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## ECONOMIC ANALYSIS OF POTATO AND TOMATO TRADE IN ROMANIA: THE GINI COEFFICIENT

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### Abstract

Potatoes and tomatoes are the key vegetables of Romanian agriculture, due to their consumption and the large growing areas. The paper analyses import and export of potatoes and tomatoes, and import and export prices for these vegetables, while based on that the Gini coefficient was calculated. According to the value of the Gini coefficient, the concentration of potato import is relatively low, while the export concentration is considerably higher. A similar situation is with tomato, as the values of the Gini coefficient indicate low concentration related to import and relatively high concentration related to export. Association with foreign partners, farmer orientation to quality certifications, investment in infrastructure and efficient marketing are some solutions that can improve the Romanian vegetable market.

**Key words:** Potatoes, tomatoes, Romania, export, import, Gini coefficient.

**JEL<sup>4</sup>:** Q10, Q17

### Introduction

Vegetables are an important source of essential nutrients in the diet. They are rich in vitamins, minerals, fiber and antioxidants and therefore play an important role in maintaining health and preventing chronic diseases.

According to the World Health Organization, a balanced diet should include at least

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400 g of vegetables and fruits per day (WHO, 2022). Studies have shown that such a diet can reduce the risk of cardiovascular disease, diabetes, obesity, and certain types of cancer (Frank et al., 2019). Certain study showed that people who eat more vegetables and fruits have a lower risk of developing chronic diseases. Studies have also shown that an adequate intake of vegetables can help reduce blood pressure, improve cognitive function, and prevent ageing (Bazzano et al., 2003).

Vegetables are also important for maintaining the weight issue, as they are rich in fiber and nutrients, so they can satisfy hunger and help control appetite. This can help prevent overeating and weight gain (Slavin, 2005). In addition to health benefits, eating vegetables can also have a positive impact on the environment. For example, growing vegetables require lesser resources than producing meat, what could reduce environmental impact (Hung et al., 2004; Sterie, Dumitru, 2021).

According to United Nations Food and Agriculture Organization (FAO, 2019), globally the most consumed vegetables are potatoes, tomatoes, onions, bell peppers, and cabbage. Among other frequently consumed vegetables at global level there are cucumbers, carrots, beans, peas, eggplants, and pumpkins.

In line to some study, in Romania are mostly used potatoes (consumed by over 90% of the population), onions (over 80%), carrots (over 60%), bell peppers (over 50%), and tomatoes (over 40%) (Sterie et al., 2022a).

Potatoes and tomatoes have a rich and long-lasting history. They are used by humans for centuries for various purposes, making them as interesting subject for research and analysis. Romania is an important producer of potatoes and tomatoes, in accordance with favorable natural and climatic conditions for their growing, as well as long tradition (Pocol, Sahli, 2010; Soare et al., 2017).

Vegetables are undoubtedly important component of the food basket, especially in terms of biological and health-promoting features. The importance of well-balanced food in disease prevention is no longer controversial. However, apart from the health and nutritional benefits, another essential aspect of vegetable consumption is long-term viability, hence they affect the sustainable agriculture (generally, sustainable development strives to meet the requirements of current generations while conserving natural resources for future generations), (Mazur Włodarczyk, Gruszecka Kosowska, 2022; Dumitru et al., 2022).

The EU's vegetable output is determined by several trends that are increasingly being offered, or accepted by consumers. One of them is micro farming, whose importance has increased constantly in previous period. The term "micro" refers to production of exceptionally small amounts of agro-food products, particularly crop species, which

are later consumed in line with the maxim “one product, one mouthful”. They can be obtained by employing specific species or tech-tech methods (Puškarić et al., 2009; Motofeanu et al., 2022).

Farmers are facing many challenges when deliver their limited crop yields (e.g. vegetables), including certain difficulties in getting in their products into the retail chain (i.e. supermarkets and hypermarkets), as they require significant volume of goods. To overcome mentioned obstacle, the short value chain approach can be involved for consolidation of harvest activities at the level of individual farms. Value chain encompasses all operators, activities, and connections involved in production and distribution process. Each step within the value chain adds certain value to products, while modify their efficiency. However, agricultural products may not be useful to consumers in their original form, requiring the use of different storage and processing methods (Ion, 2017; Tudor et al., 2022).

Globally, vegetable prices will continue to rise, particularly for those countries that are heavily rely on import. Some scenarios show that this would result in a decrease in vegetable consumption in range between 2.5-11.4% (Seferidi et al., 2019).

According to FAO, in 2020, the world’s largest producers of tomatoes were China, India and the USA. China was the global leader in tomato production in 2020, with production of about 60.8 million tons. Its followed by India with production of around 20.8 million tons, and USA with production of about 13.7 million tons. Other major tomato producers were Turkey, Iran, Egypt, Brazil, Italy, Ukraine, and Spain. At the EU level, in observed year the largest quantities of tomatoes were produced to Spain, Italy, and the Netherlands. As the EU leader, Spain have been produced around 4.9 million tons, while Italy produced around 4.2 million tone, or the Netherlands around 1.8 million tons (Dumitru et al., 2018; Cvijanovic et al., 2022). It has to be noted that the EU tomato production could significantly vary among countries, primarily in line to available weather conditions. Additionally, towards the level of market demand, some countries increase or decrease their tomato production.

At the global level, in 2020, the largest producers of potatoes were China, India, and Ukraine. China was the leader with total potatoes production of about 99.2 million tons, followed by India with approximately 52.5 million tons, and Ukraine with around 23.9 million tons. Other major potato producers were Russia, USA, Germany, Bangladesh, France, UK, and Poland. The top three largest potato producers in EU are Germany (10.4 million tons), France (6.7 million tons), and the Netherlands (6.6 million tons), (Sterie et al., 2022b).

In Romania, tomato production is one of the most important production lines in agriculture. According to Institute of National Statistics, the growing area under tomato in 2020 was 11,955 ha, while the total production was 320,063 t (Udriște et al., 2022).

In certain study, it is mentioned that tomatoes are cultivated all over the Romania, but the most suitable regions are located in the south-east, such are Muntenia and Dobrogea, as there are achieved average temperatures during the growing season around 22° C, with sufficient volume of rainfalls, ensuring the optimal conditions for plant development (Lixandru et al., 2018).

Potatoes are among important agricultural crops in Romania, both economically and socially. According to INS (2020), the potato was cultivated in 2020 on 223,670 ha, with total production of around 3.3 million tons (Sterie et al., 2022c).

In some studies (Mihalache et al., 2019; Iancu et al., 2022), it has been mentioned that potato production is carried out over the all country, while as the most suitable regions for its growing are underlined those in the southwest or central part of the Romania, such are Oltenia, Banat, and Transylvania. The climate and soil conditions are favorable for potato growing, allowing high yields.

### Methodology and Data Used

Determined by statistician and sociologist Corrado Gini in 1912, the Gini coefficient represents the measure of statistical dispersion to describe the disproportionate distribution of income or wealth. Derived percentage is defined as a numerical ratio between 0 and 1, while 0 indicates perfect equality or 1 as complete inequality (Dorfman, 1979).

$$G = \frac{\sum_i \sum_j |x_i - x_j|}{2 \sum_i \sum_j x_i}$$

The study uses data and information available in the TradeMap database to analyze import and export quantities and values for potatoes and tomatoes in Romania. The data are also used to determine the import and export prices in top ranked countries, as well as the concentration of trade (measured by the Gini coefficient).

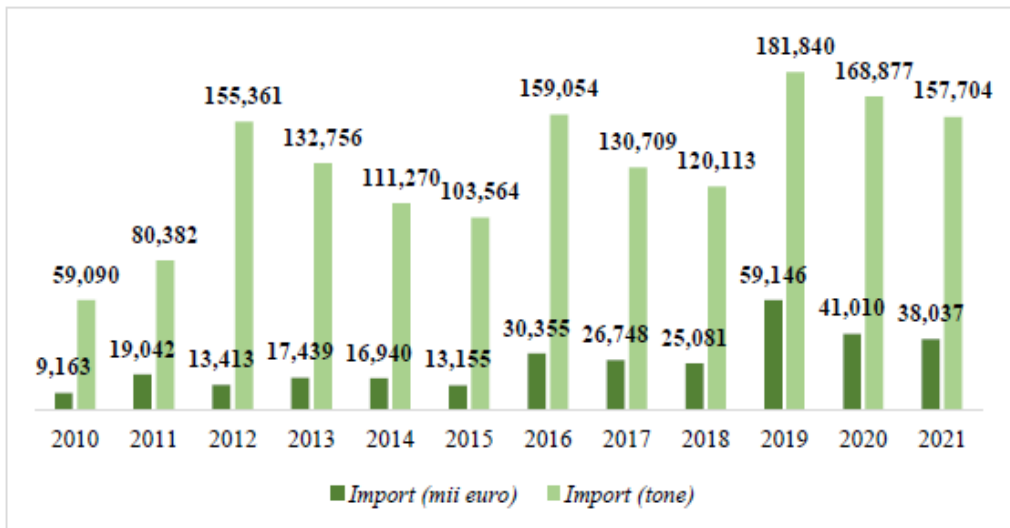
The objective of the research is to examine the import and export prices of the most commonly consumed vegetables in Romania (i.e. potatoes and tomatoes).

Additionally, the research aims to determine the level of equality or inequality in distribution of import and export values for mentioned crops.

### Results with Discussion

According to value, potato import reached 41,010 thousand EUR in 2021, while it increased for more than 315% compared to 2010 (year with the lowest import value, that is, 9,163 thousand EUR), (Figure 1.). This is a cause of increased demand at the national market and decrease in domestic production, which leads to increase in potato import in Romania.

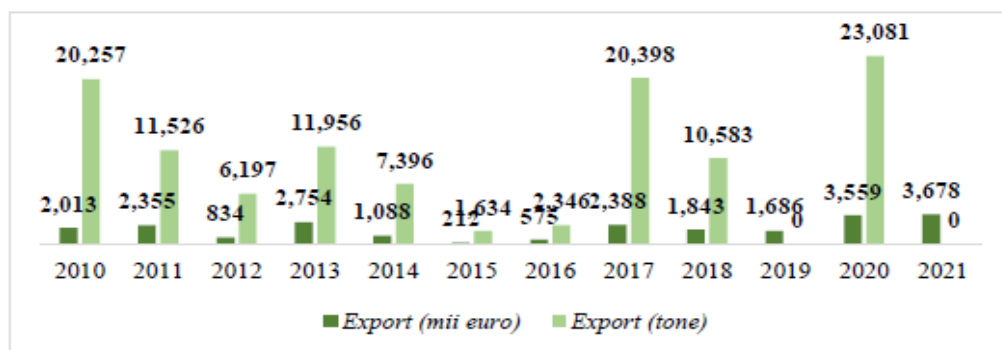
**Figure 1.** Potato import into Romania (period 2010-2021)



Source: TradeMap database.

The evolution of potato import in terms of quantity has large oscillations. The highest imported quantity was reached in 2019 (181,840 t), while the lowest was in 2010 (59,090 t). The increase in import is caused by the high consumption of potatoes, but also by certain dysfunctions at the national market. In 2021, the value of import reached 38,037 thousand EUR, what is for 35% lesser compared to 2019 (Figure 1.).

In line to potato export, in 2021 (36,78 thousand EUR) comes to increase for 82% compared to 2010 (2,013 thousand EUR). Related to quantity, export increased for more than 13% in 2020 (23,081 t) compared to 2010 (20,257 t). Growth can be attributed to increase in demand at foreign markets (Figure 2.).

**Figure 2.** Potato export from Romania (period 2010-2021)

Source: TradeMap database.

**Table 1.** Comparing of import and export prices of potato (in EUR)

Import	2010	2021	2021/ 2010	Export	2010	2021	2021/ 2010
	EUR/t	EUR/t	%		EUR/t	EUR/t	%
<b>Total *</b>	180.76	205.63	113.76	<b>Total*</b>	99.37	151.95	152.91
<b>France**</b>	165.47	161.76	97.76	<b>Republic of Moldova**</b>	85.21	137.41	161.26
<b>Germany**</b>	167.16	193.93	116.01	<b>Ukraine**</b>	-	120.30	-

Note: \*general total, \*\*top 2 importing/exporting countries.

Source: TradeMap data base.

The price at which potatoes were imported from France in 2021 (161.76 EUR/t) decreased by 2% compared to 2010 (165.47 EUR/t), while the import price from Germany increased for 16% in 2021 (193.93 EUR/t) compared to 2010 (167.16 EUR/t). According to potato export, in 2021, they were exported to Moldova at a price of 137.41 EUR/t or to Ukraine at a price of 120.63 EUR/t, reaching the overall increase in export prices for over the 50%. This increase can be explained by the increase in demand, but also by certain production problems in Ukraine as one of top producers of potato (Table 1.).

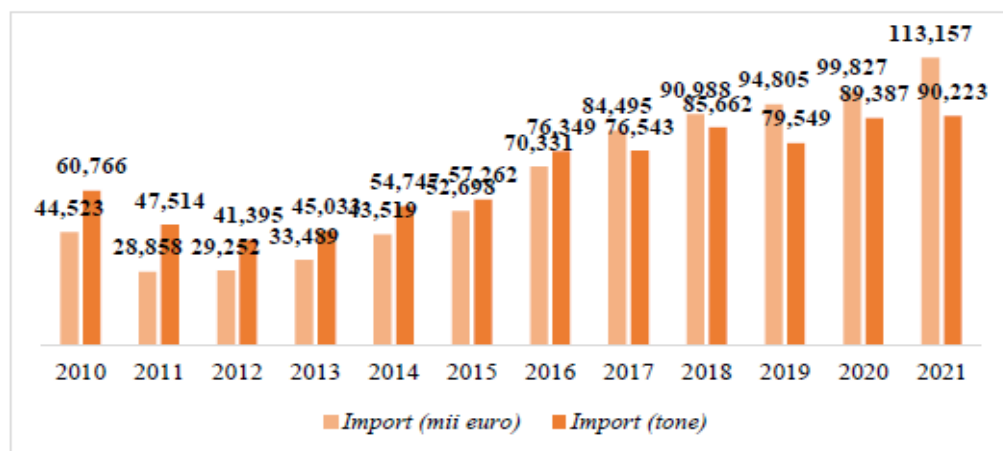
Import of tomatoes, both in quantity and value, shows an upward trend since 2012, when the value was around 29 million EUR, while reaching over 113 million EUR in 2021, or increase for more than 154% compared to 2010 (44,523 million EUR), (Figure 3.).

It should be noted that the lowest volume of tomato import was recorded in 2012 (41,395 t), while the highest was in 2021 (90,223 t). In 2021 there comes to increase in both quantity and value of tomato import, representing the year with the highest



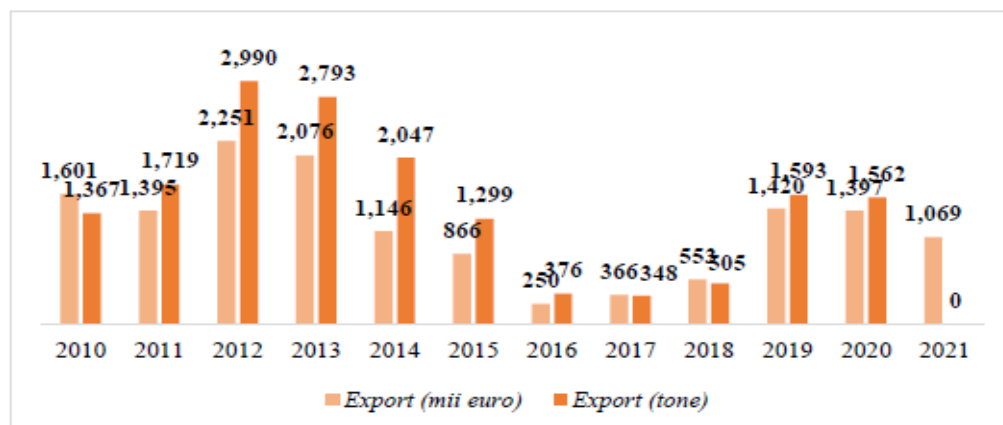
reached import in analyzed period. Therefore, in 2021 (113,157 thousand EUR) the value of imported tomatoes increased for 13% compared to 2020 (99,827 thousand EUR), or by more than 154% compared to 2010 (44,523 thousand EUR). The production year 2012 was characterized by European subsidies, while Romania highly benefited from agricultural subsidies granted by the EU after its accession in 2007 (Figure 3.).

**Figure 3.** Tomato import into Romania (period 2010-2021)



Source: TradeMap database.

**Figure 4.** Export of tomatoes from Romania (period 2010-2021)



Source: TradeMap database.

Considering tomato export, the maximal value was reached in 2012 (2,251 thousand EUR), while the minimal was in 2016 (250 thousand EUR). Related to volume, the minimum of 348 t was reached in 2017, affected by the decrease in production at



the national level in this year. Decrease can be attributed to the rise in concentration of other production lines or competition affected by other countries. In 2020, the volume and value of export were decreased compared to previous year (for 2% towards quantity, or for 1.6% towards the value), (Figure 4.).

**Table 2.** Comparing of import and export prices of tomato (in EUR)

Import	2010	2021	2021/ 2010	Export	2010	2021	2021/ 2010
	EUR/t	EUR/t	%		EUR/t	EUR/t	%
<b>Total *</b>	732.7	1,228.9	167.7	<b>Total*</b>	1,171.2	889.5	75.9
<b>Germany**</b>	709.1	1,650.9	232.8	<b>Poland**</b>	1,093.2	857.7	78.4
<b>Netherland**</b>	1,022.7	2,856.6	279.3	<b>Republic of Moldova **</b>	1,161.3	867.2	74.7

Note: \*general total, \*\*top 2 importing/exporting countries

Source: TradeMap database.

Romania has been imported tomato in 2021 mostly from Germany (1,650.93 EUR/t) and the Netherlands (2,856.6 EUR/t), at significantly higher prices than in 2010. Romania has been also exported tomato to Moldova at a price of 867.19 EUR/t and Poland at 857.66 EUR/t, at significantly lower prices compared to 2010. The fall in export price can be attributed to strong competition or lower quality of production (Table 2.).

**Table 3.** Import and Export Value of potatoes (thousand EUR)

Specification		2014	2015	2016	2017	2018	2019	2020	2021
Import value	<b>World</b>	16,940	13,155	30,355	25,747	25,250	59,058	40,251	38,087
	France	5,374	2,368	4,920	1,651	3,343	12,147	9,641	10,988
	Germany	2,282	2,086	5,157	2,705	3,264	7,329	5,751	7,501
	Greece	1,108	1,081	5,470	5,733	4982	11,628	7,432	6,651
	Netherlands	2,686	1,044	2,747	919	1744	8459	7,827	5,319
<b>Gini coefficient</b>		0.36	0.28	0.35	0.36	0.36	0.34	0.35	0.38
Export value	<b>World</b>	1,016	206	571	2,427	1,816	1,580	3,541	3,725
	Republic of Moldova	305	114	92	1,814	756	503	1,615	1,506
	Poland	206	4	357	392	309	875	721	580
	Greece	52	10	48	106	129	125	8	233
	Hungary	37	7	2	16	25	7	78	232
<b>Gini coefficient</b>		0.37	0.59	0.62	0.75	0.41	0.62	0.51	0.47

Source: Authors' computation according to TradeMap database.

In 2021, in total, Romania was imported potato for 38 million EUR, or up to 124% more compared to value recorded in 2014 (16.9 million EUR). Romania imported potato for 10.98 million EUR from France in 2021, or for 7.5 million EUR from Germany, 6.6 million EUR from Greece, and for 5.3 million EUR from the Netherlands.

In terms of exports, in 2014, Romania was exported potato for 1 million EUR, while reaching around 3.7 million EUR in 2021, or increase for 270%.

Analyzing the value of Gini coefficient for potato import and export, it can be observed that for import the degree of concentration varied between 0.28 (in 2015) and 0.38 (in 2021), indicating a low degree of concentration, while for export the degree of concentration varied between 0.37 (in 2014) and 0.57 (in 2017), indicating a high degree of concentration.

It is important that coefficient has a high degree of concentration towards the imports, so in crisis situations in certain countries related to earthquakes, wars, severe climate changes, there could be found alternatives regarding the import of these products (Table 3.).

In 2014, Romania has been imported tomato for 43.5 million EUR, reaching in 2021 the value of 113.7 million EUR (Table 4.), with the increase of 161.3%. In 2021, Romania has been imported tomato for 53.2 million EUR from Turkey, followed by Germany for 18.6 million EUR, the Netherlands for 15.7 million EUR and Spain for 12.7 million EUR. In terms of export, in 2021, Romania was exported tomato for over 1 million EUR, or for 12% less compared to 2014 (1.1 million EUR). The top export destinations for tomato in 2021 were Poland (476 thousand EUR), Moldova (222 thousand EUR), Spain (68 thousand EUR) and Belgium (63 thousand EUR). Romania could export more tomato if it increases production and quality, but also the overall promotion of Romanian products.

**Table 4.** Import and export value of tomatoes (in 000 EUR)

Specification		2014	2015	2016	2017	2018	2019	2020	2021
Import value	World	43,519	52,698	70,331	82,493	92,220	95,401	98,750	113,749
	Turkey	18,733	16,494	25,262	36,974	40,743	36,066	48,624	53,223
	Germany	2,174	5,283	6,395	10,137	11,814	14,428	14,961	18,644
	Netherlands	3483	5,159	7,304	8,857	10522	12671	12,598	15,697
	Spain	5419	9,683	9,260	8,092	8181	12975	9,914	12,770
Gini coefficient		0.43	0.34	0.37	0.45	0.44	0.4	0.5	0.49

Specification		2014	2015	2016	2017	2018	2019	2020	2021
Export value	World	1,146	866	250	367	548	1,509	1,398	1,055
	Poland	0	0	96	72	180	360	391	476
	Moldova	111	105	122	143	134	607	689	222
	Spain	5	475	12	102	76	134	76	68
	Belgium	1	0	0	0	0	0	14	63
Gini coefficient		0.31	0.48	0.56	0.42	0.31	0.39	0.5	0.41

Source: Authors' computation according to TradeMap database.

When comparing the Gini coefficients for tomato import and export, it can be considered that the concentration varies between 0.34 in 2015 and 0.5 in 2020, indicating a low degree of concentration, while in case of export concentration oscillates between 0.31 in 2014 and 2018, and 0.56 in 2016, indicating a high degree of concentration. The low degree of import concentration respects the assurance of constantly high stocks of certain agro-products (Table 4.).

Dispersion of import destinations is of high importance as it makes diversification of food supply, while importing food products from several countries could provide greater assortment of food available to consumers at national level. This could affect greater variety in the daily diet, encouraging healthy and balanced nutrition (Sterie et al., 2022a).

## Conclusions

In 2021, the value of potato imports to Romania increased significantly, for 347% (from 9.1 million EUR in 2010 to 41 million EUR). The value of potato exports also increased by 82% in 2021, reaching 3.7 million EUR, compared to 2 million EUR in 2010. Meanwhile, there was a 166% increase in imported volume, and approximately 14% increase in export volume. In average, in 2021, Romania was imported potato at price of 205.63 EUR/t, while export price was 151.95 EUR/t.

Related to volume and value, tomato import has been showing upward trend since 2012. In 2021, the value of import exceeded 113.2 million EUR, or it has achieved an increase for over 154% since 2012.

France was the largest importer of potatoes from Romania in 2021 (10.98 million EUR), followed by Germany (7.5 million EUR), Greece (6.6 million EUR), and the Netherlands (5.3 million EUR). In same year, Romania exported potatoes to Poland (721 thousand EUR), Moldova (305 thousand EUR), Greece (233 thousand EUR), and Hungary (232 thousand EUR).

Analysis of the Gini coefficient values for potato import and export show that the concentration of potato import is relatively low, varying between 0.28 (2015) and

0.38 (2021). On the contrary, the concentration of potato export is relatively high, varying between 0.37 (2014) and 0.57 (2017).

Romania in 2021 mainly imports the tomato from Turkey (53.2 million EUR), followed by Germany (18.6 million EUR), the Netherlands (15.7 million EUR) and Spain (12.7 million EUR). As the main export destinations for tomato in 2021 were Poland (476 million EUR), Moldova (222 thousand EUR), Spain (68 thousand EUR), and Belgium (63 thousand EUR).

Comparing the Gini coefficients for tomato import and export, the concentration of tomato import is relatively low, varying between 0.34 in 2015 and 0.5 in 2020. Contrary to that, concentration of tomato export varies between 0.31 in 2014 and 2018, and 0.56 in 2016, indicating relatively high degree of concentration.

To increase production and export, Romanian farmers should take measures to eliminate market failures, such as accessing European funds to invest in modern growing technologies or in improving of infrastructure, such as access roads and establishment of cold stores. Focusing on products certification and efficient marketing can also improve the reputation of Romanian products, while attract new consumers and investors. Some suggestions regarding the policy makers in Romania, respectively the EU, would be to support domestic production in order to reduce dependence on tomato import. Therefore, it would be important to support domestic production through investments in agricultural infrastructure, as well as through subsidies and other forms of public support. On the other hand, with regard to tomato export, it is important to promote the quality and safety, especially in accordance with EU and international food safety standards (Dumitru et al., 2018; Sterie et al., 2022a).

In terms of future research in economics of trade of potatoes and tomatoes in Romania, the following directions could be addressed, as are the deeper analysis of demand and supply for these two vegetables, the analysis of prices, and the analysis of the economic impact. Therefore, this article makes a valuable contribution to consideration of agri-food trade in Romania, as to development of policies and strategies that address the issues of economic inequality in this sector of agriculture.

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