RESOURCE PRODUCTIVITY: EMPIRICAL EVIDENCE OF ENTERPRISES IN MANUFACTURING

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Abstract

The investment decisions of enterprises are nowadays not only influenced by the economic efficiency of investments, but also by sustainability and corporate social responsibility. The enterprise often applies the principles of the circular economy to increase competitiveness. Traditional ratio indicators assessing the efficiency of resources spent need to be supplemented by the resource productivity indicator. The aim of this paper is to assess how new investment activity of enterprises affects enterprise resource productivity. The analysis also assesses the role of firm size and ownership concentration in this investment activity. The study focuses on the manufacturing industry in the V4 countries (Czech Republic, Hungary, Poland and Slovakia). The results provide insights into how enterprises also considers the sustainability aspect in their decision-making on new investments, which is important in view of the rising prices of production inputs and their availability.

Key words: resource productivity, investments, manufacturing, Visegrad countries

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Introduction

The investment activity of companies is not only influenced by the economic efficiency of investments, but also by other aspects such as corporate social responsibility. Enterprises must take into account the rising prices of inputs (materials, natural resources), which significantly affect their efficiency, when making investment decisions. The aim of this paper is to assess how investment activities of enterprises affect resource productivity. Important influences here may be the size of the firm or the concentration of ownership.

The traditional concept of economics considers labour and capital as the basic elements for evaluating the efficiency of production. Less attention was paid to natural resources (Šetek et al., 2019). Industrialization and economic development have made that the lack of resources is major threat to future economic development (Gan et al., 2013).

Productivity measures the efficient use of factors of production in enterprises. The most widely used indicators are labour productivity and capital productivity. Labour productivity assesses the efficiency of labour used. Capital productivity measures how efficiently capital is used in enterprises. Productivity can be measured at the level of countries, regions or firm (Mura & Hajduová, 2021). The pressure from society and governments for environmentally and socially responsible corporate behaviour has led to a drive by enterprises to use natural resources more economically. The main indicator assessing how efficiently natural resources are used in enterprises is the resource productivity indicator. This indicator can be defined as the ratio of output to material input. The indicator can be measured at the macro and micro level. At the macro level, it is the ratio of gross domestic product as the output and natural resources as the input (Fu et al., 2015). At the enterprise level, sales as output and materials as input can be used. An important factor affecting the magnitude of resource productivity is the degree of utilization of the circular economy (Blomsma, & Brennan, 2017).

The manufacturing sector is one of the main sectors that integrates ideas of circular economy to increase resource productivity. It is necessary to take into account not only the appropriate allocation of resources within individual firms but also between firms. A study by Inklaar et al. (2017) pointed out that poor resource allocation across firms leads to lower overall productivity. According to a study by Jaeger and Upadhyay (2020), barriers limiting the greater use of circular economy ideas include high upfront investment costs, challenging business-to-business (B2B) collaboration, lack of information, lack of technical skills, time-consuming and quality of human resources (Šetek et al., 2019). A study by Yu et al. (2022) for the automotive industry showed that the ideal option is to invest in technologies that integrate Industry 4.0 ideas and sustainability (social responsibility) ideas at the same time.

1   Data and methodology

The paper focuses on the analysis of whether enterprises in the manufacturing industry invest into fixed assets that increase the efficiency of the production factor of labour and at the same time are consistent with the application of the principles of the circular economy. Company data were taken from accounting statements from the database AMADEUS. The dataset of 1,090 enterprises focusing on Manufacture of machinery and equipment (NACE Division C28) from the V4 countries was firstly disaggregated into enterprises that invested between 2014 and 2018 (average growth rate of fixed assets was higher than 1) and enterprises that

experienced a decline in fixed assets in the monitored years (Figure 1) and then the ratios were analysed.

Fig. 1: Structure of enterprises according to investment activity in 2014-2018
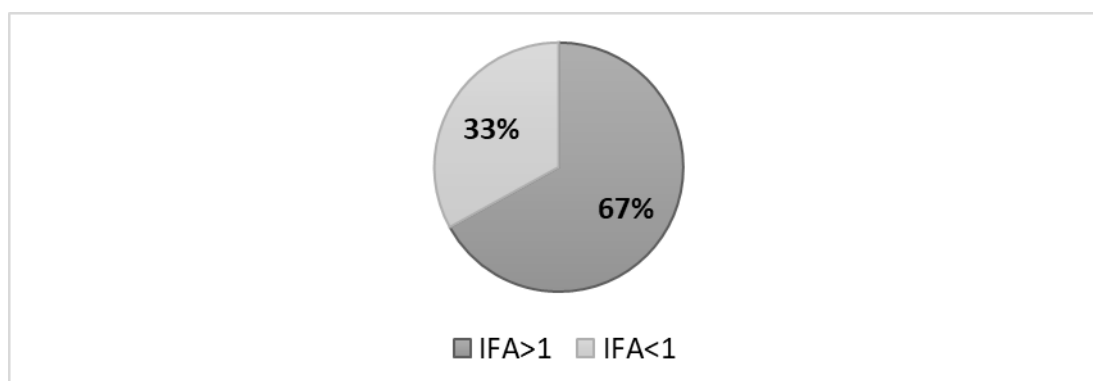
Source: Own calculations

The indicator of labour productivity (Operating revenues/ Costs of employees) has been expanded to the indicator of resource productivity. The size of enterprises and ownership concentration have also been considered. The resource productivity indicator (Operating revenues/Material costs) was derived on the basis of the macroeconomic indicator resource productivity, which is methodologically defined by Eurostat. An additional criterion for the classification of companies was their size according to the EU Directive.

In terms of ownership concentration, the analysis divided enterprises into two distinct categories depending on the degree of ownership concentration: enterprises with low ownership concentration (abbreviated LOC) and enterprises with high ownership concentration (abbreviated HOC). The category of low ownership concentration (LOC) comprises undertakings in which each shareholder holds less than 25 % of the direct shareholding and undertakings where the shareholders hold less than 50 %. High ownership concentration (HOC) includes enterprises where the shareholders have an ownership interest above 50% and enterprises where the owners have a direct ownership interest above 50%.

The ANOVA test was used to assess the statistical significance of the effect of size and ownership concentration on the dependent variable labour productivity or resource productivity. The ANOVA test the effect of multiple factors on a variable (Montgomery & Runger, 2010). The variable explained was the resource productivity (or the labour productivity), the explanatory variables referred to as factors were the ownership concentration (LOC, HOC) and firm size (SMEs- Small and Medium enterprises and LE – Large enterprises). We test the hypothesis about the so-called main effects of factors, i.e.,

hypotheses that the effects of all levels of a given factor (regardless of the level of the second factor) are zero.

H: $Xl = X2 = 0$, X (groups of companies according to type of the ownership concentration) = 1, 2;

respectively H: $Yl = Y2 = 0$, Y (groups of companies by firm size) = 1,2.

The hypothesis is that the magnitude of the effect of a change in the level of one factor does not depend on the specific level of the other factor. The normality assumption (Shapiro-Wilk test), the homogeneity of variance assumption (Levene's test for homogeneity of variances) were tested before ANOVA was performed.

2. Results

The enterprises focusing on the manufacture of machinery and equipment were first divided into 2 groups: a group of investing enterprises and a group of non-investing enterprises (see methodology). The group of investing enterprises is characterised by an increase in the value of fixed assets in the period 2014-2018. These enterprises accounted for about 67% of all surveyed enterprises (Figure 1). The relatively high share of investing enterprises is mainly due to the period under review. The period 2014 - 2018 is characterized by growing economies for all countries included in the study.

The enterprise investments are oriented to increase the enterprise competitiveness and to increase the economic enterprise performance (Dvouletý & Blažková, 2021). At the same time, corporate social responsibility is becoming increasingly important, i.e. the need to use material and natural resources more efficiently. The ideal indicator for monitoring and comparing the use of material resources is the expression of this indicator in natural units, which, however, is unavailable for practical calculations. All indicator values are taken from accounting statements, which provide information even in an imperfect structure. On the other hand, they are consistently reported for all enterprises across country borders and therefore provide relevant information. Figure 2 focuses on investing enterprises and illustrates the evolution of labour productivity and resource productivity values by ownership concentration (left part of the graph) and by size (right part of the graph).

Fig. 2: Productivity indicators for investing companies in 2014-2018 by size and by ownership concentration (in Euro)
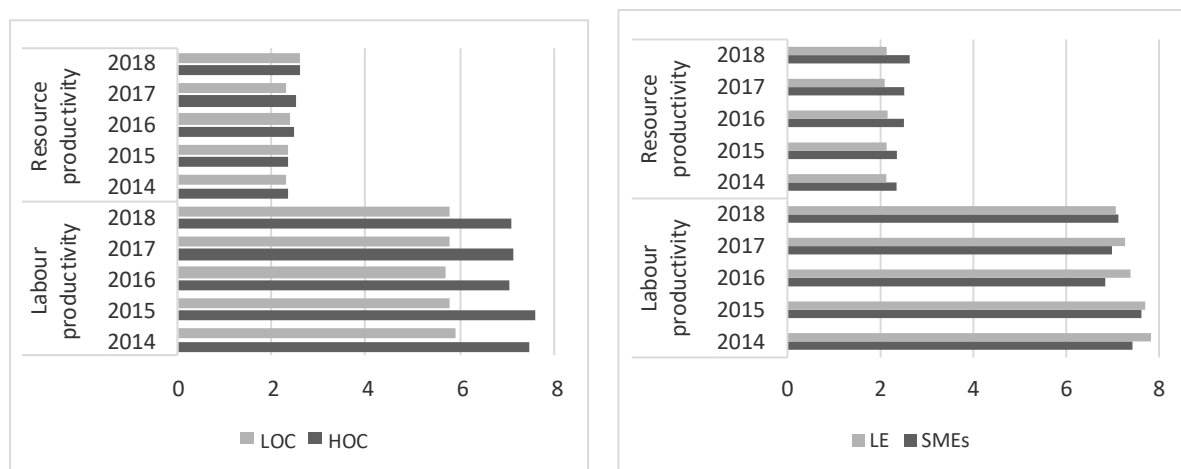
Source: Own calculations

The Figure 2 shows that the level of labour productivity is higher in enterprises with high ownership concentration (HOC) in all years under study. Higher ownership share puts more pressure on labour use efficiency. At the same time, labour productivity is, as expected, higher in large enterprises, but this difference disappears over the years. Regarding the resource productivity, it is evident that its level increases slightly over the years and, rather surprisingly, according to Figure 2, the values do not differ much by ownership concentration, but rather by firm size. SMEs use more material resources and have higher levels of resource productivity and this difference tends to widen over the years. Figure 3 illustrates the same indicators in the same classification but for enterprises that can be classified as non-investing firms in 2014 -2018 (see methodology).

Fig. 3: Productivity indicators for non-investing companies in 2014-2018 by size and by ownership concentration (in Euro)
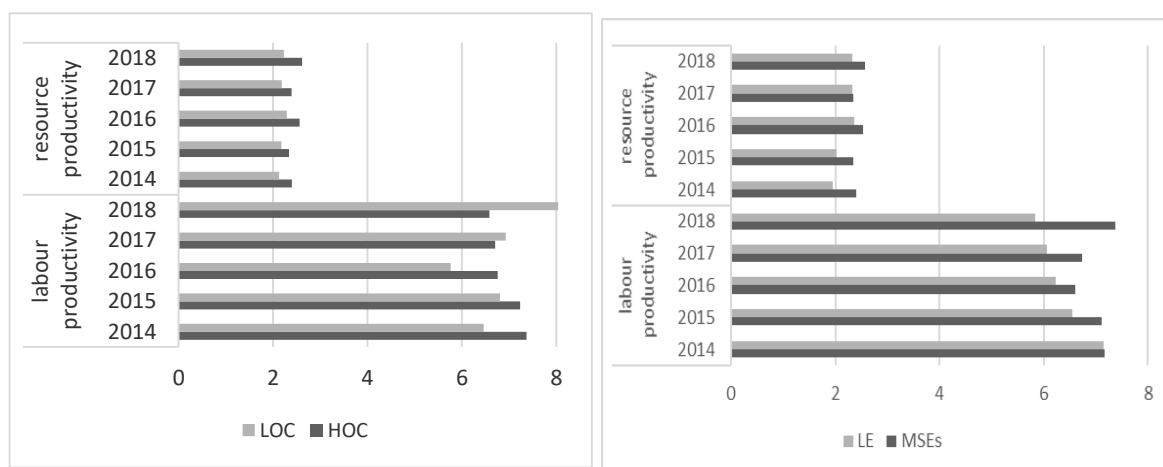
Source: Own calculations

The enterprises that have only minimal investment activity must focus on more intensive use of existing resources in order not to fall behind in the level of labour or resource productivity. The level of productivity indicators is slightly lower. The difference is also influenced by the concentration of ownership or the size of the enterprise, which is related to the degree of direction of enterprise performance. Where ownership is not diluted or ownership is separated from management, the values of the indicators are higher. Higher ownership concentration (HOC) means higher levels of both indicators (Figure 3. left part of the graph). At the same time, MSEs that are usually managed and directed by the owners themselves reach higher levels of the labour and resource productivity indicators in all years under study (Figure 3, right part of the graph).

ANOVA test was used to test the effect of factors (ownership concentration and firm size) on the dependent variable resource productivity and labour productivity for investing firms (Table 1 and Table 2).

Tab. 1: Result of the significance tests for resource productivity

	Sum of Squares	Mean Square	F-value	p-value
Absolut value	873.95	873.9480	31.63892	0.000000*
Size	20.01	20.0068	0.72429	0.395095
Ownership	2.30	2.2999	0.08326	0.773032
Country	162.55	54.1833	1.96156	0.118636

Source: Own calculations
Note:* significant at the 0.05 level

The ANOVA test showed (Table 1) that resource productivity is homogeneous across countries as well as across firm size and ownership concentration ($p > 0.05$; we do not reject the null hypothesis of equality of means at the 0.05 significance level).

Tab. 1: Result of the significance tests for labour productivity

	Sum of Squares	Mean Square	F-value	p-value
Absolut value	7358.88	7358.877	244.1859	0.000000*
Size	3.37	3.371	0.1119	0.738150
Ownership	169.56	169.559	5.6264	0.018021*
Country	599.72	199.907	6.6334	0.000207*

Source: Own calculations
Note:* significant at the 0.05 level

At the same time, the analysis showed a statistically significant difference for labour productivity (Table 2) across countries and ($p < 0.05$; we reject at the 0.05 significance level the null hypothesis of the equality of means), across groups by ownership concentration ($p < 0.05$; we reject at the 0.05 significance level the null hypothesis of the equality of means).

Conclusion

The article deals with the investment activity of enterprises and its impact on resource productivity in manufacturing enterprises in the V4 countries. The economic development has very strong similarity tendencies in all V4 countries (Pavelka, 2016). Institutional factors play an important role in these countries (Cermakova & Jasova, 2019). The analysis showed that enterprises with high investment activity have higher both labour and resource productivity compared to enterprises with lower investment activity. The growth in resource productivity was found especially in small and medium-sized enterprises. This is because SMEs use investment in areas that enable them to use material resources more efficiently. According to Sawe et al. (2021), greater use of the circular economy has positive impact on firms competitiveness.

The analysis also showed that investment activity in particular has an impact on labour productivity, especially for large enterprises and those with a high concentration of ownership. In contrast, firm size, ownership concentration or country do not have an impact on resource productivity. Enterprises with lower investment activity were found to have

lower levels of labour and resource productivity. The difference in productivity is influenced by ownership concentration and enterprise size.

Acknowledgment

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