

# Industrial production in Croatia

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**Abstract:** Croatian entrepreneurs recognize the importance of Industry 4.0. for the overall development of the economy. There is an awareness that product digitization can ensure employment growth and modernization of the economy leading to higher financial results. Some Croatian solutions in terms of digital products are already present. Nevertheless, Industry 4.0 in Croatia is still in its infancy, which is an opportunity for Croatian companies, but they are facing strong competition on a global level. There are no consistent data on the level reached by Croatia in terms of smart production, but there is data that Croatia is somewhere in the European Union average in terms of technological renewal of its companies, but in terms of the share of new products it is at the bottom of the European Union. What Croatia is like in terms of total industrial production, employment and productivity in industry, and what is the strategy for achieving greater competitiveness is the topic of this paper.

**Keywords:** INDUSTRY 4.0, CROATIA, SMART PRODUCTS, HIGH-TECH

## 1. Introduction

According to [1] technological innovations can overcome the Law of Diminishing Marginal Returns as many economists have called „gloomy science“. It was the technology that increased productivity, that is, it became the dominant force that influences economic development today. Economic growth and development involve long-term output growth that leads to an increase in average real income and living standard [2]. Employee productivity plays a decisive role in achieving growth and development. In countries in the early stages of development, there is economic growth and a simultaneous increase in income inequality, and when the country reaches a higher level of development, income inequalities decrease. This relationship is the result of the transition from low-income production (emphasizing agricultural production), marked by smaller inequalities among employees, to industrial production, which is accompanied by higher income, but also greater income differences. Later, inequalities in the industrial sector are reduced due to higher employee efficiency [3]. The term growth poles define the institutions of growth in which a key industry or branch of the industry within a particular region plays a role, characterized by a high growth rate, a high degree of dependence within and between industries and a dominant market position. Such a growth pole can attract other economic sectors and institutions that will thrive due to contact with the growth pole. This is especially true of the research and development sector that leads to competitiveness [4]. Research [5] has shown that natural resources do not have a direct correlation with national competitiveness if the economy of small countries relies on them. At the national level, the cost-competitive advantage strategy implies a low cost and high efficiency that takes advantage of cheap factors of production conditions and available labour in less developed areas, which enables cheaper production than the competition. In contrast, the strategy of differentiating competitive advantage implies a high price, but also highly values and focuses attention on the conditions of demand and obtaining the necessary experts in more developed areas, which allows the creation of a competitive product. When determining the value, i.e. the weight of certain factors and sub-factors of national competitiveness, within human resources, the weight values of personal expertise and social context in which entrepreneurs and professional managers operate and their impact within the cost and differentiation strategy of national competitiveness is determined [6].

Discussions of contemporary business in the professional and scientific literature include the impact of Industry 4.0 as a system that incorporates aspects that have been viewed separately in the past. Current business is seen as a socio-technical system that brings together human capital, companies, technologies, production systems, production and consumption. A new relationship between industry and society is emerging in the process of digitalization in which the elements of the Industry 4.0 paradigm are not only technological but also cultural [7]. Numerous research papers have

explored the impact of Industry 4.0 on various areas of production, public and social activities [8-11].

## 2. Technological level of industry in Croatia

If the value share added is low-tech and lower-middle-level industries, we cannot talk about the industry of the modern age. Croatia faced such a situation in the post-war period. The manufacturing industry in Croatia in the period from 1995 to 2007 is marked by a lag in competitiveness which is a direct consequence of unfavourable technological changes which are manifested in increasing importance and volume of production in those activities that are not technologically intensive and therefore above the EU-25 average. the growth rate of industries with a high technological intensity of production is below average, and in the EU-25 it is growing faster than in Croatia [12]. However, in the period from 1999 to 2007, the productivity of the Croatian manufacturing industry increased faster than the manufacturing industry of the EU-25 countries, which is a result of both high growth rates of low and low middle technology industries and the fact that the Croatian manufacturing industry started from a significantly lower base. According to European Commission total expenditure on research and development in Croatia for 2015 was 0,8% GDP placing Croatia fifth from the bottom of the EU countries ranking scale [13]. In Croatia, high- and upper-middle-tech industries generally record a significant increase in unit labour costs, and Croatia is losing competitiveness over these products over time. The results of the analysis of the structure of characteristics and dynamics of employment and productivity of production factors (labour and capital) by technological levels of the Croatian manufacturing industry for the period from 2002 to 2007 [12] showed that the labour factor made a greater contribution to creating added value. increased by 10.1% compared to 2002) from capital factors (capital productivity increased by 5% compared to 2002). Such results are a consequence of an insufficient investment in new, technologically modern plants and equipment that would enable faster growth of capital productivity. No technological level (from low to high) records exclusively positive shifts in productivity, but high-tech industries are expected to have the highest labour and capital productivity, measured gross value added per unit of capital, and relatively high capital equipment, and this allows achieving high productivity.

## 3. Industry potential in Croatia

The potential of the industry depends on the potential of industry spillovers within sectors and spillovers to other sectors [4]. Particularly important is the part related to the industry's contribution to research and development. In Croatia, there is potential for the development of such an industry that is recognized in smart manufacturing and/or digital products. However, in Croatia, there is better technological equipment of companies than EU companies and a comparative group of countries concerning the level of development, but without new products. According to

research [14], investments in new technologies in Croatian companies have been significantly above the average of countries in parallel groups for years. In 2018 30% of TEA companies<sup>1</sup> and 28.3% of "adult" companies use the latest technology, while in the EU 13.6% of TEA and 7.9% of "adult" companies use the latest technology. Despite this, at the same time in Croatia companies lag in terms of participation of companies whose products are new to all customers, 70% of TEA and more than 75% of "growing"<sup>2</sup> companies in Croatia have products that are not new to anyone. However, in the three observed years from 2016 to 2018, Croatia is the country with the largest share of "adult" companies with the latest technology in the European Union, and in 1st place in terms of participation of TEA companies with the latest technology in 2018. In the period from 2016 to 2018 the share of TEA companies and "adult" companies in the category of those who use the latest technology is almost equal, which was not the case in previous years when TEA companies used the latest technology more often.

However, according to European Commission data[13] in 2016 Croatia is placed in moderate innovators due to the performance of national innovation system and is at the bottom of EU average. Due to the lack of innovative products, despite the technological equipment, Croatia's competitiveness is not moving upwards and in 2018 in terms of innovation (measured by ventures with innovative products TEA entrepreneurs) is 24.6%, which is slightly below the EU average (27.7%). In the same year, in the category of "adult" companies, there were 12.1% of companies that had a product that was new to everyone or some and with low competition. This confirms that new business ventures also bring a higher level of innovation.

Unexpectedly, according [15] the share of employees in Croatian industry in 2018 is relatively higher (26.3%) than in the EU (21.7%) and higher than in Germany (24.1%), with which it is common to compare. In Croatia, the share of gross value added in industry in total gross value added is 25.8% and is higher than in the EU-28 (25.1%), and in Germany it is (31.1%) still much higher than in Croatia, although Croatian industry employs relatively more people which shows that the productivity of German industry is at a much higher level than Croatian. In 2020, 27.47 percent of employees in Croatia are active in industry [16]. The drive to develop industries to spill over into other sectors, especially research and development, is justified because labour-intensive activities can provide the impetus for growth at lower levels of development, as described [3], but the transition from medium to high income requires strengthening competitiveness in sophisticated segments of the production process and the development of domestic innovation competencies. For Croatia as a small country, the orientation towards a differentiation, as opposed to cost strategy of competitiveness is crucial for the national economy to become competitive and achieve a higher level of development [17]. The reason for this view is the previously descriptive research results [5].

In Croatia in the period 2000-2005 on average, as much as 92% of GDP per capita growth in NUTS II regions was based on productivity growth, and only 8% on employment growth [18]. According to the same research conducted in Croatia, the connection between specialization and aggregate productivity shows a negative relationship between these two variables, and the reason for this is precisely the specialization in sectors that cannot lead Croatia on the desired path. In these specialized sectors, there is employment growth without increasing productivity, the only benefit of which is ensuring social peace, which is unsustainable in the long run, with a lower rate of economic growth than would be achieved by different targeting of available factors. The largest specialization was recorded in the sectors of agriculture, hunting, fishing and forestry. Despite these limitations, structural changes as

well as modernisation possibilities offered through IoT combined with timely recognition of restrictions [19] can place these activities into an economic sector focus.

#### 4. Data and methodology

Data for the analysis of industrial production in this paper is obtained from the Croatian Bureau of Statistics presented as indices of basic economic indicators: Gross domestic product at constant previous year prices (GDP), Total volume of industrial production, Total number of employees in industry and Labour productivity in industry, as data representing the result of economic activity from the previous year (period one year ago = 100). The data follow the movement of these indicators in the period from 2006 to 2019.

To analyze the collected data, Time Series Analysis of these indicators is used in the paper, Pearson's correlation coefficient ( $r$ ) and geometric mean.

#### 5. Research results

Set of observations on a quantitative characteristic of a GDP, the volume of industrial production, labour productivity in industry and number of employees in industry in Croatia from 2006 to 2019 are presented in Table 1 as result of economic activity compared to the previous year.

**Table 1.** Indices of GDP, the volume of industrial production, labour productivity in industry and number of employees in the industry in Croatia from 2006 to 2019 [20]

Year	Gross domestic product	The total volume of industrial production	Total number of employees in the industry	Labour productivity in the industry
2006/2005	104,7	104,5	99	105,6
2007/2006	105,5	104,9	100,4	105,2
2008/2007	102,2	101,2	98,1	103,6
2009/2008	93,1	90,8	90,7	100,1
2010/2009	97,7	98,6	92,8	106,3
2011/2010	99,8	98,8	96	102,9
2012/2011	97,8	94,5	95,7	98,7
2013/2012	98,9	98,2	95,2	103,2
2014/2013	99,5	101,2	98,3	103
2015/2014	102,4	102,7	99,4	103,3
2016/2015	103,5	105,3	99,6	105,7
2017/2016	103,1	101,4	100,5	100,9
2018/2017	102,7	99	98,5	100,5
2019/2018	102,9	100,6	97,2	103,5

The volume of industrial production in Croatia by 2019 did not reach the level of 2006 (it is lower by about 3.7%), while GDP grew by 8.7%. Analysis of GDP trends and total volume of industrial production in Croatia in the period from 2006 to 2019 showed, expected, a very strong positive statistically significant correlation ( $r = 0.91$ ). However, it is not expected that the movement of these related economic indicators in the opposite direction as in 2014 and 2018, is comparing a period to the same period one year ago. In the years before the financial crisis, the growth rate of GDP was higher than the growth rate of industrial production, as a result of the financial crisis there was a decline in GDP and total volume of industrial production, and the recovery years recorded higher growth in industrial production than GDP.

The movement of labour productivity in industry, the number of employees in industry and the volume of industrial production in Croatia in the period from 2006 to 2019 was not always in the same direction (Fig. 1).

<sup>1</sup> with business ventures younger than 42 months ("beginners" and new)

<sup>2</sup> annual employment growth of 10% or more

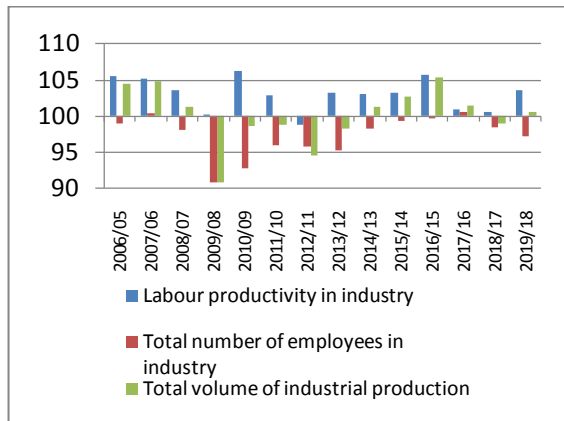


Fig. 1 Indices of labour productivity in industry, number of employees in industry and volume of industrial production in Croatia from 2006 to 2019

The movement of the volume of industrial production from year to year is not accompanied by changes in the number of employees and productivity in the industry. The average difference between the change in productivity and the change in employment in industry in the period from 2006 to 2019 was  $G = 4.63$  p.p. (geometric mean). In the years before the financial crisis, the number of employees fell despite the growth of industrial production and productivity in the industry. In the years of crisis, there was a significant decline in industrial production (until 2012) and the number of employees with a significant increase in productivity (except in 2011). The decline in the number of employees in the industry continued in the coming years, while industrial production grew with higher productivity growth than the growth of industrial production (Fig. 1).

Figure 2 shows the growth difference in percentage points between labour productivity in industry and industrial production and then between the number of employees in industry and industrial production in Croatia from 2006 to 2019.

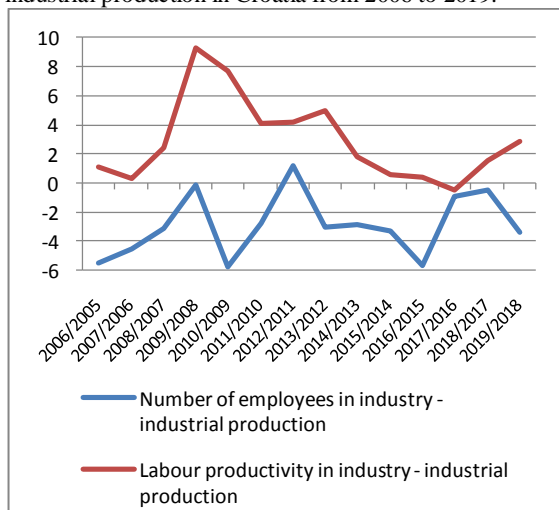


Fig. 2. Growth difference in p.p.

The results show positive signs in the difference between labour productivity in industry and industrial production, which shows that productivity growth compared to production growth was higher in the period from 2006 to 2019, while employment growth in the industry in almost all years was less than industrial production. The reasons can be found in the use of new technologies.

## 6. Conclusion

In general, for the observed period, it can be concluded that the volume of industrial production follows the number of employees in industry in crisis years (recorded decline), and in years of recovery of production volume, there is an increase in productivity, which,

with a reduced number of executors, can be attributed to technologies in the industry that has been present in Croatia in recent years [13]. The results of previous years showed similar results [12]. The same research [12, 13] showed that Croatia is lagging in terms of innovation and competitiveness. The growth of business ventures in countries with a small domestic market, such as in Croatia, requires access to international markets. The future development of digital products and artificial intelligence and its penetration into the production process reduces the importance of Croatia's cost advantages, which further leads to a reduction in the initiative of foreign investors. The ability to reach the world technological level will increasingly depend on building its capacities of technology and knowledge, i.e. turning production towards a strategy of differentiating competitive advantage.

The strategy of differentiation competitiveness is the one that, with the support of institutions at the national and regional level, regional integration and investment in knowledge and skills lead to the creation of new value. In gradually abandoning the cost competitiveness strategy, which Croatia, despite the present natural resources as a small country, has not grown up with, the combination of cost and differentiation strategy can help the Croatian national economy to overcome the transition from a weak to a highly competitive economy.

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