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**Impact of Seasonality of Fruit Production  
on Trade Balance and Prices**

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**Abstract**

*In the agricultural sector, seasonality is a very important character, and in Romania, often with a negative impact on the branch. On the fruit sector, the negative impact is significantly greater, given that this character is also doubled by the high perishability of fruits. Thus, this paper aims to determine the impact that this character, specific to the sector, has on the trade balance and on the prices charged. In the first part of the research, a quarterly analysis of the evolution of the trade balance will be performed, to determine the differences between the quarter in which the fruits are produced in Romania and the rest of the quarters, and later a linear regression analysis will be performed to determine the influence of trade balance evolution on prices.*

**Keywords:** fruit, impact, prices, seasonality, trade balance.

**JEL Classification:** Q11, Q17, Q13

**1. Introduction**

Seasonality in the agricultural sector is an issue it faces, especially for perishable, difficult or expensive to store products. Fruits fall into this category. In this study, we want to analyse whether the seasonality of fruit production influences the trade balance, and subsequently the price of their capitalization.

Zbancă and Baltag (2018) developed a study on the fruit sector in the Republic of Moldova, which can be somewhat compared with that in Romania, they argue that the development of the horticultural sector is a practical way to modernize and diversify agriculture and also a source of income in rural areas.

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According to Valpiani et al. (2015), who studied the effect of seasonality on fruit and vegetable availability and store prices in North Carolina, found that *“outside the local harvest season, the availability of many fruits and vegetables was substantially lower at farmers’ markets and roadside stands compared to supermarkets.”*

## **2. Problem Statement**

According to the Ministry of Agriculture and Rural Development, which developed the “National Strategy for Operational Programmes in the Fruit and Vegetable Sector” (2017), the statement that the seasonality of vegetable and fruit products induces changes in population consumption is supported. There are products with different degrees of seasonality that intervene on the market at the time of their appearance, for short periods of time. In this respect, it can be stated that the supply of vegetables / fruits, especially of perishable ones, is rigid and is represented by the entire quantity of products harvested in a period which, as a rule, corresponds to the type of maturation of those products.

In another research, conducted by Movileanu and Botezatu (2010), are presented the peculiarities of vegetable and fruit markets, one of these features is described as the high degree of seasonality, which determines a non-uniform supply of products and requires an operative management of product quantities according to consumer demand.

Considering the other researches carried out previously, regarding the seasonality, it is the hypothesis of the research of this study, the one in which the seasonality influences the equilibrium of the commercial balance of the fruits and at the same time, the level of capitalization prices.

## **3. Research Questions / Aims of the Research**

In this paper, we want to determine the influence that the seasonality of fruit production can have on the trade balance and subsequently on prices. Analysing from a structural point of view, the number of fruit trees, on average since Romania’s accession to the EU until now, the most common species are that of plums, with a share in the total number of fruit trees of 48%, followed by apples - 32.7%, cherries - 6.64%, pears - 4% and apricots - 2.8%.

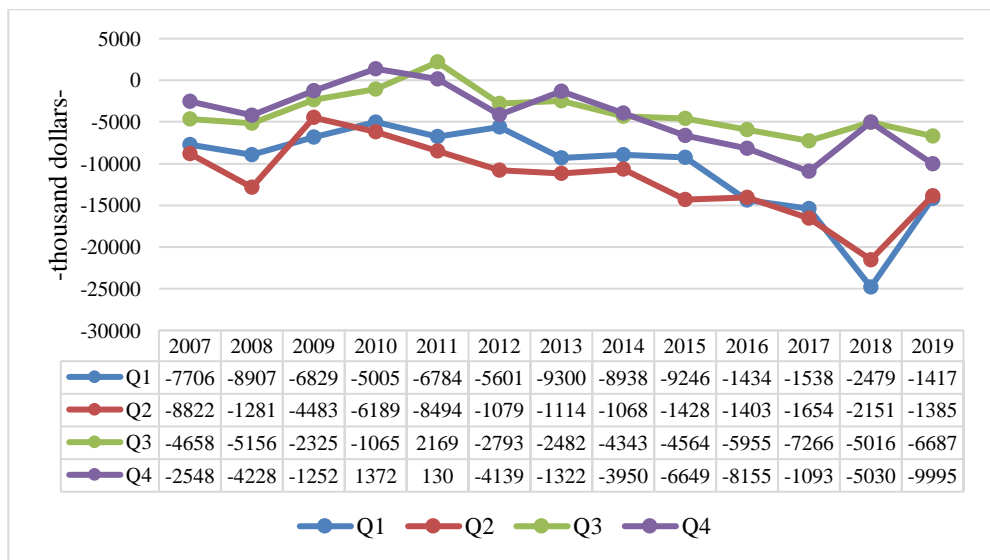
## **4. Research Methods**

Given these weights, a quantitative and qualitative analysis was performed with reference to the trade balance for these main products based on the International Trade Centre database. For each species, the dynamics of the balance of payments from 2007 to 2019 at quarterly level was analysed, and subsequently with the help of the hypothesis testing, the quarterly averages were compared, in order to determine whether the hypothesis of this research is verified. Following this analysis, an analysis of the prices of apples and pears was made, for these species the differences between quarters being more pronounced, the data on prices being

taken from national databases (National Institute of Statistics). Finally, in order to measure the impact of seasonality on the trade balance, two linear regression models were made, for apple and pear culture, in which the independent variable was the trade balance and the dependent variable was the capitalization price.

## 5. Findings

The aim of this paper is to determine the impact that the seasonal nature of the fruit sector can have on the trade balance and on the prices charged. Analysing quarterly, it can be stated that most fruits are harvested in the third quarter, so, in order to make a comparative analysis of the seasonal nature, we will analyse the balance of payments of the main categories of fruit compared to the quarters, the reference being the third quarter.



**Figure 1. Dynamics in the balance of payments for apple**

*Source: own processing based on ITC data*

Figure 1 shows the dynamics of Romania's balance of payments for apple by quarters, in the period 2007-2019. It can be seen that over the period, regardless of the quarter, the trend is a decreasing one, respectively registering an increasing value deficit. Analysing the 1<sup>st</sup> quarter, it can be seen that, during this period of the year, the balance of payments was negative for each year, recording a deficit between 5 million dollars and 24.8 million dollars, in the last year there was a higher deficit by about 84% compared to the first year, for this quarter. In the second quarter, there is a similar dynamic, the deficit of the trade balance for apple being, in the analysed period, between 4.48 million dollars and 21.5 million dollars, in the last year there was a deficit greater by 57% compared to the first year taken into analysis. In the 3<sup>rd</sup> quarter, the situation is a bit different, although

there is a deficit in the vast majority of the period, this being the quarter in which these fruits are harvested, there is also a surplus of the balance of payments in 2011, amounting to 2.17 million of dollars, but nevertheless in the rest of the period there is a deficit between 1 million and 7.27 million dollars. The downward trend is smoother, with a difference between the last year and the first of 43.5%. In the last quarter, there is a surplus in two consecutive years, respectively 2010 and 2011 amounting to \$ 1.37 million and \$ 130 thousand, respectively.

As it has been noticed, since the 3<sup>rd</sup> quarter, when this fruit is harvested, there has been an improvement in the trade balance, given its average values. Thus, in order to be able to determine exactly whether there are significant differences between quarters, in Table 1, the average value of each was analysed using the *t* test, to test the hypotheses. The hypothesis is that in which the average values of the period differ between quarters, especially compared to the third quarter.

**Table 1. Comparative analysis of quarterly balance of payments averages (apple)**

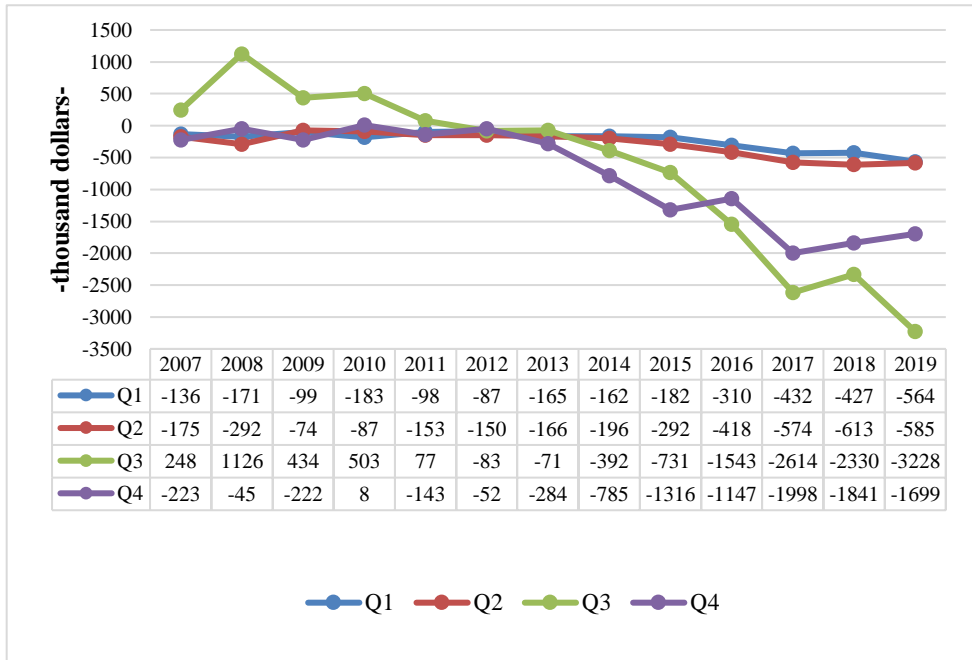
	Q1	Q3	Q2	Q3	Q4	Q3
Mean	-10539.9	-3857	-11818.8	-3857	-4361.92	-3857
Variance	29483917	6493150	20058251	6493150	14212467	6493150
Observations	13	13	13	13	13	13
Pearson Correlation	0.577967		0.634091		0.860047	
Hypothesized Mean Difference	0		0		0	
df	12		12		12	
t Stat	-5.39021		-8.25991		-0.89027	
P(T<=t) one-tail	8.13E-05		1.35E-06		0.19541	
t Critical one-tail	1.782288		1.782288		1.782288	
P(T<=t) two-tail	0.000163		2.71E-06		0.390819	
t Critical two-tail	2.178813		2.178813		2.178813	

Source: own calculations using Data Analysis of MS Excel

Analysing the averages of the trade balance for apple, between quarters 1 and 3 it can be seen, with the help of the *t* test, that the absolute value of the parameter, 5.39 is higher than the critical value of *t* (2.17), thus rejecting the null hypothesis, according to which the average of the values analysed between these two quarters can be zero. Thus, it can be stated that, from a statistical point of view, the averages of the two quarters differ significantly.

Analysing the 2<sup>nd</sup> quarter compared to the 3<sup>rd</sup> quarter, it is noticed again that the absolute value of the parameter *t* (of 8.26) is higher than the critical value of *t* (of 2.17), and the level of significance (P) is lower than the maximum accepted threshold of 0.05, thus excluding the null hypothesis, respectively between the average values of the two quarters the difference is not 0, which means that from a statistical point of view there is a significant difference between the averages.

Instead, between quarters 3 and 4, there is an absolute value of the parameter *t* (0.89) lower than the critical value, and the level of significance (P) is higher than the maximum allowed threshold of 0.05 (being 0.39), thus, it cannot be argued that the null hypothesis is excluded, there being the possibility that the values between the two quarters are equal at a given time.



**Figure 2. Dynamics in the balance of payments for plum**

*Source: own processing based on ITC data*

Figure 2 shows the dynamics of Romania’s balance of payments for plums by quarters, in the period 2007-2019. It can be seen that over the period, regardless of the quarter, the trend is a decreasing one, respectively registering an increasing value deficit. By carrying out a quarterly analysis, it can be seen a fairly significant difference in the case of plums compared to apples. In this case, quarters 1 and 2 show a more balanced balance of payments, and quarters 3 and 4 show a strictly decreasing trend.

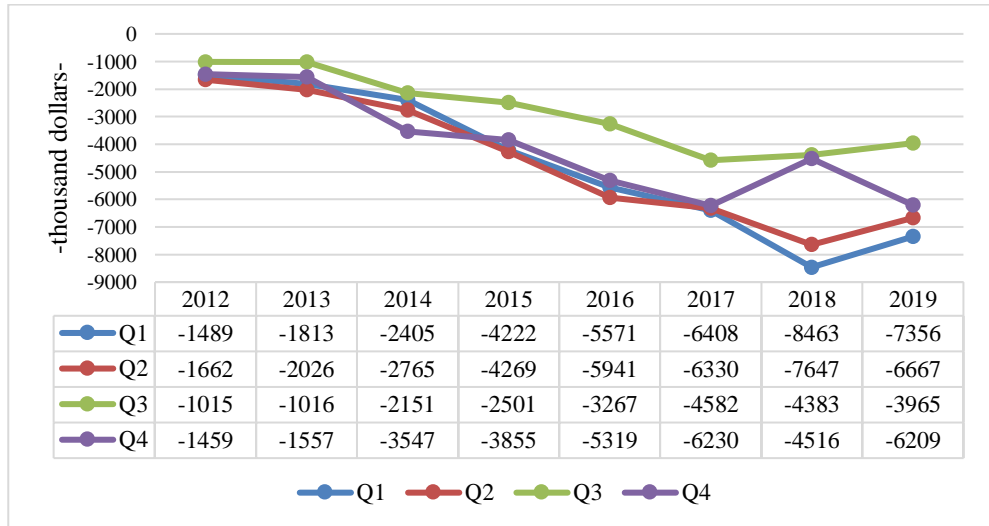
Analysing the 1<sup>st</sup> quarter, it can be seen that, during this period of the year, the balance of payments was negative for each year, registering a deficit between 87 thousand dollars and 564 thousand dollars, in the last year there being a deficit higher than about 4.15 times the first year, for this quarter. In the 2<sup>nd</sup> quarter, there is a similar dynamics, the deficit of the trade balance for plums being, in the analysed period, between 74 thousand dollars and 613 thousand dollars, in the last year there being a deficit greater than 3.2 times compared to the first year taken into analysis. In the 3<sup>rd</sup> quarter, the situation is a little different, at the beginning of the period, the first 5 years (2007-2011) there is a surplus of the balance between 77 thousand and 1.12 million dollars, in the next period (2012-2019) there is a balance deficit between \$ 71,000 and \$ 3.23 million. The downward trend in the balance is exponential. In the last quarter, there is a surplus in 2010, amounting to \$ 8 thousand, and in the rest of the years the deficit is between 45 thousand and 2 million dollars.

**Table 2. Comparative analysis of quarterly balance of payments averages (plum)**

	Q1	Q3	Q2	Q3	Q4	Q3
Mean	-232	661.846	290.385	661.846	749.769	661.846
Variance	23185.83	1820403	37672.59	1820403	569040.5	1820403
Observations	13	13	13	13	13	13
Pearson Correlation	0.922226		0.896823		0.933431	
Hypothesized Mean Difference	0		0		0	
df	12		12		12	
t Stat	1.28061		1.136669		0.45316	
P(T<=t) one-tail	0.112265		0.138933		0.32926	
t Critical one-tail	1.782288		1.782288		1.782288	
P(T<=t) two-tail	0.224529		0.277866		0.658519	
t Critical two-tail	2.178813		2.178813		2.178813	

Source: own calculations using Data Analysis of MS Excel

For each of the three comparisons, respectively quarters 1, 2 and 4 related to quarter 3, a value of the parameter *t* is recorded below its critical value, thus, in the case of plums, the null hypothesis cannot be excluded, respectively the one in which the average value of the balance trade differs between quarters, so there is a possibility that the value of the balance of payments will be the same between quarters.



**Figure 3. Dynamics in the balance of payments for pear**

Source: own processing based on ITC data

Figure 3 shows the dynamics of Romania’s balance of payments for pears by quarters, in the period 2007-2019. It can be noticed that during the period, regardless of the quarter, the trend is a decreasing one, respectively registering an increasing value deficit, and surplus is not recorded in any year, regardless of the quarter.

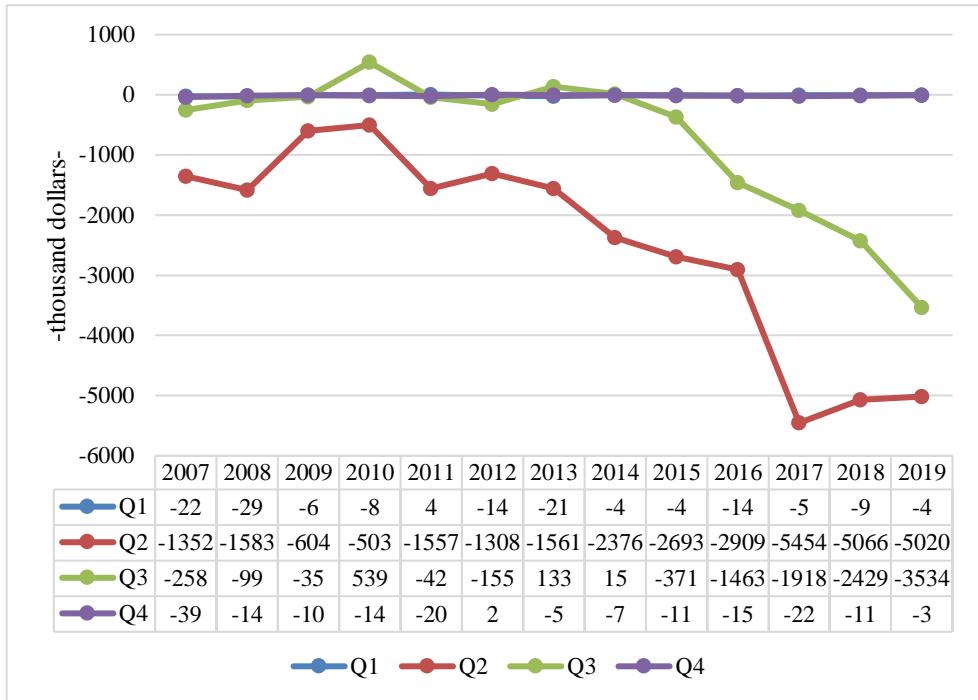
Analysing the first quarter, it can be seen that the balance of payments has a deficit between 1.49 million dollars and 8.46 million dollars, in the last year there was a deficit more than 5 times higher than the first year, for this quarter. In the second quarter, there is a similar dynamics, the deficit of the trade balance being, in the analysed period, between 1.6 million dollars and 7.6 million dollars, in the last year there was a deficit more than 4 times compared to the first year taken into analysis. In the 3<sup>rd</sup> quarter, the situation is a bit different, although there is a deficit, it is lower, given that the 3<sup>rd</sup> quarter is the one in which these fruits are harvested. The deficit is between \$ 1 million and \$ 4.5 million. In the last quarter, there is a deficit, which is between 1.46 million and 6.23 million dollars.

**Table 3. Comparative analysis of quarterly balance of payments averages (pear)**

	Q1	Q3	Q2	Q3	Q4	Q3
Mean	-4715.88	2860	4663.38	-2860	-4086.5	-2860
Variance	7004170	201534	5292836	20153	3492843	2015344
Observations	8	8	8	8	8	8
Pearson Correlation	0.950896		0.963881		0.924501	
Hypothesized Mean Difference	0		0		0	
df	7		7		7	
t Stat	-3.8342		-5.0702		4.46932	
P(T<=t) one-tail	0.003211		0.000723		0.001452	
t Critical one-tail	1.894579		1.894579		1.894579	
P(T<=t) two-tail	0.006423		0.001447		0.002903	
t Critical two-tail	2.364624		2.364624		2.364624	

Source: own calculations using Data Analysis of MS Excel

Performing the hypothesis testing with the help of the *t* test, it can be seen from table 3 that the absolute value of the parameter *t* is higher in all 3 cases than the critical value of *t* (of 2.36), and the significance level being below the threshold of 0.05, it can be stated that the null hypothesis is rejected, according to which the difference between the means is 0, which would mean that the means can be equal. Thus, it can be shown statistically that between quarters 1, 2 and 4 compared to quarter 3 there is a statistically significant difference in the trade balance for pears, in other words it can be said that the value of the balance in quarter 3 is statistically different from the other three quarters.



**Figure 4. Dynamics in the balance of payments for apricot**

*Source: own processing based on ITC data*

Figure 4 shows the dynamics of Romania’s balance of payments for apricots by quarters, in the period 2007-2019. It can be seen that over the period, regardless of the quarter, the trend is decreasing, i.e. there is a growing value deficit, except for the 1<sup>st</sup> quarter, when the value of the balance of payments is almost constant compared to the rest.

Analysing the 1<sup>st</sup> quarter, it can be seen that the balance of payments registers a deficit between 4 thousand and 29 thousand dollars, but in 2011 there is a surplus of 4 thousand dollars. In the second quarter, there is a completely different dynamics, registering a sharply decreasing trend, the deficit of the trade balance for apricots being, in the analysed period, between \$ 503 thousand and \$ 5.45 million, in the last year there was a larger deficit, 3.8 times higher than the first year considered. In the 3<sup>rd</sup> quarter, the situation reveals a slight difference, although there is a deficit, it is lower, being between 35 thousand and 3.5 million dollars, in 2010, 2013 and 2014 there is a surplus of 539 thousand dollars, 133 thousand dollars and 15 thousand dollars. In the last quarter, there is a deficit, which is between 3 thousand and 39 thousand dollars, in 2012 registering a surplus of 2 thousand dollars.



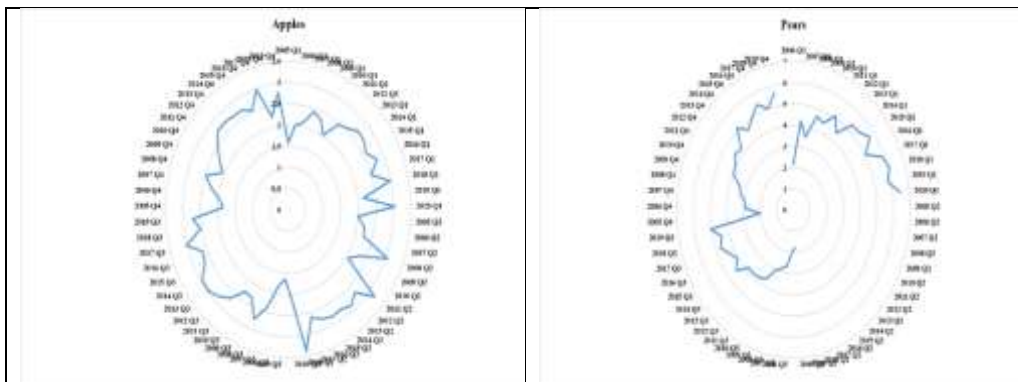
**Table 4. Comparative analysis of quarterly balance of payments averages (apricot)**

	Q1	Q3	Q2	Q3	Q4	Q3
Mean	10.4615	739.769	2460.46	739.769	-13	739.769
Variance	83.76923	1470282	2899492	1470282	104.5	1470282
Observations	13	13	13	13	13	13
Pearson Correlation	0.22122		0.903266		0.10398	
Hypothesized Difference	0		0		0	
df	12		12		12	
t Stat	2.16494		7.75634		2.159097	
P(T<=t) one-tail	0.025628		2.58E-06		0.025897	
t Critical one-tail	1.782288		1.782288		1.782288	
P(T<=t) two-tail	0.051257		5.15E-06		0.051795	
t Critical two-tail	2.178813		2.178813		2.178813	

Source: own calculations using Data Analysis of MS Excel

Performing the hypothesis testing analysis, this is not verified in 2 of the three cases, being still at the limit, the level of the statistical parameter  $t$  being at the limit, of the critical level, but below this, so there is a small probability that the average values between quarters Q1-Q3 and Q4-Q3 to be equal. Between the 2<sup>nd</sup> and 3<sup>rd</sup> quarters there is a statistically significant difference, regarding the balance of payments for apricot, the null hypothesis being rejected, it can be stated that the difference between the averages is strictly different from zero.

Given all these analyses, it can be established with certainty that the influence of seasonality on the trade balance of fruits is found mainly in apple and pear species, for which it is certain that in the 3<sup>rd</sup> quarter (the one that overlaps with the period of harvest) trade balance is lower than in other quarters. Thus, for these two species, a quarterly analysis of prices will be performed, and subsequently an analysis of the influence of the balance on them.



**Figure 5. Apple and pear price dynamics by quarters (RON)**

Source: own processing based on NIS data

Figure 5 shows the average prices on the national market for apples and pears, in the period 2007-2019 by quarters. For pears, data were recorded only for quarters 1, 3 and 4. As it can be seen, prices fluctuate greatly from year to year with a comparative analysis by quarter, and they differ depending on whether they are higher or lower.

Analysing the price of apples, on average for the entire period, in the first quarter it is RON 2.43 per kg, in the second quarter RON 2.6 per kg, in the third quarter RON 2.54 per kg and in the last quarter the price of apples raised to RON 2.45 per kg.

Analysing the price of pears, on average for the entire period, in the first quarter it is RON 4.85 per kg, in the third quarter RON 3.63 per kg and in the last quarter the price of pears rose to RON 4.13 per kg.

In order to be able to determine whether there is an influence of the trade balance on a quarterly basis on prices, a linear regression model will be developed based on which the impact that the trade balance can have on prices will be determined.

**Table 5. Linear regression model between balance of payments and price for apples**

<i>Regression Statistics</i>						
Multiple R		0.36796375				
		8				
R Square		0.13539732				
Adjusted R Square	R	0.11810527				
		4				
Standard Error		0.29032616				
Observations		7				
		52				
<i>ANOVA</i>						
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>	
Regression	1	0.659987763	0.65998776	7.83003173		
			3	8	0.007279127	
Residual	50	4.21446416	0.08428928			
Total	51	4.874451923	3			
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	2.43395847		34.7932783			2.5744669
	4	0.069954847	7	1.0442E-36	2.293450028	2
X Variable 1	0.000021	0.000007	2.798219	0.007279	0.000006	0.000036

Source: own calculations using Data Analysis of MS Excel

Table 5 shows the running of the linear regression model between the price-dependent variable and the independent variable of the trade balance for the apple fruit. As it can be seen, the correlation coefficient is quite small, 0.367 which denotes a weak relationship in intensity but positive, respectively when one variable increases and the other increases, and the coefficient of determination is 0.13. In the ANOVA table, it can be seen that the value of F is quite high above the allowed threshold, and the significance level is below the threshold of 0.05, thus

excluding the null hypothesis. Also in the table of coefficients there is a value of the parameter *t* quite high, above the critical one, considering that the significance level is also below the maximum accepted threshold of 0.05, and the confidence intervals do not contain the null value. Therefore, it can be stated that the null hypothesis is rejected, so there is no possibility that the values of the coefficients are zero.

With the help of the linear regression model it was possible to determine the resulting equation:

$$\text{Domestic price} = 0.000021 * \text{Trade balance} + 2.4339$$

It can be appreciated that an increase by one unit of the trade balance is an increase in the domestic price by 0.000021 units, and vice versa, if it is a decrease. In the case of apples, with an increase in the deficit by 10 million, there is an increase in the price of RON 0.21.

**Table 6. Linear regression model between balance of payments and price for pears**

Regression Statistics	
Multiple R	0.78991881
	0.62397172
R Square	7
Adjusted R Square	0.60687953
	3
Standard Error	0.41177695
Observations	9
	24

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	6.190007522	6.19000752	36.5062389	0.000004
Residual	22	3.730325812	0.16956026		
Total	23	9.920333333			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	3.95491688		22.0307257	1.74921E-		4.32721490
X Variable 1	0.0002465	0.17951823	6.0420393	0.0000044	3.58261886	0.0003312

Source: own calculations using Data Analysis of MS Excel

Table 6 shows the running of the linear regression model between the price-dependent variable and the independent variable of the trade balance for the pear fruit. As it can be seen, the correlation coefficient is quite high, 0.789 which denotes a close relationship in terms of intensity and positive, respectively when one variable increases and the other increases, and the coefficient of determination is 0.62. In the ANOVA table, it can be seen that the value of *F* is quite high above the allowed threshold, and the significance level is below the threshold of 0.05, thus excluding the null hypothesis. Also in the table of coefficients there is a value of the parameter *t* quite high, above the critical one, considering that the significance level is also below the maximum accepted threshold of 0.05, and the confidence intervals do not contain the null value. Therefore, it can be stated that

the null hypothesis is rejected, so there is no possibility that the values of the coefficients are zero.

With the help of the linear regression model, it was possible to determine the resulting equation:

$$\text{Domestic price} = 0.00024 * \text{Trade balance} + 3.955$$

It can be appreciated that an increase by one unit of the trade balance is an increase in the domestic price by 0.00024 units, and vice versa, if it is a decrease. In the case of pears, at an increase of the deficit by 1 million, there is an increase of the price of RON 0.24.

## **6. Conclusions**

In this paper, we wanted to analyse the impact of the seasonality of fruits on the trade balance and on market prices. In this sense, the dynamic analysis of the trade balance for apples, plums, pears and apricots was performed, the first four crops in terms of number of trees in Romania. This analysis of the balance of payments was performed quarterly and subsequently, for each fruit species in pairs, an analysis of the hypothesis test was performed, according to which in the 3<sup>rd</sup> quarter, that of harvest, a different average of the balance is recorded compared to the others.

For the first species, that of apples, following the analyses performed, the following can be concluded: the trade deficit registers increasing values, with the passage of time, but at different levels depending on the quarters. Thus, in quarters 1 and 2, when domestic supply is insignificant, the deficit is high, and in quarters 3 and 4 the deficit exists, but is lower, as it could be determined by testing the hypotheses, the average deficit in quarters 1 and 2 is significantly different from the average of the 3<sup>rd</sup> and 4<sup>th</sup> quarters, in other words, the first half of the year has a higher deficit than the second half of the year, thus confirming the hypothesis of this research.

For plums, the situation is different, analysing the deficit, it can be concluded that in quarters 1 and 2 the deficit is constant, and in quarters 3 and 4 there is a significant increase in the deficit, this being contrary to the hypothesis previously established in this research. By testing the hypotheses, it could not be established that the quarterly averages differ significantly. Analysing these aspects, it can be concluded that for this species, this situation is encountered because the demand fluctuates on the market depending on the quarter. Thus, the balance deficit is constant in the first half of the year because there is a constant demand, mainly industrial, and in the second half of the year there is an exponential increase in demand, in addition to industrial, being the fruit season, so in addition to the seasonality of fruit production, we can talk about a seasonality of consumption.

In the case of pears, the situation is similar to that of apples, the deficit being more and more accentuated, but in the 3<sup>rd</sup> quarter it is at a lower level than in the rest of the quarters, considering that it corresponds to the harvest period, respectively to an increase in internal supply, a fact also recorded by testing the hypotheses with the help of the *t* test.

Similarly to plums is the trade balance for apricots, there are constant dynamics in quarters 1 and 4, and in quarters 2 and 3, when there is a significant increase in human consumption, there is an increasing deficit.

In view of the above, it was considered that the most relevant fruit species regarding the influence of seasonality on the trade balance are apples and pears. Following the analysis of the prices charged for these two products, depending on the quarter, a statistical analysis could be performed using the linear regression model to determine whether the trade balance influences the price and what its impact is. Following the running of the two regression models, it was possible to determine the price regression equation depending on the trade balance. It was found that in the case of apples, if the trade deficit increases by \$ 10 million, there is an increase in price by RON 0.21, so in the quarters when the deficit is higher, there is a higher price, and vice versa. In the case of pears, if the trade deficit increases by \$ 1 million, there is an increase in price by RON 0.24, so in the quarters when the deficit is higher, there is a higher price, and vice versa. It is estimated that, for these two species of fruit, seasonality plays an important role in the market.

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