- Meat demand structure and welfare effects of price liberalization: toward socio-demographic policy recommendations
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5 Abstract

6 This study attempts to investigate the welfare effects of the multiple meat price shocks in consumers' different income and age groups due to the price liberalization policy. This is achieved 7 8 by using Compensating Variation welfare index (CV) and Hicksian price elasticities, based on the Almost Ideal Demand System (AIDS) and the cost-income data of 17931 urban households in 9 10 Iran. The results showed that the difference in meat's own-price elasticity for consumers of different ages decreases with the improvement of consumers' income status. The absolute own-11 price elasticity of poultry varied between 0.072-0.559 percent. The highest sensitivity of poultry 12 meat demand to price changes was observed in high-income consumer groups. As well as the red 13 meat demand sensitivity to price changes for all age groups declines along with raised income. 14 The fish own-price elasticity for all consumers was more than one and their differences were more 15 significant for low-income consumers. The CV index of consumers varied between 29 and 78% 16 and confirmed the hypothesis of difference in the consumers' vulnerability in different age and 17 income groups. Separating the welfare effect by consumer groups based on income and age 18 indicated that low-income and younger consumers experience a higher welfare loss compared to 19 low-income and older consumers. Finally, to accurately target the subsidies, the government can 20 pay a certain amount of subsidy to each person according to the economic and social 21 characteristics to prevent the wastage of resources and reach the desired goal. 22

Keywords: Meat Demand, Welfare, Food Security, Compensating Variation, Price
 Liberalization.

26 Introduction

Food price shocks can have a significant negative welfare effect on society, especially on poor
and low-income households (Alem and Söderbom, 2012). Developing countries are more affected
by food price fluctuations due to their economic structure. Because these countries are often in a

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period of economic transition, rising prices lead to many problems in these countries (Pawlak and
Kołodziejczak, 2020). Iran is also one of the developing countries facing double-digit inflation
rates for many years, and most of the government's efforts have always been focused on
identifying and eliminating the roots of inflation (Ilias, 2010).

For various reasons, such as the nature of the agricultural sector, higher risk than other sectors, 34 and food security, support for the agricultural sector has always been the focus of governments 35 (Nematollahi et al., 2013; Ehlers et al., 2021). Government interventions in pricing, revenue 36 protection, production control, customs restrictions on imports, and export subsidies to 37 agricultural products are among the policies of governments to protect consumers and producers 38 of agricultural products (Mockshell and Birner, 2015; Bellmann, 2019). Despite the positive 39 effects of the liberalization of economic activity in the world, the Iranian government still has a 40 significant contribution to the country's economy. However, almost all economists agree on the 41 low efficiency of government economic activities. Restricting government intervention in 42 agricultural activities is a measure suggested by the World Bank and other global economic 43 organizations, especially in recent decades (Bakhshoodeh, 2002). The most important goals of 44 market liberalization are to prevent the use of production facilities in the low-efficient production 45 sector, increase production and encourage competition (Arya et al., 2018). About price 46 liberalization, Tabatabaei and Asef (2021) examined how price liberalization affects energy 47 consumption intensity. They found that price liberalization can enhance productivity, energy 48 49 consumption management, and consumption reform, ultimately resulting in reduced energy 50 intensity. Norouzi et al. (2021) conducted a study on how energy cost liberalization policies impact the cost-effectiveness of wind farms versus gas power plants. In food market, Dorosh et 51 al. (2023) examined how market liberalization and global price fluctuations affect wheat price 52 policies in Sudan. A study by Ghencea et al. in 2022 found that liberalization and globalization 53 54 in Moldova's food retail industry have led to better access to high-quality food products and reasonable prices for consumers. Competition has also increased access and diversification. Iran's 55 economic policies are also aimed at diminishing government hands and liberalizing economic 56 activities, especially in the agricultural market. Although this policy can bring economic benefits 57 58 to society, its effects should also be taken into consideration by policymakers, and the liberalization policy should be well-defined and implemented. 59

To protect Iranian households from vulnerability caused by price liberalization, the government
 provides additional subsidies to consumers and eliminates cash subsidies for high-income groups.

However, the success of this policy depends on accurately determining the appropriate amount of 62 subsidies to be paid. To make well-informed decisions, policymakers must comprehend the 63 potential impact of price shocks on household expenditure. Evaluating the impact of price shocks 64 on consumer welfare can provide valuable insights into the effectiveness of government support 65 policies aimed at reducing poverty and vulnerability (Layani et al., 2020). Based on 66 microeconomics theories, whenever an economic change occurs (e.g. the price shocks) an 67 individual moves from one equilibrium point to another equilibrium point. This means that they 68 move from one indifference curve to another indifference curve. The change in welfare is 69 measured by the difference in utility (Chipman and Moore, 1980). Economists try to convert 70 changes in utility into observable indexes like money. Hicks (1942) defined Compensating 71 Variation (CV) as the deduction (or addition) required from an individual's income to maintain 72 the initial level of welfare (initial situation.) after a change in price and income. To calculating 73 CV, estimating the demand functions and calculating the price and income elasticities of different 74 goods for consumers in different groups play an essential role (Azzam and Rettab, 2012). 75

There is a large volume of published studies that worked on examining the structure of 76 commodity demand and determining their price and income elasticities. Deaton and Mulbaer 77 (1980) for Great Britain; Blanciforti et al. (1986) for the United States; Karagiannis et al. (2000) 78 for Greece; Abdulai (2002) for Switzerland; Mazzocchi et al. (2004) for Italy; Tefera (2010) for 79 Ethiopia; Ahn et al. (2018) for Korea; and Yuzbashkandi and Mehrjo (2020) for Iran are some 80 81 examples. In recent years, there has been an increasing amount of literature on welfare effects and 82 household vulnerability to price shocks in different countries (e.g., Fujii, 2013; Layani and Bakhshoodeh, 2016; Renner et al., 2019). Determining the vulnerability of households in the 83 United Arab Emirates (UAE) as a result of multiple price changes of imported food products 84 investigated by Azzam and Rettab (2012). The focus of this study was to determine the welfare 85 effects of multiple commodity price changes. Recently, Layani et al. (2020) have evaluated the 86 poverty line changes in urban households as a result of simultaneous price changes to understand 87 the extent of Iranian consumers' vulnerability. 88

Considering all of this evidence, what is less clear is the different reactions of households with varying characteristics to changes in commodity prices. Consumers with varying income and age groups may react differently to price changes. This means that the price elasticity of consumers with different economic and demographic backgrounds can vary. The impact of price shocks on the welfare of consumers can be influenced by this issue. This issue was considered by Khoiriyah

et al. (2019); Nikmatul et al. (2020); Kharisma et al. (2020); Ur Rahman (2021). In these studies, 94 the price and income elasticities of commodities were calculated in different income groups. Then 95 the welfare effects of price shocks for different groups of households were evaluated. Very little 96 was found in the literature to consider the socio-demographic characteristics of households in the 97 calculation of consumers' reactions to price shocks. Currently, Rossen et al. (2022) by 98 disentangling the impact of price shocks by household group according to income and age, 99 showed that lower-income and older households experience greater welfare losses and lower tax 100 burdens than their income compared to lower-income and younger households. Also, Nur Hamzah 101 (2022) found that regional heterogeneity plays an important role in explaining the most strategic 102 food consumption pattern in Indonesia. 103

Research has shown that accurately calculating the impact of price changes on consumers with 104 varying economic and demographic backgrounds can help governments develop targeted poverty 105 reduction policies. To do this, it's important to understand consumer behavior in the market and 106 calculate their price and income elasticity. Therfore, this study set out with the aim of assessing 107 the importance of socio-demographic characteristics and consumer demand structure in meat 108 demand structure in Iran. This study takes into consideration the necessity of analyzing consumer 109 behavior for different income and age groups, while, to the best of our knowledge, this point has 110 not been considered adequately. To enhance the government's cash subsidy payment policy, we 111 need to assess the impact of price hikes on consumers' welfare, considering their income and 112 113 demographic features. Therefore, In comparison to other studies, we report price and expenditure 114 elasticities by socio-economic group. Finally, the welfare effects of the price shock caused by the price liberalization policy are evaluated for urban meat consumers in Iran in different income and 115 age groups. 116

Within this context, the rest of the paper is structured as follows: The next section introduces the methodology of the AIDS model and the welfare Index. Own- and cross-price elasticities of meat and welfare effects of price shocks are presented in the results section. The final section offers discussion and conclusions.

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122 Methodology

123A) Welfare Index

124 There are various indexes for measuring welfare changes due to the implementation of 125 different policies (Gohin, 2005). Compensated Variation (CV), is the adjustment in income that returns the consumer to the original utility after an economic change has occurred. EV is the adjustment in income that changes the consumer's utility equal to the level that would occur if the event had happened (Varian, 2000). According to the study by Azzam and Rettab (2012) and Tefera (2012), Compensated Variation was used in this study:

$$CV = \mathop{a}\limits_{i=1}^{3} p_{i}^{0} x_{i}^{0} \left(\frac{dp_{i}}{p_{i}^{0}} + \frac{dx_{i}^{*}}{x_{i}^{0}} + \frac{dp_{i}}{p_{i}^{0}} \frac{dx_{i}^{*}}{x_{i}^{0}}\right)$$
(1)

Where p_i^0 and x_i^0 correspond to price and quantities before price shock and dx_i^* is the compensated quantity change in demand following the price shock using the compensates elasticities. The percentage change of x_i^* is not available. However, by the total differential of the Hicksian demand functions $X_i^*(.)$ for i = 1, 2, ..., N i.e., an approximation of the change is obtained.

$$\frac{dX_1^*}{x_1^0} = \epsilon_{11}^H \frac{dp_1}{p_1} + \epsilon_{12}^H \frac{dp_2}{p_2} + \dots + \epsilon_{1N}^H \frac{dp_N}{p_N}
\frac{dX_2^*}{x_2^0} = \epsilon_{21}^H \frac{dp_1}{p_1} + \epsilon_{22}^H \frac{dp_2}{p_2} + \dots + \epsilon_{2N}^H \frac{dp_N}{p_N}
\vdots
\frac{dX_N^*}{x_N^0} = \epsilon_{N1}^H \frac{dp_1}{p_1} + \epsilon_{N2}^H \frac{dp_2}{p_2} + \dots + \epsilon_{NN}^H \frac{dp_N}{p_N}$$
(2)

135 where ϵ_{ij}^{H} is the Hicksian price elasticity for i = 1, 2, ..., N and j = 1, 2, ..., N.

136 B) Hicksian price elasticities of demand

To estimate the Hicksian price elasticities, an AIDS model for N commodities by imposing the
usual restrictions: adding-up, homogeneity, and symmetry have been estimated (Deaton and
Muelbauer, 1980). The AIDS model is:

$$\mathbf{S}_{ih} = a_i + \mathbf{\mathring{A}}_{j=1}^{N} g_{ij} \ln \mathbf{P}_{jh} + b_i \ln \mathbf{\mathring{g}}_{\overline{f(p)}}^{M} \frac{\ddot{\mathbf{o}}}{\dot{\underline{f}(p)}} + n_{ih}$$
(3)

Where S_{ih} is the expenditure share of meat groups i=1,2,3 for household h; M_h is the household's total meat expenditure; P is a vector of prices and n_{ih} denotes the error term. Also, f(p) is the

142 Stone Price Index defined by $logf(p)_{ih} = \mathop{a}\limits^{\circ}_{i} s_{ih} logp_{ih}$.

143 We impose the theoretical properties of demand by: Adding up: $a^{N}_{a}a_{1}=1; a^{N}_{a}b_{2}=0; a^{N}_{a}a_{2}=0$

$$\overset{\circ}{\mathbf{a}}_{i=1}^{i} a_{i} = 1; \overset{\circ}{\mathbf{a}}_{i=1}^{i} b_{i} = 0; \overset{\circ}{\mathbf{a}}_{i} g_{ij} = 0$$

 $\mathop{a}\limits^{N}_{j=1} g_{ij} = 0$ i = 1, 2, ..., N

Homogeneity of degree zero:

Symmetry:

But one of the problems we face when using cross-sectional data at the household level and dividing the food group into several smaller groups is the phenomenon of zero budget share. In other words, some households report zero consumption, and some others spend a non-zero share. Therefore, the variable is censored. To solve this problem, based on the Bakhshoodeh (2010) study, we use the following equation instead of equation (4).

 $g_{ij} = g_{ji}$

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$$\mathbf{S}_{\mathrm{ih}} = \mathbf{F}_{\mathrm{ih}} \stackrel{\acute{\mathbf{e}}}{\underset{\mathbf{e}}{\mathbf{f}}} a_{\mathrm{i}} + \stackrel{\mathrm{N}}{\underset{j=1}{\mathbf{a}}} g_{\mathrm{ij}} \ln \mathbf{P}_{\mathrm{jh}} + b_{\mathrm{i}} \ln \stackrel{\widetilde{\mathbf{e}}}{\underset{\mathbf{e}}{\mathbf{f}}} \stackrel{\mathrm{Ou}}{\underset{\mathbf{e}}{\mathbf{f}}} + q_{\mathrm{i}} j_{\mathrm{ih}} + e_{\mathrm{ih}}$$

$$\tag{4}$$

150 Where F_{ih} is the cumulative distribution function, and j_{ih} is the probability density function for 151 purchase in each product group per household. For calculation F_{ih} and j_{ih} we have adopted the 152 two-step approach from Shonkwiler and Yen (1999).

153 The respective formulas for computing the uncompensated own, and cross-price elasticities for154 N meat groups are:

$$e_{iih}^{M} = F_{ih} \stackrel{\circ}{\underset{e}{\overset{\circ}{\mathsf{g}}}} \frac{\overset{\circ}{\mathsf{g}}_{ii}}{\overset{\circ}{\mathsf{g}}_{\mathsf{s}h}} - \overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\div}}}} \frac{\overset{\circ}{\mathsf{s}}}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\overset{\circ}{\div}}}} 1$$
(5)

$$e_{ijh}^{M} = F_{ih} \cdot \begin{array}{c} \overset{\alpha}{c} & \overset{\circ}{c} & \overset{\circ}{b}_{i} & S_{jh} \\ \overset{\circ}{c} & \overset{\circ}{c} \\ \overset{\circ}{c} & \overset{\circ}{S}_{ih} & \overset{\circ}{\pm} \\ \overset{\circ}{e} & \overset{\circ}{S}_{ih} & \overset{\circ}{\pm} \end{array}$$
(6)

155 The formula for Income (expenditure) elasticities can be written as:

$$e_{ih} = F_{ih} \frac{\dot{b}_i}{S_{ih}} + 1 \tag{7}$$

156 Compensated price-elasticities:

$$e_{ijh}^{H} = e_{ijh}^{M} + s_{jh} \cdot e_{ih}$$
(8)

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158 Data and Information

This study is based on an urban household's income-expenditure survey (2020) of the Iranian Statistics Center (17931 urban households) for computing price and expenditure elasticities. To define the price increase scenario, the information related to the price of various types of meat and the inflation index of food prices in Iran were reviewed. The food price inflation in Iran was

equal to 7.98% in January 2010, which increased to 42.79% in 2022. The average annual change 163 of this index is 57.46%. Examining the cost-income information of Iranian urban households 164 shows that 21% of the total food expenditure is devoted to meat. So that the share of red, poultry, 165 and fish meat from the total food expenditure is equal to 11.31%, 7.41%, and 2.23%, respectively 166 (Iranian Statistics Center, 2020). The producer price index of the meat group had an upward trend 167 during 2010-2021 (FAO, 2022). The average annual growth of this index over the past decade is 168 26.80%. Considering the 27% share of food expenditure from the total household expenditure, it 169 170 is expected that this food price inflation will have adverse welfare effects on Iranian households (Iranian Statistics Center, 2020). We have gathered data on meat prices before and after the 171 liberalization of prices and the decrease in subsidies for agricultural inputs. Our statistics indicate 172 that there have been positive changes in the prices of meat in Iran in recent year. Specifically, the 173 increases were 35.9% for red meat, 68.4% for poultry, and 77.7% for fish (Iranian Statistics 174 Center, 2022). In this study, to investigate the welfare effects of the price shock in the Iranian 175 meat market for Iranian households, the changes in the meat price have been defined as a price 176 shock scenario to calculate the changes in the expenditure of consumers in different age and 177 178 income consumer groups.

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180 **Result**

181 A. Meat demand data and descriptive statistics

The share of poultry expenditure for younger consumers in the low-income group is more than 182 the other meat groups (in Table 1). As the age of the consumer in this group increases, the poultry 183 expenditure share is reduced, and the red and fish expenditure share is increased. For younger 184 185 consumers, the red and fish expenditure share is estimated to be below 10%. The share of poultry expenditure is more than the share of red meat and fish in the second income group. But compared 186 to the first income group, the share of poultry expenditure is at a lower level and the share of red 187 meat and fish expenditure is at a higher level. The results show that for different age groups of 188 consumers in these two income groups, fish is not the priority of consumption. By moving from 189 190 the first to the second income group, poultry expenditure share is reduced and red meat expenditure share is increased. With the increase in income, in the third income group, the share 191 of red meat expenditure increases noticeably. So that for young consumers, the share of red meat 192 expenditure increases to 33% and the share of poultry expenditure decreases to 56%. For 193 194 consumers aged 20-40 years, the share of red meat expenditure exceeds the share of poultry meat expenditure and reaches 52%. For the 41-60 years age group, the expenditure share of red, poultry, 195

and fish meat is equal to 52%, 44%, and 4%, respectively. For the elderly, it is more important to consume poultry meat than red meat and fish. With the increase in the age of consumers in the high-income group, the expenditure share of red meat has increased and reached 65% for people over 61 years old. The expenditure share of fish meat also indicates less consumption of this type of meat than red meat and poultry in this income group.

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Household Income Specification	Age profile	Meat Type	Household meat expenditure	Per capita consumption (Kg/month)	Number of households	Average education (year)	Average househol size
•		Deducert	<u>share (%)</u>	0.000			
	25 > 4	Red meat	0.035	0.009	- (2)	10.70	2.16
	25 ≥Age	Poultry	0.949	0.641	_ 62	10.72	3.16
		Fish	0.016	0.011			
	0.000	Red meat	0.040	0.012	- 1500		a 00
	26≤Age≤40	Poultry	0.917	0.751	1529	9.77	3.89
Low Income		Fish	0.044	0.018			
	11	Red meat	0.067	0.022	-		
	41≤Age≤60	Poultry	0.896	0.747	_ 1706	7.94	4.34
		Fish	0.038	0.018			
		Red meat	0.034	0.013	_		
	61 ≤Age	Poultry	0.933	0.819	_ 573	3.47	3.55
		Fish	0.033	0.015			
		Red meat	0.120	0.079	_		
	25 ≥Age	Poultry	0.850	1.498	_ 58	9.18	2.66
		Fish	0.030	0.029			
	26≤Age≤40	Red meat	0.259	0.154	1456	10.54	3.63
		Poultry	0.689	1.237			
10111 T		Fish	0.052	0.063	-		
Middle mcome	41≤Age≤60	Red meat	0.283	0.167	1912	8.65	3.95
		Poultry	0.668	1.167			
		Fish	0.049	0.058			
	61 ≤Age	Red meat	0.177	0.133	876	3.49	2.94
		Poultry	0.796	1.325			
		Fish	0.026	0.042			
		Red meat	0.338	0.416			
	25>Age	Poultry	0.562	2.159	- 60	10.88	2.46
		Fish	0.101	0.313	- 00		
		Red meat	0.518	0.589			
	26 <age<40< td=""><td>Poultry</td><td>0.419</td><td>1 617</td><td>1379</td><td>11.65</td><td>3 47</td></age<40<>	Poultry	0.419	1 617	1379	11.65	3 47
Relatively high income	20 <u>-</u> Age <u>-</u> 40	Fish	0.064	0.156		11.05	5.17
	41≤Age≤60	Red meat	0.517	0.190	1987	9.54	3.83
		Poultry	0.317	1 388			
		 	0.437	0.001			
		Pad most	0.044	0.091			
	61 ≤Age	Reu liteat	0.441	1.526	1041	4.48	2.90
		Poultry	0.312	0.101			
		Fish	0.047	0.101			
	0.52	Red meat	0.617	1.558	-	11.50	2.22
High Income	25≥Age 	Poultry	0.318	2.133	. 64	11.58	3.11
		Fish	0.064	0.333			
		Red meat	0.651	1.425	1188		
		Poultry	0.283	1.933			
		Fish	0.066	0.292			
	41≤Age≤60	Red meat	0.660	1.575	2289	1.64	3.34

	Poultry	0.289	2.142	_		
	Fish	0.051	0.258	_		
	Red meat	0.656	1.923			
61 ≤Age	Poultry	0.310	2.709	1752	6.10	2.32
	Fish	0.034	0.208	-		

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205 B. Demand elasticity across socio-demographic groups

We divide households along socio-demographic characteristics and calculate price and income 206 elasticities to consider the effects of price liberalization. Key questions are the impact of meat 207 price shocks on different income and age groups. Accordingly, we derive and compare elasticity 208 values for (1) low-income, middle-income, relatively high-income, and high-income households 209 and (2) four age group households. All own-price elasticities of meats are negative. In terms of 210 absolute values, the highest own-price elasticity is related to fish, and the lowest own-price 211 elasticity is related to poultry. There is a competitive (and complementary) relationship between 212 commodities if cross-price elasticities are positive (and negative). The Cross-price elasticities 213 presented in Table 2 also show that red meat and fish have a competitive relationship together, 214 while red meat and poultry are competitive. This study supports evidence from previous 215 observations (e.g. Roosen et al. 2022 and Kharisma et al., 2020; Khoiriyah et el., 2020). 216

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 Table 2. Hicksian Price Elasticity of Meat in Different Income-Age Consumer Groups.

Household Income Specification	Age profile	Meat Type	Red meat	Poultry	Fish
	25 > 4 ==	Red meat	-0.284	-1.918	0.670
	25 ≥Age	Poultry	-0.247	-0.136	0.345
	years	Fish	1.853	3.554	-5.408
		Red meat	-0.310	-1.562	0.529
	26≤Age≤40	Poultry	-0.253	-0.251	0.447
I ou Incomo		Fish	0.937	1.873	-2.810
Low Income		Red meat	-0.372	-1.070	0.388
	41≤Age≤60	Poultry	-0.224	-0.294	0.433
		Fish	1.168	2.067	-3.235
	61 < 4 22	Red meat	-0.218	-2.065	0.682
	o1 ≤Age years	Poultry	-0.262	-0.207	0.428
		Fish	1.264	2.526	-3.790
	25 ≥Age years	Red meat	-0.354	-1.111	0.422
		Poultry	-0.145	-0.072	0.402
		Fish	1.141	2.199	-3.058
	26≤Age≤40	Red meat	-0.308	-0.978	0.360
		Poultry	-0.305	-0.231	0.609
Middle Income		Fish	1.155	1.940	-2.864
Mildule Income	41≤Age≤60	Red meat	-0.269	-0.969	0.389
		Poultry	-0.219	-0.212	0.515
		Fish	1.282	2.113	-3.148
	61 ≤Age	Red meat	-0.282	-1.195	0.464
		Poultry	-0.122	-0.103	0.402
	years	Fish	1.069	1.992	-2.775
Relatively high income		Red meat	-0.247	-0.501	0.223

$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$		$25 \ge Age$	Poultry	-0.261	-0.326	0.666
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$		years	Fish	1.151	1.530	-2.358
$\begin{tabular}{ c c c c c c c c c c c } \label{eq:hold_states} High Income $$ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $			Red meat	-0.206	-0.466	0.240
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$		26≤Age≤40	Poultry	-0.481	-0.448	0.781
$\begin{tabular}{ c c c c c c c c c c } High Income & Red meat & -0.202 & -0.506 & 0.257 \\ \hline & & Poultry & -0.458 & -0.439 & 0.747 \\ \hline & Fish & 1.355 & 1.672 & -2.848 \\ \hline & & Red meat & -0.203 & -0.531 & 0.264 \\ \hline & & Poultry & -0.318 & -0.365 & 0.662 \\ \hline & & Poultry & -0.318 & -0.365 & 0.662 \\ \hline & & Fish & 1.199 & 1.515 & -2.451 \\ \hline & & Red meat & -0.174 & -0.398 & 0.209 \\ \hline & & Poultry & -1.181 & -0.522 & 1.199 \\ \hline & & Fish & 1.313 & 1.371 & -2.571 \\ \hline & & Red meat & -0.150 & -0.410 & 0.218 \\ \hline & & Red meat & -0.150 & -0.410 & 0.218 \\ \hline & & Red meat & -0.150 & -0.410 & 0.218 \\ \hline & & Red meat & -0.138 & -0.440 & 0.233 \\ \hline & & & Red meat & -0.138 & -0.440 & 0.233 \\ \hline & & & & Red meat & -0.131 & -0.439 & 0.241 \\ \hline & & & & & & & & & & & \\ \hline & & & & &$			Fish	1.341	1.631	-2.781
$\begin{tabular}{ c c c c c c c c c c } \label{eq:holdsymbol} & 41 \le Age \le 60 & Poultry & -0.458 & -0.439 & 0.747 \\ \hline Fish & 1.355 & 1.672 & -2.848 \\ \hline & 61 \le Age & Red meat & -0.203 & -0.531 & 0.264 \\ \hline & Poultry & -0.318 & -0.365 & 0.662 \\ \hline & Poultry & -0.318 & -0.365 & 0.662 \\ \hline & Fish & 1.199 & 1.515 & -2.451 \\ \hline & Red meat & -0.174 & -0.398 & 0.209 \\ \hline & Poultry & -1.181 & -0.522 & 1.199 \\ \hline & Fish & 1.313 & 1.371 & -2.571 \\ \hline & Red meat & -0.150 & -0.410 & 0.218 \\ \hline & 26 \le Age \le 40 & Poultry & -1.005 & -0.560 & 1.110 \\ \hline & Fish & 1.401 & 1.463 & -2.762 \\ \hline & Red meat & -0.138 & -0.440 & 0.233 \\ \hline & 41 \le Age \le 60 & Poultry & -1.030 & -0.559 & 1.110 \\ \hline & Fish & 1.412 & 1.474 & -2.793 \\ \hline & 61 \le Age & Red meat & -0.131 & -0.439 & 0.241 \\ \hline & Poultry & -0.883 & -0.545 & 1.012 \\ \hline & Fish & 1.291 & 1.292 & -2.471 \\ \hline \end{array}$			Red meat	-0.202	-0.506	0.257
$\begin{tabular}{ c c c c c c c c c c } \hline Fish & 1.355 & 1.672 & -2.848 \\ \hline & & Fish & 1.355 & 1.672 & -2.848 \\ \hline & & & & & & & & & & & & & & & & & &$		41≤Age≤60	Poultry	-0.458	-0.439	0.747
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$			Fish	1.355	1.672	-2.848
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$		$61 < \Lambda g_0$	Red meat	-0.203	-0.531	0.264
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$		01 <u>></u> Age	Poultry	-0.318	-0.365	0.662
$\label{eq:HighIncome} {\rm High Income} \begin{tabular}{ c c c c c c } & 25 \geq & {\rm Age} & {\rm Red meat} & -0.174 & -0.398 & 0.209 \\ & {\rm Poultry} & -1.181 & -0.522 & 1.199 \\ & {\rm Fish} & 1.313 & 1.371 & -2.571 \\ \hline & & {\rm Red meat} & -0.150 & -0.410 & 0.218 \\ & & 26 \leq & {\rm Age} \leq 40 & {\rm Poultry} & -1.005 & -0.560 & 1.110 \\ & & & {\rm Fish} & 1.401 & 1.463 & -2.762 \\ \hline & & {\rm Red meat} & -0.138 & -0.440 & 0.233 \\ & & 41 \leq & {\rm Age} \leq 60 & {\rm Poultry} & -1.030 & -0.559 & 1.110 \\ & & & {\rm Fish} & 1.412 & 1.474 & -2.793 \\ \hline & & 61 \leq & {\rm Age} & {\rm Red meat} & -0.131 & -0.439 & 0.241 \\ & & & {\rm Poultry} & -0.883 & -0.545 & 1.012 \\ & & & {\rm Fish} & 1.291 & 1.292 & -2.471 \\ \hline \end{tabular}$		years	Fish	1.199	1.515	-2.451
$\label{eq:HighIncome} \text{High Income} \begin{tabular}{ c c c c c c } \hline 1.313 & -0.522 & 1.199 \\ \hline years & Poultry & -1.181 & -0.522 & 1.199 \\ \hline Fish & 1.313 & 1.371 & -2.571 \\ \hline Red meat & -0.150 & -0.410 & 0.218 \\ \hline 26 \leq & \text{Age} \leq 40 & Poultry & -1.005 & -0.560 & 1.110 \\ \hline Fish & 1.401 & 1.463 & -2.762 \\ \hline & & \text{Red meat} & -0.138 & -0.440 & 0.233 \\ \hline 41 \leq & \text{Age} \leq 60 & Poultry & -1.030 & -0.559 & 1.110 \\ \hline & & & Fish & 1.412 & 1.474 & -2.793 \\ \hline & & & & & & & & & & \\ \hline 61 \leq & & & & & & & & & & \\ \hline & & & & & & & &$		25 ≥Age years	Red meat	-0.174	-0.398	0.209
High IncomeFish1.3131.371-2.571Red meat-0.150-0.4100.21826≤Age≤40Poultry-1.005-0.4100.218Tight Poultry-1.005-0.5601.110Fish1.4011.463-2.762Red meat-0.138-0.4400.23341≤Age≤60Poultry-1.030-0.5591.110Fish1.4121.474-2.79361 ≤Age yearsRed meat-0.131-0.4390.241Poultry-0.883-0.5451.012Fish1.2911.292-2.471			Poultry	-1.181	-0.522	1.199
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High Income $26 \le Age \le 40$ Poultry -1.005 -0.560 1.110 Fish 1.401 1.463 -2.762 Red meat -0.138 -0.440 0.233 $41 \le Age \le 60$ Poultry -1.030 -0.559 1.110 Fish 1.412 1.474 -2.793 $61 \le Age$ yearsRed meat -0.131 -0.439 0.241 Fish 1.291 1.292 -2.471			Red meat	-0.150	-0.410	0.218
High IncomeFish1.4011.463-2.762 $41 \le Age \le 60$ Red meat-0.138-0.4400.233 $41 \le Age \le 60$ Poultry-1.030-0.5591.110Fish1.4121.474-2.793 $61 \le Age$ yearsRed meat-0.131-0.4390.241Fish1.2911.292-2.471		26≤Age≤40	Poultry	-1.005	-0.560	1.110
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$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$		41≤Age≤60	Poultry	-1.030	-0.559	1.110
$ \begin{array}{c ccccc} 61 \leq & \text{Red meat} & \textbf{-0.131} & -0.439 & 0.241 \\ \hline \text{Poultry} & -0.883 & \textbf{-0.545} & 1.012 \\ \hline \text{Fish} & 1.291 & 1.292 & \textbf{-2.471} \end{array} $			Fish	1.412	1.474	-2.793
OT_SAGE Poultry -0.883 -0.545 1.012 years Fish 1.291 1.292 -2.471		61 < A go	Red meat	-0.131	-0.439	0.241
Fish 1.291 1.292 -2.471		Vers	Poultry	-0.883	-0.545	1.012
		years	Fish	1.291	1.292	-2.471

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Looking at the age profile (fig. 3), it becomes apparent that the differences in reaction to price 219 changes for different age categories. The sensitivity of red meat demand to price changes in the 220 221 age group between 26 to 40 and 41 to 60 years is more than in the other age groups. The own price elasticity of red meat for the middle-aged low-income group is more than for the young and 222 223 very high-age groups. With the increase in income, the absolute value of the red meat own-price elasticity increases for consumers under 25 years old and over 60 years old, and decreases for 224 225 consumers between 25 and 60 years old. According to the result, the red meat demand sensitivity to price changes for all age groups decreases along with increased income. 226

227 Examining the own-price elasticity of poultry meat in different income and age groups indicates 228 that the highest sensitivity of demand to price changes is related to households with high income. 229 The absolute price elasticity of poultry meat for consumers varies between 0.072-0.559 percent. By moving towards lower-income groups, the difference in price elasticities of poultry meat 230 increases in different age groups. The highest absolute price elasticity of poultry meat is related 231 to age groups 26-40 and 41-60 years old. The own-price elasticity of fish meat for low-income 232 households is higher than for high-income groups. In the low-income group, younger consumers 233 have the highest absolute price elasticity and the consumers in the 26-40 age group have the lowest 234 absolute price elasticity. 235



Fig. 3. The absolute value of own-price elasticity.

The expenditure elasticity of red meat varies between 1.906-1.489 percent for low-income consumer groups (fig. 4). The highest and lowest expenditure elasticity in this group is related to people under 25 years old and 26-40 years old, respectively. The sensitivity of red meat demand to income changes for low-income households is higher than in other groups. By moving towards higher income groups, the amount of expenditure elasticity decreases. Also, for all income-age groups of people, the expenditure elasticity of red meat is higher than one, which shows that red meat is considered a luxury good.

243



Fig. 4. Expenditure elasticity of red meat for different income-age groups.

The expenditure elasticity of poultry meat for different income-age groups is positive and smaller 244 245 than one. Therefore, this type of meat is considered an essential good. For younger people, the expenditure elasticity of poultry meat varies between 0.214-0.720 percent. In general, with the 246 increase in income, the sensitivity of poultry meat demand to changes in income decreases. In the 247 high-income group, the expenditure elasticity of people over 61 years old is equal to 0.077% and 248 for people under 25 years old, it is equal to 0.214%. Meanwhile, in the low-income group, the 249 expenditure elasticity of people over 61 and under 25 years old is equal to 0.728% and 0.716%, 250 respectively. 251

252



Fig. 5. Expenditure elasticity of poultry for different income-age groups.

Based on the expenditure elasticity of fish meat, this type of meat is considered a luxury good. In the low-income group of consumers, the highest and lowest expenditure elasticity has been obtained for people over 60, and 41-60 years old. With the increase in income, the expenditure elasticity of fish meat for people over 60 years old decreases to 1.106 percent. For younger consumers, the expenditure elasticity of fish meat varies between 1.18% (low-income group) and 1.098% (high-income group).

259



Fig. 5. Expenditure elasticity of fish for different income-age groups.

260 C. Welfare effect of multiple price shock

The welfare effects of meat price increase as a result of the price liberalization policy are reported 261 262 in Table 3. For different age groups, along with the increase in consumer income, meat expenditure changes increase due to the price shock. The CV index for young people in different 263 income groups varies between 30.58-69.80 percent. In more detail, for the consumer under 25 264 years old, the CV index in the low-income group is equal to 69.80% per person, and this index 265 decreases to 30.58% for high-income consumers. With the increase in the age of consumers to 26-266 40, the CV index decreased for most income groups. The change in consumer meat expenditure 267 due to the price shock varies between 29.27-70.76 percent in this age group of consumers. So that 268 for high and relatively high-income groups, the CV index is equal to 29.27 and 38.26%, 269 270 respectively. For the 41-60 years age group, as a result of the simultaneous meat price increase, 62.18%, 50.59%, 38.04%, and 29.25% will be added to the initial consumer meat expenditure. 271 Finally, for old consumers, the CV index in different income groups varies in the range of 32.06-272

70.39 percent. The biggest change in expenditure happens to consumers with low income. On
average, younger Iranian urban consumers need to be compensated with approximately 58.54%
of initial meat expenditure to accommodate the adverse impact of food price changes they faced
due to price liberalization. This index, on average, is equivalent to 52.02% for older consumers.

Age profile	Welfare index	Low Income	Middle Income	Relatively high income	High Income
	Initial meat				
25 years≥Age 	expenditure	3.37	8.28	19.41	38.28
	(USD)				
	CV (%)	69.80	78.24	55.06	30.58
	Initial meat				
26≤Age≤40 	expenditure	3.71	8.57	18.13	35.16
	(USD)				
	CV (%)	70.76	56.64	38.26	29.27
41≤Age≤60	Initial meat				
	expenditure	3.85	8.53	15.03	38.13
	(USD)				
	CV (%)	62.18	50.59	38.04	29.25
61 years≤Age	Initial meat				
	expenditure	3.95	8.58	15.29	46.04
	(USD)				
	CV (%)	70.39	61.20	44.44	32.06

Table 3. Per-capita Welfare Effect of Multiple Meat Price Shocks.

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279 Discussion and Conclusion

280 In this paper, we have investigated the welfare effect of multiple price shocks, as a result of agricultural market liberalization, for urban households in Iran. An initial objective of the study 281 282 was to identify the price and expenditure elasticity of meat in different income and age groups of consumers. Therefore, both the price and expenditure elasticities of meat are evaluated for 283 consumers grouped into four income groups as well as four age groups. Analysis of the data 284 obtained from the Iranian Statistics Center (2021) showed that the poultry expenditure's share for 285 most income groups is higher than the share of red meat and fish. This result may therefore point 286 to the effect discussed by Cotterill and Samson (2002) and Rossen et al. (2022) that low-income 287 households may be already buying type of meat with lower price. In the lower income groups, as 288 consumer age, the poultry expenditure's share decreases, and the red meat expenditure's share 289 increases. For consumers in the third quartile, by increasing in age the consumer's tendency to 290 291 consume red meat increases. The current study found that the sensitivity of high-income 292 households' poultry meat demand is higher than lower-income households. This finding was also 293 reported by Rossen et al. (2022). On the contrary, for red and fish, low-income households react 294 more elastically to price changes compared to high-income households. This finding is consistent with that Ni Mhurchu et al. (2013) for New Zealand, who reports higher own-price elasticities in 295

low-income groups. Another important finding was that the difference in price elasticities between 296 297 different age groups of consumers is noticeable. For instance, by moving toward low-income groups, the difference in price elasticities of poultry meat increases in different age groups. As 298 well as, the sensitivity of red meat demand to price changes in the age group between 26 to 40 299 and 41 to 60 years is more than in the other age groups. It is interesting to note that in all absolute 300 own-price fish elasticities for the different age and income groups are more than one. For high-301 income consumers, the absolute value of the fish's own-price elasticities is reduced. Considering 302 the importance of fish meat consumption for age groups over 60 years old, it can be expected that 303 a price shock in the meat market can have a significant impact on the demand for fish meat and 304 people's health. Another important finding was that the expenditure elasticity of red and fish meat 305 for urban households in Iran is greater than one. This implies a fairly large response of demand 306 for these food groups to changes in total food expenditure. Therefore, these types of meat are 307 considered luxury goods. These results agree with those obtained by Layani et al. (2020) for Iran 308 and Syrovátka (2007) for Czech. We also obtain higher red meat expenditure elasticities for 309 younger households compared to older households. The estimated expenditure elasticity of 310 poultry is less than unity, so this good is fairly inelastic concerning total food expenditure. For 311 312 most income groups, the results of this study show that poultry expenditure elasticity is higher for older consumers compared to younger consumers, although this difference is not very evident. 313 Akin et al. (2019) also concluded a statistically significant relationship exists between gender, 314 315 income level, monthly food budget, and the amount of monthly budget allocated to meat.

316 It is interesting to note that the difference in welfare effects of meat price shocks is noticeable among different income groups. The greatest CV is related to high-income groups and the lowest 317 is related to lower-income consumers. The low-income consumer already consuming lower meat. 318 So, the change in meat expenditure as a result of its price shock for these consumers is less than 319 320 for high-income consumers. But the change in expenditure due to the price shock for low-income consumers accounts for a larger share of these consumers' total meat expenditures. Therefore, 321 322 these consumers are more vulnerable than higher-income consumers. As well as the CV index increases as the age of consumers increases. This finding was also reported by Rossen et al. 323 324 (2022). Tekindal et al. (2020) showed that the quality of life has a significant relationship with the increase in the monthly income of students. Increased income was associated with improved 325 scores on physical role limitation, emotional role limitation, energy/spirit/vigor, mental health, 326

bodily pain, and general health perception. This statistically significant improvement must bearising out of the rising level of welfare.

The results of CV suggest that Iranian urban consumers need to be compensated with 329 approximately 29%-78% to accommodate the adverse impact of meat price changes they faced as 330 a result of price liberalization. The lowest value of the CV index is related to the high-income 331 consumers between 41-60 years old and the highest CV index is for middle-income consumers 332 under 25 years old. Generally, meat price shocks have had differential effects on consumers of 333 different ages and incomes. The results of this study can be effective for planning to support 334 vulnerable households in society. One of the most important consumer protection policies in Iran 335 in the last 40 years has been the payment of subsidies for goods and services. This policy was 336 implemented with the aim of controlling and stabilizing prices, supporting vulnerable groups, 337 reducing poverty, and distributing income fairly. But in recent years, there have been many 338 criticisms of this policy and its implementation. So that despite the implementation of this policy 339 since 1970, the poverty rate in Iran is still high and this policy has not been able to have the 340 necessary effectiveness in reducing poverty and food security. As such, this instrument is seen as 341 inefficient given its high budget costs, as a potential source of market distortions, and as 342 benefitting some groups who do not need to be supported (e.g. target groups are not identified and 343 households receive the same subsidy) (Azzam and Rettab, 2012; Bakhshoodeh, 2010; Tefra, 344 2012). The subsidy payments of 1.56 USD per month for each person have been constant without 345 346 considering inflation over the last two decades. These untargeted subsidy payments to the 347 households, regardless of considering their vulnerability and their income level, in addition to being costly for the government, do not improve welfare indicators at the national level. 348 349 Identification of vulnerable households and determining the amount of subsidy paid to the target groups is one of the most important challenges that policymakers in Iran are facing. In this regard, 350 351 after the implementation of the price liberalization policy, the government pays \$13.92 per person 352 for the first three income deciles and \$10.44 per person for the next six deciles and removes the 353 tenth income decile from receiving direct subsidies. This direct payment to consumers is the same for different people with different social characteristics. The results of the present study showed 354 355 that the level of vulnerability of consumers in different social-economic groups is different from 356 each other. Therefore, to accurately target the subsidies, the government can pay a certain amount of subsidy to each person according to the economic and social characteristics to prevent the 357 358 wastage of resources and reach the desired goal. In the same way, to achieve goals such as food

security and reducing welfare losses caused by price shocks, it is necessary to implement policies 359 such as increasing wages and paying subsidies to vulnerable households. Of course, it is necessary 360 to consider the inflationary effects of the implementation of these policies. Finally, to reduce the 361 vulnerability of low-income households, it is necessary to identify the factors affecting the price 362 of meat, so that food price shocks can be avoided through appropriate policies. Controlling 363 exchange rate fluctuations and thus the price of imported inputs (Mat et al., 2020; Arican et al., 364 2022) can play an effective role in controlling meat price shocks in the agricultural market. 365 Domestic market prices of feed raw materials interact with the global market at the dollar 366 exchange rate. Knowing the direction of the relationship between the price of the product and the 367 price of input in animal husbandry would lead to adopting effective courses of action and forming 368 efficacious policies to support the industry beginning from the sub-industries. 369

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