European Research Studies Journal
Volume XXV, Issue 3, 2022

pp. 74-83

Impact of Labor Productivity on the Export Performance of the Food Industry in EU Member States

Submitted 11/08/22, 1st revision 23/08/22, 2nd revision 12/09/22, accepted 15/10/22

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Abstract:

Purpose: *The main objective of the study was to assess the relationship between labor productivity and the volume of food industry exports in EU Member States.*
Design/Methodology/Approach: *The relationships between labor productivity and the volume of exports in the food industry in 2013, 2016 and 2019 in the EU Member States were analyzed. The scatter plot, Pearson's linear correlation coefficients and linear regression models were used for the analysis. Models with no time lag and with annual and two-year time lags of the labor productivity index were created.*
Findings: *The conducted empirical research confirmed the existence of an impact of labor productivity in the food industry on the volume of exports to the EU market. The strongest relationships between these categories were observed in models without a time delay of the labor productivity indicator. Moreover, it was observed that the relationship between labor productivity and export volume is became stronger in the subsequent years.*
Practical Implications: *Identifying the factors influencing the export volume of an industry is important in the context of long-term and effective economic policy-making, taking measures to increase exports, industry competitiveness and stimulate economic growth.*
Originality/Value: *The study is an attempt to fill the research gap identified in the literature on the subject in the field of cause-effect analysis explaining the factors behind the export activity of the food industry on the EU market.*

Keywords: *Labor productivity, export, foody industry, Melitz's model, regression models.*

JEL Classification: *L66, C20, F16.*

Paper Type: *Research article.*

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1. Introduction

In a globalised economy, the level of export potential achieved by individual industries determines the further development of national economies (Derunova and Andryushchenko, 2019) and raising the welfare of societies and countries participating in international trade (Michalek, 2014). Under conditions of the ever-increasing competition on the global market, there is a need to pursue a well-thought-out economic policy and take actions aimed at a permanent increase in exports (Fornalska-Skurczyńska, 2020).

For this reason, it is important to identify the factors influencing the export activities of companies and industries. Attempts to explain the causes and directions of international trade have been made in trade theories within the classical school, the neoclassical school and in contemporary currents, as well as in studies by various authors (Gorynia, 2007). Despite the great importance and interest in the issue, it is still not fully recognised why the industries of some countries achieve export success and others do not.

The food industry is important not only because of the strategic nature of the goods produced, but also because of its high importance in the economy of the EU as a whole and individual Member States (Turi *et al.*, 2014). Intra-EU exports of food products in 2021 amounted to nearly EUR 303.7 billion. Studies of the food industry conducted in the literature are mainly concerned with assessing the value of exports, export destinations and structure, and ranking trade performance (Bezić *et al.*, 2013, Carraresi, Banterle, 2015; Juchniewicz and Łukiewska, 2015; Matkovski *et al.*, 2021). Much less attention is paid to the cause-effect analyzes define the determinants of exports.

The study attempted to clarify whether food industry exports depend on the level of labor productivity. The main objective of the study was therefore to assess the relationship between labor productivity and the volume of food industry exports in EU Member States. In addition, the following research questions (RQs) have been formulated:

RQ1: How has the relationship between labor productivity and export value changed over the years?
RQ2: Does labor productivity affect the value of exports with a time delay?

2. Literature Review

Productivity is a category that describes how efficiently an individual operates. According to the general and most commonly used definition, it is a relation of a quantitative measure of production to a quantitative measure of inputs (Measuring productivity 2001; Ameh and Osegbo, 2011; Jang *et al.*, 2011; Durdyev and Mbachu 2018; Zhiqiang *et al.*, 2019).

Depending on the sort of input adopted, we can distinguish between different types of productivity (OECD Compedium…, 2021). Labor productivity expresses the amount of output per unit of labor, such as the number of employees (Latruffe, 2010). Many authors emphasise the importance of productivity in the development and competitiveness of enterprises and industries, as well as national economies (Hulten, 2001; Aiyar and Dalgaard, 2004; Balcerzak, 2012). Gableta and Maksimowicz (2005) point out that productivity growth leads to lower production costs and, as a result, better financial performance. Goel *et al.* (2017) point out that high productivity can not only help in covering the increasing costs, it also leads to improved quality and enhanced customer satisfaction. Porter (2001) treated productivity as synonymous with competitiveness, believing that the ability of companies to increase it depends on the increase in the standard of living of its citizens.

The theoretical basis for the link between labor productivity and export activity is the model developed by Melitz (2003). The model is regarded as a groundbreaking approach to explaining the causes of international trade and marks the beginning of the so-called New New Trade Theory (NNTT) (Gabrielczak and Serwach, 2014). The basic assumption of the model was that firms were differentiated in terms of productivity. In addition, Melitz assumed that market entry requires certain fixed costs and that starting to export is associated with additional costs, such as learning the specifics of the foreign market, finding counterparties, creating distribution channels, promotion, meeting technical standards, additional transport costs. As a result, according to Melitz's (2003) model, the lowest-productivity firms are unable to stay in the market because they cannot generate positive profits, the medium-productivity firms sell only on the domestic market, and the most productive export. Similar conclusions have been obtained in extensions of this model (Helpman *et al.*, 2004; Melitz and Ottaviano, 2008).

The links between productivity and export activity are indicated not only in theoretical, but also empirical considerations, both at the firm and sector level. In the work of Gabrielczak and Serwac (2014), based on a study of firms from the Łódź Province in Poland, it was shown that entities undertaking activities outside the state turned out to be more productive than non-internationalised firms. Moreover, it was shown that the complexity of the internationalization process was also associated with the productivity advantage. The positive impact of productivity on the extensive export margins of enterprises was analysed by Fornalska-Skurczyńska (2020) based on an analysis of 708 Polish firms (exporters and non-exporters). Examples confirming the relationship between firm productivity and exports can be found in the works of Pavcnik (2002), Aghion *et al.* (2006), Cieślik *et al.* (2012), Brodzicki and Ciolek (2016).

In the context of the industry, research was conducted by, among others, Olczyk and Kordalska (2015). Based on an analysis covering the period 1995-2011, the authors

concluded that labor productivity was one of the most important factors influencing the value of Polish manufacturing exports.

Positive relationships between productivity and exports at the sectoral level were also observed in studies of international exchange between Canada and the USA by Trefler, (2004) and studies of European industry by Chen *et al.* (2009). Based on the literature review the following research hypothesis was formulated:

H1: Export activity is positively related to labor productivity in the food industry in EU Member States.

3. Research Methodology

The subject of the analyses was the food industry in EU Member States. It was determined on the basis of the Statistical Classification of Economic Activities in the European Community (NACE), division 10-Manufacture of food products and the Standard International Trade Classification (SITC) Rev 3.- aggregation of divisions 01-09 and 4. The source of empirical data was the database of the Statistical Office of the European Union - EUROSTAT. The following categories were used in the analysis:

- labor productivity (*LP*) – relation between the value of products sold and the number of employees,
- export volume (*EXP*) – value of exports to the EU market.

The relationships between labor productivity and export volumes in 2013, 2016 and 2019 were analysed. The analysis was conducted without any time delay and with one-year and two-year time delay of the labor productivity index. The correlation was assessed using a scatter plot and Pearson's linear correlation coefficients ($r_{LP,EXP}$) calculated according to the formula (Kot *et al.*, 2011):

$$r_{LP,EXP} = \frac{\sum_{i=1}^{n}(LP_i - \overline{LP})\cdot(EXP_i - \overline{EXP})}{\sqrt{\sum_{i=1}^{n}(LP_i - \overline{LP})^2}\cdot\sqrt{\sum_{i=1}^{n}(EXP_i - \overline{EXP})^2}} \quad (1)$$

where: $\overline{LP}, \overline{EXP}$ – arithmetic means of the indicators, n – number of observations.

The statistical significance of the calculated Pearson's linear correlation coefficients was checked using the t-test (Pułaska-Turyna, 2011). The test hypotheses were verified at the significance level α=0.05. Following Cieciura, Zacharski (2007), it was assumed that: if $0<|r_{LP,EXP}|<0.3$, the correlation is weak, if $0.3\leq|r_{LP,EXP}|<0.5$ the correlation is medium, if $0.5\leq|r_{LP,EXP}|<0.7$ the correlation is strong, and if $|r_{LP,EXP}|<0.7$ the correlation is very strong.

The linear regression model (Yao and Li, 2014) made it possible to analyze the impact of labor productivity (explanatory variable) on the value of exports (dependent variable) in individual EU Member States in 2013, 2016, 2019. The models took the following form:

$$EXP_{it} = \beta_0 + \beta_1 LP_{it} + \varepsilon_i, \quad i=1,\ldots,n \quad (2)$$

$$EXP_{it} = \beta_0 + \beta_1 LP_{it-1} + \varepsilon_i, \quad i=1,\ldots,n \quad (3)$$

$$EXP_{it} = \beta_0 + \beta_1 LP_{it-2} + \varepsilon_i, \quad i=1,\ldots,n \quad (4)$$

where: EXP – export value, LP – labor productivity, n – number of observations, β_0, β_1 – parameters of the regression equation.

The classical least squares method was used to estimate the regression coefficients. The usefulness of the estimated functions was assessed by the coefficient of determination R^2, which indicates the degree of fit of the model to the observational results. In addition, standard errors (SE) of structural parameters were estimated, a t-test was performed to assess the significance of the structural parameters in the regression model and coincidence was assessed (Stanisz, 2000). The statistical package Statistica 13.3 was used to analyse the results.

4. Results and Discussion

The value of intra-EU exports of the food industry in individual Member States was clearly differentiated. By far the largest food exports in 2016 and 2019 with a value of EUR 44.8-50.4 billion per year stood out for the Netherlands (Table 1, Figure 1). In this country, the highest labor productivity in the EU was also recorded in the years indicated, at the level of EUR 503-524 thousand of production per employee. In 2013, this country ranked second in terms of both analyzed categories.

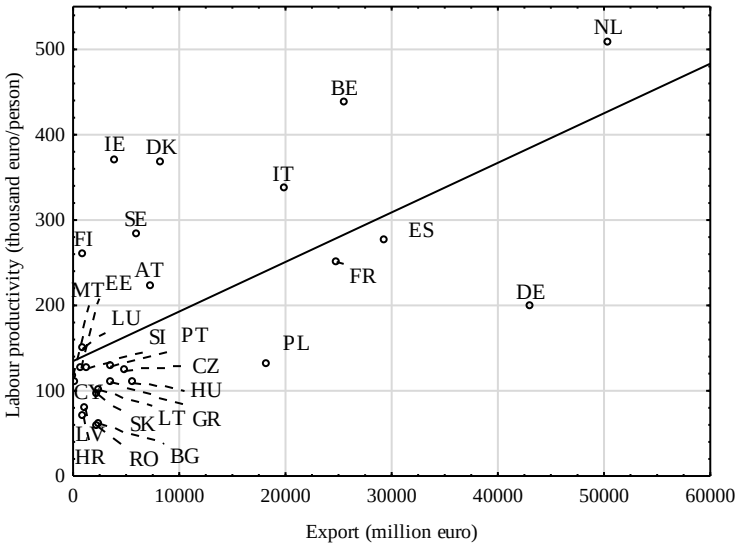
Table 1. *Labor productivity (LP) and value of exports to the EU market (EXP) of the food industry in EU Member States in 2013, 2016, 2019*

Specification		LP (thousand euro/person)			EXP (million euro)		
		2013	2016	2019	2013	2016	2019
Austria	AT	215	209	223	6 149	6 446	7 291
Belgium	BE	492	499	437	22 063	24 569	25 587
Bulgaria	BG	47	53	62	1 783	1 966	2 369
Croatia	HR	66	68	70	414	864	994
Cyprus	CY	103	107	109	101	121	174
Czechia	CZ	108	103	123	4 001	4 805	4 842
Denmark	DK	378	392	367	7 879	8 126	8 339
Estonia	EE	104	104	126	652	599	782
Finland	FI	277	265	260	623	770	1 004
France	FR	260	252	251	25 080	23 183	24 821
Germany	DE	205	197	198	38 691	40 198	43 131
Greece	GR	149	119	110	2 924	3 467	3 531

Hungary	HU	97	98	109	5 014	4 839	5 606
Ireland	IE	527	484	371	2 704	3 150	3 970
Italy	IT	348	345	336	15 197	17 418	19 907
Latvia	LV	64	65	80	933	966	1 164
Lithuania	LT	89	85	101	1 663	2 176	2 465
Luxembourg	LU	117	139	149	718	793	883
Malta	MT	-	-	118	14	22	11
Netherlands	NL	503	524	508	35 841	44 820	50 451
Poland	PL	118	116	131	11 895	14 658	18 236
Portugal	PT	128	119	128	2 412	2 922	3 508
Romania	RO	50	51	58	1 587	1 689	2 351
Slovakia	SK	96	85	97	2 245	2 123	2 242
Slovenia	SI	117	121	126	972	1 063	1 385
Spain	ES	280	279	277	22 216	26 035	29 338
Sweden	SE	307	288	283	4 441	5 690	5 954
mean		202	199	193	8 082	9 018	10 012

Source: *Own study based on Eurostat data (access: 18.07.2022).*

Figure 1. *Labor productivity and value of exports to the EU market of the food industry in EU Member States in 2019*



Source: *Own study based on Eurostat data (access: 18.07.2022).*

The first food exporter in 2013 and the second in 2016 and 2019 was Germany. In this country, labor productivity was significantly lower than in the Netherlands, but above average, at 198-205 thousand euro/person. Germany was ranked 11th in this respect. Spain, Belgium and France were also distinguished by the high value of their food exports (over EUR 20 billion per year), ranking 3-5 depending on the year of analysis. At the same time, these countries were distinguished by their high labor productivity, especially Belgium, which had the highest value of production per

employee in the food industry after the Netherlands, i.e., EUR 437 thousand per year.

Italy and Poland were next in the ranking (exports in 2019 amounted EUR 18.2 and 19.9 billion, respectively). In Italy, high exports were matched by high efficiency in the use of labor resources. However, such an analogy did not take place in Poland, where labor productivity was lower than EU average in 2019 and amounted to EUR 131 thousand/person. It is worth noting the clear increase in labor productivity in 2013-2019 in the food industry in this country (by 11.2%). In the following countries, the value of food exports to the EU market was clearly lower and did not exceed EUR 9 billion. In Ireland, Denmark, Sweden, Austria and Finland, labor productivity was above average (EUR 223-367 thousand/person), while in the others, labor productivity did not exceed the EU average and in 2019 stood at EUR 58.33-148.67 thousand/person.

The conducted statistical and econometric modeling confirmed the existence of a general relationship between labor productivity and the value of exports of the food industry in the EU Member States. The calculated Pearson linear correlation coefficients confirmed the occurrence of a statistically significant positive relationship between these categories in all the years analysed (Table 2).

Table 2. *Pearson's correlation coefficients between labor productivity and export value*

Specification	EXP					
	2013		2016		2019	
LP	2013	0.5377*	2016	0.5871*	2019	0.6422*
	2012	0.5410*	2015	0.5857*	2018	0.6340*
	2011	0.5481*	2014	0.5829*	2017	0.6280*

Note: *** *Correlation significant at the 0.05 level*
Source: *Own study based on Eurostat data (access: 18.07.2022).*

This means that the higher the labor productivity in the food industry in a country was, the higher the value of export (and vice versa). The calculated coefficients were at the level of 0.5377-0.6422. The strength of the relationship can therefore be described as strong. The highest coefficients was recorded in the approach without time delay (except for exports in 2013). It is also worth noting that Pearson's linear correlation coefficients in the subsequent years analysed, 2013, 2016 and 2019, were increasingly higher at 0.5377, 0.5871 and 0.6422, respectively (in the models without time delay). This indicates an increasingly strong relationship between labor productivity and export value.

Empirical assessment of the cause-effect relationship was made on the basis of regression models (Table 3). The estimated models described the studied phenomenon sufficiently well and could form the basis for further evaluation. This is

evidenced by the relatively high level of determination coefficients, the significance of regression coefficients, low standard errors and the fulfilled coincidence property.

Table 3. *Estimation results for linear regression models*

DV	IV	b_0	SE b_0	b_1	SE b_1	t test	p-value	R^2
Model without time delay								
EXP_{2013}	LP_{2013}	0.5377	0.1721	41.0488	13.1371	3.1246	0.0046	0.2892
EXP_{2016}	LP_{2016}	0.5871	0.1652	50.5680	14.2313	3.5533	0.0016	0.3447
EXP_{2019}	LP_{2019}	0.6422	0.1533	70.9700	16.9430	4.1888	0.0003	0.4124
Model with a delay of 1 year								
EXP_{2013}	LP_{2012}	0.4961	0.1772	38.1617	13.6328	2.7993	0.0099	0.2461
EXP_{2016}	LP_{2015}	0.5785	0.1665	48.8195	14.0522	3.4741	0.0020	0.3069
EXP_{2019}	LP_{2018}	0.6214	0.1567	64.6123	16.2942	3.9653	0.0005	0.3861
Model with a delay of 2 years								
EXP_{2013}	LP_{2011}	0.5255	0.1737	43.1955	14.2754	3.0259	0.0058	0.2761
EXP_{2016}	LP_{2014}	0.5602	0.1691	47.7154	14.4009	3.3134	0.0029	0.3139
EXP_{2019}	LP_{2017}	0.6020	0.1630	56.4384	15.2799	3.6936	0.0011	0.3624

Note: *DV- dependent variable, IV-independent variable, SE – standard error*
Source: *Own study based on Eurostat data (access: 18.07.2022).*

The use of one-year and two-year delays for the independent variable was not associated with an improvement in model quality. Determination coefficients and regression coefficients were highest in models without a time delay. Taking into account the value of exports and labor productivity in 2019, the estimated model explained 41.24% of the variation in the dependent variable (value of exports). A β_1 coefficient at the level of 70.97 indicates that a higher labor productivity of 1 thousand euro/person resulted in an increase of EUR 70.97 million in the value of exports.

For the 2016 data, the model explained 34.47% of the variation in the dependent variable, with higher labor productivity of 1 thousand euro/person causing an increase in export value of EUR 50.57 million. Whereas, for the 2013 data it was 28.92% and an increase in exports of EUR 41.05 million respectively. It was therefore observed that the cause-effect relationships were getting stronger in the following years.

5. Conclusion

In the conditions of increasing competition on the international market, it is important to identify factors that improve the export activity of companies and industries. According to the Melitz model and research by other authors, such factors include labor productivity. The conducted empirical research confirmed the existence of an impact of labor productivity of the food industry on the volume of exports to the EU market. The hypothesis adopted was therefore confirmed.

The strongest relationships between these categories were observed in models without a time delay of the labor productivity indicator. Moreover, it was observed that the relationship between labor productivity and export volume is became stronger in the subsequent years. Enterprises should therefore strive to improve the efficiency of their use of labor resources and economic policy should create appropriate conditions for this.

An exploration of this topic could be related to the number of exporting firms, capital productivity rates or total factor productivity. Further research should also look for other factors in the export activity of the food industry, such as domestic and foreign demand or unit labor costs.

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