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Managing Food Imports for Food Security in Qatar

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Abstract: Faced with food supply disruptions due in part to geopolitics and political instability in its traditional food source markets in the Kingdom of Saudi Arabia and the United Arab Emirates, Qatar—a wealthy, highly import-dependent open economy—plans to identify a set of alternative markets that can assure it of a stable food supply chain and food security. This study develops a set of preferences and import substitution elasticities for the country's four most important food categories: meats, dairy, vegetables, and cereals. We used quarterly food import data from 2004 to 2017 and the Restricted Source-Differentiated Almost Ideal Demand System (RSDAIDS) to estimate import-substitution elasticities for meats, dairy, vegetables, and cereals imported by Qatar. Based on our findings, India, Australia, and the Netherlands emerged as Qatar's most competitive sources of food, followed by Brazil, Jordan, and Argentina. Qatar can assure sustained demand for food imports from the aforementioned countries in order to address its food security.

Keywords: Qatar food supply chain; food imports; restricted source-differentiated almost ideal demand system; Qatar

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1. Introduction

Import demand analysis enables researchers to empirically examine the nexus between consumer choice and international trade theories. Traditional consumer choice theory posits that autonomous rational consumers aim to maximize utility and will allocate their incomes at the margin among an assortment of consumer goods that meet their preferences (Gowdy and Mayumi 2001). International trade theory, on the other hand, holds that while countries trade in the goods for which they have comparative advantage, those goods must satisfy the preferences of end-users.

It is well established that consumers recognize the same good from different countries of origin as different products due in part to quality, price, and other differences (Thanagopal and Housset 2014). Thus, through international trade, consumers reveal their preferences or willingness to pay for a wider variety of differentiated products beyond the limit set by their domestic production possibilities (Bernhofen 2001). In essence, import demand analysis helps researchers to examine the nature and type of opportunities offered by international trade in expanding the range of consumer choices beyond their national boundaries. Such analyses provide policy makers and private sector players with tools to plan and synchronize imports. For example, through setting aside sufficient forex outlays to finance the import bills, and designing critical import-based social programs such as strategic food reserves in food deficit countries that align consumer preferences with import possibilities.

The ultimate products of import demand analysis are import price and income elasticities, or the so-called import substitution elasticities. Knowledge of such elasticities is important in forecasting future import demand profiles for planning purposes, to identify alternative (competitive) sources of commodities that satisfy consumer tastes and preferences, and for evaluating the impact of economic policies on consumer welfare (Jorgenson et al. 1988). Qatar—an arid, water-deficit country that depends on food imports for over 90 percent of its domestic food demand—is an interesting and strong case to estimate import-substitution elasticities for its products.

While Qatar is the wealthiest country in the world on a per-capita basis, the country is hugely vulnerable to potential food supply disruptions either in its food source markets or along its food supply chain. For example, since June 2017, Qatar has been operating under an economic blockade imposed by its neighbors: Bahrain, the Kingdom of Saudi Arabia (KSA), the United Arab Emirates (UAE), and Egypt. Before the blockade, the KSA and the UAE accounted for 27.6 percent of Qatar's total food imports with about 40 percent of those imports transiting overland through the KSA from the Suez Canal (Wintour 2017). After the blockade, both the food imports and all the supply routes through its neighbors stopped. As such, the Qatari policy makers may be hugely interested in finding stable alternative (competitive) sources of food imports to feed their burgeoning population. In the midst of the COVID-19 pandemic coupled with disruptions of food systems resulting in devastating trends across the world which are expected to continue in the coming months and years (Béné et al. 2021; Kang et al. 2021), it follows that the measurement of substitution elasticities of food imports and identifying alternative food source markets could be crucial for Qatari policy makers. This study is designed to generate knowledge to bridge this important gap.

The objective of this study is to determine food import substitution elasticities for Qatar so as to identify a set of alternative food source markets that Qatar can tap into as a way to hedge against the risk of food supply disruption and food insecurity. We estimate a Restricted Source-Differentiated Almost Ideal Demand System (RSDAIDS) model—a novel econometric model, on a unique dataset with data that span from 2004 to 2017. The findings from this study are the first of their kind and have potential relevance to policy makers in Qatar and indeed in other highly food import-dependent countries in designing effective food security strategies to assure uninterrupted food supply and food security.

The rest of this paper is organized as follows: Section 2 provides literature review of the methods as used for demand estimation. Section 3 describes the methods and data used in this study. Section 4 presents results and discussion. Finally, Section 5 provides a conclusion highlighting some policy implications.

2. Literature Review

To estimate food-import substitution elasticities for Qatar, we employed the RSDAIDS model. RSDAIDS is a variant of the Source Differentiated Almost Ideal Demand System (SDAIDS) which was initially proposed by Yang and Koo (1994). The SDAIDS model is an extension of the source-undifferentiated linear approximate almost ideal demand system (LA-AIDS) which was originally developed by Deaton and Muellbauer (1980).

The RSDAIDS model is frequently used to estimate import substitution elasticities because of the following theoretical properties: first, the RSDAIDS model supports the estimation of cross-price elasticities, own-price elasticities, and income elasticities. Second, the RSDAIDS model's functional form relaxes the assumption of strictly homothetic preferences by allowing for quasi-homothetic preferences. Third, the RSDAIDS model incorporates the Armington model which allows for imperfect substitutability of a product sourced from different origins. Moreover, restrictions such as additivity, homogeneity, block separability, and Slutsky symmetry are also allowed in RSDAIDS model. The restrictions of additivity and homogeneity hold if consumers hold rational preferences while the Slutsky symmetry is true if these rational preferences are convex. Block separability allows for the consumers to follow a two-stage decision-making process particularly when they allocate their budget to the consumption of a particular product (Thanagopal and Housset 2014; Pourmokhtar et al. 2018).

In food import demand analysis, the SDAIDS was originally and empirically employed by Yang and Koo (1994) in their seminal study of Japanese meat import demand. Henneberry and Hwang (2007) later used the RSDAIDS model to study meat demand in South Korea. Other studies that have applied the SDAIDS model or the RSDAIDS model in demand analysis include Mutondo and Henneberry (2007) in the analysis of US meat demand. Lee et al. (2008) used the RSDAIDS model to study South Korean wine import demand while (Mekonnen et al. 2011; Wang and Reed 2013) respectively used the same model to analyze US apple juice and US fishery products import demand, respectively.

Thanagopal and Housset (2014) revisited the RSDAIDS model in which they included the variables price and quality in order to correct for bias in estimating 'true' price and quality elasticities. Capitello et al. (2015) applied the model to estimate Chinese import demand for wine. Pourmokhtar et al. (2018) used the RSDAIDS model to investigate the effects of economic and non-economic factors such as meat prices, costs, and animal disease outbreaks on meat demand from different sources in Iran. Lee et al. (2020) used RSDAIDS model in India to estimate the effect of tariffs on fresh apples from the United States. As far as the authors know, this is the first application of RSDAIDS in the analysis of Qatar's food import demand.

3. Data and Methods

3.1. Model Specification

Following Henneberry and Hwang (2007), the SDAIDS model is

$$w_{i_h} = \alpha_{i_h} + \sum_j \sum_k \gamma_{i_h j_k} \ln(p_{j_k}) + \beta_{i_h} \ln\left(\frac{E}{P^*}\right), \text{ for } i, j = 1, 2, \ldots, N; \quad h = 1, \ldots, m, \quad k = 1, \ldots, n \text{ where } i \neq j, \tag{1}$$

where i and j represent different goods while h and k, respectively, represent different countries of origin. The term w_{i_h} denote the budget share of product i_h, and p_{j_k} is the price of product j_k. Finally, E is the total expenditure for all goods in the demand system, and P^* is a price index, which is defined as

$$\ln(P^*) = \alpha_0 + \sum_i \sum_h \alpha_{i_h} \ln(p_{i_h}) + \frac{1}{2} \sum_i \sum_h \sum_j \sum_k \gamma^*_{i_h j_k} \ln(p_{i_h}) \ln(p_{j_k}). \tag{2}$$

Equation (2) presents difficulties in empirical estimation due to its nonlinear form. Deaton and Muellbauer (1980) suggest the use of Stone's price index given by

$$\ln P^* = \sum_i \sum_h w_{ih} \ln(p_{ih}). \tag{3}$$

However, the Stone's index introduces a simultaneity problem due to the fact that the budget share, w_{i_h} ordinarily appears in both the right- and left-hand sides of the equal sign (Yang and Koo 1994). It has been suggested that w_{i_h} be used either in its lagged (Eales and Unnevehr 1988) or mean (Haden 1990) form to avoid the problem. In this study, we used its mean.

The SDAIDS model in Equation (1) was converted into a Restricted SDAIDS (RSDAIDS) by assuming block substitutability following Yang and Koo (1994), i.e., $\gamma_{i_h j_k} = \gamma_{i_h j}$, $\forall k \in j \neq i$. This reduced the number of parameters in each equation from $MN + 2$ to $M + (N - 1) + 2$, thereby saving the degrees of freedom. First differences were taken to induce stationary. Accordingly, the final RSDAIDS model estimated is

$$\Delta w_{i_h} = \alpha_{i_h} + \delta_{i_h} Qt_{i_h} + \sum_k \gamma_{i_{hk}} \Delta \ln(p_{i_k}) + \sum_{j \neq i} \gamma_{i_h j} \Delta \ln(p_j) + \beta_{i_h} \left(\Delta \ln(E) - \left[\sum_i \sum_h \overline{w}_{i_h} \Delta \ln(p_{i_h}) \right] \right), \tag{4}$$

where $Q_{t_{i_h}}$ is the quarterly dummy $t = 1, 2, 3$ and $\ln(p_j) = \sum_k w_{j_k} \ln(p_{j_k})$ such that only the prices of the same type of food commodity from different sources varied; the prices of other types of food commodity from various origins were represented by an aggregate price for that food commodity in the equation of a given food commodity type from a differentiated source in keeping with the block substitutability assumption (Yang and Koo 1994; Deaton and Muellbauer 1980; Pourmokhtar et al. 2018; Henneberry and Hwang 2007; Mutondo and Henneberry 2007).

The following conditions were imposed and tested in keeping with demand theory:

Adding up: $\sum_i \sum_h \alpha_{i_h} = 1$; $\sum_h \gamma_{i_{hk}} = 0$; $\sum_i \sum_h \gamma_{i_{hj}} = 0$; $\sum_i \sum_h \beta_{i_h} = 0$;

Homogeneity: $\sum_k \gamma_{i_{hk}} + \sum_{j \neq i} \gamma_{i_{hj}} = 0$;

Symmetry: $\gamma_{i_{hk}} = \gamma_{i_{kh}}$.

Homogeneity and symmetry conditions were tested separately and jointly in the SDAIDS model using the likelihood ratio test. The testing could not be undertaken in the RSDAIDS model because of block substitutability (Henneberry and Hwang 2007). The uncompensated (Marshallian) price elasticities for each food type were computed at the mean of expenditure shares ($\overline{w}_{i_h}$) using RSDAIDS model parameters as

$$\varepsilon_{i_h i_h} = -1 + \frac{\gamma_{i_{hh}}}{w_{i_h}} - \beta_{i_h}, \tag{5}$$

$$\varepsilon_{i_h i_k} = \frac{\gamma_{i_{hk}}}{w_{i_h}} - \beta_{i_h}\left(\frac{w_{i_k}}{w_{i_h}}\right), \tag{6}$$

$$\varepsilon_{i_h j} = \frac{\gamma_{i_h j}}{w_{i_h}} - \beta_{i_h}\left(\frac{w_j}{w_{i_h}}\right), \tag{7}$$

where Equation (5) computes own-price elasticities, Equation (6) represents cross-price elasticities between the same food commodity type from different sources while Equation (7) calculates cross-price elasticities between different food commodity types within the same food chapter. The expenditure elasticity was calculated as

$$\eta_{i_h} = 1 + \frac{\beta_{i_h}}{w_{i_h}}. \tag{8}$$

Adding $w_{i_h}\eta_{i_h}$ to each of the Marshallian price elasticities would give the compensated (Hicksian) price elasticities (Goodwin et al. 2018). They were estimated but not reported in this study, due to general consistency in results with Marshallian price elasticities and space limitations. The RSDAIDS model was estimated using the iterative seemingly unrelated regression (ITSUR) using the PROC Model procedure in SAS software.

3.2. Data Sources

This study used quarterly data obtained from Qatar's Foreign Trade System for the period 2004–2017. The initial data comprised 8-digit HS code with 22 chapters of food imports showing commodity weight and value, port of import, year, and source country. We focused on four important food import categories in Qatar, i.e., meats (Chapter 2), dairy (Chapter 4), vegetables (Chapter 7), and cereals (Chapter 10). Population and consumer price index (CPI) data were obtained from quarterly returns of Qatar's Ministry of Development Planning and Statistics. Commodity import prices were obtained by dividing import values by their corresponding weights and then deflated using the CPI. The real per capita expenditure on each commodity was obtained by dividing total import value in each quarter by the population and then deflating by the CPI.

As in Yang and Koo (1994), a country was identified as an eligible food exporter to Qatar if it accounted for at least 10 percent of the food import value in each food type. All countries which did not meet this criterion in each food type were lumped together in the food import source called "rest of the world [ROW]". The food import data were then subjected to the restricted source-differentiated almost ideal demand system (RSDAIDS) model written in SAS software to derive Marshallian, Hicksian, and expenditure elasticities for each commodity type.

4. Results

4.1. Summary of Food Imports in QATAR

4.1.1. Meat Imports

Beef, goat, pork, poultry, and sheep were the most important meat types imported in Qatar during the study period because pork had many missing observations, and together with other meat types—such as frog, offal, rabbit, horses, and reptile—we classified them as "other meats". Therefore, this study examined five meat types. Poultry was the most demanded meat and accounted for 53.6 percent of total import value. It was followed by sheep, beef, goat, and other meats in that order.

Table 1 presents the set of countries that constituted the meat import sources to Qatar between 2004 and 2017. The main source of poultry was Brazil and the KSA a minor source, while the main source of beef, goat, and sheep meat was Australia. Goat meat had the most diverse sources compared with poultry, beef, and sheep. The United States of America (USA) overtook India in 2013Q2 as the main source of beef. Countries such as Brazil and Australia have the highest percentage of total import value in a given category as shown in Table 1. A similar observation can be made from Table 2.

Table 1. Sources of major meat products imported in Qatar (2004–2017).

Meat Type	Source Country	% of Total Import Value in That Meat Category
Poultry	Brazil	67.1
	KSA	12.5
	ROW	20.3
Sheep	Australia	62.7
	India	13.8
	ROW	23.5
Beef	Australia	35.4
	India	18.7
	USA	11.9
	ROW	33.9
Goat	Australia	27.4
	India	24.1
	UAE	11.9
	Brazil	11.6
	ROW	24.9
Other meats		3.9

Table 2 presents the mean expenditure shares for various meats imported in Qatar between 2004 and 2017. Poultry from Brazil had the highest mean share followed by sheep from Australia and poultry from the KSA which suggests that these values may impact both Marshallian price and expenditure elasticity computations that follow.

Table 2. Summary statistics of expenditure shares of different meats imported in Qatar (2004–2017).

Meat Type and Source	Mean	Standard Deviation	Minimum	Maximum
Beef				
Australia	0.0458	0.0151	0.0014	0.0689
India	0.0248	0.0089	0.0041	0.0451
USA	0.0208	0.0244	0.0000	0.1441
ROW	0.0478	0.0145	0.0191	0.0805
Goat				
Australia	0.0163	0.0193	0.0000	0.1006
Brazil	0.0119	0.0151	0.0000	0.0697
India	0.0115	0.0087	0.0003	0.0401
UAE	0.0065	0.0066	0.0001	0.0249
ROW	0.0130	0.0086	0.0000	0.0407
Poultry				
Brazil	0.3786	0.0763	0.2455	0.5473
KSA	0.0679	0.0253	0.0107	0.1292
ROW	0.0966	0.0393	0.0155	0.1709
Sheep				
Australia	0.1211	0.0741	0.0168	0.3485
India	0.0356	0.0146	0.0138	0.0691
ROW	0.0589	0.0194	0.0276	0.1024
Other	0.0429	0.0389	0.0000	0.2452

4.1.2. Dairy Imports

Milk accounted for almost half of dairy product imports. It was followed by cheese and yoghurt at 22.6 and 15.3 percent, respectively. Butter was the least important product. Before June 2017, the KSA was the leading dairy product exporter to Qatar accounting for 45.1 percent of the dairy imports, followed by the Netherlands (11.5%), the UAE (5.1%), and Turkey (4.2%).

Table 3 shows the major sources of particular dairy products imported in Qatar between 2004 and 2017. These countries accounted for at least 10 percent of import value as defined in Yang and Koo (1994). As expected, the KSA was the major source of all the three leading dairy products imported in Qatar over the study period. This shows that trade in dairy products in Qatar was not diversified before the blockade which exposed the country to risk of supply disruptions. Dairy imports from the KSA dominated in all products with an average annual growth rate of 3.97%, 1.36%, and 11.18% for cheese, milk, and yoghurt, respectively. However, all dairy product imports declined after 2017Q2 following the blockade.

Table 3. Sources of major dairy imports in Qatar (2004–2017).

Dairy Product	Source Country	% of Total Import Value in That Meat Category
Cheese	KSA	25.7
	ROW	74.3
Milk	KSA	47.1
	Netherlands	23.5
	ROW	29.4
Yoghurt	KSA	86.7
	ROW	13.3
Other dairy products	ROW	7.3

As shown in Table 4, milk and yoghurt from the KSA had the highest expenditure shares. This suggests that even in presence of alternatives, Qatari consumers had a higher preference for dairy products from the KSA as high expenditure share favoring a particular exporter implies consumer preference for the products from that country.

Table 4. Summary statistics of expenditure shares for various dairy imports in Qatar (2004–2017).

Dairy Type and Source	Mean	Standard Deviation	Minimum	Maximum
Cheese				
KSA	0.0611	0.0155	0.0024	0.0828
ROW	0.1618	0.0368	0.0109	0.2322
Milk				
KSA	0.2883	0.1170	0.0090	0.6713
Netherlands	0.1179	0.0367	0.0420	0.2136
ROW	0.1465	0.0696	0.0650	0.4770
Yogurt				
KSA	0.1186	0.0835	0.0004	0.2768
ROW	0.0129	0.0178	0.0000	0.1259
Other	0.0930	0.0205	0.0206	0.1399

4.1.3. Vegetable Imports

The most important vegetables imported in Qatar between 2004 and 2017 were leeks, parsley, onions, and potatoes. The "other vegetable" category comprised capsicum, cabbage, garlic, chickpeas, cauliflower, beans, and cucumber, among others.

India was the leading vegetable exporter to Qatar, accounting for 19.7 percent of vegetable imports value. It was followed by the KSA and Jordan with 10.5 and 10.1 percent, respectively. India was the major source of onions, leeks, and parsley which accounted, respectively, for 31.2, 28.2, and 15.3 percent of its vegetable export value in Qatar. The KSA, on the other hand, was the leading source of potatoes, which accounted for 14.2 percent of its vegetable export value in Qatar followed by cucumber (9.1%) and Brussels sprouts (8.9%). Jordan was the major source of tomatoes which comprised 59.8 percent of its vegetable export value in Qatar followed by capsicums and cabbages at 8.8 percent each.

Despite leeks and parsley being the leading vegetable imports in Qatar between 2004 and 2017, a lot of the data were missing and therefore were dropped from the RSAIDS analysis. Instead, onions, potatoes, and tomatoes were considered in the analysis. Onion imports have been increasing throughout while those from the ROW have been fluctuating over time. Potato imports from all source markets have been highly variable over the study period. There was a sharp increase in tomato imports from Jordan in 2012Q1 and an increase thereafter. However, there was a sharp fall of tomato imports from Jordan in 2017Q2.

All the expenditure shares of the three vegetables considered in this study were stable as indicated by their narrow standard deviation (Table 5). The expenditure share of Indian onions was relatively higher than that of onions from the ROW. As well, potatoes from the ROW had the highest expenditure share followed by those from the Netherlands and Egypt. Jordanian tomatoes enjoyed higher expenditure share relative to those from the ROW.

4.1.4. Cereal Imports

Rice accounted for 64.2 percent of the total cereal import value in Qatar between 2004 and 2017. It was followed by wheat (17.8%), barley (10.3%), and corn (2.8%). Some of the cereals in the "other cereals" category were oats, meslin, millet, and sorghum, among others.

In this study, we considered corn, rice, and wheat because of missing data in other cereal types. All the three cereals experienced substantial volatility as evidenced by the high fluctuation. This probably reflects changes in cereal production cycles, import regulations, and consumer tastes and preferences.

Table 5. Summary statistics of expenditure shares for different vegetables imported in Qatar (2004–2017).

Vegetable Type and Source	Mean	Standard Deviation	Minimum	Maximum
Onion				
India	0.0634	0.0231	0.0108	0.1372
ROW	0.0358	0.0268	0.0089	0.1404
Potato				
Egypt	0.0174	0.0133	0.0000	0.0609
Lebanon	0.0135	0.0153	0.0000	0.0849
Netherlands	0.0174	0.0154	0.0001	0.0546
ROW	0.0567	0.0136	0.0349	0.0906
Tomato				
Jordan	0.0469	0.0325	0.0047	0.1033
ROW	0.0262	0.0176	0.0055	0.1040
Other	0.7227	0.0274	0.6626	0.7914

There was considerable variability in expenditure shares for corn and wheat from Canada and the ROW (Table 6). Overall, rice had the highest expenditure share, followed by wheat and corn in that order. In particular, Qatari consumers devoted a large proportion of their income to Pakistani rice followed by Indian rice; then, Canadian wheat and Argentinian corn in that order.

Table 6. Summary statistics of expenditure shares for different cereals imported in Qatar (2004–2017).

Cereal Type and Source	Mean	Standard Deviation	Minimum	Maximum
Corn				
Argentina	0.0136	0.0201	0.0000	0.0911
India	0.0057	0.0111	0.0000	0.0603
ROW	0.0101	0.0116	0.0002	0.0542
Rice				
India	0.2514	0.1858	0.0393	0.6953
Pakistan	0.2548	0.1521	0.0243	0.5830
ROW	0.0683	0.0272	0.0151	0.1743
Wheat				
Australia	0.0827	0.0726	0.0000	0.2482
Canada	0.1083	0.1484	0.0000	0.8862
ROW	0.0831	0.0867	0.0002	0.3022
Other	0.1220	0.1032	0.0041	0.4184

4.2. Empirical Results from the RSDAIDS Model

Tests for Homogeneity and Symmetry

Tests for homogeneity and symmetry were conducted on the different food categories. The results are presented in Table 7. For meat import data, both the homogeneity and symmetry tests were statistically significant at $\alpha = 0.05$, suggesting that the data were a good fit to the model.

Table 7. Homogeneity and symmetry test results for the RSDAIDS model.

Test	χ^2	$Pr > \chi^2$
Meats		
Homogeneity	35.69	0.0200
Symmetry	342.76	<0.0001
Joint homogeneity and symmetry	407.71	<0.0001
Dairy		
Homogeneity	6.33	0.5020
Symmetry	64.82	<0.0001
Joint homogeneity and symmetry	66.16	<0.0001
Vegetables		
Homogeneity	23.14	0.0032
Symmetry	56.96	0.0010
Joint homogeneity and symmetry	76.41	<0.0001
Cereals		
Homogeneity	19.16	0.0238
Symmetry	78.16	<0.0001
Joint homogeneity and symmetry	98.86	<0.0001

4.3. Marshallian Price and Expenditure Elasticities

4.3.1. Marshallian Price and Expenditure Elasticities of Demand for Various Meats Imported into Qatar (2004–2017)

Table 8 presents the Marshallian price and expenditure elasticities as well as the parameters for seasonal demand shifters. Notably, all the own-price country of origin elasticities were negative as expected from theory. Within each meat group, Australian beef, goat, and sheep meat—as well as poultry from all the three sources—were price elastic with an absolute own-price elasticity of more than unity.

Positive (negative) cross-price elasticities reveal whether a commodity is a substitute (complement). Accordingly, Australian beef is a substitute for that from the USA and the ROW but a complement for Indian beef probably due to its high (grass-fed) quality (Mutondo and Henneberry 2007). Indian beef is a complement to that from USA and the ROW. However, between beef from the ROW and beef from USA, the former is a preferred substitute to Australian beef, as can be observed from their respective elasticities (0.0424 against 0.002). The implication is that Qataris would rather consume beef from sources other than the USA and India, in the absence of beef from Australia. Examples of other sources encountered in Qatari beef markets include New Zealand, a well-regarded meat exporter.

In the goat meat market, Australian goat is a substitute for all the other goat meat sources—i.e., Brazil, India, the UAE, and the ROW—suggesting its high competitiveness in the Qatar meat market. Interestingly, this substitution is symmetric. A look at the magnitudes of the respective elasticities suggests that Australian Indian goat meat is a much bigger substitute to Indian Australian goat compared to the other sources which is an indication that, between goat meat from Brazil, India, the UAE, and the ROW, Qataris will settle for that from India (0.467), followed by Brazil (0.253), the UAE (0.198), and then the ROW (0.133), in that order, in the absence of Australian goat meat. Brazilian goat meat is a substitute for the UAE's but a complement for India's and ROW's. At the same time, Indian goat meat substitutes that of the UAE and the ROW.

Table 8. Marshallian and expenditure elasticities and seasonality parameters of Qatar's meat import demand (2004–2017).

Variable	Beef				Goat					Poultry			Sheep			Other
	Aus	**Ind**	**USA**	**ROW**	**Aus**	**Bra**	**Ind**	**UAE**	**ROW**	**Bra**	**KSA**	**ROW**	**Aus**	**Ind**	**ROW**	
PbeefAus	−1.147	−0.031	0.002	0.0424												
PbeefInd	−0.053	−0.336	−0.436	−0.405												
PbeefUSA	0.035	−0.496	−0.507	−0.203												
PbeefROW	0.045	−0.207	−0.970	−0.849												
PGoatAus					−1.398	0.253	0.467	0.198	0.133							
PGoaBra					0.338	−0.525	−0.037	0.172	−0.097							
PGoatInd					0.647	−0.044	−0.949	0.014	0.186							
PGoatUAE					0.475	0.309	0.025	−0.259	−0.025							
PGoatROW					0.154	−0.094	0.164	−0.013	−0.459							
PPoultBra										−1.04	0.012	0.169				
PPoultKSA										−0.109	−1.052	0.216				
PPoultROW										0.724	0.314	−1.939				
PSheepAus													−1.086	−0.004	−0.065	
PSheepInd													0.170	−0.874	−0.272	
PSheepROW													−0.026	−0.167	−0.802	
POther	−0.094	−0.170	−0.177	−0.085	2.064	2.818	2.911	2.573	5.192	0.126	0.337	0.487	0.204	0.882	0.529	−3.192
PBeef					1.509	2.057	2.125	3.789	1.878	0.140	0.391	0.565	0.377	1.471	0.885	−0.094
PGoat	−0.330	−0.605	−0.697	−0.311						−0.524	−2.214	−3.143	−0.819	−2.602	−1.575	0.781
PPoult	0.139	0.259	0.336	0.137	−0.833	−1.150	−1.196	−2.133	−1.058				0.0145	0.2358	0.139	0.774
PSheep	0.371	0.687	0.849	0.359	−3.294	−4.520	−4.683	−8.353	−4.12	0.395	1.387	1.981				0.731
Expenditure	1.130	1.299	0.1589	1.023	0.323	0.485	0.880	0.653	0.9854	0.897	1.064	1.019	1.448	0.957	1.041	1.000
Q1	0.009 **	0.005	−0.014	0.013 **	−0.000	−0.001	−0.000	−0.001	0.001	−0.019	0.007	0.001	−0.005	−0.002	0.000	0.006
Q2	0.004	−0.005	0.010	0.004	0.004	−0.005	0.001	0.004 **	0.003	−0.029	0.003	−0.010	0.016	0.007 **	0.009	−0.016
Q3	−0.010 **	−0.001	0.008	−0.008	−0.001	0.003	−0.005	−0.001	−0.01 **	−0.002	−0.004	0.005	0.020	−0.002	−0.007	0.012

Aus = Australia; Ind = India; Bra = Brazil; UAE = United Arab Emirates; Pbeef = price of beef; PGoat = price of goat meat; PPoult = price of poultry meat; PSheep = price of sheep meat; Q1–3 = Quarter 1 to 3. ** = significance at 5% level.

The results in Table 8 also show that the Qatari poultry market is dominated by Brazilian meat, which dwarfs that from the KSA and the ROW. Nevertheless, between poultry meat from the ROW and that from the KSA, the results in Table 8 indicate that poultry from the ROW is a preferred alternative and the KSA is a substitute for that from the ROW. This is not surprising following the expenditure shares in Table 2. Indian sheep are a strong substitute for Australian sheep, but a complement to that from the ROW.

Only a few quarterly dummies were statistically significant at the 5% significance level (Table 8). The expenditure share of beef imports from Australia increased in Quarter 1 but declined in Quarter 3 relative to Quarter 4. Likewise, the expenditure share of beef from ROW, goat from the UAE, and sheep from India increased significantly in Quarter 2 relative to Quarter 4, while that of goat from the ROW decreased in Quarter 3.

4.3.2. Marshallian Price and Expenditure Elasticities of Demand for Various Dairy Products Imported into Qatar (2004–2017)

As shown in Table 9, all of the own-price elasticities of demand for dairy products were negative as expected from theory. The fact that cheese's own-price elasticities were less than unity suggests inelastic demand for cheese from all sources. It also indicates that cheese from the KSA is a gross complement to that of the ROW and vice versa. In the milk market, the demand for milk from the Netherlands and the ROW is highly elastic as indicated by their respective high absolute own-price elasticities. However, that for milk from the KSA is inelastic, and perhaps reflects the strong economic and cultural ties that the KSA had with Qatar before the blockade. Milk from the KSA is a substitute for that from the Netherlands and ROW, while that from the Netherlands substitutes that from the ROW. The latter is a gross complement to milk imports from the other two sources.

Table 9. Marshallian price and expenditure elasticities and seasonality parameters of Qatar's dairy product import demand (2004–2017).

Variable	Cheese		Milk			Yogurt		Other
	KSA	ROW	KSA	Net	ROW	KSA	ROW	
PCheese_KSA	−0.8764	−0.1090						
PCheese_ROW	−0.0798	−0.9919						
PMilk_KSA			−0.6108	0.15914	0.22070			
PMilk_Net			−0.2778	−1.0130	0.17061			
PMilk_ROW			−0.3694	−0.1297	−1.39986			
PYogurt_KSA						−0.9191	0.01558	
PYogurt_ROW						−0.8786	−1.2771	
Pother	0.48255	0.14361	0.04650	−0.5534	−0.7123	0.07800	−0.3039	−0.5903
PCheese			0.38562	0.27617	−0.0447	−0.2839	−3.6356	0.28629
PMilk	−0.7065	−0.3054				0.62704	4.75095	−0.6634
PYogurt	0.44394	0.12903	0.36152	0.21724	−0.0922			−0.0326
Expenditure	0.23221	1.12911	0.09666	1.25474	2.98770	0.12687	6.34520	1.000
Q1	0.004844	0.025586 **	−0.012	−0.01724	−0.00781	0.004419	−0.00511	0.007291
Q2	0.001563	−0.00307	−0.0028	−0.00608	−0.01121	0.021359	0.000191	4.7E−05
Q3	−0.006 **	−0.0165 *	−0.0238	0.007142	0.049067 **	−0.01745	0.013984 **	−0.00734

KSA = Kingdom of Saudi Arabia; Net = Netherlands; ROW = Rest of the world; PCheese = Price of cheese; PMilk = Price of milk; PYogurt = Price of yogurt; Q1–3 = Quarters 1 to 3; **, * = significance at 5% and 10% levels, respectively.

With respect to the yoghurt market, the demand for yoghurt from the KSA is inelastic, again suggesting a high preference for it among Qatari consumers. On the other hand, the demand for yoghurt from the ROW is highly elastic as expected, owing to diverse sources of yoghurt in the ROW with quality and seasonal differences. As in the case of milk, yoghurt from the KSA is a gross substitute for that from ROW, highlighting its high preference among Qatari consumers.

All expenditure elasticities for the three dairy products were positive, suggesting that dairy products are considered a luxury in Qatar (Table 9). Within specific commodity groups, dairy products from the ROW were preferred to those from the KSA and the Netherlands. In addition, milk from the Netherlands was preferred to that from the KSA, perhaps reflecting perceived quality differences.

Of the three quarterly dummies evaluated in the model, Q1 was statistically significant for cheese from ROW; Q2 was statistically insignificant for all the dairy products, while Q3 was statistically significant for four out of eight products considered (Table 9). Notably, Q3 was negative for all dairy products sourced from the KSA. This probably reflects the negative effect of the blockade on Qatar's dairy imports from the KSA.

4.3.3. Marshallian Price and Expenditure Elasticities of Demand for Vegetable Imports in Qatar (2004–2017)

As expected from theory, all the own-price elasticities of demand were negative (Table 10). The fact that the own-price elasticity of demand for onions is greater than unity suggests that the demand for onions is highly elastic relative to that for potatoes and tomatoes whose own-price elasticity is less than one. Onions from India are gross substitutes for those from the ROW.

Table 10. Marshallian price and expenditure elasticities and seasonality parameters of Qatar's vegetable import demand (2004–2017).

Variable	Onion		Potato				Tomato		Other
	Ind	**ROW**	**Egy**	**Leb**	**Net**	**ROW**	**Jor**	**ROW**	
POnion_Ind	−1.0807	0.28829							
POnion_ROW	0.55763	−1.0958							
PPotato_Egy			−0.9285	−0.1279	0.35980	0.04908			
PPotato_Leb			−0.1583	−0.4325	0.11791	−0.0499			
PPotato_Net			0.35531	0.08282	−0.9459	−0.1566			
PPotato_ROW			0.02874	0.00034	−0.0331	−0.8332			
PTomato_Jor							−0.8987	0.07974	
PTomato_ROW							0.17034	−0.7911	
Pother	−0.1743	−0.2616	−0.5801	−0.7395	−0.5836	−0.1641	−0.8549	−1.5033	−0.918
POnion			−2.5081	−3.2176	−2.5097	−0.7552	1.69779	3.06772	−0.014
PPotato	−0.0606	−0.0603					−1.0812	−1.9085	−0.014
PTomato	−0.0773	−0.0898	2.73512	3.52147	2.72820	0.85223			−0.0547
Expenditure	1.32955	0.71976	1.00525	0.56029	1.24199	0.75887	1.24458	0.73184	1.0000
Q1	0.03 **	−0.01112	0.02 ***	−0.02 **	0.006 **	0.005	−0.02 ***	−0.01 **	−0.01
Q2	−0.01016	−0.00992	−0.00327	0.009482	−0.00243	−0.001	0.006 *	0.00344	0.008
Q3	−0.02 **	0.02 **	−0.01 **	0.012 **	−0.001 **	−0.005	0.003715	0.006036 *	−0.01

Ind = India; Egy = Egypt; Leb = Lebanon; Net = Netherlands; Jor = Jordan; ROW = Rest of the world; POnion = Price of onion; PPotato = Price of potato; PTomato = Price of tomato; Q1–3 = Quarters 1 to 3; ***, **, * = significance at 1%, 5%, and 10% levels, respectively.

With regard to potatoes, Egyptian potatoes are gross complements for those from Lebanon but substitutes for potatoes from the Netherlands and the ROW. Additionally, potatoes from Lebanon are gross substitutes for those from the Netherlands but complements for potatoes from the ROW. As well, potatoes from the Netherlands complement those from the ROW. Jordanian tomatoes are gross substitutes for tomatoes from the ROW and vice versa.

Based on the Marshallian income elasticity of demand, onions from India are preferred to those from the ROW. Furthermore, potatoes from the Netherlands are preferred to those from Egypt, which in turn are preferred to those from the ROW. For some unknown reason, potatoes from Lebanon were least preferred by Qatari consumers. Finally, Jordanian tomatoes were preferred to those from the ROW.

Most of the seasonal dummies were positive and statistically significant in Q1 except for potatoes from Lebanon whose coefficient was negative but significant (Table 10). However, in Q3, all the positive dummy coefficients in Q1 turned out to be negative, probably reflecting the negative effect of the blockade on vegetable imports in Qatar. Interestingly, the coefficient on Q3 for Lebanese potatoes turned out positive. The data reveal that Lebanon became the biggest beneficiary after the exit of the UAE and the KSA in 2017Q2. In fact, it was the second most important source of vegetables after India in 2017Q3 and 2017Q4, replacing the UAE which was in second position in 2017Q1.

4.3.4. Marshallian price and expenditure elasticities of demand for various cereals imported into Qatar (2004–2017)

All the own-price elasticities of the three cereals were negative as expected from theory (Table 11). In corn, all own-price elasticities were greater than unity in absolute terms indicating elastic demand for corn in Qatar. On the other hand, all cross-price elasticities were less than unity. Argentinian corn was a gross substitute for corn from the ROW, but a gross complement for Indian corn. The latter was a gross substitute for corn from the ROW.

Table 11. Marshallian price and expenditure elasticities and seasonality parameters of Qatar's cereal import demand (2004–2017).

Variable	Corn			Rice			Wheat			Other
	Arg	Ind	ROW	Ind	Pak	ROW	Aus	Can	ROW	
PCorn_Arg	−1.2974	−0.1292	0.19318							
PCorn_Ind	−0.2885	−1.0316	−0.1788							
PCorn_ROW	0.25844	−0.1147	−1.4665							
PRice_Ind				−0.09	−0.9919	−1.1870				
PRice_Pak				−0.877	−0.1672	−0.5008				
PRice_ROW				−0.323	−0.7024	−0.1719				
PWheat_Aus							−1.172	−0.0257	0.13241	
PWheat_Can							0.210	−0.9350	0.3617	
PWheat_ROW							0.0920	0.13536	−1.4115	
POther	−0.2116	−0.4845	−0.2883	0.4401	0.30714	1.61887	2.0371	1.78482	1.98573	−3.28
PCorn				−0.095	−0.2204	−0.3478	−2.18	−1.4335	−2.2061	−0.0230
PRice	0.309	0.7536	0.41488				0.0737	0.28604	0.0336	0.90428
PWheat	0.105	0.269	0.13964	−0.052	−0.1779	−0.1894				1.3951
Expenditure	1.3775	−0.1414	1.93652	0.996	1.49440	0.94	1.27	−0.9650	1.74	1.000
Q1	−0.007	−0.001	−0.005	−0.041	−0.79 **	−0.013 *	0.025	0.031	0.025	0.775
Q2	0.0068	0.002	−0.005	0.018	0.017	0.02 **	−0.01	−0.04	0.0161	−0.025
Q3	−0.001	−0.006	0.001	−0.00	0.012	−0.009	−0.001	0.053	−0.01	−0.036

Arg = Argentina; Ind = India; Pak = Pakistan; Aus = Australia; Can = Canada; PCorn = Price of corn; PRice = Price of rice; PWheat = Price of wheat; Q1–3 = Quarters 1 to 3; **, * = significance at 5% and 10% levels, respectively.

In the rice market, all own-price elasticities were less than unity in absolute terms, indicating inelastic demand for rice in Qatar. This suggests that rice is a major food staple in Qatar. Indian rice was a gross complement for both Pakistani rice and rice from the ROW and vice versa, suggesting a lack of product differentiation. In other words, Qatari consumers consider rice from the three sources as being similar in all respects. These elasticities could be linked to the expenditure shares reported in Table 6.

Only Q1 and Q2 quarterly dummies were statistically significant for Pakistani rice and rice from the rest of the world (Table 11). The coefficients on Q1 for both rice types were negative, suggesting that the demand for Pakistani rice and rice from the ROW decreased in the first quarter. However, the demand for rice from the ROW increased in Q2. The lack of statistical significance of the Q3 dummy is testimony to the lack of effect of the blockade on cereal imports. This could be because none of the blockading quartet is a major exporter of the three cereals considered in the study.

5. Discussion

Based on our findings, Brazil was the main poultry source for Qatar while the Kingdom of Saudi Arabia was a minor source of the commodity within the period of analysis. This is plausible since Brazil is one of the top poultry producers, coming only behind the USA (Food and Agricultural Organization (FAO) (2021)). It is also consistent with Zhuang and Moore's (Zhuang and Moore 2015) report that 43% of Brazilian poultry is exported against

14% of the total USA poultry exports to Muslim countries. The KSA being the minor source could be due to the fall in its exports to Qatar due to the 2017 blockade. Unsurprisingly, Australia was the main source of beef, goat, and sheep meat and has currently continued trade with Qatar despite the geopolitics and instability in the region (Australian Trade and Investment Commission (ATIC) (2022)). This suggests that Australia remains a fertile ground to trade with Qatar to enhance its food security status. While there was a clear increase in the demand for poultry, sheep, and beef, our results showed that the goat meat demand remained subdued over the study period. These trends suggest that the value of meat imports was highly volatile over the study period, perhaps reflecting changes in consumer tastes and preferences, as well as possible import supply disruptions. In terms of the expenditure shares, the mean expenditure share for goat meat was the least, followed by that for beef. The results for expenditure shares on goat meat are consistent with the goat meat demand was seemed to have cowed down. Milk, cheese, yoghurt, and butter were the most important dairy products imported by Qatar between 2004 and 2017 by import value. Buttermilk, cream, ghee, laban, other fats and oils derived from milk, and whey were lumped into "Other" dairy products. More specifically, following the June 2017 blockade, the KSA and the UAE ceased exporting dairy products to Qatar. The Qatari dairy industry was hard-hit by the sudden withdrawal particularly of products originating from the KSA. However, Monroe (2020) contends that the former prime minister of Qatar, Abdullah bin Hamad Al Attiyah, echoed (at a public event at Georgetown University, USA) that the 2017 crisis is somehow a blessing for Qatar because of the country's ability to emerge unscathed from the blockade. In other words, Qatar learnt a lot of lessons to increase domestic production and expand trade beyond borders. For example, Baladna (i.e., 'our country' in Arabic) started in 2014 as a small goat and sheep farm, but was quickly transformed into a huge dairy farm in 2017 (Gengler and Al-Khelaifi 2019). Sergie (2018) and Koch (2021) suggest that the Baladna received thousands of dairy cows that were 'airlifted' by Qatar Airways from Europe and North America to increase production of dairy products during the blockade. Our results indicate that even Turkey took over from the KSA and the UAE as the leading dairy product exporter to Qatar in 2017Q3. However, that role has abated somewhat with a sharp drop of imports from all countries in 2017Q4 and 2018Q1, perhaps reflecting an increase in domestic production that Qatar pursued.

Moreover, within the study period, our findings showed that trade in dairy products in Qatar was not diversified before the economic blockade imposed by Qatari neighbors. Prior to the blockade, dairy imports from the KSA dominated all products with an average annual growth rate of 3.97%, 1.36%, and 11.18% for cheese, milk, and yoghurt, respectively. However, all dairy product imports declined after 2017Q2 following the blockade. Gengler and Al-Khelaifi (2019) also suggest this may be attributed to the move by Baladna to replace Saudi and Emirati dairy products. Qatari consumers, however, seemed to prefer dairy products from the KSA, they seemed to prefer cheese from the rest of the world (ROW) to that from the KSA.

While the KSA, Egypt, and the UAE were among the top 10 vegetable sources for Qatar before the blockade, they were all replaced after the blockade—i.e., from 2017Q3—from the top 10 by the Netherlands, China, and Lebanon. In 2017Q4 and 2018Q1, the three suppliers were variously replaced by Spain, Morocco, and Lebanon. There was however, an overall drop in the volume of vegetable imports after 2017Q2, perhaps as a result of the blockade's impact on food supply routes. This drop in vegetable imports observed in this study is consistent with the report by Ben Hassen et al. (2020). To mitigate this drop, Qatar continued with its initiatives in sourcing seeds, fertilizers, agrochemicals, marketing, loans with reduced interest rates, guidance and support for farms from alternative countries, and greenhouse vegetable farming (Monroe 2020; Ben Hassen et al. 2020). For other agricultural produce such as cereals—which are important for food security for many countries in Middle East and Africa (Ben Hassen et al. 2020; Lu et al. 2021; Miniaoui et al. 2018)—we observed that India was the leading cereal exporter to Qatar accounting for 34.9 percent of the total cereal import value over the study period. It was followed by Pakistan and

Australia at 25.9 and 11 percent respectively. India and Pakistan were the major sources of rice imports while Australia and Ukraine were the major suppliers of wheat and barley, respectively. These attempts contributed to making Qatar progress toward food self-sufficiency (Knecht 2019). The fact that only one of the blockading quartets (Bahrain, Egypt, the KSA, and the UAE), i.e., the UAE, was among the top 10 cereals exporters to Qatar over the study period means that cereal imports were not heavily affected by the blockade. However, there was a sharp decline in cereal imports after 2017Q3, perhaps due to the blockade again. Overall, cereal import remained high over the study period with a growth rate of 3.92 percent per annum, which is consistent with Knecht (2019).

In our empirical analysis, although the homogeneity test was not statistically significant for dairy, both symmetry and the joint homogeneity and symmetry tests were highly significant suggesting consistency of the model with theoretical expectations. All regularity tests for vegetable imports were statistically significant at the 95% confidence level, indicating that the RSDAIDS model conforms with existing demand theory. Finally, all the homogeneity and symmetry tests for cereals were statistically significant as expected from theory. This validates the fitting of RSDAIDS model of Yang and Koo (1994).

The magnitude of the Marshallian and expenditure elasticities could suggest the relative extent of the complementarities or the substitutability. For instance, the magnitude of the cross elasticity of demand for beef between India and USA is 0.4362, and that between India and the ROW is 0.4052. This suggests that beef from USA is more complementary for beef from India, than the beef from the ROW. Similarly, beef from USA is a better substitute for beef from Australia than the beef from the ROW. We also note that Australian goat meat is the most preferred in the Qatari meat market followed by that from Brazil, India, and the UAE in that order. These findings are consistent with Miniaoui et al. (2018) and may reflect quality differences.

Moreover, all the expenditure elasticities for the meat market are positive. The results suggest that as beef imports increase, Qatar imports more from India, Australia, and the ROW in that order than from the USA. This could be explained by the close proximity that India and Australia are to Qatar relative to the USA despite having strong ties with the latter (Al-Eshaq and Rasheed 2022). It could also reflect the close cultural ties that Qatari residents have with the Indian subcontinent. Surprisingly, goat meat from all sources has an expenditure elasticity of less than unity. Nonetheless, all the expenditure elasticities being positive suggests a high preference for goat meat from ROW, India, and UEA in that order. Among poultry meat sources, Qatari residents seem to have a higher preference for poultry meat from the KSA and the ROW than from Brazil, which could be because the former was the main source of these products for a long time and Qatari residents got used to their commodities. In the sheep market, meat from Australia and the ROW is preferred to that from India. As mentioned above, stronger ties between Qatar and Australia regardless of the geopolitics between Qatar and its neighbors could have attributed to this (Australian Trade and Investment Commission (ATIC) (2022)).

With regard to seasonality effects, a few quarterly dummies were statistically significant, while the expenditure share of beef imports from Australia had swings conditional on the quarter of interest. This was also noticed for beef from ROW, goat from the UAE, and sheep from India. Most importantly, these changes in expenditure shares could be associated with the shifts in consumer tastes and preferences, as well as surges in the demand for particular meat types during religious, cultural, and social festivities in Qatar over those periods. Cultural, religious, and social festivities are significant to preserve the Qataris and Islamic image in Qatar (Fromherz 2017) which might have contributed to such seasonal swings in import demand.

Generally, our findings revealed that both Australian wheat and wheat from the ROW were own-price elastic, while Canadian wheat was price inelastic. Australian wheat was a gross complement for Canadian wheat while at the same time Canadian wheat was a gross substitute for both Australian wheat and wheat from the ROW. The price inelastic demand for Canadian wheat suggests that consumers are not as responsive to changes in the price of Canadian wheat as they are to wheat from Australia and the ROW. This somewhat suggests that wheat from Canada may be of higher quality and, thus, attracts a higher preference—and therefore, price—when everything else is held constant. That is, even though the price of wheat from Canada is higher than elsewhere, consumers from Qatar have inherent preference for Canadian wheat such that they would still buy it, which is common among consumers for goods that matter the most in their lives. This is consistent with Capitello et al. (2015), who observed that Chinese consumers have an attachment to French bottled wine and, therefore, are irresponsive to price changes. The Marshallian expenditure elasticities for all cereals were all positive except those for Indian corn and Canadian wheat. Therefore, keeping everything else constant, an increase in income of Qatari consumers will raise the demand for all cereals but diminish that for Indian corn and Canadian wheat. In other words, both Indian corn and Canadian wheat are inferior goods. Within each cereal group, Qataris preferred corn from the ROW followed by that from Argentina. They, however, did not prefer corn from India. Pakistani rice was preferred to that from the ROW and India; the latter was least preferred. Furthermore, wheat from the ROW was preferred to that from Australia. Canadian wheat was not preferred although it had the lowest unit price, which is rather counterintuitive.

6. Conclusions

Given Qatar's heavy dependence on food imports amidst the ever-changing political environment and supply-side challenges in food source countries, the question arises about how Qatar can design a food import strategy that meets its consumer preferences. This study determined import substitution elasticities that Qatar could use to address its food supply problem. We used the Restricted Source-Differentiated Almost Ideal Demand (RSDAIDS) model of Yang and Koo (1994) to estimate these elasticities for the four most important food chapters imported in Qatar between 2004 and 2017. This paper presents a useful empirical application of the Yang and Koo (1994) model which we recommend for wider use in similar studies. Theoretically, our results conform to demand theory, especially with respect to negative own-price Marshallian elasticities, except in the case for Indian and Pakistani rice which the study classifies as "Giffen" goods.

On Qatari consumer preferences, it is notable that beef and goat are better sourced from India while poultry and sheep could be competitively supplied by Brazil and Australia, respectively, given that the KSA would no longer be in the picture. In general, the raw materials are imported, and a large part of them is further processed. Consumer preferences may apply to vegetables, dairy products; but as regards to cereals, these are rather the preferences of food processors, so they are based on the price of the raw material and processing suitability. With regard to dairy products, cheese, and yoghurt, they could be sourced from the rest of the world while milk could be sourced from the Netherlands. India can supply onions while the Netherlands and Jordan could provide potatoes and tomatoes, respectively. Finally, corn is best sourced from Argentina while rice and wheat could come from Pakistan and Australia respectively.

Based on these results, India, Australia, and the Netherlands emerge as food import sources of major importance for Qatar. Minor suppliers include Brazil (poultry), Jordan (tomatoes), and Argentina (Corn). In sum, at the midst of disruptions of food systems brought about by the COVID-19 pandemic (Food and Agricultural Organization (FAO) (2021)) as well an economic blockade imposed by Qatar's neighbors, policymakers in Qatar and the Qatari government can assure sustained demand for food imports from India, Australia, the Netherlands, Brazil, Jordan, and Argentina in order to address its food security. Consistent with Ben Hassen et al. (2020); Siddiqi and Anadon (2011); Pearce (2008), while the COVID-19 pandemic and the 2017 blockade are different scenarios—both which threaten food security, the policies and international trade strategies adopted by Qatar in response to the 2017 rift prepared the country chiefly well for the COVID-19 outbreak. Their ability to overcome the 2017 crisis had already established a strong supply chain network (Ben Hassen et al. 2020) which is consistent with the results in this paper. Moving forward, it would be advisable for Qatar and other import-dependent countries to look into ways of enhancing good bilateral relations with these countries for a more sustainable and mutually beneficial food trade that would enhance global food security in the midst of the current pandemic and potential future crises.

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