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ORIGINAL PAPER

INFLUENCE OF REVERSE LOGISTICS ON COMPETITIVENESS, ECONOMIC PERFORMANCE, ECOLOGICAL ENVIRONMENT AND SOCIETY

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ABSTRACT. Background: Today, companies operate in an environment that is significantly affected by the forces of transformational changes, which create problems for logistics. Reverse logistics is a relatively new topic for businesses. Therefore, the purpose of this article is to study the relationship between reverse logistics and competitiveness, economic performance, the environment, and society.
Methods: The research methodology includes general scientific and special methods, such as synthesis and analysis, logical generalization, correlation and regression analysis. The hypotheses were empirically tested using sample data from 37 countries of the Organization for Economic Co-operation and Development (OECD). The analysis period ranged from 2000 to 2019, which corresponds to an unbalanced group of 591 observations.
Results: Eight different models were developed to analyse the proposed hypotheses. It was confirmed that reverse logistics has a positive effect on competitiveness, economic performance, environmental performance and society.
Conclusions: Therefore, companies should pay attention to reverse logistics, as it will promote their development and benefit during their activities. The aspects highlighted in the article will help to understand the development and scientific substantiation of logistics management measures. The conclusions of this document can serve as a guide for leadership and management.

Keywords: Reverse Logistics, Competitiveness, Economic performance, Ecological environment, Society
JEL Classification: F63, L23, O14

INTRODUCTION

The spread of globalization, growing consumer demand, the production of "special" products, lean management, shortening production cycles or the rapid development of information technology are placing increasing demands on businesses. These trends affect and form the logistics systems of enterprises.

Research conducted on the territory of some countries examined the issue of reverse logistics implementation only at the state level [Huang and Yang, 2014; Maheswari et al., 2018]. Regarding research into the experience of large corporations in reverse logistics, they were conducted by Zhang et al. [2016]; Alnoor et al. [2019]; Cricelli et al. [2021]. For small and medium-sized enterprises the implementation of reverse logistics for them was studied by Lopes et al. [2014]; Satyanarayana and Venugopal [2019]; Strong, et al. [2019]; Yang et al. [2019]; Pawar et al. [2021] and others. However, none of these studies has taken into account a comprehensive study of reverse logistics and its impact on competitiveness, economic performance, the environment, and society. There has also been insufficient research on reverse logistics in OECD countries. This study is important because it will allow making the right management decisions on reverse logistics and implementation of some strategies at the enterprise level.

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The other sections of this article are organized as follows. The next section is a review of the scientific literature on reverse logistics. The conceptual framework is then outlined, and hypotheses formulated. Then comes the section on the methodology of the study. The following is a test of the hypothesis. The article concludes with discussions, also offering suggestions for future research conclusions.

LITERATURE REVIEW AND HYPOTHESES

This section briefly reviews the scientific literature on the concepts used in this study. These are reverse logistics, competitiveness, economic performance, environment and society.

Reverse logistics and competitiveness

The implementation of reverse logistics strategy can effectively help modern manufacturing enterprises to improve the competitiveness of enterprises [Gao, 2018]. Job et al. [2020] recommend that implementation of reverse logistics should be guided by a process that requires identifying the uniqueness of resources the organization has and strategically utilizing these resources in a manner that builds comparative advantage. Studies by Mwanyota et al. [2017] have shown that the adoption of reverse logistics can lead to a sustainable competitive advantage for firms.

Reverse logistics and economic performance

When the organizations competently manage their reverse logistics, it results in positive economic performance outcomes and maintains the competitive situation in the industry, as it can reduce the use of resources [Phoosawad et al., 2018]. Results from analysis Mutingi [2014] indicate that reverse logistics may have an impact on economic performance. Reverse logistics has a positive and significant impact on economic and environmental performance [Huang et al., 2012].

Reverse logistics and the ecological environmental

Nowadays, there has been a growing interest in reverse logistics in both theory and practice due to ecological benefits [Aksoylu and Demirel, 2018]. Reverse logistics is an alternative that reduces negative impacts on the environment associated with the recovery of materials [Peña-Montoya et al., 2015]. Mangla et al. [2016] considered reverse logistics as a systematic approach to improve environmental impacts and to ensure sustainability in business.

Reverse logistics and the society

The research results of Hong and Yue-Jun [2021] show significant correlations between reverse logistics and social impact. As a result of research, Barky [2016] indicates a significant impact of reverse logistics on customer satisfaction in terms of the remanufactured product price, quality and a lower impact done by the service representatives and acquisition processes. Mohamed et al. [2015] in the work have shown that the application of reverse logistics has a significant impact on customer satisfaction.

Figure 1 presents our conceptual research model.

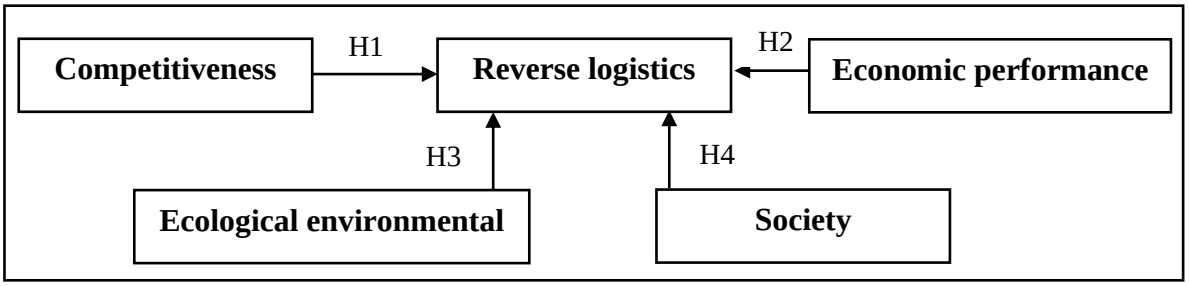

Fig. 1. Conceptual Model

AIMS

This paper aims to extend the literature by advancing research into the influence of reverse logistics on competitiveness, economic performance, ecological environment and society in the OESD countries.

The following research hypotheses were identified:

Hypothesis 1: Reverse logistics has a positive impact on the competitiveness of the enterprise.

Hypothesis 2: Reverse logistics has a positive impact on the economic performance of the enterprise.

Hypothesis 3: Reverse logistics has a positive impact on the ecological environment of the enterprise.

Hypothesis 4: Reverse logistics has a positive impact on society.

METHODOLOGY

Data

In the study, the reverse logistics impact on competitiveness, economic performance, ecological environment and society was analysed using data analysis for 37 Organization for Economic Co-operation and Development (OECD) countries in the period of 2000-2019 (data that available at the beginning of the 2021 year). This data provided was by the OECD (https://stats.oecd.org/).

Measures

Dependent variables

The real growth of gross domestic product the real growth (GDP_GR) is one of the main depend on indicators. Another indicator is Transport infrastructure investment (TII). This variable collected includes investment, maintenance spending and capital value of the road, rail, inland waterways, maritime ports and airports.

Control variables

The control indicators used in this analysis include the total population (POP), Share of employment of the transport sector (SETS) and Share of value added by the transport sector (SVATS).

Independent variables

1. Competitiveness

The first indicator, which is analysed, is Foreign Direct Investment (FDI). Another indicator used is the Regulatory Restrictiveness Index (RRI), which measures statutory restrictions on foreign direct investment and gauges the restrictiveness of a country.

2. Economic performance

An indicator referring to lean management used in this article was Environmental and resource productivity (ERP), which indicates whether economic growth is becoming greener with more efficient use of natural capital and to capture aspects of production. Also, the investigation included Total amounts of waste

generated by sector (TAW), because this indicator show waste produced by the various sectors of economic activity.

3. Ecological environmental

This study included business with bioecological component (BBC) and business sub-ecological (BS). These indicators correspond to environmental technologies in various sectors of the economy.

4. Society

One of the indicators of customization is Consumer Support Estimate (CSE). Another indicator is Gross domestic expenditure on R&D by sector of performance and socio-economic objective (GDE_SEO).

Data analysis

A model of fixed effects was used to analyse the countries studied in the study and their indicators. The model used in the analysis is as follows:

$$LGDP\_GR_{it} = \alpha_i + \lambda_t + \beta_1 TII_{it} + \beta_2 POP_{it} + \beta_3 SETS_{it} + \beta_4 SVATS_{it} + \beta_5 LOGIST_{it} + \varepsilon_{it}, \quad (1)$$

Where: $LGDP\_GR_{it}$ - an indicator of the impact of megatrends on logistics, $i = 1 \dots N$, i - country, $t = 1 \dots T$, t - time, α_i - country fixed effect, λ_t - time constant, β - estimate coefficient, TII - transport infrastructure investment, POP – population, SETS - share of employment of the transport sector, SVATS - share of value added by the transport sector, ε_{it} - error term. LOGIST shows the variables which are used as a proxy of megatrends in the context of logistics. Eight different models were formed in the study to analyse the relation between megatrends and logistics. As a proxy of the logistics sector used all independent variables (FDI, RRI, ERP, TAW, BBC, BS, CSE, GDE_SEO).

All the equations were estimated using the statistical analysis software STATA version 13.5.

RESULTS

Table 1 presents the results of descriptive statistics of the variables used in econometric modelling.

Table 2 presents the results of the correlation coefficients of the variables used in the study.

As it is shown in the Table 3, there is a positive and generally high correlation between GDP_GR levels and TII, POP, SETS, SVATS, RRI, ERP, BBC, BS, CSE, GDE_SEO. Also, there is a negative correlation between GDP_GR and FDI, TAW.

The analysis results belonging to the models are summarized in Table 3.

Table 1. Descriptive statistics for study variables

Variable	Mean	Standard deviation	Minimum	Maximum
GDP_GR	2.15	3.41	-14.84	25.18
TII	11996256079.80	49708243741.14	274052.45	655814699587.19
POP	34505697.66	55334234.92	281200.00	327167434.00
SETS	5.52	1.10	3.42	9.59
SVATS	27.84	7.67	7.14	48.41
FDI	25263.30	54415.38	-79075.29	483849.00
RRI	0.069	0.061	0.004	0.283
ERP	1.37	2.39	-13.06	14.25
TAW	85417.47	102764.29	501.43	405523.60
BBC	93.66	6.07	68.10	100.00
BS	73.08	12.15	41.45	96.28
CSE	-4139.12	12933.88	-61515.13	34198.73
GDE_SEO	2690143.80	10679335.32	29.87	89047077.12

Source: Calculated by the authors

Table 2. Correlation matrix for the variables

Variable	GDP_GR	TII	POP	SETS	SVATS	FDI	RRI	ERP	TAW	BBC	BS	CSE	GDE_SEO
GDP_GR	1.000												
TII	0.387	1.000											
POP	0.111	-0.267	1.000										
SETS	0.669	0.716	-0.169	1.000									
SVATS	0.102	-0.361	-0.120	-0.199	1.000								
FDI	-0.086	-0.273	0.621	-0.136	-0.422	1.000							
RRI	0.009	-0.207	0.010	-0.169	-0.499	0.589	1.000						
ERP	0.782	0.516	0.111	0.680	-0.386	0.007	-0.117	1.000					
TAW	-0.032	-0.089	-0.394	-0.198	0.347	-0.536	-0.349	-0.132	1.000				
BBC	0.521	0.403	-0.660	0.483	-0.177	-0.443	-0.067	0.489	0.222	1.000			
BS	0.370	0.465	-0.251	0.396	-0.399	-0.231	-0.113	0.641	0.217	0.712	1.000		
CSE	0.081	0.047	0.093	-0.145	-0.278	0.139	0.192	-0.009	-0.601	-0.021	-0.161	1.000	
GDE_SEO	0.137	-0.099	0.211	0.094	-0.572	0.658	0.584	-0.072	-0.322	-0.195	-0.088	0.070	1.000

Source: Calculated by the authors

Table 3. Regression results

LGDP	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
TII	−0.025***	−0.037***	−0.032***	−0.036***	−0.033***	−0.029***	−0.032***	−0.042***
	(0.093)	(0.081)	(0.098)	(0.086)	(0.097)	(0.084)	(0.081)	(0.085)
POP	0.021***	0.022***	0.025***	0.026***	0.028***	0.031***	0.023***	0.025***
	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
SETS	0.003***	0.004***	0.005***	0.003***	0.004***	0.005***	0.003***	0.004***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0002)	(0.0002)
SVATS	0.019***	0.015***	0.018***	0.015***	0.011***	0.016***	0.019***	0.022***
	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)
FDI	0.022***	0.019***	0.017***	0.021***	0.015***	0.014***	0.019***	0.025***
	(0.005)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
RRI		0.026***						
		(0.002)						
ERP			0.016***					
			(0.004)					
TAW				-0.015***				
				(0.001)				
BBC					0.052***			
					(0.0002)			
BS						0.021***		
						(0.0003)		
CSE							0.011***	
							(0.0002)	
GDE_SEO								0.052***
								(0.0005)
Constant	11.732***	15.875***	10.594***	12.132***	16.283***	11.107***	14.735***	10.285***
	(1.498)	(1.648)	(1.438)	(1.512)	(1.653)	(1.473)	(1.533)	(1.466)
R2	0.85	0.88	0.84	0.86	0.89	0.85	0.87	0.84
F test	212.48	367.82	287.66	327.84	315.52	263.37	315.71	274.54
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Number of obs.	468	468	468	468	468	468	468	468

Source: Calculated by the authors

DISCUSSION

Regarding the variables in Table 4 referring to the reverse logistics and competitiveness, the Foreign Direct Investment (FDI) (Model 1: $\beta = 0.022$, $p < 0.05$) and the contemporary Regulatory Restrictiveness Index (RRI) (Model 2: $\beta = 0.026$, $p < 0.05$) have a positive impact. In this way, we support our *Hypothesis 1: Reverse logistics has a positive impact on the competitiveness of the enterprise.*

The results of another study also indicate a positive link between reverse logistics and competitiveness Reverse logistics brings strategic competitive advantage and helps to minimize the total costs generated by the launch

of new products in the market and their reintegration into the value chain [Chaves et al., 2020]. Sabawi and Israa [2019] made a number of conclusions were reached that there is a significant role of reverse logistics in sustaining the competitive advantages. Reverse logistics is becoming more important to companies through achieving more competitive advantages [Moktadir et al., 2020]. Hence, reverse logistics management ensure that enterprises' competitive advantages are central to enterprise management [Yang et al., 2020].

Regarding the reverse logistics and competitiveness of the enterprise, Environmental and resource productivity (ERP) (Model 3: $\beta = 0.016$, $p < 0.05$) and Total amount of waste generated by sector (TAW) (Model 4: $\beta = 0.15$, $p < 0.05$) have a positive impact. In this way, we support *Hypothesis 2: Reverse logistics has a positive impact on the economic performance of the enterprise*.

This result is confirmed by other studies. The findings of the study Mutuku concluded that reverse logistics have a positive relationship with economic performance [Mutuku and Moronge, 2020]. In the study Bor [2020] was also established that reverse logistics had a significant and positive effect on the economic performance of enterprises. Another research showed that reverse logistics has a positive impact on financial performance [Prajapati et al., 2021].

Regarding the reverse logistics and ecological environmental impact of the enterprise, Business with bioecological component (BBC) (Model 5: $\beta = 0.052$, $p < 0.05$) and Business sub-ecological (BS) (Model 6: $\beta = 0.21$, $p < 0.05$) have a positive impact. In this way, we support *Hypothesis 3: Reverse logistics has a positive impact on the ecological environment of the enterprise.*

This result is in agreement with the other studies. Implementation of reverse logistics programs has been contemplated to mitigate the negative environmental effects of manufacturing [Job et al., 2020]. When the organizations competently manage their reverse logistics, it results in improving the environment [Phoosawad et al., 2019]. According to research by Fernando et al. [2018], reverse logistics contributes to the company's greater compliance with environmental standards.

Regarding reverse logistics and society, Consumer Support Estimate (CSE) (Model 7: $\beta = 0.011$, $p < 0.05$) and Gross domestic expenditure on R&D by sector of performance and socio-economic objective (Model 8: $\beta = 0.52$, $p < 0.05$) have a positive impact. In this way, we support *Hypothesis 4: Reverse logistics has a positive impact on society*.

The results of this study are consistent with the study by other authors. Findings of the research Milichovsky [2017] show the connection of reverse logistics and individual communication tools, which are well-accepted on the customer side. Majzoub et al. [2020] prove the significant impact of reverse logistics on customer satisfaction. Thus, reverse logistics acts as an element of differentiation among competitors, able to simultaneously intensify the growth of customer satisfaction and profitability of the company [Miranda et al., 2016].

CONCLUSIONS

The purpose of this study was to investigate the relationship between reverse logistics and competitiveness, economic performance, ecological environment and society. The main section of this study analysed data on 37 European countries for the period from 2000 to 2019. All the hypotheses that were proposed at the beginning of the study were eventually accepted. The study confirms the opinion that the introduction of reverse logistics has a positive impact on enterprises. Thus, this study provides confirmation of similar research findings and can serve as a benchmark for conducting similar studies.

The study has some limitations as the data are collected only from OESD countries. For more accurate results, similar research should be conducted in other countries. Perhaps if perform research within other countries, can find some additional dependencies.

Another limitation is that only the relationship between reverse logistics, competitiveness, economic performance, ecological environment, society is mentioned in the article. Therefore, subsequent research should investigate and identify patterns with other aspects. In addition, the impact of national legislation and culture on reverse logistics should be monitored.

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