IRANIAN ECONOMIC REVIEW
Print ISSN: 1026-6542
Online ISSN: 2588-6096
https://ier.ut.ac.ir/
University of Tehran

Measuring Price and Income Elasticity of Demand Function of the Iranian Imports

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Article Info

Article Type: Research Article

Article history:
Received: 06 January 2021
Received in revised form: 21 April 2021
Accepted: 05 May 2021
Published online: 09 May 2023

Keywords:
Almost Ideal Demand System, Elasticity of Demand, Import Allocation Pattern, Seemingly Unrelated Regression.

JEL Classification:
D04, E64, H60.

ABSTRACT

Investigating the import demand function has particular importance in identifying the macroeconomic models and effectiveness and commercial efficiencies of the Iranian economy. For this reason, one of the major issues that can be addressed in the field of importing goods is the estimation of import demand function and investigation of impacting factors on imports. Therefore, in this paper, by using seasonal data for the period 1992-2017 and applying the almost ideal demand system (AIDS), and using a seemingly unrelated regression (SUR) econometric technique, we have estimated import price and income elasticities for five commodity groups based on one-digit tariffs code for the Iranian economy. The empirical results indicated that the import allocation pattern is single-stage and depends on domestic sales. In addition, the own-price elasticities had a negative sign that supports import behavior. Cross-price elasticities also showed a poor complementarity between the other portable and metal commodities and, Social & personal services and Financial & Business Services, domestic sales with Agricultural, forestry & fishing products, other portable & metal commodities, and Financial & Business Services groups. The expenditure elasticities in five commodity groups were significant, except in the first group, which implied the effectiveness of demand for each commodity group relative to income.

Cite this article: Ranjbar, H., Mozafari Shamsi, H., Mohammadi, V., & Mirzaii, F. (2023). Measuring Price and Income Elasticity of Demand Function of the Iranian Imports. *Iranian Economic Review, 27*(1), 159-180. DOI: https://doi.org/10.22059/ier.2021.81923

Publisher: University of Tehran Press.
DOI: https://doi.org/10.22059/ier.2021.81923

1. Introduction

To adopt an economic development strategy, especially an industrial one, it is necessary to pay more attention to and focus on the foreign trade sector and trade policies. It is in light of the identification of the texture and structure of foreign trade of the country that industrial and economic development strategy can be evaluated and analyzed. Today, the foreign trade section is considered one of the most important economic sections in most developing countries. Recent experience has shown that only countries can take the initiative in this section that have planned and organized certain programs according to their long-term economic-social goals. Countries that have been able to implement the right policies in this area not only have all their facilities in service of development goals but also prevented crises such as the crisis in a balance of payments. To adopt appropriate policies in the foreign trade sector, it is necessary to recognize more precisely exports and imports and their impacting factors.

In analyzing macroeconomic issues and economic policy-making, the examination of the import demand function is of particular importance. Because imports, on the one hand, as one of the factors influencing GDP, and on the other hand, it is very momentous as one of the most important items in a balance of payments for each country. Hence any change in the volume of imports in the country has an impact on domestic production and ultimately on the growth and development of the country (Dadgar and Nazari, 2010). Nowadays, every country needs to import, and nowadays no country can meet all its needs from domestic production. By the way, the largest exporters of goods are large importers. The objective sample of such a country is the United States, which, in addition to its high exports, is also the largest importer. Imports are also one of the categories whose importance and position have been expanding steadily, due to the emergence of the oil sector, in the foreign trade section of the Iranian economy. Iran has undergone many economic changes in recent decades. Iranian imports have gradually risen as a result of increased domestic demand, the transformation of economic structure, and inconsistency and disintegration between the economic sectors of production and consumption of the society; and have absorbed substantial foreign exchange revenues. Change in Iranian imports is significant in terms of weight and value, and in terms of diversity in imported goods (Farah Bakhsh and Mehrabian, 2001). Figure 1 represents the import value of the Iranian economy over the 1992-2017 period.

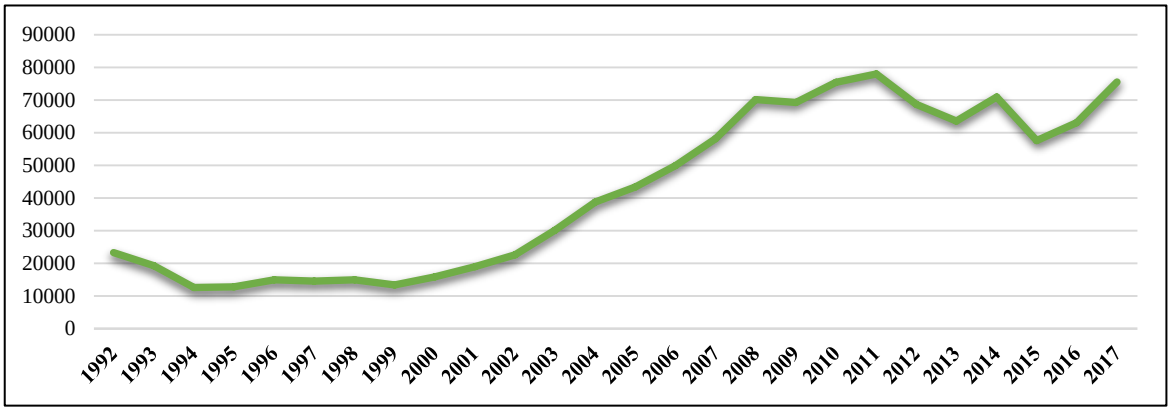

Figure 1. The Trend of Importing Different Commodities in Iran during 1992-2017 (million US$)
Source: Central Bank of Iran.

As can be seen, the value of Iranian imports has grown significantly, and usually, import growth has been more than its reduction. The basic step in identifying the structure of imports is to identify the determinant factors and to calculate the elasticities of effective variables on it. It is appropriate to carry out this investigation based on the import of goods or commodities sorted according to the commodity groups since the import structure is different for each one of the functions and as a result, the analysis of the imports demand function in general form is not of remarkable validity and application. Evaluating this function based on commodity group sorting could assist us in identifying the influential factors on it and the efficiency rate of each factor and adopting economic and commercial policies with more efficiency and effectiveness for each group of commodities. In this paper, each of the import demand functions has been estimated by considering the nine commodity groups (based on one-digit tariffs code) which have been combined into five groups in the present paper and it has focused on the income and price elasticities of all import functions. Therefore, this paper seeks to determine an appropriate form of Iran's import demand function using an almost ideal demand system (AIDS) and seemingly unrelated regression (SUR) method based on seasonal data over the 1992-2017 period to achieve the following objectives that could help the macro decisions about the Iranian economy in regard with international commercial exchanges: 1- Determining the allocation pattern of Iran's imports based on commodity groups (based on one-digit tariffs codes). 2- Determining the price elasticities of imports demand function based on commodity groups (based on one-digit tariff codes). 3- Determining expenditure (income) of imports demand function based on commodity groups (based on one-digit tariffs code). In the following, Section 2 presents the theoretical framework and empirical background of the research. Section 3 describes all data of the research. Section 4 specifies the research methodology and designed equations. Section 5 represents the technical discussions and analysis of empirical findings. Finally, section 6 expresses conclusions and policy recommendations.

2. Literature Review

Theoretical and also empirical studies of aggregate import function behavior generally show the flow of imports to be determined chiefly by aggregate economic activity and by import prices relative to prices of domestically produced substitutes. For many less developed countries, however, this relationship is questionable because of the effects of trade and exchange restrictions. For these countries, imports consist largely of producer goods-capital equipment, maintenance items, and imported components and there are no adequate domestic substitutes. If restrictions are used to limit imports, there will be a tendency for imports to determine output, rather than the reverse, particularly in the manufacturing sector (Hemphill, 1974). In addition, indices of import prices are typically based on foreign supplier prices, and therefore the price effects of trade and exchange restrictions imposed by the importing country are omitted. For many less developed countries, these effects are very important relative to changes in supplier costs, so the major part of the influence of relative prices on imports is overlooked (Hemphill, 1974).

Even if some part of the price effects of restrictions is measurable and is included in the relative price variable, there is a problem with estimation; to the extent that all changes in trade and exchange restrictions are positively correlated, which is likely, the omission of part of the price effects necessarily results in positive bias in the estimates of the price elasticity. In such cases, the extent to which foreign and domestic goods can be substituted is overrepresented (Hemphill, 1974). Before 1980, demand analysis was discussed mainly based on three models: "the linear Expenditure system, Translog Model, and Rotterdam Model. In 1980, to study the demand elasticity for commodity price changes and real income changes, the Almost Ideal Demand System (AIDS) was invented by Deaton and Muelbauer (1980) and was used to analyze consumer behavior in the UK. The study became the basis of all studies from the 1980s onwards and was used in a variety of fields including demand theories, international trade, and income distribution (Goodarzi et al., 2007).

2.1 Almost Ideal Demand System (AIDS) Model

In the general theory of demand, assuming a household (consumer) with rational behavior with a utility function and certain income for a given basket of goods, the function of the minimum required expenditure to reach a desired special level (the level of maximum desirability conditional on certain incomes) can be specified at predetermined prices. Therefore, considering additive preferences between consumption of minimum subsistence (a) and at a level above the minimum subsistence with bliss (b) (known as Price Independent Generalized Linear Logarithm[1]) for an assumed basket of commodity, it is possible to achieve price-independent generalized linear expenditure function for the amount of utility (U) and vector of price (P) as follows:

$$[\mathrm{C}(\mathrm{U}.\mathrm{P})]^{\mathrm{a}} = (1-\mathrm{U})[\mathrm{a}(\mathrm{P})]^{\mathrm{a}} + \mathrm{U}[\mathrm{b}(\mathrm{P})]^{\mathrm{a}} \quad (1)$$

1. PIGLOG

In this function, U is between 0 (minimum subsistence) and 1 (bliss limit), and (1-U) is the ratio of minimum subsistence consumption, and U is the ratio of bliss limit consumption. Also, a is a constant parameter, a(P) and b(P) are linear homogeneous functions and respectively represent an expenditure of minimum subsistence and bliss limit (Tayyebi and Ranjbar, 2005).

Now, when a gets near zero, the logarithm of the expenditure function known as the expenditure function of (PIGLOG) obtained as follows:

$$\mathrm{Log\ C(U.P)} = (1-\mathrm{U})\mathrm{Log[a(P)]} + \mathrm{ULog[b(P)]} \quad (2)$$

First of all, this kind of expenditure function due to linear positive homogeneity of functions a and b relative to prices will lead to extraction of homogeneous demand functions homogenous of degree zero relative to prices. Second, the share of expenditures is independent of prices. Third, because steady increasing transfer does not change the utility levels (attributed to different commodities of a utility function), therefore the logarithmic form of this function can be used to extract demand functions. For the function to have a functional, flexible form, sufficient parameters should be included in it so that its derivatives at each distinct point (that is, $\frac{\partial^2 C}{\partial U^2} \cdot \frac{\partial^2 C}{\partial U \partial P_i} \cdot \frac{\partial^2 C}{\partial P_i \partial P_j} \cdot \frac{\partial C}{\partial U} \cdot \frac{\partial C}{\partial P_i}$) can be equal to the same derivatives of any optional expenditure function (Tayyebi and Ranjbar, 2005).

So, to achieve an expenditure function with a flexible functional form that leads to the derivation of a system of demand equations with intended specifications, Log [b(p)], Log [a(p)][1]. Functions are defined as follows:

$$\mathrm{Log[a(p)]} = \mathrm{a_0} + \sum_k \mathrm{a_k log p_k} + \frac{1}{2}\sum_k \sum_j \gamma_{ij} \log \mathrm{p_k log p_j} \quad (3)$$

$$\mathrm{Log[b(p)]} = \mathrm{log[a(p)]} + \beta_0 \prod_k \mathrm{p_k^{\beta_k}} \quad (4)$$

As a result, the expenditure function of the almost ideal demand system is defined as follows:

$$\mathrm{Log\ C(U.P)} = \mathrm{a_0} + \sum_k \mathrm{a_k log p_k} + \frac{1}{2}\sum_k \sum_j \overset{\circ}{\gamma}_{kj} \log \mathrm{p_k log p_j} + \mathrm{U}\beta_0 \prod_k \mathrm{p_k^{\beta_k}} \quad (5)$$

Where $\overset{\circ}{\gamma}_{kj}$, β_k, β_0, a_k, a_0 are parameters and p_j and p_k are prices of commodity j and product k, respectively. This expenditure function has adequate parameters for adopting a flexible functional form and considering being ranking of the utility function, is normalized in a way that at each point of that $\frac{\partial \mathrm{log C}}{\partial \mathrm{U}^2} = 0$ is established. Meanwhile, the homogeneous linearity of C(U.P) relative to P (to meet predetermined preferences) is essential. This necessity will become conditional on the provision of $\sum_j \overset{\circ}{\gamma}_{kj} = \sum_k \overset{\circ}{\gamma}_{kj} = \sum_k \beta_k = 0. \sum_k \alpha_k = 1$. So, by applying Shephard's Lemma for expenditure function and considering $\gamma_{ij} = \frac{1}{2}\left(\overset{\circ}{\gamma}_{ij} + \overset{\circ}{\gamma}_{ji}\right)$, will become the budget share of i commodity (w_i) (Ranjbar et al., 2015).

1. This function, is called Trans log price index.

$$w_i = a_i + \sum_j \gamma_{ij} \log p_j + \beta_i U \beta_0 \prod_k p_k^{\beta_k} \quad (6)$$

But since for a household maximizing utility, the total expenditures x is the same as above mentioned $C(U.P)$, so from this equality, we can obtain the value of U in a function of p and x (indirect utility function).

$$U = \left[(\log x - \log p) \left| \left(\beta_0 \prod_k p_k^{\beta_k}\right)\right.\right] \quad (7)$$

Now, by replacing the value of U from (7) in equation (5):

$$i = 1. \ldots . n \quad \text{for} \quad w_i = a_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log\left(\frac{x}{p}\right) \quad (8)$$

Along with:

$$\text{Log}p = a_0 + \sum_k a_k \log p_k + \frac{1}{2}\sum_k \sum_j \gamma_{kj} \log p_k \log p_j \quad (9)$$

But such a definition of P creates the requirement to use a nonlinear estimation method. Bidders of the ideal demand system, Deaton and Muellbauer (1980) avoid this problem and proposed using the stone price index in the following format instead of Logp.

$$\text{Log}p^* = \sum_i w_i \log p_i \quad (10)$$

However, the proposed constraints on expenditure function logarithmic parameters along with mentioned constraints in Equation (6), imply the following constraints on parameters of Equation (8), that is, the almost ideal demand system (AIDS) (Ranjbar and Merikh, 2009).

$$\sum_{i=1}^n \alpha_i = 1. \quad \sum_{i=1}^n \gamma_{ij} = 0. \quad \sum_{i=1}^n \beta_i = 0: \text{additive constraint} \quad (11)$$

$$\sum_{i=1} \gamma_{ij} = 0: \text{homogeneity constraint} \quad (12)$$

$$\gamma_{ij} = \gamma_{ij}: \text{Slutsky symmetry constraint} \quad (13)$$

The total of these constraints causes the AIDS equation represents demand systems that show the total sum of a budget share equal to 1 ($\sum_{i=1}^n w_i = 1$), homogeneous from zero degrees in terms of prices and expenditures, and has a symmetric Slutsky matrix.

Therefore, considering the equation of the ith commodity budget share introduced in Equation (6) at time t and replacing the value of Logp* from Equation (10) with Logp in Equation (6), uncompensated price elasticities (own and cross) and expenditure (income) elasticity of AIDS pattern are extractable as follows (Deaton and Muelbauer, 1980):

$$\varepsilon_{ij} = -1 + \frac{\gamma_{ij}}{\overline{w_i}} - \beta_i : \text{Own-price elasticity} \quad (14)$$

$$\varepsilon_{ij} = \frac{\gamma_{ij}}{\overline{w_i}} - \beta_i \left(\frac{\overline{w_j}}{\overline{w_i}}\right) : \text{Cross price elasticity} \quad (15)$$

$$\varepsilon_{ij} = 1 + \frac{\beta_i}{\overline{w_i}} : \text{Expenditure (income) elasticity} \quad (16)$$

The empirical literature related to the import demand function is widespread throughout the world. Nasrollahi (2005) reassessed the existence of a long-run relationship among the constituent variables of traditional Iran's import demand function by applying a new approach called the "Bounds Testing Approach" over the

1959-2000 period. The results of the study indicated that the value of demanded imports, relative import prices, and real domestic income of Iran throughout 1959-2000 are co-integrated. Also, the long-run estimated income and price elasticities whit the ARDL approach are 1.595 and -1.44 respectively. Tabibi and Ranjbar (2005) examined the Iranian import demand structure using the almost ideal demand system (AIDS) model over the 1978-2002 period. The results of testing constraints governing the model suggested budgeting of commodities demands is one-stage and homogeneity and symmetry constraints are rejected. Results also indicated that the structure of the Iranian long-term import demand does not suffer structural failure by any of the trade liberalization scenarios.

Ranjbar and Merikh (2009) examined Iran's import demand pattern for three capitals, intermediary, and consumption commodity by using the almost ideal demand system (AIDS) model. Accordingly, the hypotheses of dependence of import demand on domestic prices, correlativeness, homogeneity, and symmetry of this demand function have been investigated over the 1978-2004 period. The results indicated that the formation of Iran's import allocation pattern is based on one-stage budgeting that is dependent on domestic sales. Also, homogeneity and symmetry assumptions are rejected in the Iranian imports demand. Dadgar and Nazari (2010) investigate the demand function of imports in the Iranian economy by employing the ARDL model over the 1974-2007 period. In this study, the impact of GDP, both with and without petroleum has been analyzed. One result of the paper indicated that the relationship between GDP without petroleum and oil revenue on one hand and the Iranian import from the other side is positive. Nevertheless, the impact of relative prices on imports is negative.

Belicka (2013) estimated the import demand model for pharmaceutical products in Australia. The results of this study indicate that change in relative prices of pharmaceutical products causes relatively small changes in demand for pharmaceutical products, while influenced by real income changes in Australia, changes in demand for pharmaceutical products will be larger. Also, according to the results, the price elasticity of imports from the United States has minimal, and the price elasticity of imports from the United Kingdom has maximum amounts. In terms of income elasticity, imports from the United States have the smallest and from Germany are the largest. Kanjilal and Ghosh (2014) explored the co-integration relationship between demand for gold imports, gold prices, and gross domestic product for the Indian economy using the ARDL method during 1990-2013. Also, short-term and long-term elasticity of demand was estimated for gold imports about gold price and gross domestic product. Results of the study showed an average elasticity of gold prices in the long term as well as a relatively high elasticity of gold imports over income in the long run. This result suggests that gold is luxury goods.

Abedin Moghanaki and KhosraviNejad (2014) investigated the Iranian industrial import demand function by applying an almost ideal demand system (AIDS) during the 1996-2011 period. The results showed that the total price elasticity of industrial groups has expectable signs for all groups. Ranjbar et al. (2015) estimated the import demand

function of antibiotic drug groups from different suppliers' countries and the calculation of price and expenditure elasticities in the Iranian economy by using a seemingly unrelated regressions (SUR) model over the 1981-2013 period. The results of the paper represented that Iran demands imports of antibiotics from the United Kingdom, Italy, and Switzerland and has no affiliation with Germany in this regard. Athukorala and Khan (2016) using the ARDL method during the period 1990-2007 have investigated concepts of global production sharing in measuring the price elasticity in international trade using a series of unique data related to manufacturing imports. Strong evidence indicates that components that represent a larger share of manufacturing trade compared to final products are significantly less sensitive to changes in relative prices.

Crucini and Davis (2016) constructed a model where the discrepancy between the short- and long-run elasticities is due to frictions in distribution. Goods need to be combined with local non-traded input, and well-specific distribution capital. Home and foreign goods may be close substitutes, but if distribution capital is slow to adjust then agents cannot shift their consumption in the short run following a change in relative prices, and home and foreign goods appear as poor substitutes in the short run. In the long run, this distribution capital can be reallocated, and agents can shift their purchases following a change in relative prices. Panahi et al. (2016) have estimated the price, and income elasticity of drug imports demand in Iran by major import origin countries in Iran during the 1992-2014 period, using autoregressive distributed lag (ARDL) and source differenced quadratic almost ideal demand system (SDQUAIDS) methods. Results showed that price elasticity, either totally or in terms of exporting countries were less than 1 and is low elastic. Total income elasticity is also smaller than 1, indicating the necessity of a large segment of drug imports.

Sun and Niquidet (2017) investigated Import demand for wood pellets by the European Union (EU) using a source-differentiated non-linear Almost Ideal Demand System (AIDS) model with monthly data from 2009 to 2015. Expenditure elasticities revealed that wood pellets from the United States have the most to gain from an expansion in EU expenditures, followed by Canada, while Russia has the least to gain. Hummels and Lee (2018) constructed a synthetic panel of household expenditures from the Consumer Expenditure Survey (CEX) and used the Quadratic Almost Ideal Demand System to estimate expenditure shares and income elasticities of demand that vary by good-time income. They showed that the size and distribution of income shocks drive expenditure change in a manner that varies profoundly across traded goods. Also, it is explored that an application involving the Great Trade Collapse.

Raissi and Tulin (2018) estimated the short-term and long-run price and income elasticity of Indian exports and investigated the role of supply-side bottlenecks in shaping India’s export-demand relationship. They used disaggregated export volume data for 45 Indian industries over the period 1990–2013, as well as industry-specific international relative prices, for estimation. The findings indicated that Indian exports are sensitive to international relative-price competitiveness, world demand, and energy shortages. In addition, binding supply-side constraints (notably energy shortages) dampen price responsiveness in the short term. Çulha et al. (2019) studied the import

demand function for Turkey using the newly defined national income data and examines the evolution of the income and price elasticities over time. So, demand functions are estimated for the total imports and their subcomponents separately, and the corresponding time-varying elasticities are obtained by applying the method of the Kalman filter between 2003 and 2018. The results represented that the growth of total imports is mainly explained by income and relative price changes. The income and expenditure elasticities decreased over time in total imports and sub-components except for intermediate goods.

Alnafissa and Alderiny (2019) analyzed Saudi demand for natural honey imported from Yemen, Pakistan, Australia, Argentina, Mexico, and Germany, which contribute around 73.7% of the value of natural honey imports during the period of study (1991–2017). Marshallian elasticities estimation using the AIDS model showed all own-price elasticities were negative and significant except for own-price elasticity associated with demand for natural honey imported from Pakistan. According to these study results, it is important to encourage the domestic production of honey to meet the increase in the demand for natural honey. Other studies have expanded the empirical import function demand such as Hamori and Matsubayashi (2001), Tang (2003), Katsimi and Moutos (2011), Wang and Lee (2012), Mitra and Shin (2012), Fukumoto (2012), Soderbery (2015), Mukherjee et al. (2017), Giansoldati and Gregori (2017), Oladosu et al. (2018), and Fedoseeva and Zeidan (2018).

3. Data Description

To do this research, a seemingly unrelated regression econometric method for import demand functions has been used by considering five commodity groups merged by a one-digit tariff code for imports along with domestic sales. The commodities in each of these one-digit tariff codes are represented in Table 1, in order:

Table 1. One-digit Tariff Codes and Commodity Groups of the Iranian Imports

Codes	Commodity groups	Description
0	1	Agricultural, forestry, and fishing products
1		Ores and minerals, electricity, water, and gas
2		Food products, beverages, and tobacco; textiles, clothing, and leather products
3	2	Other portable commodities, except metal products, machinery, and equipment
4		metal products, machinery, and equipment
5	3	Structures and building services
6		Commercial Distribution Services; Catering Services; Food and Drink; Transportation Services; Electricity, Gas, and Water Distribution Services
7	4	Financial Services and Related affairs; Real Estate Services; Rental and Leasing Services
8		Business and Production Services
9	5	Social and personal services

Source: www.mimt.gov.ir

One-digit tariff codes contained in each of the five commodity groups are codes zero, one, and two of Group One, code three and four of Group Two, codes five and six of Group Three, codes seven and eight of Group Four, and codes nine of group Five; which were estimated using seasonal data over the 1992-2017 period. Income and price elasticities have been determined in each import function. Data on import share indices of commodity groups, domestic sales share, import price index, and total real expenditures have been extracted from the customs administration of Iran and statistical

yearbooks of the Central Bank of the Islamic Republic of Iran. All variables were calculated in terms of US$ values, and their values were realized and indexed based on the fourth chapter of the base year of 2017. Also, due to the lack of monthly and seasonal information on the volume and value of imports during 2005-2008, the Diz method has been used to make seasonal data based on annual data for these years.

4. Methodology

In empirical studies, demand equations are usually presented in two single and systemic ways. In classic methods, demand for commodities is estimated on the equation-by-equation basis and separately. In such a case, it is possible that the intended constraints cannot be applied and this diminishes the role of theory. But with the advancement of econometric techniques and access to computer facilities, simple equations are presented in more complex forms, and the estimation of commodities' demand will be considered separately and systemically. Our discussion also relates to the latter, namely systemic. This study aims to measure the price and income elasticity of Iranian import demand function in terms of commodity groups, according to the pattern derived from the article by Athukorala and Khan (2016). To meet the purpose of research, the following equations are considered:

$$w_1 = c_1 + c_{11}\log p_1 + c_{12}\log p_2 + c_{13}\log p_3 + c_{14}\log p_4 + c_{15}\log p_5 + c_{16}\log p_6 + c_{17}\log\left(\frac{X}{P^*}\right) \quad (17)$$

$$w_2 = c_2 + c_{21}\log p_1 + c_{22}\log p_2 + c_{23}\log p_3 + c_{24}\log p_4 + c_{25}\log p_5 + c_{26}\log p_6 + c_{27}\log\left(\frac{X}{P^*}\right) \quad (18)$$

$$w_3 = c_3 + c_{31}\log p_1 + c_{32}\log p_2 + c_{33}\log p_3 + c_{34}\log p_4 + c_{35}\log p_5 + c_{36}\log p_6 + c_{37}\log\left(\frac{X}{P^*}\right) \quad (19)$$

$$w_4 = c_4 + c_{41}\log p_1 + c_{42}\log p_2 + c_{43}\log p_3 + c_{44}\log p_4 + c_{45}\log p_5 + c_{46}\log p_6 + c_{47}\log\left(\frac{X}{P^*}\right) \quad (20)$$

$$w_5 = c_5 + c_{51}\log p_1 + c_{52}\log p_2 + c_{53}\log p_3 + c_{54}\log p_4 + c_{55}\log p_5 + c_{56}\log p_6 + c_{57}\log\left(\frac{X}{P^*}\right) \quad (21)$$

$$w_6 = c_6 + c_{61}\log p_1 + c_{62}\log p_2 + c_{63}\log p_3 + c_{64}\log p_4 + c_{65}\log p_5 + c_{66}\log p_6 + c_{67}\log\left(\frac{X}{P^*}\right) \quad (22)$$

w_1: imports share of first commodity group[1], w_2: imports share of second commodity group[2], w_3: imports share of third commodity group[3], w_4: imports share of fourth commodity group[4], w_5: imports share of the fifth commodity group[1], w_6: domestic

1. Corresponds to commodity group 0, 1 and, 2 according to the international axial classification of products of Iran (CPC-2)
2. Corresponds to commodity group 3 and 4 according to the international axial classification of products of Iran (CPC-2)
3. Corresponds to commodity group 5 and 6 according to the international axial classification of products of Iran (CPC-2)
4. Corresponds to commodity group 7 and 8 according to the international axial classification of products of Iran (CPC-2)

sales share (commodities produced and consumed inside the country). p_1: imports price index of first commodity group, p_2: imports price index of the second commodity group, p_3: imports price index of third commodity group, p_4: imports price index of the fourth commodity group, p_5: imports price index of the fifth commodity group, p_6: domestic price index. X: Consumption expenditures (total supply assumed equals total demand). P^*: Stone price index and $i.j = 1.2. \ldots .6$ represents commodity groups.

5. Model Estimation and Analysis of Findings

Before estimating the model, it is necessary to test the stationary of all variables used in estimation. In the case of time series data, to do a unit root (stationary) test, the augmented Dickey-Fuller test (ADF) is commonly used. In this test, the null hypothesis is based on the existence of a unit root. If the calculated test statistic is greater than the critical value associated with a confidence level of 95%, the nonstationary hypothesis will be rejected. The results of the unit root test of variables are illustrated in Table 2.

Table 2. The Results of Unit Root Test of the Estimated Variables[2]

Variable	Variable	Test statistics	Prob.	Result
Imports share of first commodity group	w_1	-3.70	0.027**	Stationary, I (0), First difference
Imports share of second commodity group	w_2	-9.14	0.000***	Stationary, I (0), First difference
Imports share of third commodity group	w_3	-2.21	0.026**	Stationary, I (0)
Imports share of fourth commodity group	w_4	-10.75	0.000***	Stationary, I (0), First difference
Imports share of the fifth commodity group	w_5	-3.94	0.014**	Stationary, I (0), with a trend
Domestic sales share	w_6	-1.70	0.083*	Stationary, I (0)
An Imports price index of the first commodity group	p_1	-6.91	0.000***	Stationary, I (0)
An Imports price index of the second commodity group	p_2	-7.34	0.000***	Stationary, I (0)
An Imports price index of the third commodity group	p_3	-7.24	0.000***	Stationary, I (0)
An Imports price index of the fourth commodity group	p_4	-3.11	0.002***	Stationary, I (0)
An Imports price index of the fifth commodity group	p_5	-2.30	0.021**	Stationary, I (0)
Domestic price index	p_6	-2.99	0.003***	Stationary, I (0)
Total real expenditure	X/P^*	-1.99	0.045**	Stationary, I (0)

Source: Research findings.

As seen, in all variables, the null hypothesis is rejected, so variables are stationary, but considering that variables are stationary at different levels, therefore, it is necessary to do an Engle-Granger co-integration test to examine the relationship between variables. In this method, firstly, the regression equation is determined based on economic theory and estimated it using the regression equation. Then, the unit-root or stationary test will be performed on residuals. If residual terms were stationary, co-integration or long-term equilibrium relationships between variables would be accepted. Table 3 illustrates the cointegration test of the estimated model.

1. Corresponds to commodity group 9 according to the international axial classification of products of Iran (CPC-2)
2. Respectively, one, two and three stars (*) indicate statistical significance at 10%, 5%, and 1% levels.

Table 3. The Results of the Engle-Granger Co-integration Test[1]

Equation	Test statistics	Prob.
w_1	-1.65	0.0915*
w_2	-2.05	0.0398**
w_3	-3.62	0.0006***
w_4	-1.89	0.0564*
w_5	-2.98	0.0036***

Source: Research findings.

Results of stationary examination of residual terms indicate that the null hypothesis based on the existence of unit root of residual terms at a 10% significance level for the first equation and a 5% significance level for the other four equations is rejected. In other words, residual terms derived from model estimation are stationary in level, I (0), and do not have a unit root, and it can be said that there is a long-term equilibrium relationship between the model variables. So, the estimated regression is not spurious.

5.1 Estimation of the Research Model and Analysis of Price and Income Elasticity of the Iranian Demand Function in Terms of Commodity Groups

Considering the pattern of Equations (17) to (22) and applying an additive pattern of Equation (11) on a parametric matrix for the imports allocation pattern of Iran, without taking account of domestic sales[2], we test the null hypothesis (H_0) against the opposite hypothesis (H_1) through the Wald test.

$$H_0 : c_{i6} = 0 \qquad (i = 1.2.3. \ldots .6) \qquad (23)$$
$$H_1 : c_{i6} \neq 0$$

Where c_{i6} is the parameter of the domestic prices variable ($\mathrm{Log}\, p_6$) of the model. The result of the independence of the imports allocation pattern of the Iranian economy through domestic prices, on coefficients of domestic prices variables using the Wald test, would reject the null hypothesis. Because if the calculated test statistics is greater than the critical value associated with a 95% confidence level (probability of test statistics were less than 5%), H_0 hypothesis will be rejected. Table 4 represents the results of the Wald test.

Table 4. The Results of the Wald Test

Test statistics	Prob.
225.73	0.000

Source: Research findings.

This reflects the fact that imports depend on domestic prices. So, to achieve the correct structure of the country's import, it should be used from the import pattern along with domestic sales. In other words, the demand allocation pattern is one-stage. That is, initial budget allocation for foreign commodities does not take place to separate domestic, and foreign commodities and market demand is examined holus-bolus. Therefore, demand estimation for imports and domestic sales should be performed simultaneously and in the form of a demand system. So, in this paper, import's almost ideal demand system is estimated in the form of a demand system, including the share

1. Respectively, one, two and three stars (*) indicate statistical significance at 10%, 5%, and 1% levels.
2. Import pattern only in such way that amount of expenditures in the model (X) will be the amount spent on imports.

of expenditures of five included commodity groups along with a share of domestic sales. This result is following the results of Tayyebi and Ranjbar's (2005), and Belicka's (2013) studies.

In this section, due to the sum of constraints ($\sum w_i = 1$), imports demand function system by commodity groups along with domestic sales presented in Equations (17) to (22), will be estimated using seemingly unrelated regression (SUR) estimation method. In this method, by Zellner (1962), due to the sum of constraints of the demand system, it is necessary to eliminate one of the share equations from the estimation process, and its coefficients must be calculated through additive constraints of Equation (11). For this purpose, in this study, the share equation of the sixth commodity group (domestic sales) is eliminated, and five import shares equations were estimated by the SUR method. In a seemingly unrelated regression estimator, the correlation between the error components of the regression equation is considered and the minimum variance condition is met to provide the efficiency of the estimates (Zellner, 1962). Results of estimating these equations based on this method for the first season of 1992 to the last season of 2017 are shown in Table 5.

Table 5. The Results of Estimation of the Research Models (SUR)[1]

Eqs.	Independent variables	Variable acronym	Coef.	Z-statistics	Prob. $(P > \|Z\|)$
First Equation (w_1)	Intercept	b_0	0.32	15.93	0.000***
	An Imports price index of the 1st commodity group	p_1	0.03	1.98	0.047**
	An Imports price index of the 2nd commodity group	p_2	0.01	0.63	0.531
	An Imports price index of the 3rd commodity group	p_3	0.05	1.43	0.152
	An Imports price index of the 4th commodity group	p_4	0.06	2.32	0.020**
	An Imports price index of the 5th commodity group	p_5	-0.01	-0.59	0.552
	Domestic price index	p_6	-0.08	-7.78	0.000***
	Real total expenditure	X/P^*	0.01	0.94	0.345
Second Equation (w_2)	Intercept	c_0	0.21	8.88	0.000***
	An Imports price index of the 1st commodity group	p_1	0.03	2.96	0.003***
	An Imports price index of the 2nd commodity group	p_2	-0.01	-7.77	0.441
	An Imports price index of the 3rd commodity group	p_3	0.02	0.84	0.401
	An Imports price index of the 4th commodity group	p_4	0.07	2.92	0.003***
	An Imports price index of the 5th commodity group	p_5	-0.02	-1.66	0.097*
	Domestic price index	p_6	-0.02	-2.18	0.044**
	Real total expenditure	X/P^*	0.11	10.34	0.000***
Third Equation (w_3)	Intercept	d_0	0.05	2.61	0.009***
	An Imports price index of the 1st commodity group	p_1	0.02	2.11	0.035**
	An Imports price index of the 2nd commodity group	p_2	-0.001	-0.09	0.925
	An Imports price index of the 3rd commodity group	p_3	-0.02	-0.79	0.428
	An Imports price index of the 4th commodity group	p_4	0.03	1.47	0.143

1. One, two and three stars (*) indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Eqs.	Independent variables	Variable acronym	Coef.	Z-statistics	Prob. $(P > \|Z\|)$
	An Imports price index of the 5th commodity group	p_5	-0.002	-0.20	0.840
	Domestic price index	p_6	0.004	0.42	0.672
	Real total expenditure	X/P^*	0.06	6.36	0.000***
Fourth Equation (w_4)	Intercept	e_0	0.57	16.22	0.000***
	An Imports price index of the 1st commodity group	p_1	0.05	2.19	0.028**
	An Imports price index of the 2nd commodity group	p_2	-0.01	-0.36	0.722
	An Imports price index of the 3rd commodity group	p_3	0.03	0.62	0.535
	An Imports price index of the 4th commodity group	p_4	0.12	2.99	0.003***
	An Imports price index of the 5th commodity group	p_5	-0.03	-1.48	0.138
	Domestic price index	p_6	-0.10	-6.45	0.000***
	Real total expenditure	X/P^*	0.13	7.21	0.000***
Fifth Equation (w_5)	An Imports price index of the 1st commodity group	p_1	0.006	1.18	0.239
	An Imports price index of the 2nd commodity group	p_2	0.003	0.49	0.626
	An Imports price index of the 3rd commodity group	p_3	0.008	0.61	0.543
	An Imports price index of the 4th commodity group	p_4	-0.05	-5.10	0.000***
	An Imports price index of the 5th commodity group	p_5	-0.01	-2.98	0.003***
	Domestic price index	p_6	0.01	3.52	0.000***
	Real total expenditure	X/P^*	0.01	2.33	0.020**

Source: Research findings.

Since the estimated coefficients of total expenditures for each of the five import commodity groups presented in Table 5 are smaller than 1; the hypothesis test of the coefficient is equal to 1 ($H_0 : c_{i7} = 1$) for each of these five commodity groups ($i = 1.2.3. \ldots .5$) is rejected. So, it can be said that none of these commodity groups do not include luxury goods. However, because of the significance of this variable's coefficient for second to fifth groups in less than a 5% significance level, importing these commodity groups is essential, but it could not make definite comments on the necessity or inferiority of importing the first commodity group[1].

Own-price coefficients are negative for all commodity groups, which reflects the fact that with increasing the price of imported goods of each group, expenditures share of the same group will reduce in the sum of the imports. Being Negative of the cross-price coefficient in each equation indicates its complementarity and its positivity indicates the substitutability of two commodities.

5.2 Diagnostic Tests

5.2.1 Breusch-Pagan Test

One of the diagnostic tests for the SUR equations pattern is the Breusch-Pagan test because it is necessary to test the simultaneous correlation between residuals in five equations. After comparing the test statistic with a critical value, in case of rejecting the

1. In AIDS pattern, the sign of total expenditures coefficient ($\beta_i = c_{i7}$), indicates which commodity is luxury and which one is essential. If β_i is positive and more than 1, the commodity is a luxury item, and if β_i is positive, and less than one, the commodity is an essential one, and if β_i is negative, the commodity is an inferior one.

null hypothesis, the simultaneous correlation between residuals is not rejected, and therefore seemingly unrelated regression approach can be used to estimate the system of equations. Table 6 shows the result of the Breusch-Pagan test.

Table 6. The Results of the Breusch-Pagan Test for Residuals

Test statistics	Prob.
324.25	0.000

Source: Research findings.

The results of Table 6 represent that the simultaneous correlation between residual terms in five equations is accepted. Therefore, it is needed to use the SUR equations technique to estimate the model equations.

5.2.2 Wald Test

One advantage of AIDS is the ability to test theoretical limitations in the system. Regarding the results of the previous test and considering the pattern of Equations (17) to (22) and applying an additive pattern of Eq. (11), on a matrix of parameters for the Iranian imports allocation pattern, with no real total expenditures, the null hypothesis (H_0) against the opposite hypothesis (H_1) through Wald test will be examined:

$$H_0 : c_{i7} = 0 \qquad (i = 1.2.3. \ldots .6) \tag{24}$$
$$H_1 : c_{i7} \neq 0$$

In which c_{i7} is the parameter of the real total expenditure variable ($\mathrm{Log}\, X/P^*$) of the pattern. The result of the independence of the import allocation pattern of the Iranian economy from real total expenditure indicated using the Wald test, would reject the null hypothesis. Because according to the following Table, if the test statistics be greater than the critical value at a 95% confidence level, the H_0 hypothesis will be rejected.

Table 7. The Result of Wald Test

Test statistics	**Prob.**
178.70	0.000

Source: Research findings.

This reflects the fact that real expenditures impact import function, which means that the import allocation pattern is not homothetic. This result is following the results of Tayyebi and Ranjbar's (2005), and Winter's (1984) studies. Also, by considering the pattern matching Equations (17) to (22) and applying an additive pattern of Equation (11) on the parameters matrix for the Iranian import allocation pattern, the null hypothesis (H_0) against the opposite hypothesis (H_1) will be tested through the Wald method.

$$H_0: \sum c_{ij} = 0 \quad . \quad H_1: \sum c_{ij} \neq 0 \ \ (j = 1.2.3. \ldots .6 \text{ and } i = 1.2.3. \ldots .6) \tag{25}$$

That, c_{ij} is the parameter corresponding to the model price variable. If the test statistic is greater than the critical value associated with a 95% confidence level, the H_0 hypothesis will be rejected.

Table 8. The Result of Wald Homogeneity Test

Test statistics	Prob.
29.84	0.000

Source: Research findings.

The homogeneity hypothesis implies the homogeneity of the demand equations system of zero degrees relative to the price variables vector. According to the results, the null hypothesis is rejected. It can be said that rejection of the homogeneity hypothesis implies a change in budget shares of $w_i (i = 1.2. \ldots .6)$ in an amount of $\sum c_{ij}$ which will be in result a 1% increase in total expenditures and prices. That this result is following the results of Ranjbar and Kabirian (2011), and De Boer et al. (2000) studies.

Another limitation is the test of rejection or non-rejection of the symmetry hypothesis. The symmetry hypothesis implies the equality of substitution effects (Slutsky), the equality of the price variable parameter of group j^{th} in the demand share equation of group i^{th} (c_{ij}). This hypothesis, like the homogeneity hypothesis, is one of the fundamental hypotheses of demand and was tested in a series of research.

$$H_0: c_{ij} = c_{ji} \quad . \quad H_1: c_{ij} \neq c_{ji} \qquad (i \neq j. j = 1.2.3. \ldots .6 \text{ and } i = 1.2.3. \ldots .6) \tag{26}$$

Table 9. The Result of Wald Symmetry Test

Test statistics	Prob.
40.08	0.000

Source: Research findings.

According to the results, the null hypothesis regarding the existence of symmetry is rejected. This result is following the results of Motafaker Azad et al. (2007) and De Boer et al. (2000) studies.

5.3 Estimation of Elasticities

Given the fact that in an almost ideal demand system, the dependent variable is the share of commodity groups and independent variables are the logarithm of the price index of groups and expenditures, it is necessary to calculate elasticities to examine the intensity of demand changes relative to the price of commodities and income. For this purpose, by using the estimated coefficients in Table 5, long-run price and income elasticities of demand have been estimated based on Equations (14) to (16) throughout using the average amount of budget share in the considered period. Results of estimating own and cross-price elasticities and income elasticities are given in Table 10. Uncompensated price elasticities based on the average shares are illustrated over the 1992-2017 period for $\mathbf{w_i}$ with t-statistics (through corrected standard deviation) in Table 10.

Table 10. The Results of Estimating Price and Income Elasticities during 1992-2017

Eqs.	Income elasticities	Price elasticities					
		p_1	p_2	p_3	p_4	p_5	p_6
w_1 (t)	1.07 (14.07)	- 0.82 (-8.29)	0.05 (0.50)	0.30 (1.39)	0.37 (2.31)	- 0.18 (-1.70)	- 0.48 (-7.15)
w_2 (t)	1.54 (29.29)	0.10 (1.47)	-1.17 (-15.18)	0.07 (0.52)	0.12 (1.13)	-0.15 (-2.15)	-0.15 (-2.97)
w_3 (t)	1.71 (15.27)	0.16 (1.20)	-0.16 (-0.99)	-1.30 (-4.19)	0.08 (0.34)	-0.07 (-0.49)	-0.003 (-0.03)
w_4 (t)	1.33 (28.92)	0.06 (1.87)	-0.09 (-1.64)	0.05 (0.56)	-0.82 (-8.23)	-0.11 (-0.94)	-0.28 (-2.86)
w_5 (t)	1.18 (14.94)	0.08 (0.84)	0.02 (0.18)	0.12 (0.54)	-0.99 (-6.02)	-1.33 (-12.72)	0.16 (3.25)

Source: Research findings.

The elements of the main diameter of price parameters indicate own-price elasticity and elements of non-main diameter represent cross-price elasticity. Own-price elasticities include all commodity groups that have expected negative signs, indicating that with an increase in import prices from each country, imports will decrease.

Uncompensated cross-price elasticities for importing the first group (first row) are positive about the fourth group's import price. This indicates the substitutability of importing these two groups in the imports share equation. Of course, as seen, this mutual relation is violated in Eq. (4). Therefore, it can be said that these two commodity groups are weak substitutes for each other. Uncompensated cross-price elasticities for importing the second group (second row) are negatively related to the price of importing the fifth group. This indicates the complementarity of importing these two groups in the import share equation. But as seen, the mutual relationship is violated in equation (w_5). Therefore, it can be said that these two commodity groups weakly complement each other. Similar analyzes can be made for other equations.

Among calculated price elasticities, the own-price elasticity of the second, the third, and the fifth groups are larger than 1, indicating that these import groups are elastic. One percent increase in the import price of these groups has led to a decrease of 1.17 percent in importing the second group, a decrease of 1.30 percent in imports of the third group, and a 1.33 percent decrease in imports of the fifth group. As shown in Table 10, imports of the fifth group are affected more than other groups by imported prices. This result is following the results of Athukorala and Khan (2016), and Sepanlo and Ghanbari (2011) studies.

Each of the columns in Table 10, after the column related to income elasticity, represents price changes of imported goods of a commodity group against other groups in rows. For example, in the first column of Table 10, price changes of imported goods of the first group led to an increase in demand for commodities of the second group to 0.10%, third group to 0.16%, fourth group to 0.06%, and fifth group to 0.08%. A similar analysis can be done for other columns in Table 10. In addition, this result is following Panahi et al. (2016), and Kanjilal and Ghosh's (2014) studies.

6. Conclusion

The amount of a country's imports is one of the factors that can determine the degree of extroversion, amount of transactions, and trading relations of a country. Growth and development in different countries of the world have also increased international trade, and consequently, imports of countries have grown. Therefore, in this study, a proper functional form investigated for imports demand in terms of share of imported goods of the Iranian economy. Due to the dependence of the Iranian industry structure on imports from other countries, it is important to understand and identify dimensions of imports demand. Accordingly, using data during 1992q1–2004q4 and applying the seemingly unrelated regressions econometric technique, price elasticity and income elasticity of demand function of Iran were determined by commodity groups. The results of tests indicated that about the determination of imports allocation pattern of the Iranian economy through the share of commodity groups, it is not possible to achieve a proper discernment without consideration the share of produced and consumed goods inside the country. Accordingly, it can be mentioned that consumers formulate their demand based on one-stage budget. Due to the susceptibility of imported goods from different origins relative to expenditures and own-prices, estimated results from the selected pattern indicating, approximately, being structural of the Iranian imports. While not proportioning, heterogeneity hypothesis of imports demand along with domestic sales implies that consumers suffer from money illusion, that is, by an identical increase in income and prices, shares of their consumption expenditures on the group of imported goods change as well as the share of goods produced and consumed internally. The results of own-price elasticity show that demand law governs on import demand with domestic sales. Also, results of cross-price elasticities also indicate a weak complementary relationship between second and fifth, fifth and fourth commodity groups, domestic sales with first, second and fourth commodity groups. There is also a weak substitution relationship between the first and fourth commodity groups. Based on research findings, some recommendations can be made to improve in import status of various commodity groups of the Iranian economy.

Considering the results about the impact of relative prices, consistency of coefficients signs, and estimated price elasticities with demand theory on commodity groups, these can be used from these results in policy-making, and regulation of economic programs, including an optimal allocation of resources, income distribution, growth, and economic stability (through affecting commodities' demand at macroeconomic). These goals can be achieved by adopting a combination of appropriate economic policies in allocation, distribution, growth, and economic stability of the economy by using financial instruments such as positive and negative tax rates.

Concerning the results about the impact of income on commodity groups, the reason for being necessary importation of these commodity groups, and given that imports are heavily influenced by political decisions, Iran's sensitivity to importing these groups should be reduced by adopting appropriate and prospective policies.

- Policies and measures have to be taken to reduce imports and dependencies through the mobilization of the country's industries. Innovations, initiatives, and inventions should be honored and appropriate funding should be provided for them.
- Instead of devoting itself to activities that the private sector can do, the government needs to carry out scientific policy makings that their consequences have been well seen by their implementation. Also, the assignment of these affairs should be carried out with the support of explicit and appropriate laws that consider equal rights for all.
- Briefly, it is suggested that the Iranian economic-trade policymakers, while, in the short-term, diversifying the imported goods market; in the long term, they should also consider adopting appropriate methods to increase the country's productive-industrial capacity in certain fields and considering priorities such as comparative advantage of producing strategic goods, and so on. Because in the long run, the country will be deprived of oil revenue, and given the current political state regarding the nuclear deal and re-imposing sanctions in the absence of reliable alternatives instead of oil exports, the country will face serious problems with funding import sources.
- The estimated price and income elasticity coefficients can be used to guide planners in this regard. Pricing policies, due to the elasticity of demand for each commodity group at their prices, can have an impact on demand for commodities. It is suggested that authorities take into account that their decisions, impact the preferences of consumers as desired.

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