

ECONOMIC IMPACT OF INDUSTRIAL SEGMENT IN THE SELECTED COUNTRY

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Abstract:

The inducted paper discusses economic effect resulting from industrial activities realized within national economy of the chosen country. The country of selection represents Poland. Economic impact is scrutinized through reflexing on gross domestic product. Industrial segment is deputized over various indicators whose scope strives to include different views on the industry field. The main point of this paper is to identify the exact relationship between dependent variable (gross domestic product) and a group of independent variables (picked industrial representatives). Such determination offers thereafter the possibility to estimate dependent variable's value and its next forecast. What is more, the eventual sorting of involved industrial indicators is facilitated according to their importance. The multiple regression analysis is utilized as the method of investigation. Findings answer the stated questions and aims with a suggestion of an appropriate equation.

Key words: *economic impact, gross domestic product, industrial segment, multiple regression analysis, national economy*

INTRODUCTION

National economies of all countries are influenced by complex worldwide trends. Undeniable is rapid progress and high level of innovations. Suggestions concerning the innovative practices are stated e.g. in the study formed by [6]. Decisive development in the innovation management field is similarly important just like in the project management (see e.g. [3]).

All necessary changes and improvements are reflected in each and every segment of the economy. Industrial segment connotes the significant element in this comprehensive whole. As it is known industry signifies a crucial origin in the sphere of job formation and also evidently contributes to overall economic growth [5]. Furthermore, it is a principal motivator for innovations arising.

Changes in the connection with industry are markedly needed even more when the new industry release is running [16]. In such case technological modifications are probably the most important in the particular economy. Economic impact can be then observed through indicators like profitability or employment.

LITERATURE REVIEW

The research area offers various studies where the influence of industry on economy is analyzed. There can be found strongly empirical studies, studies with method improvements and subsequent implementation on real data

likewise as studies aimed exclusively on new approaches development. Researchers investigate selected partial matters related to this topic and strive to put them into a broader context. The local, national as well as international impact and connections are discussed.

The industrial subsidies were main subject of interest for [14]. Strategy built on the industry model was suggested. This practical strategy included results of the quantification targeted on the subsidies impact looking at industry costs, prices, consumer excess and redistribution of production between individual countries. Application was conducted for world shipbuilding. More specifically, the Chinese shipbuilding was examined.

Another partial matter regarding the influence of industrial segment on economy was reviewed by [11]. The key indicator was industry concentration. It's incidence on capability of the markets, investors in fact, to foresee incoming earnings was tracked there. Considering industry concentration, two items were reflected, namely intra-industry information transfer and product market power. The chosen approach constituted evaluation of the informativeness of stock returns regarding incoming earnings through using so-called future earnings response coefficient. Representative dataset contained 38 economies. The paper therefore presented international point of view.

Manufacturing system from innovative practice and sales perspective was surveyed by [24]. The country of selection was Poland. Crucial idea signified the detection if origin of manufacturing system's innovations lay in the tight regional relationships or in the performing on the national as well as global markets. Empirical nature of analysis can be observed over entry data. These constituted findings from 5,209 questionnaires completed by manufacturing companies. Every Polish region was incorporated.

Within industry studies, the industrial symbiosis denotes relatively large research group. One of the papers dedicated to this theme prepared [7]. As the authors highlighted, the great point of such symbiosis utilization is gaining bilateral benefits involving environmental and economic angle for participating companies. Calculations were realized under an enterprise input-output technique. What is more, a case instance was stated to underline the practical implementations.

As mentioned above, there exist numerous works addressed to the industrial symbiosis. Next noteworthy is [17]. Using agent-based modeling the verification of industrial symbiosis indicators was handled that accompanied design of a proper model. This model enabled the computation of three particular indicators. In the connection with business concerning industrial symbiosis, an agent-based modeling was picked in [8], as well. The concrete case problem was examined and economic advantages, *inter alia*, were counted. In the same area, flows optimization was the motive for investigation performed by [20]. The mathematical model was suggested with aim to make the symbiotic profit and economic profit as great as possible. It was very positive that the research was grounded on real data. The study of [12] offered a bi-objective model followed by its application to a practical case study related to China.

An economic paper compiled by [23] dealt with economic impact caused by country's industry through industrial clusters regarding industrial parks and special economic zones. The experimental target was precisely Russia. The exploration was focused on very activity of executing and expanding mentioned zones and parks. With reference to development, individual applied government policies were investigated with consequent author's findings and conclusions. Russian industrial parks represented goal in another work that assembled [22]. Economic productiveness, progress and prospects were reflected.

Industrial clustering served as an approach type also for [1]. Economic and logic justification of the special economic zones was analyzed, exactly in India. Review was collated on terrain contemplations alike as on detailed interviews. Developers, businessmen, administrators or

staffers typified the sample. Similar substance scrutinized [26] while this time the questions of China's development were opened.

METHODOLOGY OF RESEARCH

The essential purpose of the analysis is to find out the connection among a group of delineated independent variables and given dependent variable. Such action thereafter offers the possibility for figure valuation appertaining to dependent variable as well as its incoming figures prognosis. What is more, effort lead also to the survey of the selected variables weightiness and likewise their probable classification when the insignificance is detected.

Discussing the particular variables, as dependent variable is stated gross domestic product. It is chosen for the role of indicator that expresses the economic situation in the country, in other words the comprehensive stage of specific economy.

As independent variables are claimed selected representatives of the industrial sector, according to the main aim that is realization of the analysis concerning economic impact of industrial segment. When collecting the individual indicators the aim was to incorporate different perspectives on industry. These are specifically employment by activity – manufacturing, employment by activity – industry (including construction), employee compensation by activity – industry, producer price indices – manufacturing (domestic market), producer price indices – manufacturing (total market), value added by activity – manufacturing, value added by activity – industry (including energy), industrial production – manufacturing and industrial production – total.

For the purposes of paper, the country of selection is Poland. Modeling is performed over data received from OECD databases [21]. The exact sources are Aggregate National Accounts, Labour market statistics, National Accounts at a Glance, Producer prices alike as Production and sales. The selection of data meets the conditions of relevance, timeliness, availability and, last but not least, comparability. All of them are publicly accessible. The scrutinized period is 2005-2019, therefore fifteen years. First mentioned year of the period under review is related to the Poland's accession to the European Union. Although the country has become a member since 1 May 2004 [4], the year of choice is 2005. The reason is fact that year 2004 could contain data collected or evaluated by different methods and procedures. To be sure of avoiding the possibility of potential distortion, the year after accession is decisive. There is a certainty of standardization and that way a smooth comparison of all indicators for the whole analyzed period. The year 2019 represents the latest current, complete and available data for the necessary variables. The intention is to keep the highest possible level of validity.

Picked method for the research is regression analysis. This approach is very popular and thus frequently used. It can be found in the application studies with various orientation, for instance [15, 18, 25]. The fact is that regression analysis has its notable place, among others, in the field of economics looking at linked studies.

There exist divers software solutions which operate supportively. Reached results using mentioned technique are explicit, well interpretable and practically workable.

Detailed method specification leads to the multiple regression analysis (see e.g. [2, 9, 13, 19]) employed in this paper. The reason is selection of numerous indicators applied as independent variables in modeling. Such decision allows contemplation of every eventually important indicator in the identical research model. However, exploratory papers implement different kinds of regression. It turned out the most optimal type is linear regression (e.g. [10]) for intended analysis here.

Model construction is formed on the standard regression equation where the dependent variable is on the left side and regression constant, coefficients of independent variables as well as independent variables themselves are on the right. Concrete equation adjusted to the research objective with setted variables is following:

$$GDP_t = \beta_0 + \beta_1 EA_m + \beta_2 EA_{iic} + \beta_3 ECA_i + \beta_4 PPI_{mdm} + \beta_5 PPI_{mtm} + \beta_6 VAA_m + \beta_7 VAA_{iie} + \beta_8 IP_m + \beta_9 IP_t \quad (1)$$

where:

GDP_t is gross domestic product – total (million US dollars),

EA_m is employment by activity – manufacturing (thousand persons),

EA_{iic} is employment by activity – industry including construction (thousand persons),

ECA_i is employee compensation by activity – industry (% of gross value added),

PPI_{mdm} are producer price indices – manufacturing, domestic market (2015 = 100),

PPI_{mtm} are producer price indices – manufacturing, total market (2015 = 100),

VAA_m is value added by activity – manufacturing (% of value added),

VAA_{iie} is value added by activity – industry, including energy (% of value added),

IP_m is industrial production – manufacturing (2015 = 100),

IP_t is industrial production – total (2015 = 100).

RESULTS

First of all, the descriptive analysis was conducted. This preceded the regression analysis itself. The principal results can be found in Table 1. The first column shows the gross domestic product, which is a dependent variable. All the following columns manifest the independent variables.

Table 1
Descriptive statistics

	GDP_t	EA_m	EA_{iic}	ECA_i	PPI_{mdm}	PPI_{mtm}	VAA_m	VAA_{iie}	IP_m	IP_t
Mean	893486.73	3109.14	4837.85	14.29	98.81	98.86	18.81	25.31	89.13	90.67
Median	907168	3059.1	4836.1	14.2	100.3	100.1	18.8	25.2	88.1	90.1
Standard Deviation	229774.55	206.98	309.19	0.43	7.62	5.53	0.73	0.47	19.66	17.16
Kurtosis	-0.947	-1.060	0.732	0.849	-1.255	-1.664	0.574	2.146	-0.802	-0.698
Skewness	0.042	0.463	-0.767	0.984	-0.335	-0.295	0.626	1.402	0.190	0.182
Minimum	530341	2831.3	4127.1	13.693	86	90.7	17.68	24.68	56.8	62
Maximum	1281449	3463.8	5260.3	15.308	109.4	105.7	20.44	26.51	123.1	120.9

Gained statistics cohered to regression are exhibited in Table 2.

Further, the multiple regression technique was used, more precisely the linear type. Goal was to identify the connection among dependent variable and a group of selected independent variables.

Table 2
Regression statistics - the first level of analysis

Multiple R	0.999461341745212
R Square	0.998922973643139
Adjusted R Square	0.996984326200788
Standard Error	12618.1043281071

By applying mentioned method the coefficients pertaining to each variable were received. Resulting from it, an exact participation of independent variable predictions can be observed. Particular figures of reached coefficients are stated in Table 3.

Table 3
Multiple regression analysis - the first level of analysis

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	363518.5	750371.6	0.484451	0.64854129	-1565373.109	2292410
EA_m	-234.178	80.91875	-2.89399	0.034028069	-442.186479	-26.1699
EA_{iic}	95.85759	29.81185	3.215419	0.023585754	19.22379484	172.4914
ECA_i	20428.39	18664.73	1.094492	0.323640087	-27550.82703	68407.61
PPI_{mdm}	-10768.7	10645.49	-1.01157	0.358163661	-38133.75733	16596.45
PPI_{mtm}	17397.7	11518.48	1.510417	0.19132632	-12211.49194	47006.89
VAA_m	43480.51	34463.67	1.261633	0.262735831	-45111.18015	132072.2
VAA_{iie}	-62533.2	35643.02	-1.75443	0.139722264	-154156.5193	29090.07
IP_m	37092.21	10230	3.625828	0.015126658	10795.1616	63389.25
IP_t	-29718.3	12269.5	-2.42213	0.059959985	-61258.00804	1821.484

Findings pertaining to the given regression reported in Table 3 offer, among other things, p-values. These are authoritative for elimination of substandard variables (if needed) which are identified over common rules applied for such decisions. Based on the results of p-values, it was resolved that it is necessary to exclude some variables from the suggested model. In this case, employee compensation by activity - industry and producer price indices - manufacturing (domestic market) were removed.

New equation valid for proposed model was ensuing:

$$GDP_t = \beta_0 + \beta_1 EA_m + \beta_2 EA_{iic} + \beta_3 PPI_{mtm} + \beta_4 VAA_m + \beta_5 VAA_{iie} + \beta_6 IP_m + \beta_7 IP_t \quad (2)$$

Realized actions described above can be considered as the first level of analysis. Next, the same scrutinizing method was utilized again. This was the start of the second level of economic impact investigation related with industry. Naturally, a new equation with editing served for modeling. Adequate statistics can be seen in Table 4.

Table 4
Regression statistics - the second level of analysis

Multiple R	0.999303243443403
R Square	0.998606972356505
Adjusted R Square	0.997213944713009
Standard Error	121.282125003302

The results of the regression analysis after previously made adjustments are shown with the necessary particulars in Table 5.

Focusing on p-values from Table 5, no variable was further required to banish according to general principles for decision taking on p-value basis. Another substantial numbers that can be observed from Table 5 are individual coefficients. After their implementation into accommodated equation with seven relevant independent variables the consecutive outcome was achieved:

$$GDP_t = 10328.36 - 2.33 EA_m + 0.85 EA_{iic} + 54.41 PPI_{mtm} + 551.25 VAA_m - 745.76 VAA_{iie} + 398.17 IP_m - 337.82 IP_t \quad (3)$$

Specified equation poses the final expected relationship to which the research was directed. It should be mentioned that for the sake of greater clarity and a simpler idea of the effect of independent variables on the dependent variable, it was decided to adjust the unit of measure for gross domestic product. The unit of million US dollars was changed to hundreds of million US dollars. The individual coefficients obtained thus no longer represented initially relatively high values. Ultimately, the final relationships between the variables and their informative feature do not change with this adjustment.

Table 5
Multiple regression analysis - the second level of analysis

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	10328.36236	4026.607	2.565028	0.037277175	806.9489219	19849.78
EA_m	-2.329342804	0.583766	-3.9902	0.005255123	-3.70973113	-0.94895
EA_{iic}	0.851204153	0.252344	3.373185	0.011868582	0.254504582	1.447904
PPI_{mtm}	54.4103857	19.08348	2.851177	0.024646874	9.285119137	99.53565
VAA_m	551.2506512	253.7102	2.172757	0.066346409	-48.6786682	1151.18
VAA_{iie}	-745.7617218	282.427	-2.64055	0.033396934	-1413.59538	-77.9281
IP_m	398.169556	76.18928	5.226058	0.001217695	218.010545	578.3286
IP_t	-337.8215997	87.69673	-3.85216	0.006274883	-545.191408	-130.452

DISCUSSION AND CONCLUSIONS

From a broader perspective each country's national economy consists of several sectors which together form a coherent and interconnected whole. One of them, considerably very significant, is industrial sector. All activities in individual parts of the economy are then reflected in the summary indicator – gross domestic product.

The principal objective of the paper was to explore economic influence of industrial segment in the chosen national economy. Poland was the subject of interest. Economic impact was examined through already mentioned gross domestic product. In order to assess the impact of industry, nine indicators were selected from this area with the intention of describing and covering the segment as best as possible.

Multiple linear regression served as the method for analysis which was considered like the most suitable for the stated purposes. Therefore, the relationship among dependent variable and a group of independent ones was ascertained. The dependent variable was deputized by gross domestic product and as independent variables were standing picked industrial indicators. During the analysis realization there occurred a need for a two-step procedure with respect to the specific data used. The whole effort resulted in obtaining the final equation with decisive coefficients.

All the research was supported by the survey of numerous scientific works related to the discussed topic. Among them were studies focusing on methodology and the methods themselves, but most of them had empirical character. These were economic as well as industrial papers. What is important, reviewed were also studies dealing with and highlighting various issues or unsolved tasks connected to this theme. The research of other authors was taken into account both in the selection of individual indicators and in deciding on the method used with regard to the set objectives.

It is potentially worth considering the implementation of additional indicators into the modeling. Even more, these could be indicators reflecting the industrial segment secondary way. By such modification, it would be possible to take industrial impact into account within the newly acquired equation in an even broader context. The subsequent economic effects would be expressed thus more precisely.

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