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Efficiency and Capacity of Iran's Cropland Products Exports: An Application of Stochastic Frontier Gravity Model

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Abstract

Iran's agricultural exports have grown significantly in recent years. Cropland products (HS07) have become the second most important group in Iran's agricultural exports over the last years. However, few studies have investigated the export potentials of cropland products. Therefore, this study aims to determine the main factors of Iran's cropland products exports and calculate the export efficiency and potential in the trading partners. For this aim, the stochastic frontier gravity model is estimated based on balanced panel data covering 21 importing countries over the period of 2001 to 2021. The results indicated that economic and physical size of importing countries have positive and significant effect on the exports of Iran's cropland products. In addition, common border between Iran and trading partners and economic sanctions have also positive and significant effect on the cropland products exports, while geographical distance between Iran and importing countries has negatively effects on the exports. The results of export efficiency showed that Iran does not have 100 percent efficiency in any destination market over the period of 2015 to 2021. Iran has an export efficiency of more than 50 percent only in Afghanistan, United Arab Emirates, Canada and Iraq. According to the results, Iran has the highest potential for exports of cropland products in Iraq. Hence, considering the high potentials in neighboring countries and significantly positive effect of common border partners, it is suggested that trading countries with common border like Iraq should be a top priority for the exports of cropland products.

Keywords: Agricultural exports, Trade efficiency, Trade potential

Introduction

The global trade network helps exporting countries adjust their production plans from low-efficiency sectors to high-efficiency sectors by identifying their advantageous production capacities (Isaiah Zayone *et al.*, 2020). Export-based growth is one of the approaches that researchers have always emphasized. In this approach, the analysis of export determinants is examined along with growth, because no export program can be successful without a deep understanding of the economic environment and its influencing factors on export (Atif *et al.*, 2017).

In recent decades, studies have determined the export capacities of countries using different methods. These studies examine various concepts such as measuring the degree of competitiveness (Fertö and Hubbard, 2003; Pawlak and Smutka, 2022), identifying trade determinants (Shepherd and Wilson, 2013; Hejazi *et al.*, 2022), analyzing survival rates in markets (Bojnec and Fertő, 2009; Engemann *et al.*, 2023) and other topics have been discussed. One of the concepts that has recently received

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serious attention from researchers and policymakers is export efficiency, which shows the export performance of a country in the destination markets. Export efficiency shows the amount of a country's actual exports compared to its maximum export capacity (Doan and Xing, 2018). From the perspective of bilateral trade, trade potential between two countries refers to the maximum amount of trade that can be achieved without any natural or man-made obstacles (Mohammadi *et al.*, 2020). Efficient export potentially improves the efficiency in the allocation of entities between different activities and increases market opportunities and creates jobs and businesses (European Commission, 2010). The performance and efficiency of countries in exporting products to trading partners are different and it is necessary to determine its degrees. Because focusing on determining the degree of export efficiency allows policy makers and planners to identify suitable export markets and minimize the restrictions and obstacles in trade in order to achieve full export potential. Analyzing the efficiency and performance of trade flows of different products is necessary for Iran as a developing country that needs planning and targeting in different economic sectors such as the agricultural sector.

The agricultural sector is considered as one of the most important axes of economic development in many countries of the world. In Iran, due to the existence of climatic diversity and lands prone to agriculture, this sector is one of the dynamic and productive sectors of the economy. Strengthening this sector is necessary in order to ensure food, political, and economic security, as well as reducing food imports and implementing non-oil export expansion policies (Mehrparvar Hosseini *et al.*, 2013; Mortazavi and Mojtahedi, 2016; Aminizadeh *et al.*, 2020). The development of the agricultural sector by paying attention to export capacities will increase the income of farmers and the rural community in the short term, improve the standard of living and well-being, as well as reduce poverty in the medium term and reverse migration from cities to villages in the long term (Hosseini *et al.*, 2018; Ghorbani and Aminizadeh, 2020). For this reason, in recent years, policy makers and decision makers have paid special attention to this sector. For example, in the Law on the Sixth Five-Year Economic, Cultural and Social Development Plan of the Islamic Republic of Iran for 2017-2021, which was approved in 2017, the development of agricultural exports and the strengthening of villages with an export-oriented approach have been emphasized.

In the last 20 years, the amount and share of Iran's agricultural sector's export has increased from the total export. Iran's agricultural exports have increased from $1 billion in 2001 to more than $5 billion in recent years (ITC, 2021). The share of agricultural exports has also increased from 4% in 2001 to about 8% (Fig. 1). It is worth noting that the growth of exports in recent years has not been focused on garden products and dry fruits as Iran's traditional export products, and the export of agricultural products, fishery products and processed and industrial products have grown significantly. Although in the last decade, the export of other products has grown and taken a high share, most of the studies have focused on the export of horticultural products and dry fruits. In recent years, selected cropland products (HS07), have a share of more than 16% of the export of agricultural products. While this share was nearly 6% in the period of 2001-2007.Also, the export amount has increased from about 100 million dollars in 2001 to more than 800 million dollars in 2021. In years like 2018 and 2019, the export amount was more than 1 billion dollars (Fig. 2). A high share of the export of cropland products is to regional trading partners, which creates a higher profit margin due to the reduction of transaction costs, including market search, contract closing, and transportation costs. Therefore, it can be said that these products has a high export potential and it is necessary to pay attention to identifying its various trade dimensions for planning and policy making. Therefore, this study attempts to examine the efficiency of Iran's agricultural products export and the factors affecting its export.

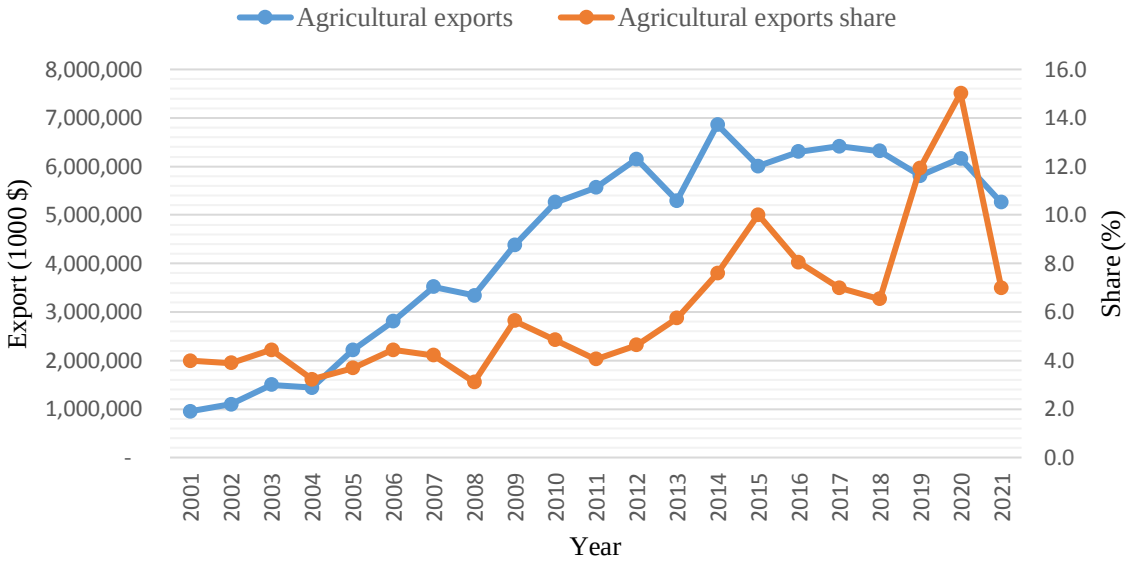

Figure 1- The amount and share of Iran's agricultural exports (2001-2021)
Source: International Trade Center, 2023

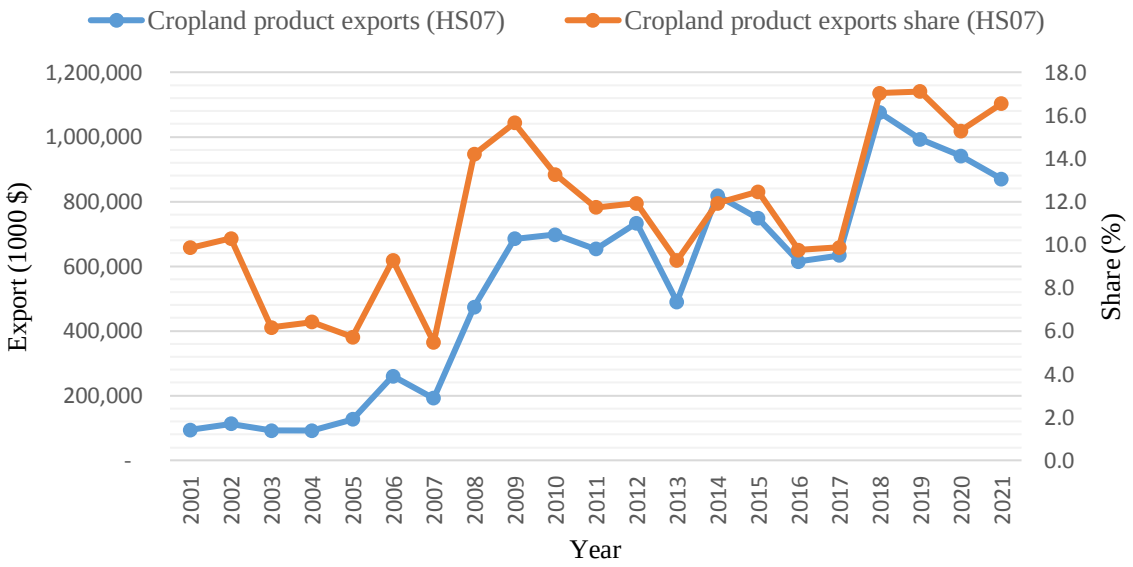

Figure 2- The amount and share of Iran's cropland products exports (HS07) (2001-2021)
Source: International Trade Center, 2023

Determining the efficiency of exports has received serious attention from researchers in recent years. Atif *et al.* (2017) showed that the economic size of the trading partners, regional trade agreements, bilateral exchange rate and common border have positive effects on Pakistan's agricultural exports, while geographical distance and tariff have negative effects on exports. Also, the efficiency results showed that Pakistan has great export potential with neighboring, European and Middle Eastern countries. Mohammadi *et al.* (2020)

showed that the efficiency of Iran's pistachio exports in European countries has been declining, while the export efficiency has been increasing for Asian countries and has reached from 0.412 to 0.567. Hajivand *et al.* (2020) showed that GDP and population have a positive and significant effect, while geographical distance and tariff have a negative and significant effect on Iran's agricultural exports. They also showed that Iran has high potential in destination markets. Abdullahi *et al.* (2021) indicated that the economic size of Nigeria and its trading partners, the population of importers, EU membership, ECO agreement membership, and common border between Nigeria and its partners increase the agricultural exports, while, distance, internal population, exchange rate, language and landlocked have a negative effect on the export of agricultural products. Their findings indicate that there is potential to expand agricultural trade with most of the world's major economies (including China, USA, Brazil, India, Russia, Japan, and EU countries) and Nigeria's neighboring countries. Abdullahi *et al.* (2022) showed that the economic size variable of China and its importing countries and the virtual variables of the countries in the Belt & Road Initiative, the common border and the Chinese language have a positive effect on the flow of China's agricultural exports. On the other hand, the results also show that China's agricultural exports are adversely affected by GDP per capita of China and its trading partners, currency depreciation, distance, and landlocked. According to the findings, on average, China has not used the potential of 51 percent in its agricultural exports. Nguyen (2022) revealed that Vietnam has great potential to increase rice and coffee exports with its main trading partners. They suggested that exports to EU member countries should be given serious consideration. Ahmad Hamidi *et al.* (2022) indicated that Indonesia and Malaysia have great potential to use more than similar countries, namely China, India, Thailand, and USA. They suggested that policymakers of both countries should formulate a new hybrid strategy to maximize palm oil exports to their trading partners. Mohammadi *et al.* (2022) showed that the efficiency of Iran's saffron exports in 2017 is equal to 45 percent. The results revealed that Iran has the highest efficiency in Spain (93 percent) and United Arab Emirates (87 percent), respectively, while the lowest efficiency is in Japan (7 percent) and England (13 percent). Also, the results showed that the export efficiency in Asian markets has increased and reached 0.41 in 2017 from 0.31 in 2001. Tandra and Suroso (2023) found that Importer's GDP, bilateral exchange rate and WTO membership have a positive and significant effect on Indonesia's palm oil exports. However, there are significant and negative effects of geographical distance between Indonesia and trading partners and landlocked countries. In addition, the results show that Indonesia does not have maximum efficiency in any destination market. Xu and Num (2023) indicated that the variables of the economic size of the trading partner and the added value of the agricultural sector and membership in the WTO have positive effects on exports, while distance has negative effect. The efficiency results also show that Vietnam has low efficiency in large markets and its potential is very high. They suggested that the Vietnamese government should focus on designing a policy framework to encourage export companies to invest more in technology, especially for large markets such as USA, Japan, and Korea.

The purpose of this paper is threefold. First, to identify the factors affecting the export of Iran's cropland products to trading partners. Second, to measure the efficiency of Iran's exports in the destination markets and determine the export potential of these markets. Third, to identify the markets with higher levels of profitability by forming the efficiency-potential matrix. The rest of this study is organized as follows. Section 2 provides data and methodology. Section 3 presents the results and discussion. Section 4 concludes some policy recommendations for policy makers and future studies.

Data and Methodology

The gravity model was first used by Tinbergen (1962) in international trade and became a widely used tool for analyzing trade flows (Natale *et al.*, 2015; Assoua *et al.*, 2022; Ha, 2023) and in recent years, it is used in various fields of study such as foreign direct investment (Kahouli and Maktouf, 2015; Badarinza *et al.*, 2022; Okara, 2023) and migration (Manzoor *et al.*, 2021; Arif, 2022). The basic form of the gravity model is defined as equation (1):

$$T_{ijt} = \beta_0 + \beta_i X_{ijt} + \varepsilon_{ijt} \quad (1)$$

where i, j and t represent Iran, importing countries and year, respectively. T_{ijt} and X_{ijt} denote the trade flows and independent variables, respectively. β is regression coefficients and ε_{ijt} is residual error.

Considering the importance of determining the export efficiency degree, many researchers used the traditional gravity model to measure the trade potential between countries (see Nilsson, 2000; Egger, 2002; Ülengin *et al.*, 2015). However, a number of studies such as Anderson and Wincoop (2003) and Armstrong (2007) showed that this method is not effective.

The stochastic frontier gravity model, which is a combination of two widely used methods, the gravity model and the stochastic frontier production function model (Aigner *et al.*, 1977), has well solved the problems of calculating efficiency using the previous method (Xu *et al.*, 2022). This method has been used in recent years in extensive international studies (Kalirajan, 2007; Ravishankar and Stack, 2014; Nasir and Kalirajan, 2016; Atif *et al.*, 2019; Noviyani *et al.*, 2019; Xu *et al.*, 2022; Abdullahi *et al.*, 2022; Ahmad Hamidi *et al.*, 2022; Tandra and Suroso, 2023; Liu and Zhou, 2023). The stochastic frontier gravity model is defined as equation (2):

$$T_{ijt} = \beta_0 + \beta_i X_{ijt} + \upsilon_{ijt} - u_{ijt} \quad (2)$$

where u_{ijt} shows technical efficiency and identifies the extent to which the actual exports level strays from the maximum potential exports .v_{ijt} represents a double-sided error term. Other parameters are defined in equation (1). For export efficiency can be estimated by equation (3) (Battese and Coelli, 1988):

$$E\left[\exp\left(-u_{ij}^{t}\middle|\varepsilon_{ij}^{t}\right)\right] = \left[\frac{1-\phi\left(\sigma_* - \frac{\mu_{*ij}^{t}}{\sigma_*}\right)}{1-\phi\left(-\frac{\mu_{*ij}^{t}}{\sigma_*}\right)}\right]\exp\left(-\mu_{*ij}^{t} + \frac{1}{2}\sigma_*^2\right) \quad (3)$$

The export efficiency can be calculated for each importing country range between 0 and 1. A score equal to 1 shows that the actual and potential exports coincides while score near to 0 reveals that the actual exports is below the potential exports. This means there are possibilities for the further exports.

The model specification of export determinants between Iran and its trading partners is specified as equation (4):

$$\begin{aligned} LnEXP_{ijt} = {} & \beta_0 + \beta_1 PCGDP_{jt} \\ & + \beta_2 POP_{jt} \\ & + \beta_3 DIS_{ij} + \beta_4 ED_{ijt} \\ & + \beta_5 LandBorder_{ij} \\ & + \beta_6 SeaBorder_{ij} \\ & + \beta_7 INT - Sanc_t \\ & + \beta_8 USA - Sanc_t \\ & + \beta_9 COVID19_t \\ & + \upsilon_{ijt} - u_{ijt} \end{aligned} \quad (4)$$

where EXP_{ijt} denotes the exports of Iran's cropland products to trading partners. $PCGDP_{jt}$ and POP_{jt} represent the GDP per capita and population of importing countries, respectively, and DIS_{ij} shows the geographical distance between Iran and importing countries as a proxy of transaction costs between countries. ED_{ijt} denotes the economic distance. Considering that Iran's trade relations with many neighboring countries are only through the sea, in this study, the common border variable between Iran and its trading partner is divided into two common land border ($LandBorder_{ij}$) and common sea border ($SeaBorder_{ij}$) variables. These variables are defined as dummy variables (i.e. 1 if Iran and importing countries have common border and 0 otherwise).The variables of $INT\text{-}SANC_t$ and $USA\text{-}SANC_t$ denote international sanction (2010-2015) and US sanction (2018-2021). These variables are defined as dummy variables (i.e. 1 for years of sanctions and otherwise).COVID19 variable shows the pandemic of COVID19 and defined as a

dummy variable (i.e. 1 for the years 2020 and 2021 and 0 otherwise). Table 1 provide expected sign and source of variables.

In order to achieve the aims of this study, the export data of selected cropland products (HS07) of Iran to 21 main importing countries, which account for more than 99% of Iran's exports, have been analyzed. The stochastic frontier gravity model is estimated from the procedure proposed by Belotti *et al.* (2013) using Stata 17 software.

Results and Discussion

The results of unit root test and collinearity test are presented in Table 2. Our findings indicated that all variables are stationary. Additionally, the results showed that there is no multicollinearity in our model.

Table 1- Data source and expected sign of each variable

Variable	Expected sign	Source
Iran's Exports		International Trade Center (ITC)
Trading partners' income	+	World Bank
Trading partners' population	+	World Bank
Geographical distance	−	CEPII
Economic difference	− / +	Author calculation based on World Bank data
Common land border	+	-
Common sea border	+	-
International Sanction (2010-2015)	− / +	Samore (2015)
US sanction (2018-2021)	− / +	-
Covid-19 pandemic (2020-2021)	− / +	-

Table 2- The results of unit root test (Levin, Lin and Chu -LLC) and multi-collinearity (VIF)

Variable	VIF	LLC	
		Coefficient	p-Value
Iran's Exports	−	-4.587	0.000
Trading partners' income	2.80	-8.442	0.000
Trading partners' population	2.10	-7.741	0.000
Geographical distance	2.73	-	-
Economic difference	2.66	-5.590	0.000
Common land border	2.05	-	-
Common sea border	2.20	-	-
International Sanction (2010-2015)	1.18	-	-
US sanction (2018-2021)	1.98	-	-
Covid-19 pandemic (2020-2021)	1.81	-	-
Mean VIF	2.17	-	-

Source: Research findings

Table 3 provides the results of stochastic frontier gravity model. Lambda coefficient is statistically significant at 1 percent level, showing that there is inefficiency and the stochastic frontier gravity model is suitable method.

The results indicated that GDP per capita of importing countries has positive and statistically significant effect at 5 percent level on Iran's cropland products exports. Increase in GDP per capita leads to increase in food demand and so more import. This result is consistent with Atif *et al.* (2017) for agricultural exports in Pakistan, Mohammadi *et al.* (2020) for pistachio exports in Iran and Mohammadi *et al.* (2022) for Iranian exports of saffron, revealing that the economic size of importing countries positively affect the exports. The population of importing countries has positive and statistically significant effect at 1 percent level on Iranian exports of cropland products. Importing countries with higher population have more imports. The distance variable has the expected negative and statistically

significant effect at 1 percent level on the exports of cropland products. This means export of cropland products is more in near importing countries. The main reasons are the high perishability of cropland products and transaction costs. The results show that economic distance between Iran and its trading partners has positive but insignificant effect on exports of cropland products. This result is contrary to the results of Mohammadi *et al.* (2020) for Iranian pistachio exports, indicating that economic distance has a significantly positive effect on pistachio exports to the trading partners. Possible reason is that pistachio is one of product with high price which leads high-income countries import more compared to other countries. The results indicated that common land border and common sea border have positive and statistically significant effect at 1 percent level on cropland products exports. Similar social and cultural factors, lifestyle and food preferences between neighboring countries leads to more food trade between them. This finding is consistent with the results of Atif *et al.* (2017) for agricultural products in Pakistan and Mohammadi *et al.* (2020) for pistachio exports in Iran. Our results show that international economic sanctions (2010-2015) and USA economic sanctions (2018-2021) have positive and significant effect on the exports of cropland products. The main reason is that important trading partners are neighboring countries such as Iraq with similar conditions. So, Iran increases the agricultural exports to trading partners with similar cultural, social and political conditions. This finding is contrary to the results of Mohammadi *et al.* (2020), showing that international economic sanctions has negative and significant effect on pistachios exports. Because EU countries as the most important trade partner of USA were main importers of Iran's pistachios and international sanctions reduced Iran's pistachio exports to these countries. Our findings reveal that COVID19 pandemic has not significant effect on exports of cropland products from Iran to its trading countries.

Table 3- The results of stochastic frontier gravity model

Variable	Coefficient	Std. dev.	T statistics	p-Value
Trading partners' income	0.358	0.156	2.30	0.022
Trading partners' population	1.032	0.136	7.56	0.000
Geographical distance	-2.190	0.435	-5.03	0.000
Economic difference	0.153	0.204	0.75	0.452
Common land border	2.606	0.510	5.11	0.000
Common sea border	2.262	0.567	3.98	0.000
International Sanction (2010-2015)	0.263	0.140	1.88	0.060
US sanction (2018-2021)	0.863	0.261	3.30	0.001
Covid-19 pandemic (2020-2021)	0.505	0.319	1.59	0.113
Constant	2.463	2.686	0.92	0.359
Lambda coefficient	7.485	1.502	4.68	0.000
Wald statistics	541.84 (0.000)			

Source: Research findings

The results of Iran's export efficiency and export potential in the destination markets are shown in Table 4. Efficiency results are reported in the period 2001-2021 and three sub-periods 2001-2007, 2008-2014 and 2015-2021. In the period of 2015-2021, Iran does not have 100 percent export efficiency in any country, and the highest level of efficiency has been observed in Afghanistan. Iran has used 65.1 percent of the Afghanistan and 35 percent of its capacity has not been used. Therefore, it can be seen that the efficiency of Iran's exports in the three countries of the United Arab Emirates, Canada and Iraq is more than 50 percent. While the lowest level of efficiency has been observed in India with 1 percent. In other words, Iran faces a high capacity (99 percent) in the Indian market. Also, the export efficiency in Türkiye (2 percent), Bahrain (2.5 percent), Kuwait (8.3 percent), Armenia (9.4 percent) and Azerbaijan

(9.4 percent) is less than 10 percent. In other words, a high export potential is observed in these countries. The results show that in the period of 2015-2021, the most unused potential is allocated to Iraq with more than 533 million dollars. Also, countries of Azerbaijan (295.3 million dollars), Pakistan (288.0 million dollars), Türkiye (238.8 million dollars), Russia (170.8 million dollars), Turkmenistan (131.0 million dollars) and Kuwait (118.8 million dollars) have an export potential of more than 100 million dollars, while the export potential of Canada, Kyrgyzstan, Georgia, Ukraine, Uzbekistan and Germany is less than 10 million dollars.

Table 4- The efficiency (EFF) and potential (PO) of Iran's export in importing countries (HS07)

Country	2021		2001-2021		2001-2007		2008-2014		2015-2021	
	EFF	PO	EFF	PO	EFF	PO	EFF	PO	EFF	PO
Afghanistan	54.90	62.0	47.50	19.5	19.10	10.0	58.30	16.3	65.10	32.2
Armenia	15.60	52.8	8.80	21.1	3.90	11.1	13.00	19.0	9.40	33.2
Azerbaijan	4.30	566.4	17.30	165.1	14.90	66.8	27.70	133.2	9.40	295.3
Bahrain	0.90	37.8	7.30	10.7	14.00	3.5	5.50	8.1	2.50	20.4
Canada	19.20	1.0	46.70	0.2	47.50	0.1	39.60	0.2	52.90	0.4
Georgia	28.70	3.6	35.80	1.2	14.30	0.8	48.40	1.0	44.80	1.9
Germany	1.90	18.8	10.20	6.1	8.70	3.6	10.00	5.0	11.80	9.9
India	0.30	173.1	19.00	54.6	66.60	11.9	0.40	45.9	1.00	92.6
Iraq	23.80	1075.1	47.10	278.2	24.00	116.1	65.00	185.3	52.20	533.3
Kazakhstan	22.30	41.1	21.20	12.7	13.80	4.1	31.80	9.9	17.80	24.3
Kuwait	2.50	213.6	7.00	69.8	9.00	27.6	3.70	62.9	8.30	118.8
Kyrgyzstan	70.30	0.5	25.80	0.2	33.10	0.1	8.30	0.2	28.50	0.4
Oman	37.50	31.6	18.10	10.5	6.90	4.0	6.10	9.8	39.70	16.7
Pakistan	10.20	536.1	12.80	163.2	21.20	63.0	6.60	138.5	10.50	288.0
Qatar	39.00	61.9	24.00	19.7	29.10	4.7	3.10	21.5	39.70	33.0
Russia	20.20	342.0	31.80	98.0	6.60	51.2	54.20	72.1	34.60	170.8
Türkiye	0.40	422.2	2.60	139.8	2.30	65.0	3.40	115.4	2.00	238.8
Turkmenistan	5.50	263.8	29.30	64.4	5.10	25.5	50.30	36.7	32.40	131.0
United Arab Emirates	57.90	114.2	65.10	35.2	61.70	12.1	70.10	29.1	63.50	64.3
Ukraine	51.90	3.7	26.30	2.1	36.80	1.2	10.60	2.2	36.10	2.5
Uzbekistan	73.20	5.1	12.80	2.5	6.40	1.1	3.10	2.9	28.40	3.8

Source: Research findings

The results of the efficiency-capacity matrix based on the time period of 2015-2021 are presented in Table 5. According to the results, among all importing countries, only Iraq has an export efficiency above 50% and export potential of more than 100 million dollars. This shows that the trading link between Iran and Iraq in the last two decades due to political, cultural and religious similarities has created suitable conditions for Iran to export agricultural products. It can also be seen that the markets of Russia, Turkmenistan and Pakistan have a high export potential with medium efficiency. So, these countries are in the main export priorities after Iraq. On the other hand, trading partners such as Canada, Ukraine, Uzbekistan, Kyrgyzstan, Germany and Georgia, have low export potential and are in the last priority. It is worth noting that the countries of Canada and Germany have no advantage in terms of geographical distance and transportation costs compared to other trading partners.

Conclusions and Policy implications

The importance of export and measuring the performance of countries in global markets has led studies to investigate the export efficiency in order to determine the degree of success of marketing programs and trading policies in destination markets. In this study, it has been tried to investigate the export of selected cropland products that have received less attention from researchers. Therefore, this study has three main objectives. First, to determine the factors affecting the Iran's cropland products exports to the main trading partners. Second, to determine the export

efficiency of Iran in destination markets. Third, to provide an efficiency/capacity matrix to present appropriate marketing packages. For these objectives, the stochastic frontier gravity model is estimated for 21 Iran's trading partners over the period of 2001-2021.

Table 5- Efficiency/Potential matrix for Iran's trading partners

		Efficiency		
		High $EFF > 50\%$	**Medium** $10\% < EFF < 50\%$	**Low** $10\% > EFF$
Future Potential	High $PO > 100\ million\$$	Iraq	Russia, Turkmenistan, Pakistan	Azerbaijan, Türkiye, Kuwait
	Medium $10\ million\$ < EFF < 100\ million\$$	UAE, Afghanistan	Kazakhstan, Oman, Qatar	Armenia, Bahrain, India
	Low $10\ Million\$ > EFF$	Canada	Ukraine, Uzbekistan, Kyrgyzstan, Germany, Georgia	–

Source: Research findings

Our findings showed that the economic and physical size of the importing countries have a positive and significant effect on Iran's exports, while the geographical distance has a negative effect. In addition, the common border has a positive and significant effect on Iran's exports. International sanctions and USA sanctions do not have a restrictive effect. In other words, sanctions has positive effect on Iran's cropland products exports. According to the results, on the one hand, Iran has export efficiency higher than 50% only in four countries, namely, Afghanistan, United Arab Emirates, Canada and Iraq. On the other hand, it can be seen that the export potential for the countries of Iraq, Azerbaijan, Pakistan, Türkiye, Russia, Turkmenistan and Kuwait was more than 100 million dollars. This means there is a lot of potential for Iran to develop the export of cropland products. Based on the results, the following suggestions can be presented. Considering the low export efficiency and high export potential, it is recommended to pay attention to the characteristics of destination markets such as health standards, customer taste preferences, cultural and social status in order to adopt appropriate marketing plans and trade policies. It is also suggested to pay special attention to competitive pricing and packaging in destination markets where there are main trading competitors such as Türkiye and Russia. Based on the results, the common border has a positive effect on Iran's exports, and considering the cultural and food similarities between Iran and its trading partners with common border, it is recommended to special attention to the market of these countries. Because cultural, social and political similarities between Iran and this group of trading partners make it easier to obtain information and generally reduce transaction costs. Considering the significant effect of GDP per capita and population, it is recommended to pay attention to the markets with large economic and physical size, which have faced market growth in recent years. For example, Iran has high export potential and high export efficiency in Iraq. In future studies, it is suggested to measure the export efficiency of Iran and its competitors in destination markets. This helps to choose the suitable destination markets with less competition in order to adopt the suitable trade policies. Especially, Türkiye and Russia have an active presence in the countries of the Middle East region like Iraq and United Arab Emirates and in Central Asian countries like Kazakhstan and Kyrgyzstan, respectively. Therefore, determining the level of competitiveness of competitors can be of great help in shaping marketing plans.

References

1. Abdullahi, N.M., Huo, X., Zhang, Q., & BolanleAzeez, A. (2021). Determinants and potential of agri-food trade using the stochastic frontier gravity model: Empirical evidence from Nigeria. *Sage Open*, *11*(4), 21582440211065770. https://doi.org/10.1177/21582440211065770
2. Abdullahi, N.M., Zhang, Q., Shahriar, S., Irshad, M.S., Ado, A.B., & Huo, X. (2022). Examining the determinants and efficiency of China's agricultural exports using a stochastic frontier gravity model. *Plos One*, *17*(9), e0274187. https://doi.org/10.1371/journal.pone.0274187
3. Ahmad Hamidi, H.N., Khalid, N., Karim, Z.A., & Zainuddin, M.R.K. (2022). Technical efficiency and export potential of the world palm oil market. *Agriculture*, *12*(11), 1918. https://doi.org/10.3390/ agriculture12111918
4. Aigner, D., Lovell, C.K., & Schmidt, P. (1977). Formulation and estimation of stochastic frontier production function models. *Journal of Econometrics*, *6*(1), 21-37. https://doi.org/10.1016/0304-4076(77)90052-5
5. Aminizadeh, M., Rafiee, H., Riahi, A., & Mehrparvar Hosseini, E. (2020). Assessing the role of institutional quality of Iran and its trade partners on Iran's agricultural products exports. *Iranian Journal of Agricultural Economics and Development Research*, *51*(1), 1-13. https://doi.org/10.22059/ijaedr.2019.258788.668610
6. Anderson, J.E., & Van Wincoop, E. (2003). Gravity with gravitas: A solution to the border puzzle. *American Economic Review*, *93*(1), 170-192. https://doi.org/10.1257/000282803321455214
7. Arif, I. (2022). Educational attainment, corruption, and migration: An empirical analysis from a gravity model. *Economic Modelling*, *110*, 105802. https://doi.org/10.1016/j.econmod.2022.105802
8. Armstrong, S.P. (2007). Measuring trade and trade potential: A survey. *Crawford School Asia Pacific Economic Paper*, (368). http://dx.doi.org/10.2139/ssrn.1760426
9. Assoua, J.E., Molua, E.L., Nkendah, R., Choumbou, R.F.D., & Tabetando, R. (2022). The effect of sanitary and phytosanitary measures on Cameroon's cocoa exports: An application of the gravity model. *Heliyon*, *8*(1). e08754. https://doi.org/10.1016/j.heliyon.2022.e08754
10. Atif, R.M., Haiyun, L., & Mahmood, H. (2017). Pakistan's agricultural exports, determinants and its potential: an application of stochastic frontier gravity model. *The Journal of International Trade & Economic Development*, *26*(3): 257-276. https://doi.org/10.1080/09638199.2016.1243724
11. Atif, R.M., Mahmood, H., Haiyun, L., & Mao, H. (2019). Determinants and efficiency of Pakistan's chemical products' exports: An application of stochastic frontier gravity model. *PLOS ONE*, *14*(5), 1-15. https://doi.org/10.1371/journal.pone.0217210
12. Badarinza, C., Ramadorai, T., & Shimizu, C. (2022). Gravity, counterparties, and foreign investment. *Journal of Financial Economics*, *145*(2), 132-152. https://doi.org/10.1016/j.jfineco.2021.09.011
13. Battese, G.E., & Coelli, T.J. (1988). Prediction of firm-level technical efficiencies with a generalized frontier production function and panel data. *Journal of Econometrics*, *38*(3), 387-399. https://doi.org/10.1016/0304-4076(88)90053-X
14. Belotti, F., Daidone, S., Ilardi, G., & Atella, V. (2013). Stochastic frontier analysis using Stata. *The Stata Journal*, *13*(4), 719-758. https://doi.org/10.22004/ag.econ.252689
15. Bojnec, Š.,& Fertő, I. (2009). Agro-food trade competitiveness of Central European and Balkan countries. *Food Policy*, *34*(5), 417-425. https://doi.org/10.1016/j.foodpol.2009.01.003
16. Centre d'Etudes Prospective et d'Informations Internationals. (2023). CEPII Database. Available at http://www.cepii.fr/

17. Doan, T.N., & Xing, Y. (2018). Trade efficiency, free trade agreements and rules of origin. *Journal of Asian Economics*, *55*, 33-41. https://doi.org/10.1016/j.asieco.2017.12.007
18. Egger, P. (2002). An econometric view on the estimation of gravity models and the calculation of trade potentials. *World Economy*, *25*(2), 297-312. https://doi.org/10.1111/1467-9701.00432
19. Engemann, H., Jafari, Y., & Heckelei, T. (2023). Institutional quality and the duration of agri-food trade flows. *Journal of Agricultural Economics*, *74*(1), 135-154. https://doi.org/10.1111/1477-9552.12491
20. European Commission. (2010). Trade, growth and world affairs. Trade policy as a core component of the EU's 2020 strategy. European Economic and Social Committee, France.
21. Fertö, I., & Hubbard, L.J. (2003). Revealed comparative advantage and competitiveness in Hungarian agri-food sectors. *World Economy*, *26*(2), 247-259. https://doi.org/10.1111/1467-9701.00520
22. Ghorbani, M., & Aminizadeh, M. (2020). Investigating the effective factors on Iranian date exports to European Union. *Agricultural Economics*, *14*(2), 131-153. https://doi.org/10.22034/iaes.2021.135209.1782
23. Ha, L.T. (2023). The role of financial development in enhancing trades in environmental goods: International insights from 119 countries. *Journal of Commodity Markets*, *29*, 100301. https://doi.org/10.1016/j.jcomm.2022.100301
24. Hajivand, S., Moghaddasi, R., Zeraatkish, Y., & Mohammadinejad, A. (2020). An application of stochastic frontier gravity approach (the case of Iran's potential agricultural exports). *International Journal of Analysis and Applications*, *18*(3), 482-492.
25. Hejazi, M., Grant, J.H., & Peterson, E. (2022). Trade impact of maximum residue limits in fresh fruits and vegetables. *Food Policy*, *106*, 102203. https://doi.org/10.1016/j.foodpol.2021.102203
26. Hosseini, S.S., Aminizadeh, M., & Yazdani, S. (2018). Assessing the implications of tax-trade policies on soil erosion; Application of multi-sector general equilibrium model. *Agricultural Economics Research*, *10*(37), 41-64. (In Persian with English abstract)
27. International Trade Center. (2023). www.trademap.org.
28. Isaiah Zayone, T., Henneberry, S.R., & Radmehr, R. (2020). Effects of agricultural, manufacturing, and mineral exports on Angola's economic growth. *Energies*, *13*(6), 1494. https://doi.org/10.3390/en13061494
29. Kahouli, B., & Maktouf, S. (2015). The determinants of FDI and the impact of the economic crisis on the implementation of RTAs: A static and dynamic gravity model. *International Business Review*, *24*(3), 518-529. https://doi.org/10.1016/j.ibusrev.2014.10.009
30. Kalirajan, K. (2007). Regional cooperation and bilateral trade flows: an empirical measurement of resistance. *The International Trade Journal*, *21*(2), 85-107. https://doi.org/10.1080/08853900701266555
31. Liu, Z., & Zhou, X. (2023). Can direct subsidies or tax incentives improve the R&D efficiency of the manufacturing industry in China?. *Processes*, *11*(1), 181. https://doi.org/10.3390/pr11010181
32. Manzoor, W., Safdar, N., & Mahmood, H.Z. (2021). A gravity model analysis of international migration from BRIC to OECD countries using Poisson Pseudo-maximum likelihood Approach. *Heliyon*, *7*(6), e07357. https://doi.org/10.1016/j.heliyon.2021.e07357
33. Mehrparvar Hosseini, E., Aminizadeh, M., Rafiee, H., Riahi, A., & Bastani, M. (2013). Designing of Iranian dates trade model; Application of trade advantages and theory of market structure. *Iranian Journal of Agricultural Economics*, *7*(2), 19-46. (In Persian with English abstract)
34. Mohammadi, H., Aminizadeh, M., & Aghasafari, H. (2020). Investigating the Iran's export efficiency in pistachio target markets: Application of stochastic frontier gravity model. *Agricultural Economics & Development 34*(1): 1-18. (In Persian with English abstract). https://doi.org/10.22067/JEAD2.VI0.83705

35. Mohammadi, H., Aminizadeh, M., & Aghasafari, H. (2022). Measuring the export efficiency of Iran's saffron. *Saffron Agronomy and Technology 10*(1): 69-83. (In Persian with English abstract). https://doi.org/10.22048/jsat.2022.297596.1432
36. Mortazavi, S.A., & Mojtahedi, F. (2016). Exchange rates translation effect on export price of dates Iran: Application Model ARDL. *Iranian Journal of Agricultural Economics and Development Research, 46*(4), 719-727. (In Persian with English abstract). https://doi.org/10.22059/ijaedr.2016.58027
37. Nasir, S., & Kalirajan, K. (2016). Information and communication technology-enabled modern services export performances of Asian economies. *Asian Development Review, 33*(1), 1-27. https://doi.org/10.1162/ADEV_a_00059
38. Natale, F., Borrello, A., & Motova, A. (2015). Analysis of the determinants of international seafood trade using a gravity model. *Marine Policy*, *60*, 98-106. https://doi.org/10.1016/j.marpol.2015.05.016
39. Nguyen, D.D. (2022). Determinants of Vietnam's rice and coffee exports: using stochastic frontier gravity model. *Journal of Asian Business and Economic Studies*, *29*(1), 19-34. https://doi.org/10.1108/JABES-05-2020-0054
40. Nilsson, L. (2000). Trade integration and the EU economic membership criteria. *European Journal of Political Economy*, *16*(4), 807-827. https://doi.org/10.1016/S0176-2680(99)00060-9
41. Noviyani, D.S., Na, W., & Irawan, T. (2019). Indonesian export efficiency: a stochastic frontier gravity model approach. *International Journal of Scientific Research in Science, Engineering and Technology*, *6*(1), 488-497. https://doi.org/10.32628/IJSRSET1196190
42. Okara, A. (2023). Does foreign direct investment promote political stability? Evidence from developing economies. *Economic Modelling*, *123*, 106249. https://doi.org/10.1016/j.econmod.2023.106249
43. Pawlak, K., & Smutka, L. (2022). Does Poland's agri-food industry gain comparative advantage in trade with non-EU countries? Evidence from the transatlantic market. *Plos One*, *17*(9), e0274692. https://doi.org/10.1371/journal. pone.0274692
44. Ravishankar, G., & Stack, M.M. (2014). The gravity model and trade efficiency: a stochastic frontier analysis of eastern European countries' potential trade. *The World Economy, 37*(5): 690-704. https://doi.org/10.1111/twec.12144
45. Samore, G. (2015). Sanctions against Iran: a guide to targets, terms, and timetables. *Belfer Center for Science and International Affairs*, 28-29.
46. Shepherd, B., & Wilson, N.L. (2013). Product standards and developing country agricultural exports: The case of the European Union. *Food Policy*, *42*, 1-10. https://doi.org/10.1016/j.foodpol.2013.06.003
47. Tandra, H., & Suroso, A.I. (2023). The determinant, efficiency, and potential of Indonesian palm oil downstream export to the global market. *Cogent Economics & Finance*, *11*(1), 2189671. https://doi.org/10.1080/23322039.2023.2189671
48. Tinbergen, J. (1962). Shaping the world economy: Suggestions for an international economic policy. Twentieth Century Fund, New York.
49. Ülengin, F., Çekyay, B., Palut, P.T., Ülengin, B., Kabak, Ö., Özaydın, Ö., & Ekici, Ş.Ö. (2015). Effects of quotas on Turkish foreign trade: A gravity model. *Transport Policy*, *38*, 1-7. https://doi.org/10.1016/j.tranpol.2014.09.006
50. World Bank. (2023). World Bank Database. Available at https://databank.worldbank.org.
51. Xu, H., & Nam, N.H. (2023). Determinants of Vietnam's potential for agricultural export trade to Asia-Pacific economic cooperation (APEC) members. *Heliyon*, *9*(2). e13105. https://doi.org/10.1016/j.heliyon.2023.e13105
52. Xu, J., Lu, C., Ruan, S., & Xiong, N.N. (2022). Estimating the efficiency and potential of China's steel products export to countries along the "Belt and Road" under interconnection: An

application of extended stochastic frontier gravity model. *Resources Policy*, *75*, 102513. https://doi.org/10.1016/j.resourpol.2021.102513

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بررسی کارایی و ظرفیت صادراتی محصولات زراعی ایران: کاربرد الگوی جاذبه مرزی تصادفی

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چکیده

صادرات کشاورزی ایران در سال‌های اخیر رشد قابل توجهی داشته است. در این میان محصولات زراعی (کد ۰۷) به دومین گروه مهم صادرات بخش کشاورزی ایران در سال‌های اخیر تبدیل شده است. با این وجود مطالعات اندکی به بررسی ظرفیت‌های صادراتی محصولات زراعی پرداخته‌اند. از این رو هدف این مطالعه بررسی مولفه‌های اثرگذار بر صادرات محصولات زراعی و سنجش کارایی صادرات ایران است. به منظور دستیابی به هدف، الگوی جاذبه مرزی تصادفی براساس داده‌های تابلویی متوازن برای ۲۱ کشور در دوره زمانی ۲۰۲۱-۲۰۰۱ برآورد شد. نتایج بیانگر این است که اندازه اقتصادی و فیزیکی بازار هدف اثری مثبت و معنی‌دار بر صادرات محصولات زراعی ایران داشته‌اند. همچنین مرز مشترک میان ایران و شرکای تجاری و تحریم‌های اقتصادی دارای اثری مثبت و معنی‌دار بر صادرات محصولات زراعی بوده است، در حالی‌که فاصله جغرافیایی میان ایران و کشورهای واردکننده اثری منفی بر صادرات داشته است. نتایج کارایی نشان داد که در دوره زمانی ۲۰۱۵-۲۰۲۱ ایران در هیچ بازار هدفی دارای کارایی ۱۰۰ درصدی نبوده است و در چهار کشور افغانستان، امارات متحده عربی، کانادا و عراق با کارایی بیش از ۵۰ درصد روبرو بوده است. براساس نتایج، ایران بیشترین پتانسیل صادرات محصولات زراعی را در عراق دارد. در نتیجه، با توجه به اثر مثبت و معنی‌دار مرز مشترک و ظرفیت‌های بالای شرکای تجاری هم‌مرز با ایران، پیشنهاد می‌شود که کشورهای تجاری دارای مرز مشترک مانند عراق در اولویت صادرات محصولات زراعی قرار گیرند.

واژه‌های کلیدی: پتانسیل تجاری، صادرات کشاورزی، کارایی تجاری

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