THE CAPITAL INTENSITY OF MANUFACTURING COMPANIES IN VISEGRAD COUNTRIES

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Abstract

The companies have tended to have a higher capital-labour ratio by investing in new technology and innovations to maintain their competitiveness. The companies seek to gain productivity improvements. An important factor affecting the size of capital-labour ratios is the level of technological intensity of enterprises. The aim of this paper is to assess differences in capital intensity of companies in high-technology industry and low-technology industry of manufacturing in Visegrad Countries. The firm-level analysis is focused on the Visegrad Countries (Czech Republic, Hungary, Poland and Slovakia). The source of data for the conducted analysis of the enterprises is a database containing accounting data of large companies. Analysis of variance (ANOVA) was used to verification the differences of capital intensity among groups of enterprises divided by technology intensity and divided by countries. It was found that capital intensity is lower for high tech industry than low tech industry. The analysis found no statistical significantly difference in capital intensity between Visegrad Countries in manufacturing.

Key words: Capital intensity, companies, Visegrad Countries, manufacturing

JEL Code: R11, E01, O18

Introduction

Capital intensity is a key factor that influencing economic growth and competitiveness of individual companies or whole economy. The Investments to increase of using capitals are limiting especially manufacturing. The capital increase must be always considered in the context of the efficiency of labour used. Some importance in assessing the capital intensity can have the technological intensity of enterprises. The aim of this paper is to assess differences in capital intensity of companies in high-technology industry and low-technology industry of manufacturing in Visegrad Countries.

The basis for assessing the significance of capital intensity is the production function. The article based on the neoclassical concept of production function of Cobb–Douglas. With Yt being output at time t, Kt the capital stock, Lt the effective labour force, and A a total factor productivity factor, we thus have form $Y_t = AK_t^{\alpha}L_t^{1-\alpha}$ (Fougère et al., 2009). The ratio K and L (K/L = k) is called the capital-labour ratio (sometimes the capital intensity). If the capital intensity increases without increasing the labour input, we may call it capital deepening. On the other hand, if it increases with an increasing labour input, we will call it capital widening (Takahashi et al., 2012).

The capital labour ratio (c.l. ratio) can be viewed both from a macroeconomic point of view and from a sectoral or corporate point of view. From a macroeconomic point of view, capital intensity can be found as an incremental capital output ratio (K/GDP) (Campano, Costantiello & Salvatore, 2016) or the capital labour ratio (K/L). At the enterprise level capital intensity is the key determinant for evaluation investment is as capital-intensity investments (Gilje & Taillard, 2016) or human capital intensity is related to education of employees (Teixeira & Tavares-Lehmann, 2014). The firm's study of Powell et al. (2015) found that high capital intensity impedes industry growth.

The important factor that influencing the decision-making of companies regarding the size of capital intensity and efficiency of use is their competitiveness (Nielen & Schiersch, 2014). If a company wants to ensure its long-term competitiveness, it is forced to have a high capital intensity. It should also be noted that there are large differences within European regions as old or new member states EU. Among the factors influencing the economic performance and competitiveness of the Visegrad 4 countries we can include the economic cycle (Pavelka, 2016), situation on labour market (Mura et al., 2017), cultural and social factors (Setek & Petrach, 2016) or territorial cooperation (Dusek, 2013).

1 Data and methodology

The paper is focused on analysis of company's capital intensity according the technological intensity of enterprises. The paper is to assess if companies in the high-technology industry reach higher capital intensity than companies in low-technology industry in manufacturing. The last part of the article to find statistically significant differences in the level c.l.ratio in enterprises by technological intensity in the Visegrad Countries The firm-level analysis is focused on the Visegrad Countries - V4 for short - (Czech Republic, Hungary, Poland and

Slovakia). The source of data for the conducted analysis of the enterprises is a database Amadeus.

Large size enterprises were analysed. We used the classification by Commission Recommendation 2003/361/ESES based on the number of employees, turnover and balance sheet total. The companies were sorted into four categories by technological intensity that corresponds to the structure of the manufacturing industry in every EU country found by Eurostat. Aggregation of the manufacturing industry according to technological intensity is based on NACE Rev. 2 at 2-digit level (Eurostat indicators – Annex 3).

The main part of the analysis is based on the audited financial statements of a selected 800 manufacturing companies in 2018. In each of the four V4 countries, 200 companies were analysed. Capital intensity was measured using the indicator c. l. ratio (share of the sum of Tangible and Intangible fixed assets and Costs of employees). Another analysed indicator is the personal cost ratio (the share of costs of employs and operating revenues).

The hypotheses of the level capital-labour ratio in companies are verified by using the ANOVA test. This test allows you to test the effect of multiple factors on a variable. The variable explained was c.l. ratio, the explanatory variables referred to as factors were the groups of technological intensity (HT: high technology, M-HT: Medium-high technology, M-LT: Medium-low technology, LT: Low technology) and Visegrad Countries. Analysis of variance (ANOVA) is a collection of statistical models used to analyse the differences among group means and their associated procedures (such as "variation" among and between groups), ANOVAs assess the importance of one or more factors by comparing the response variable means at the different factor levels. The null hypothesis states that all population means (factor level means) are equal while the alternative hypothesis states that at least one is different. The basic statistic calculated in the analysis of variance is generally test criterion F, which is used to test the hypothesis whether the means in the groups determined by the factor (or factors) differ from each other more than on the basis of the effect of natural variability (random fluctuations) (Montgomery& Runger, 2007). The aim was to determine whether the observed variability of the indicator c.l. ratio corresponds only to random fluctuations, or whether it also reflects a different level of values in individual groups. The null hypothesis for ANOVA is capital intensity for groups by technology intensity and by each country are exactly equal.

We test hypotheses 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: $X_1 = X_2 = \ldots = X_k = 0$, X (groups of companies according to technological intensity) = 1, …,4;

respectively H: $Y_1 = Y_2 = \ldots = Y_k = 0$, Y (groups of enterprises by V4 countries) = 1, …,4

on the one hand, the hypothesis of the effect of interaction

H: $(XY)_{11} = (XY)_{12} = \ldots = (XY)_{ij} = 0$ (1)

This means the hypothesis 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 results of the observations Zij at nX different levels of factor X and nY different levels of factor Y can be described by the Anova model for two factors X, Y:

$$Z_{ij} = Z_0 + \alpha_i X_i + \beta_j Y_j + \lambda_{ij} + \varepsilon_{ij,} \quad i = 1, \ldots,4, j = 1,\ldots,4, \qquad (2)$$

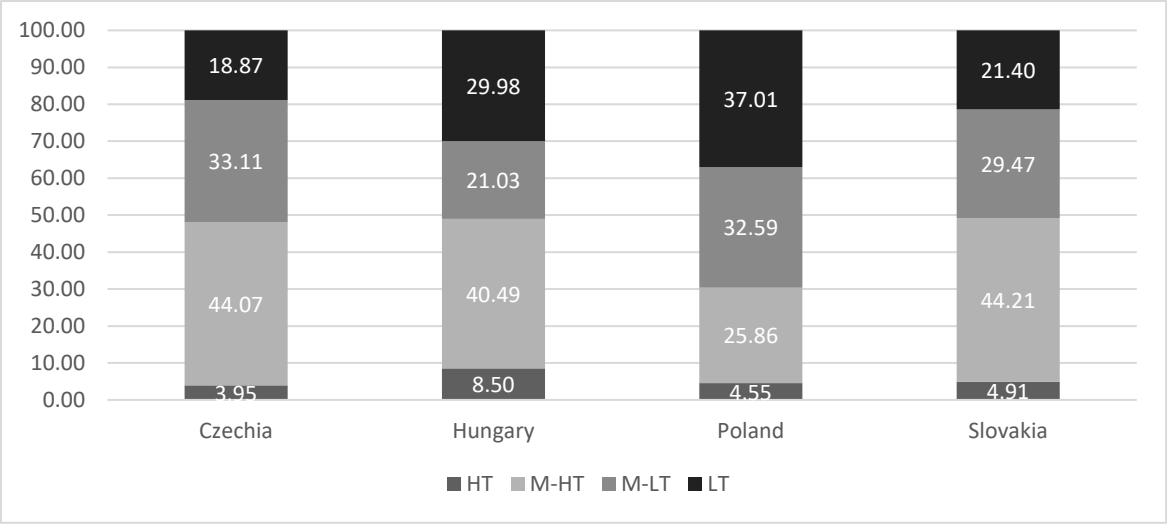
where Z_0 is an absolute term (total mean value), α and β are vectors of contributions of individual levels, elements of the matrix λij are called interactions of both factors and ε_{ij} is a random error with normal distribution and by definition zero mean value, $\varepsilon \sim N(0,\sigma^2)$. It is given: $\Sigma\alpha i = 0$, $\Sigma\beta j = 0$, $\Sigma\lambda i(j) = 0$, $\Sigma\lambda j(i) = 0$.

2 Results

2.1 Capital intensity in Visegrad countries (V4)

The first part of the analysis focuses on the differences in the technological intensity of companies in individual countries. The structure of large enterprises according to their technological intensity in the monitored countries was obtained from the Eurostat database (Figure 1) and was the basis for the representation of individual enterprises in the analysed sample of entities. The purpose was to adequately represent NACE 2 divisions within the Manufacturing industry.

Fig. 1: Structure of enterprises according to their technological intensity in 2017



Source: Own calculations based on the data National account

Note: HT: high technology, M-HT: Medium-high technology, M-LT: Medium-low technology, LT: Low technology

Figure 1 illustrates the structure of the number of enterprises in manufacturing in the V4 countries. In all countries (except Poland) the largest number of economic entities operates in M-HT (from 40% to 44%). In Poland, the largest number of companies operate in LT (37%). On the contrary, as expected, the smallest part of large companies has economic activity classified in the HT group (Czechia 4%, most Hungary 8.5%).

In the sample of companies, attention was focused on capital intensity measured by the capital labour ratio (C-L ratio). This indicator was found both for large enterprises grouped according to technology intensity and for enterprises grouped according to individual countries (Table 1).

Tab. 1: Capital intensity in Visegrad countries in 2018 (in EUR)

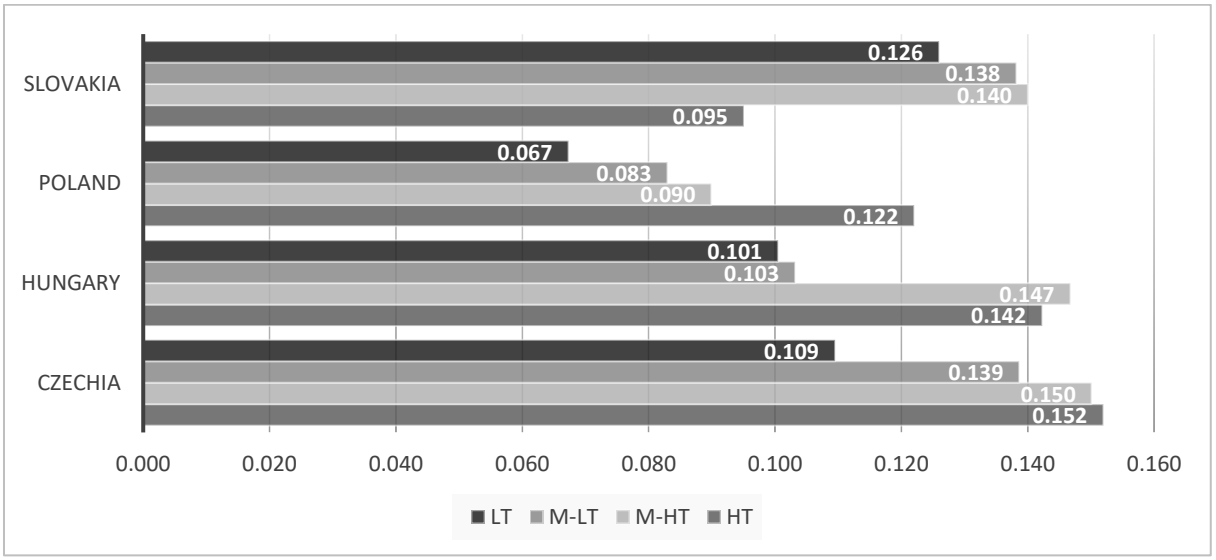
	HT	M-HT	M-LT	LT	Average	The Coefficient of Variation
Czechia	1.301	1.892	2.226	2.895	2.128	0.8
Hungary	2.375	1.827	2.935	3.48	2.555	2.336
Poland	1.377	2.791	3.695	4.142	3.478	1.403
Slovakia	1.502	1.696	2.552	2.366	1.981	2.178
Average	1.782	1.913	2.704	3.298	x	x
Coefficient of Variation	0.838	0.976	2.298	1.457	x	x

Source: Own calculations

Table 1 shows that the lowest share of Intangible and Tangible fixed assets in 1Euro Costs of employees is achieved by companies classified in the HT group in all countries (except

Hungary, which has a lower c-l ratio value in the M-HT group. The highest value of the indicator is recorded This may be due to a lower number of employees and thus lower personnel costs or to employees with a lower qualification structure, which would also lead to lower personnel costs. For this reason, the personal costs incurred per 1 Euro of operating revenues created were also determined (Figure 2).

Fig. 2: Structure of enterprise´s personal cost ratio according to their technological intensity in 2018

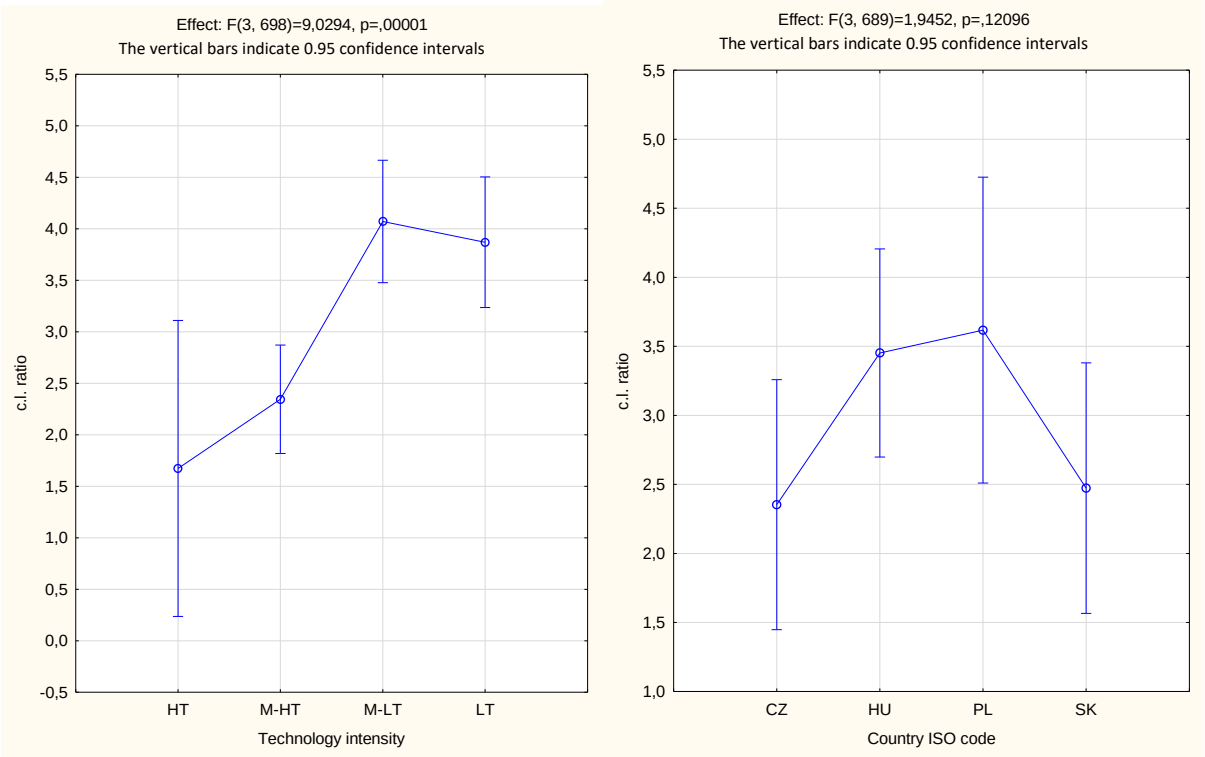


Source: Own calculations

The graph 2 shows that the lowest share of personnel costs per 1 Euro operating revenues is achieved by companies included in the LT group (except Slovakia) and thus these companies have lower labour costs (fewer employees or lower wages). This may be the reason for their higher level of the c. l. ratio indicator. On the contrary, the highest share of personnel costs per 1 Euro of income is recorded in the HT group of companies (except Slovakia).

Based on the ANOVA test of the main effects performed using the statistical software STATISTICS (Figure 3), as expected, a statistically significant difference in groups of companies according to technological intensity was demonstrated in the contrast to the capital intensity (c.l. ratio) broken down by individual countries, which shows a statistically insignificant difference ($p > 0.05$). This fact follows from the F test and the significance level p value.

Figure 3: Differences of capital intensity



Source: Own calculations

Table 2 shows the detailed results of the two-factor analysis of variance. The analysis showed that companies broken down by country within the V4 do not affect the level of capital intensity (the effect of the factor is insignificant, p> 0.05). The influence of the second factor, i.e. the group of enterprises according to technological intensity, is statistically significant (p <0.05), i.e. the influence of the NACE 2 sector on the level of capital intensity was proved. The existence of interactions has not been proven. Capital intensity of companies by technology intensity are very unlikely to be equal.

Tab. 2: Analysis of Variance for c.l. ratio

	Sum of Squares	Degrees of Freedom	Mean Squares	F	p-value
Total mean value	3023.89	1	3023.891	158.6699	0,000000
Technology intensity	495.83	3	165.277	8.6724	0,000012
Country ISO code	111.21	3	37.071	1.9452	0.120955
Technology intensity*Country ISO code	204.38	9	22.709	1.1916	0.297150

Source: Own calculations

Conclusion

The paper deal with capital intensity of large companies in Visegrad Countries that is measured by the indicator c.l. The indicator is significantly affected not only by the amount of labour but also by the price of labour. This is in line with Elshennawy and Bouaddi (2020), who confirm that capital intensity can be influenced by the sector average wage. The analysed personal cost ratio indicator shows that the monitored large companies in the high tech industry in almost all V4 countries have the highest share of personal costs in 1 EURO of operating revenues. It was found that the level of the c.l. ratio is different between large companies divided according to technological intensity. The companies from the high tech industry (HT) show a lower level of capital intensity in all countries V4. At the same time, it was found that no statistically significant difference in capital intensity was found between companies in different V4 countries. The borders of the V4 countries do not play any role from the point of view capital intensity. Horridge and Rokicki (2018) pointed out the big impact of V4 countries accession to the EU. The authors plan to expand research in the future in terms of assessing capital intensity over time and regional convergence.

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