047** | 0.007 | 0.019 | **-0.081** | **0.032** | **0.032** | **0.082** | -0.035 | 0.19 |
| | $w_6$ | 0.108 | **-0.026** | **0.027** | -0.001 | -0.006 | 0.007 | **0.030** | -0.008 | 0.005 | **-0.024** | -0.013 | 0.020 | 0.008 | 0.16 |
| | $w_7$ | **0.292** | -0.022 | -0.004 | -0.021 | **0.016** | 0.019 | -0.008 | **0.017** | 0.011 | **-0.033** | **-0.024** | -0.014 | **0.066** | 0.26 |
| | $w_8$ | **-2.033** | **0.048** | 0.014 | **0.032** | **0.037** | **-0.081** | 0.005 | 0.011 | -0.096 | -0.042 | **0.105** | **-0.082** | -0.039 | 0.43 |
| | $w_9$ | **1.329** | **-0.028** | **-0.042** | -0.029 | **-0.023** | **0.032** | **-0.024** | **-0.033** | -0.042 | 0.009 | 0.004 | -0.018 | -0.042 | 0.18 |
| 2nd | $w_1$ | 0.119 | **0.053** | 0.002 | 0.001 | 0.002 | **0.010** | **-0.019** | -0.010 | **-0.046** | 0.001 | 0.007 | 0.044 | -0.026 | 0.27 |
| | $w_2$ | **0.387** | 0.002 | -0.041 | **-0.018** | **-0.029** | 0.006 | 0.001 | **-0.019** | **0.013** | **-0.018** | -0.018 | 0.015 | -0.047 | 0.16 |
| | $w_3$ | 0.054 | 0.001 | -0**.018** | **0.047** | -0.013 | -0.007 | 0.007 | -0.008 | **-0.018** | -0.007 | -0.001 | 0.015 | -0.002 | 0.19 |
| | $w_4$ | **0.220** | 0.002 | **-0.029** | -0.013 | **0.022** | 0.003 | 0.001 | -0.004 | **0.015** | **0.006** | -0.011 | 0.014 | -0.025 | 0.16 |
| | $w_5$ | **0.453** | **0.010** | 0.006 | -0.007 | 0.003 | -0.008 | -0.006 | **-0.024** | **0.050** | **-0.014** | **-0.025** | -0.025 | 0.047 | 0.27 |
| | $w_6$ | -0.028 | **-0.019** | 0.001 | 0.007 | 0.001 | -0.006 | **0.028** | 0.018 | -0.017 | -0.004 | 0.004 | -0.007 | 0.011 | 0.19 |
| | $w_7$ | 0.177 | -0.010 | **-0.019** | -0.008 | -0.004 | **-0.024** | 0.018 | **0.062** | **0.031** | -0.010 | -0.012 | -0.042 | **0.077** | 0.26 |
| | $w_8$ | **-1.329** | **-0.046** | **0.013** | **-0.018** | **0.015** | **0.050** | -0.017 | **0.031** | -0.008 | **-0.027** | **0.077** | 0.013 | **-0.068** | 0.36 |
| | $w_9$ | **0.427** | 0.001 | **-0.018** | -0.007 | **0.006** | **-0.014** | -0.004 | -0.010 | **-0.027** | **0.017** | -0.002 | -0.034 | 0.046 | 0.18 |
| 3rd | $w_1$ | **0.223** | **0.038** | -0.003 | -0.003 | **-0.011** | **0.011** | -0.004 | 0.002 | **-0.033** | -0.005 | -0.007 | 0.019 | -0.040 | 0.19 |
| | $w_2$ | 0.007 | -0.003 | 0.004 | **0.017** | -0.007 | 0.006 | 0.006 | **0.033** | **-0.029** | 0.002 | 0.012 | 0.033 | **-0.058** | 0.28 |
| | $w_3$ | **0.074** | -0.003 | **0.017** | 0.013 | -0.001 | **-0.015** | 0.001 | **-0.015** | 0.005 | -0.001 | -0.007 | 0.004 | 0.002 | 0.28 |
| | $w_4$ | 0.060 | **-0.011** | -0.007 | -0.001 | **0.011** | -0.006 | -0.006 | -0.005 | 0.003 | **0.010** | -0.001 | -0.004 | -0.005 | 0.22 |
| | $w_5$ | **0.462** | **0.011** | 0.006 | **-0.015** | -0.006 | 0.005 | -0.001 | -0.001 | **-0.017** | **-0.024** | **-0.048** | -0.012 | 0.046 | 0.17 |
| | $w_6$ | **0.333** | -0.004 | 0.006 | 0.001 | -0.006 | -0.001 | **0.016** | **-0.036** | **-0.013** | -0.013 | -0.003 | -0.013 | 0.003 | 0.37 |
| | $w_7$ | -0.039 | 0.002 | **0.033** | **-0.015** | -0.005 | -0.001 | **-0.036** | **0.050** | -0**.108** | -0.012 | **0.026** | 0.008 | **-0.046** | 0.28 |
| | $w_8$ | -0.316 | **-0.033** | **-0.029** | 0.005 | 0.003 | **-0.017** | **-0.013** | **-0.108** | **0.077** | **-0.015** | **0.039** | **0.115** | **0.117** | 0.39 |
| | $w_9$ | **0.613** | -0.005 | 0.002 | -0.001 | **0.010** | **-0.024** | -0.013 | -0.012 | **-0.015** | 0.004 | -0.029 | 0.018 | -0.036 | 0.19 |
| 4th | $w_1$ | **0.165** | **0.020** | **0.011** | 0.003 | -0.006 | -0.001 | -0.002 | 0.002 | **-0.017** | **-0.013** | -0.003 | -0.014 | **-0.034** | 0.28 |
| | $w_2$ | **0.171** | **0.011** | **0.038** | 0.001 | **-0.022** | **-0.014** | **0.007** | 0.004 | **-0.022** | **-0.014** | -0.003 | -0.011 | -0.007 | 0.23 |
| | $w_3$ | **0.078** | 0.003 | **0**.001 | **0.008** | **-0.011** | **-0.007** | -0.002 | 0.001 | 0.003 | -0.003 | **-0.006** | 0.006 | 0.003 | 0.28 |
| | $w_4$ | 0.078 | -0.006 | **-0.022** | **-0.011** | **0.062** | -0.003 | -0.005 | **0.024** | **-0.011** | **-0.014** | -0.003 | -0.004 | -0.022 | 0.29 |
| | $w_5$ | **0.453** | -0.001 | **-0.014** | **-0.007** | -0.003 | 0.010 | 0.001 | -0.007 | **0.024** | **-0.012** | **-0.032** | 0.010 | 0.022 | 0.31 |
| | $w_6$ | **0.066** | -0.002 | **0.007** | -0.002 | -0.005 | 0.001 | **0.014** | 0.004 | -0.007 | **-0.012** | -0.004 | -0.011 | 0.007 | 0.18 |
| | $w_7$ | 0.029 | 0.002 | 0.004 | 0.001 | **0.024** | -0.007 | 0.004 | -0.015 | -0.005 | **0.012** | 0.015 | 0.012 | 0.056 | 0.29 |
| | $w_8$ | **-0.695** | **-0.017** | **-0.022** | 0.003 | **-0.011** | **0.024** | -0.007 | -0.005 | 0.044 | -0.008 | **0.055** | **0.013** | -0.050 | 0.18 |
| | $w_9$ | 0.407 | **-0.013** | **-0.014** | -0.003 | **-0.014** | **-0.012** | **-0.012** | **0.012** | -0.008 | **0.016** | -0.024 | -0.001 | 0.024 | 0.28 |

Figures in bold show coefficients significant at least at the 10% level.

**Table 4: Own Price and Cross Elasticities of Composite Rice in Iran**

| | Quartiles | Rural Households | | Urban Households | |
|---|---|---|---|---|---|
| | | Mean | SE of mean | Mean | SE of mean |
| Own-price elasticities ($\eta^D$) | 1st | -0.728 | 0.040 | -1.932 | 0.112 |
| | 2nd | -0.549 | 0.040 | -1.142 | 0.008 |
| | 3rd | -0.444 | 0.072 | -0.506 | 0.060 |
| | 4th | -0.429 | 0.017 | -0.690 | 0.047 |
| Cross-price elasticities ($\phi^D$) | 1st | 0.656 | 0.025 | -0.869 | 0.117 |
| | 2nd | 0.712 | 0.025 | -0.093 | 0.012 |
| | 3rd | 0.654 | 0.030 | 0.642 | 0.132 |
| | 4th | 0.945 | 0.079 | 0.348 | 0.044 |

**Table 5: Armington and Pass through Elasticities in Rural Areas, Iran**

| | Quartiles | Mean | Std Dev | Minimum | Maximum |
|---|---|---|---|---|---|
| Armington | 1st | .441 | 2.606 | -6.743 | 23.074 |
| | 2nd | .690 | 5.055 | -20.881 | 28.508 |
| | 3rd | .312 | 5.223 | -29.579 | 31.168 |
| | 4th | .095 | 6.155 | -29.015 | 37.504 |
| Pass-through | 1st | .893 | 4.757 | -27.027 | 28.141 |
| | 2nd | .386 | 2.869 | -15.373 | 32.853 |
| | 3rd | .347 | 2.572 | -20.419 | 18.880 |
| | 4th | .065 | 2.555 | -18.736 | 22.635 |

**Table 6. Armington and Pass-through Elasticities in Urban Areas, Iran**

| | Quartiles | Mean | Std Dev | Minimum | Maximum |
|---|---|---|---|---|---|
| Armington | 1st | 1.569 | 4.839 | -21.531 | 64.232 |
| | 2nd | .896 | 4.074 | -13.026 | 41.948 |
| | 3rd | .646 | 3.824 | -24.744 | 14.613 |
| | 4th | .502 | 3.938 | -18.954 | 17.452 |
| Pass-through | 1st | .172 | 1.582 | -9.890 | 16.052 |
| | 2nd | .205 | 2.270 | -9.973 | 20.971 |
| | 3rd | .157 | 1.689 | -11.747 | 17.339 |
| | 4th | .068 | 2.412 | -28.581 | 20.995 |

**Table 7: Welfare Gains of Rice Price Change in Iran**

| | Quartiles in rural areas | | | | Quartiles in urban areas | | | |
|---|---|---|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | 1st | 2nd | 3rd | 4th |
| Compensating variation | 1308 | 1027 | 1032 | 865 | 2776 | 2225 | 1976 | 1670 |
| Welfare gain | -85953 | -113039 | -163502 | -275610 | -42835 | -46917 | -127114 | -164226 |

**Figure 1: Mean Armington and Pass-through Elasticities in Rural Iran**

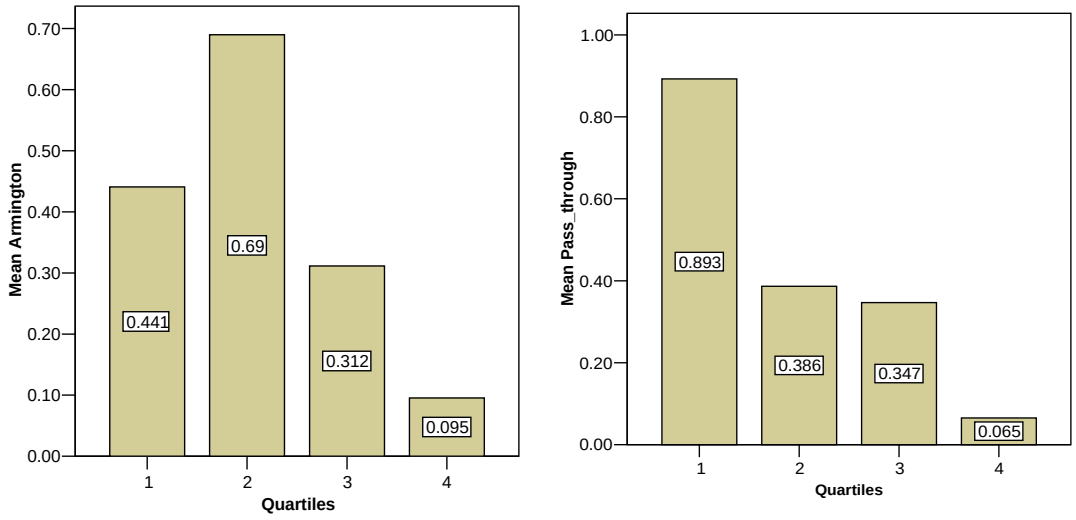


**Figure 2: Mean Armington and Pass-through Elasticities in Urban Iran**

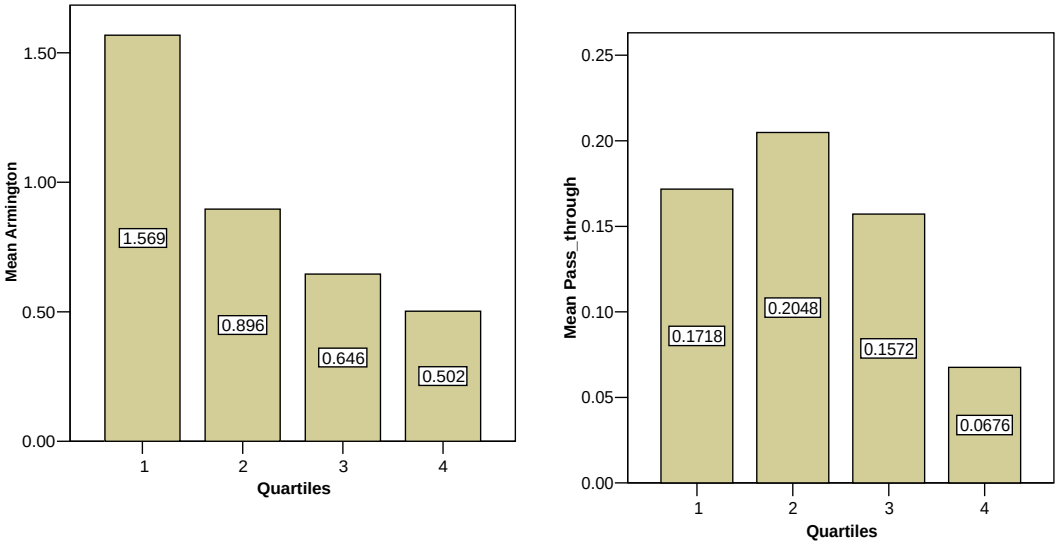

**Figure 3: Mean Welfare Gains from Rice Price Increase in Rural (left) and Urban (right) Iran**