

Forecasting the Global Market Behavior of Pistachio

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Abstract

Expanding the exports of agricultural products is an important current issue in Iran. There is a high potential in the production of pistachios as one of the main agricultural products with high foreign demand. The availability of salty water and lands in many areas of Iran has made a comparative advantage in producing this product. Iran is the biggest producer of pistachios comparing to the other countries and this is the third product (after oil and carpet) that yields the highest export income for Iran. However, the United States and Turkey have decreased the share of Iran in the trade market of pistachios from 77% in 1980 to 50% in 2016. Yet, the world trade market was getting affected from Iran's market. In this study, we are investigating the structure of the pistachio's world market and forecasting it until the year 2020.

Keywords: Market structure; Concentration Index; Pistachio.

1. Introduction

Iran is a four-season climate country that makes it possible to produce a wide range of agricultural products [1, 2]. According to the Food and Agriculture Organization (FAO), there are 66 main products consisting of 41 crops and 25 horticulture products which build the agricultural market structure in the world [3]. Iran has a better situation in trade of horticulture products comparing to crops. Pistachio makes the highest foreign income in the agricultural sector for this country and is the third main exporting product after oil and carpet [4, 5]. Pistachio is planted in Iran in the lands that have salty water and soil and generally, this kind of lands are not suitable for growing other products. Since there is a sufficient availability of salty water and land in Iran, pistachio has a comparative advantage between most of the other products.

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Iran has started exporting pistachio since 1974 and it was the only exporter for many years. This country has a main role in the global market of pistachio. For instance, because of the drought in Iran in 1997, the world price has increased significantly. The United States was the biggest importer of this product, but it became an exporter as well since 1979. Same as the United States, Turkey became a trade competitor for Iran after a while.

Investigating the market behavior of a strategic agriculture product like pistachio is an essential for success in the world market considering different competitors. To study the market behavior, the first step is to determine the competitors. In the second step, the share of each supplier or competitor should be calculated. Using the market shares and some other indexes, the market structure can be determined. Finally, the last step is to forecast the market behavior of pistachio in the future which can be helpful in determining policy decisions on the level of production.

Forecasting the market behavior is important for agricultural products because specially for some of these products, it takes a long period of time to change and adjust the level of production [6]. Unfortunately, undertaking some unsuitable policies and programs in Iran tends to decrease the share of this country in pistachio global market [7]. In this paper, I determine the global market structure of pistachio considering the level of production and market issues, as well as the trend of market concentration for this product in the future.

2. Methodology

In this section, we introduce some of the indexes that explain the market structure. The Concentration Ratio (CR) is a measure of the market shares held by particular suppliers in a market. In the other words, it is the percentage of total market sales by a given number of leading firms. For instance, a four-firm concentration ratio (CR4) is the total market share of the four firms with the largest market shares and an eight-firm concentration ratio (CR8) is associated to the eight largest firms [8]. Table 1 shows the standard values of CR4 and CR8 and the corresponding concentration in a market.

Table 1: Standard Criteria of Concentration

CR4	CR8	Concentration in market
≥ 75	≥ 90	Very high
65-75	85-90	High
50-65	70-85	Relatively high
35-50	45-70	Relatively low

Another useful index for measuring the market concentration is the Herfindhal-Hirschman index (HHI). This index is calculated as:

$$HHI = \sum_i s_i^2, \text{ where } s_i = \frac{f_i}{F}. \quad (1)$$

f_i shows the trade or investment flows of country i and F shows the total world trade or investment flows (i.e. $F = \sum_i f_i$); thus, s_i is the share of country i in the world trade or investment flows. The Herfindhal-Hirschman index is a flow-weighted concentration index which implies that it can be decomposed according to the shares of total flows of each country. The weight given to each country depends on the trade share of that country [8].

The Theil Entropy Coefficient (T) is another measure of concentration and is given by:

$$T = \sum_i s_i \log(s_i) \quad (2)$$

The other similar indicator is the Mean Logarithm Deviation (L) which is given by:

$$L = \log\left(\frac{1}{n} \sum_i f_i\right) - \frac{1}{n} \sum_i \log(f_i) \quad (3)$$

where n is the number of countries.

The data that we use in this paper includes the export values of pistachio from Iran and other exporters for the period of 1980-2016. We calculate the four indexes introduced using this data. The sources of data are Food and Agriculture Organization (FAO), The Islamic Republic of Iran Customs Administration, United States Department of Agriculture, and customs administrations of other major exporters [3, 9].

After determining the market structure, we use a simple method to forecast the market concentration. The Autoregressive Integrated Moving Average method (ARIMA) is one of the most popular models for time series forecasting analysis. This model has been generated from the combination of autoregressive model (AR) and the moving average model (MA) [10]. The ARIMA method can be used when the time series is stationary and there is no missing data. In the ARIMA analysis, an identified underlying process is generated based on the observations to estimate a good fit which can explain the process-generating mechanism precisely (Box and Jenkins, 1976). We use the concentration ratio for the top four exporters (CR4) in order to estimate the ARIMA model. The software that is used for this estimation is Eviews. To determine the best fitted ARIMA model, we use the mean absolute error (MAE) over N days given by

$$|\bar{\varepsilon}| = \frac{1}{N} \sum_{n=1}^N |\varepsilon_n|, \quad (4)$$

in which ε is prediction error. Furthermore, we use the mean absolute error percentage (MAEP) which is given by [11]

$$|\bar{\varepsilon}\%| = \frac{1}{N} \sum_{n=1}^N |\varepsilon_n\%| \quad (5)$$

A lower measure for MAEP shows a better fit for the model.

3. Results

Table 2 presents the concentration indexes for the world market of pistachio calculated using the formulas in the methodology section.

Table 2: Concentration Indexes for the World Market of Pistachio (1980-2016)

Year	CR4	HHI	T	L
1980s	0.92	0.45	1.40	0.45
1990s	0.81	0.44	1.35	0.43
2000s	0.88	0.32	1.26	0.31
2011	0.92	0.34	1.26	0.31
2012	0.95	0.41	1.19	0.33
2013	0.84	0.19	1.47	0.17
2014	0.68	0.19	1.46	0.18
2015	0.89	0.20	1.48	0.19
2016	0.85	0.20	1.47	0.18

As it can be seen in the table, the market was highly concentrated during the whole period of the study. The main competitors of Iran are United States, Germany, and Turkey. Although Turkey is a big producer, it is losing its share in the world market because of high domestic consumption and increasing costs of production. Some countries are re-exporters; when a producer country does not know about target market preferences, re-exporting has a high benefit for other countries. Therefore, if a country aims to increase its share and trade income from exporting pistachio, it should determine the target market preferences of this product. Countries like Germany and Netherlands does not have enough farm production for exporting; these countries are re-exporters.

As we mentioned in the previous section, the ARIMA model is used to forecast the market concentration of pistachio. Before estimating the ARIMA model, we should test if the variable has are stationary or not. The Augment Dickey-Fuller test (ADF) is used for this purpose and Table 3 shows the result of this test for the two variables of 'Concentration Ratio' and 'Share of Iran'.

Table 3: Results of Stationary Test with ADF

Variable Name	Stationary Type	ADF	Critical Value
Concentration Ratio	Trend and intercept	-3.55	-3.22
Share of Iran	Intercept	-6.87	-2.62

According to the table, 'Concentration Ratio' is stationary at level and the variable of 'Share of Iran' is stationary at first difference. After testing for the stationarity of the variables, the ARIMA model can be estimated and compared with different models. In order to determine the best fitted model, we are using MAEP. The results of different ARIMA models are reported in Tables 4 and 5.

Table 4: Results of the ARIMA model for Market Structure

	R ²	Se	AIC	SW	MAEP (%)
MA (4)	0.55	5.6	6.40	6.66	5.81
AR (1)	0.45	5.9	6.40	6.56	8.87
ARIMA (1,4)	0.73	4.6	6.03	6.31	9.04

Table 5: Results of different ARIMA models for Share of Iran

	R ²	Se	AIC	SW	MAEP (%)
ARIMA (2,1,0)	0.52	8.03	7.10	7.20	13.71
ARIMA (0,1,2)	0.43	8.80	7.28	7.42	18.79
ARIMA (1,1,2)	0.53	8.20	7.10	7.30	16.56
ARIMA (2,1,3)	0.58	6.07	6.64	6.92	9.18

The model ARIMA (2, 1, 3) has the best specification according to the results. Therefore, this model is used for forecasting concentration ratio. The results of forecasting CR4 are reported in Table 6.

Table 6: Predicting the share of Iran as CR4 (2014-2020)

Market Structure					Share of Iran	
Year	Real Value	MA(4)	AR(1)	ARMA(1,4)	Real Value	ARIMA(2,1,3)
2014	67.79	68.45	71.66	76.94	35.46	41.91
2015	89.35	78.92	72.87	82.32	44.68	46.30
2016	85.21	81.13	87.33	80.29	48.19	50.93
2017	-	78.95	84.55	72.70	-	49.90
2018	-	92.01	83.20	70.60	-	53.40
2019	-	95.56	82.01	69.80	-	51.10
2020	-	87.55	77.84	74.67	-	48.50

4. Conclusion

In this study, the market structure of pistachio is forecasted till the year 2020 by determining the market structure of this product from 1980 to 2016. The results show that Iran can use market power for determining the global market of pistachio due to its high market share.

Market concentration will decrease in 2020 which implies that the exporters should increase the quality of their products for better performance in the global market. The results also show that the global demand for pistachio will not decrease, but the share of Iran will decrease until 2020. Therefore, marketing policies like packaging, etc. should be undertaken. Also, in order to satisfy the high global demand, productivity management plans should be applied to increase the overall productivity in the agricultural sector [12], specially in the production of pistachio as a main exporting product. The role of government in undertaking both marketing policies and productivity management plans is an important issue to consider. As a less developed country, Iran is most likely to benefit from an increase in the focus on the role of government in policy making [13].

The final suggestion of this study could be related to the countries who are re-exporters. As we mentioned before, when a producer country doesn't know about the target market preferences, re-exporting would have a high benefit for other countries. Therefore, Iran should determine the target market preferences of pistachio to increase its share and trade income from exporting this product.

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