



Article Assessing the Net Import Welfare Impacts of the Rising Global Price of Food in Italy

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Abstract: In Italy, as one of the developed countries, the agricultural sector is key in supplying food, food security and food safety. In this study, the amount and value of net imports for various foodstuffs in Italy was used. At first, compensatory price elasticities were calculated by using the Almost Ideal Demand System (AIDS) and the effect of increasing the global price of food on net import welfare was studied. The results show that the welfare index of compensatory changes calculated for the entire food groups is 126.46 billion USD. Meat and beverage groups have the most and the least compensatory changes, respectively.

Keywords: net import; welfare; Compensated Variation (CV); Almost Ideal Demand System (AIDS); Italy

1. Introduction

Food security is a broad concept that is determined by the interaction of a set of biological, economic, social, agricultural and physical factors. This complexity can be summed up by focusing on three components of food security: food availability, food access and food use [1]. In developed countries, the agricultural sector's main function is to supply food, food security and food safety with the achievement of sustainable growth and development goals [2]. Although high-income countries have for long considered their population sheltered from food insecurity, the recent economic and financial crisis challenged such assumptions and food access has become an increasingly relevant policy issue across European wealthy states. Over the last decade, food security has also become a salient policy issue in high-income countries where an increasing number of people have problems in accessing safe and nutritious food [3]. For example, reports of food insecurity in high-income countries include the following: 29% amongst low-income households in the United Kingdom (UK) [4], 20% of households with children in New Zealand [5,6], 15% in Canada, 11% in the United States [7] and 5% in Australia. Within countries, there are often marked inequalities in the prevalence of food insecurity among ethnic and socioeconomic groups. For example, in New Zealand, half of the peoples of Pacific Islands ethnicity (who collectively comprise around 7% of the total population) and one-third of the Māori population (indigenous New Zealanders who comprise 15% of the total population) report a lack of food security, compared to 14% of the general population [8].

Generally, in the long run the demand for food is estimated to increase because of a growing population and income, shifting diets from grains to meats and diverting grains from food to biofuels production. Considering the latter, food supply decreased as a result of declining agricultural productivity, increasing water scarcity and diversion of land from food to biofuels production [3–9]. As well, surely, the price of food will increase in future. Therefore, it is important to understand how changes in price may affect demand and welfare. In this regards, food safety and food security are the main goals to consider in domestic and foreign policy decisions in different European states [9,10].

During the last two decades, many studies have been done on imports and exports through using economy-wide models, especially Computable General Equilibrium (CGE) models. These studies have focused on liberalization [11].

Import and export are determined by a set of relative prices and the degree of substitutability in the empirical models that trade liberalization may lead to an increase in imports and also exports of agricultural products [11–13].

Welfare has also been analyzed in the trade liberalization context. The positive impact of trade liberalization on welfare has been identified in developed countries [14–16]. As one of the sources, welfare gains might be caused by a decrease in import prices due to the removal of trade barriers or increase by exporting. Furthermore, welfare is expected to increase and import prices are expected to decrease when production occurs in a more efficient way or when it is produced by more productive firms. Possible welfare gains are available as far as import prices are low or export value is high; however, the expected condition turns out to be different as the recent trend for an increase in food prices is expected to food price shocks. These shocks include changing in relative price, substitution of commodities, income, as well as reaction and response of consumers to all these factors [17].

Many studies worked on relative prices and substitution relation among commodities by estimating elasticities of demand functions based on the Translog cost function, Almost Ideal Demand System (AIDS) or Quadratic (QAIDS) forms [18–29].

There are only a few empirical studies in which the AIDS model has been used to provide a model for net import demand. The current study uses an AIDS model to analyze the net import demand for foodstuffs. According to the variation of food in Italy, food security in Italy has always been concerned for policymakers. Specially, measuring changes in welfare due to increases in global food prices to provide a compensation support system is an essential issue. During the last decades, a significant portion of some foodstuffs has been provided via imports into Italy. Although domestic agricultural output was high (especially for fruits and vegetables), considering the population growth and number of immigrants over last years, food imports increased [30]. In other words, in Italy, except for the fruit and vegetable groups where their net import is negative, other groups' net imports are positive. It means that the quantity of import is more than the quantity of export in other groups of food, such as cereals, meat, beverage, dairy, olive oil and sugar.

Considering the values, Italian net import quantities during 1995–2016 has shown that the average annual net imports of the six main groups of food (including cereal, meat, beverages, dairy, olive oil and sugar) were more than 13.05 million tons [30]. Italy's net import value for these groups of food also grew by 2.23% annually during 1995-2016, increasing from 8 to over 11 billion USD [30].

Italy from the 1970s has significantly increased the volume of food imports, and after the implementation of the AGENDA 2000 of CAP, with the constant market liberalization, and considering the feature of Italian economic crisis, the increasing prices of imported foods can affect the social welfare of Italian consumers since a significant amount of their everyday food is imported [31,32].

Given the above-mentioned conditions, the present study aims to contribute to the empirical literature of net import demands by using an AIDS model and to explore the welfare net impacts of an increase in global food prices through Compensated Variation (CV).

Within this context, the objectives of this paper are (1) determining the price and income elasticities for food groups by using the Almost Ideal Demand System (AIDS); (2) exploring the welfare impacts of increasing global food prices by using Compensated Variation (CV); and (3) calculating the lost welfare due to food price shocks.

The rest of the paper is structured as follows. The next section provides the methodology of the Compensated Variation (CV), AIDS model and lost welfare index and data. The results are reported and discussed in Results section. The final section offers concluding remarks and policy discussions.

2. Methodology

2.1. Welfare Index with Multiple Price Changes

In general, in the welfare literature, there are various indexes for measuring the welfare changes due to implementation of different policies [33]. By changing economic conditions, such as price changes, utility rates may increase or decrease. To determine how and how much of the utility changes due to changing economic conditions, criteria such as Compensated Variation (CV) is used [9,25,34].

The starting point of the CV model with multiple price changes is minimizing expenditures on N food commodities subject to a specific utility level U^0 . By substituting optimal Hicksian quantities into the expenditure function would be [9]:

$$E = E(P_1, P_2, \dots, P_3, U^0) = p_1 q_1^H(P_1, P_2, \dots, P_3, U^0) + p_2 q_2^H(P_1, P_2, \dots, P_3, U^0) + \dots + p_N q_N^H(P_1, P_2, \dots, P_3, U^0).$$
(1)

Pi for i = 1, 2, ..., N are respected to N commodities prices, and the superscript H stands for Hicksian. Denoting the initial and the subsequent periods by superscripts "0" and "1", respectively. CV has been defined as the maximum Willingness to Pay (WTP) for an increase in consumption, without becoming worse off compared to the initial level of utility.

$$CV = E(p_1^1, p_2^1, \dots, p_N^1, U^0) - E(p_1^0, p_2^0, \dots, p_N^0, U^0).$$
(2)

Using (1), we can expand (2) as follows:

$$CV = p_1^1 q_1^H (p_1^1, p_2^1, \dots, p_N^1, U^0) - p_1^0 q_1^0 + p_2^1 q_2^H (p_1^1, p_2^1, \dots, p_N^1, U^0) - p_2^0 q_2^0 + \dots + p_N^1 q_N^H (p_1^1, p_2^1, \dots, p_N^1, U^0) - p_N^0 q_N^0$$
(3)

Direct measurement of CV using (3) is not possible because the Hicksian demand functions $q_i^H(...)$ for i = 1, 2, ..., N depend on the utility level U^0 , which is unobservable. The respective changes in prices and Hicksian quantities are defined as

$$dp_{i} = p_{i}^{1} - p_{i}^{0} \text{ for } i = 1, 2, \dots, N.$$
(4)

And substituted in to (3), CV can be approximated by

$$dq_i^H = q_i^H - q_i^0 \text{ for } i = 1, 2, \dots, N.$$
(5)

The percentage change in Hicksian quantities is not observed. However, an approximation of the change is obtained though the total differential of the Hicksian demand functions $q_i^H(.)$ For i = 1, 2, ..., N. As an example:

$$\frac{dq_{1}^{H}}{q_{1}^{0}} = \epsilon_{11}^{H} \frac{dp_{1}}{p_{1}} + \epsilon_{12}^{H} \frac{dp_{2}}{p_{2}} + \ldots + \epsilon_{1N}^{H} \frac{dp_{N}}{p_{N}},$$

$$\frac{dq_{2}^{H}}{q_{2}^{0}} = \epsilon_{21}^{H} \frac{dp_{1}}{p_{1}} + \epsilon_{22}^{H} \frac{dp_{2}}{p_{2}} + \ldots + \epsilon_{2N}^{H} \frac{dp_{N}}{p_{N}},$$

$$\frac{dq_{N}^{H}}{dp_{N}^{0}} = \epsilon_{N1}^{H} \frac{dp_{1}}{p_{1}} + \epsilon_{N2}^{H} \frac{dp_{2}}{p_{2}} + \ldots + \epsilon_{NN}^{H} \frac{dp_{N}}{p_{N}},$$
(6)

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

2.2. Almost Ideal Demand System (AIDS)

To estimate the Hicksian price elasticities as shown in (6), an Almost Ideal Demand System (AIDS) model was estimated for N commodities by imposing the usual restrictions: adding-up, homogeneity and symmetry. The AIDS model function is [35,36].

$$S_{i} = \alpha_{i} + \sum_{j=1}^{N} \gamma_{ij} log p_{j} + \beta_{i} log \left[\frac{M}{f(p)}\right],$$
(7)

where S_i is the Share of *i* food group in total expenditure on the N food groups, p_j is a vector of prices and M is total expenditure. In addition, f (p) is the Paasche price index defined by

$$logf(p)^* = \sum_{i} s_i logp_i.$$
(8)

The restrictions are

$$\sum_{i=1}^{n} \alpha_{i} = 1, \sum_{i=1}^{n} \gamma_{ij} = 0, \sum_{i=1}^{n} \beta_{i} = 0 \quad , \ \gamma_{ij} = \gamma_{ji} \quad i, j = 1, 2, \dots, N.$$
(9)

The respective formulas for computing the Hicksian price elasticities for N groups are

$$e_{ij}^{h} = -\delta_{ij} + \left(\frac{\gamma_{ij}}{s_i}\right) s_j,\tag{10}$$

where δ_{ij} is the Kronecker delta taking the value $\delta_{ij} = 1$ if i = j and $\delta_{ij} = 0$ if $i \neq j$. In terms of the u_i , the formula for income elasticities can be written as

$$e_i = 1 + \frac{\alpha_i}{s_i}.\tag{11}$$

Negative cross-price elasticities indicate a complementary relationship and the positive values for cross-price elasticities indicate substitution. The positive (negative) values for income elasticity also indicate non-inferior (inferior).

The system of Equation (7) is estimated by using the Seemingly Unrelated Regression (SUR) to calculate elasticities for six groups of food (cereals, meats, dairy, beverages, dairy, olive oil and sugar).

3. Data and Information

This study is based on the amount and value of net imports for various foodstuffs in six main groups, including cereal, meat, beverages, dairy, olive oil and sugar in Italy. These groups have the most share of foodstuff in consumer baskets. This information was obtained from the Food and Agriculture Organization (FAO) in series from 1995 to 2016 for computing price changes and income elasticities. For this aim, the average annual growth of the net imported food prices was defined as a price shock scenario.

The average annual net import expenditure, average net import expenditure share and standard deviations of six groups of foods including cereal, beverages, dairy, olive oil, meat and sugar are represented in Table 1. Among six food groups, the maximum and the minimum average expenditure share is related to meats 30.71% (3166.85 billion USD) and olive oil 5.00% (515.47 billion USD) respectively.

	Coefficient of Variation	Standard Deviation	Average Net Import Expenditure Share (%)	Average Annual Net Import Expenditure (Billion USD)
Cereals	1968.45	19.09	864.98	0.44
Beverages	1150.15	11.15	332.92	0.29
Dairy	2894.41	28.07	617.95	0.21
Olive Oil	515.47	5.00	171.93	0.33
Meats	3166.85	30.71	805.80	0.25
Sugar	617.24	5.99	439.86	0.71
Total	10,312.56	100.00	2965.40	0.29

Table 1. Expenditure of different food groups (1995–2016).

Source: Food and Agriculture Organization (FAO).

4. Results and Discussion

The estimated results by using Eviews 9 Software, regarding demand system coefficients have been presented in Table 2.

It is difficult to interpret the demand system parameters directly. The five systems of equations were estimated based on Equation (7) using the Seemingly Unrelated Regression (SUR) estimation method. To meet the theoretical conditions, restrictions of homogeneity and symmetry as well as the additional restriction for Slutsky symmetry were imposed on the systems while one of the expenditure shares was excluded in each system. The results have been presented in the following sections.

	α_i	γ_{1j}	γ_{2j}	γ_{3j}	γ_{4j}	γ_{5j}	γ_{6j}	β_i
Cereals	-1.22 (0.45)	0.14 (0.03)	-0.03 (0.01)	-0.03 (0.03)	-0.01 (0.02)	-0.10 (0.03)	-0.00 (-0.13)	0.15 (0.04)
Beverages	0.72 (0.11)		0.08 (0.01)	-0.02 (0.01)	0.00 (0.00)	-0.04 (0.01)	0.01 (0.01)	-0.06 (0.01)
Dairy	3.05 (0.44)			0.06 (0.05)	-0.03 (0.02)	-0.01 (0.04)	0.02 (-0.15)	0.23 (0.03)
Olive Oil	-0.08 (0.39)				0.02 (0.02)	-0.02 (0.02)	0.01 (0.01)	0.01 (0.03)
Meats	0.58 (0.47)					0.18 (0.06)	-0.02 (0.01)	-0.05 (0.04)
Sugar	-2.05 (-0.85)						-0.03 (0.25)	0.20 (-0.40)

Table 2. Estimated parameters of the Almost Ideal Demand System (AIDS) model for individual groups.

* The numbers in parenthesis are standard deviation; Source: Authors' calculations by using Eviews 9.

According to the price elasticities of the AIDS model, all own-price elasticities are negative. In terms of absolute values, the highest own-price elasticity is related to olive oil (0.95%) and the lowest own-price elasticity is related to cereals (0.05%). It means that demand for olive oil is highly responsive to any change in the price. This could be important for Italy since it is the country producing the most olive oil. In this regard, any changes in global price affect the domestic price and subsequently on domestic demand for olive oil. The estimated own price elasticities of beverages (-0.14%) and meat (-0.11%) are approximately close to each other and less than one. In fact, demand for these two groups has little response to changes in their relative prices.

Cross-price elasticities shown competitive or complementary relations among products. Positive cross-price elasticities indicate competitive relations, while negative cross-price elasticities indicate

complementary relations. The cross-price elasticities shown in Table 3 show that most of the selected goods have substitution relationships with each other. It means that for the olive oil group, if the global price of dairy and meat increased in one percentage, it caused to increase the demand 0.29% and 0.31%, respectively.

The estimated total income elasticities in Table 3 have the expected positive signs in all six commodities. For sugar (e = 4.83%) and cereals (e = 1.80%) they are much greater than others. This implies a large response of demand for these food groups to changes in total net import expenditure. The demand for olive oil is elastic with respect to total net import expenditure. The estimated income elasticities of meats, beverages and dairy are less than unity, so these goods are inelastic with respect to total net import expenditure.

	Cereals	Beverages	Dairy	Olive Oil	Meats	Sugar
Cereals	-0.05	-0.02	0.29	0.05	-0.22	-0.08
Beverages	-0.04	-0.14	0.09	0.05	-0.07	0.12
Dairy	0.18	0.03	-0.71	0.05	0.31	0.13
Olive Oil	0.18	0.11	0.29	-0.95	0.31	0.25
Meats	-0.13	-0.03	0.29	0.05	-0.11	0.001
Sugar	-0.28	0.26	0.71	0.08	-0.01	-0.94
Income Elasticities	1.80	0.49	0.19	1.26	0.84	4.83

Table 3. Price and income elasticities of different food groups (1995–2016).

Source: Authors' calculations.

After obtaining compensated own and cross price elasticities, in this section we examine the welfare impacts of changing in selected food items price. Following some recent literature, we estimate the change in welfare by using Compensating Variation (CV). The compensating variation is the amount needed to compensate for increasing prices in order to remain at the same utility level after a price change. We define price shock scenarios based on average annual changes in global food prices presented by the FAO (2016) for the period of 1995–2016.

Results of Compensating Variation (CV) show that welfare losses from the price increases in cereals, meats, dairy, beverages, fruits and vegetable, is about 126.46 billion USD (Table 4). In other words, Italian net import need to be compensated with approximately 1.17% of their 2016 total net import expenditures on food in order to accommodate the adverse net impact of food price changes they faced between 1995 and 2016. The highest amount of CV as result of the increase of prices is obtained for dairy. The amount of CV for olive oil is estimated at 43.96 billion USD, which is equivalent to 0.41% of the average net import expenditures in 2016. The CV index of cereals is also estimated at 35.79 billion USD, equivalent to 0.33% of the average net import expenditure in 2016. Thus, with an increase of 0.67% in the price of dairy (considering simultaneous prices change), net import expenditures increase and welfare decrease. The last column of Table 4 shows the weight of the calculated compensating variation index for each food group from the total welfare index. According to the results, the amount of CV of olive oil (34.77%), cereals (28.30%) and dairy (19.53%) constitutes the highest share of the total CV index.

	Average Annual Net Import (1000 Ton)	Price Change (%)	Quantity Change (%)	Compensated Variation (Billion USD)	Compensated Variation (%)	Proportion of CV (%)
Cereals	8113.51	1.80	-0.46	35.79	0.33	28.30
Beverages	408.82	1.20	-0.08	0.68	0.01	0.54
Dairy	2488.50	0.67	0.56	24.69	0.23	19.53
Olive Oil	186.02	3.03	1.19	43.96	0.41	34.77
Meats	1001.11	0.10	-0.19	17.15	0.16	13.56
Sugar	848.72	0.75	-0.29	4.19	0.04	3.31
Total	13,046.68	-	-	126.46	1.17	100

Table 4. Welfare impacts of price changes (1995–2016).

Source: Authors' calculations.

Table 5 represents the welfare effects of rising global food prices in Italy. The highest and lowest amount of loss of welfare due to rises in global food prices are related to cereals (759.42 billion USD) and beverage groups, respectively (7.51 billion USD). It means that according to share of net import expenditure of cereals group (19.09%), after rising global food price, welfare would decrease and the net import expenditure to compare last year will increase. In the dairy group, to compensate for welfare that was lost and to be on the same level of previous utility after the increasing global food price, 460.42 billion USD should be added to total expenditure in this group.

Table 5. The net import welfare effects of rising global food prices for consumers in Italy (1995–2016).

	Cereals	Beverages	Dairy	Olive Oil	Meat	Sugar
Average annual net import expenditure (Billion USD)	1968.45	1150.15	2894.41	515.47	3166.85	617.24
Average net import expenditure share (%)	19.09	11.15	28.07	5.00	30.71	5.99
The weight of the welfare effect of each commodity group	0.28	0.01	0.20	0.35	0.14	0.03
lost welfare * (Billion USD)	759.42	7.51	460.42	209.97	387.48	30.00
Share of lost welfare ** (%)	40.94	0.40	24.82	11.32	20.89	1.62

* **lost welfare=** Weight of the welfare effect ×Average annual net import expenditure ** Total lost welfare is equal to 1854.80 Billion USD. (Source: Authors' calculations.).

5. Conclusions

In high-income countries, considerable resources are directed towards the problem of obesity and overnutrition while many people in these countries still do not have sufficient nutritious food to eat. People who are food insecure tend to have a less varied diet, a lower intake of fruit and vegetables, and a diet that is nutritionally inadequate, leading to micronutrient deficiencies and malnutrition.

Food security can be broadly defined as the availability of and assured access to sufficient food that is nutritionally adequate, culturally acceptable, safe, and which is obtained in socially acceptable ways [37]. This definition acknowledges the need to have the physical or financial means to obtain sufficient good-quality food to meet nutritional needs on a consistent and sustainable basis. While global changes can have an impact on the intensity of the food insecurity, consumer nutrition patterns are changed by increasing or decreasing the global price of the group of food. This may shift them to have limitation to access to sufficient food even they have enough income. It also recognizes that to be truly food secure, the food supply must consider the social and cultural dimensions of food production, collection, and consumption. It is difficult to obtain an accurate picture of its true extent because of variations in measurement methods within and among countries, high-income nations seem neglected. Thus, the need to address issues of food security in high-income countries seems pressing.

While the focus of the empirical works in Italy has been on the effects of removal of food subsidies, a narrow focus has been on the increasing prices of imported food products. Azzam and Rettab (2012) have indicated that the increasing prices of imported food can result in welfare losses. This study considering net import demand for the main imported food products by using the AIDS model and by considering the welfare impact of an increase in global prices of the six main food groups. For this aim,

Compensate Variation (CV) was used, based on changes in global food prices between 1995 and 2016. Substitution effects among food items were estimated by including own and cross price elasticities obtained through the estimation of an AIDS demand system. According to the demand theory, all the estimated price and expenditure elasticities are acceptable (negative for own elasticities and positive for expenditure elasticities). Increasing thee food price causes net import welfare loses and increasing net import expenditures. The result of CV also suggests consumer welfare of 126.46 Billion USD, approximately 17.16% of the total import expenditure of the six food groups in 2016.

Although the food price changes have had differential effects for each food groups, to reach food security and food safety goals, the Italian government should compensate for lost welfare by implementing different trade supportive policies.

Linkages between trade and food security and nutrition direct effects through three key factors: total food supply, which affects how much and what kind of food is available and how it is distributed across space and time; household income, which affects the access to and utilization of food and therefore the composition of diets; and government revenues and services, which affects all four dimensions of food security. The impact of trade on nutrition will depend on whether diverse, safe and nutrient rich foods that cover people's nutrient needs and promote healthy dietary practices are readily available and accessible for all. As countries become more open to international trade in agricultural products, they import greater volumes of food which could be more diverse than what is produced domestically. Additionally, by diversifying the sources of food, trade can help to ensure that nutritious and safe food is available throughout the year. In the long run, a greater openness to trade can promote greater competition between domestic and international producers, and among domestic producers. This can lead to a greater specialization in production, improved productivity and a boost in production. On the other hand, in the short run, for net exporting countries in particular, greater openness to trade may facilitate access to more lucrative export markets for domestically produced foods, decreasing their availability in local markets. Furthermore, greater openness to trade may lead to lower domestic food production through greater competition from sudden increases in volumes of imports (all these factors could be the topic for future research).

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