EMPIRICAL ESTIMATION OF THE MULTIPLICATIVE EFFECTS OF STEEL INDUSTRY IN MACEDONIA BY USING INPUT-OUTPUT MODEL

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Abstract

The main goal of the paper is quantitative and scientifically based economic assessment of basic metal industry and its importance for the national economy. The empirical assessment involves exploring the direct effects (the contribution of the steel industry to GDP and economic growth, export, employment, taxes and corporate – social responsibility) and more important estimating the multiplicative effects (indirect through the chain of suppliers and induced by the effect of final household's consumption) that the industry generates in the national economy by the reproduction processes. The economic impact methodology based on input-output model is applied to estimate the multiplicative effects. Furthemore, the empirical analysis of economic and financial indicators is done to capture the performance of steel industry in Republic of Macedonia. This type of studies based on scientific and methodological foundation is very usefull tool in creation the national industrial policy.

Keywords: economic impact analysis, input-output model, basic metal industry.

INTRODUCTION

The scientific literature highlights the fact that the development dynamics of each country is largely based on more efficient and productive industrial system. This is more obvious if we take into account the fact that the technological progress as a main driver of long-run economic growth is materialize within the manufacturing sector. In this context, identifying and quantifying the role and the importance of each industry to the national economy is of paramount importance in the process of creating the best industrial policy.

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The main aim of this paper is quantitative and scientifically based assessment of basic metal industry and its role and importance for the Macedonian economy by applying the economic impact methodology. This methodology is based on input - output model and its aim is to assess the economic impact of an industry to national economy. Furthemore, the empirical analysis of economic and financial indicators is done so as to capture the performance of the steel industry in Republic of Macedonia. The economic assessment and analysis involves studying the direct effects (the contribution of the steel industry to GDP, exports, employment, taxes and corporate-social responsibility) and multiplicative effects (indirect through the chain of suppliers and induced by the effect of consumption) that the industry generates in the national economy by the reproduction processes.

The steel sector or the industry of basic metals in Republic of Macedonia is defined to include several industries according to NAICS Classification System: 1) iron and steel mills (electrical arc furnace); 2) ferroalloy manufacturing (companies producing ferroalloy inputs to steel making, including ferrochrome, ferronickel and related products); 3) steel products manufactured form purchased steel (companies producing steel pipe and tube manufacturers and companies rolling and drawing purchased steel to produce finished steel products; 4) smelting industry; and 5) non-ferrous metal industry. Only the biggest companies in the steel industry is considered in this empirical study: Makstil a.d – Skopje; Jugohrom a.d – Jegunovce; Trade doo IGM – Kavadarci; RZ Institut a.d – Skopje; FZC October 11 a.d – Kumanovo; Zeleznik a.d - Demir Hisar; Skopski Leguri a.d – Skopje; 8) MZT a.d – Skopje; Feni – Kavadarci; a.d Dojran Steel – Dojran; ArcelorMittal a.d – Skopje; Fakom a.d – Skopje; and Bucim a.d – Radovish.

1. THEORETICAL REVIEW OF INPUT-OUTPUT MODEL

An input-output (I/O) analysis uses an economic model that traces the flow of goods and services, income, and employment among related sectors of the economy, Leontief (1941). The I/O approach triggers the flow of activities as follows: When final demand for a good changes, the sector producing the good (output) purchases inputs from other industrial sectors, which in turn purchase inputs from other industries, Hughes (2003). Moreover, according to Kahn (1931) all of these industrial sectors purchase additional labor input. The employees use their compensation to purchase goods and services from the economy. Linkages among industries in a region create a ripple effect as a result of change in demand for a product. Strong linkages can lead to healthier economies, as capital flows through the economy rather than out of it, Isard (1953).

An input-output model is a snapshot of an economy in equilibrium, where the gross output of each industry is equal to the gross inputs to the industry. The gross output of an industry includes both inter-industry sales and sales to final demand. The gross input of an industry includes the purchase of goods and services, labor, investment, and profit. The (I/O) model provides a means of examining relationships within an economy both among different sectors and between sectors and final consumers such as households and government. The model allows examining the impact on the entire economy of a change in one or several economic activities. So, this model is applied to estimate the economic impact of different industries, sectors and areas to the national economy. For illustration, Fletcher (1989) demonstrates the usefulness of impact analysis and input-output models to study the economic impact of tourism for national economy. Choong-Ki et al. (2005) assess the economic impact of world cup championship in football as a mega-event for

South Korea by using input-output model. Recently, the economic impact models are used in the field of enviroment. Lave (1995) attempts to quantify the enviromental implications of alternative product and processes, tracing pollution discharges and resources use through the chain of products and consumers. Similarly, Wiedmann et al. (2007) offers detail review of single and multi regional input-output models to assess the environmental impact of internationally traded goods and services Siegfried, et al. (2006) discuss the application of regional multipliers in the context of college and university impact studies, another area where this analysis is used. Guy (1995) integrates input-output model with the econometric and computable general equilibrium model as a more sophisticated models for estimation of economic impact within the economy, while Oosterhaven (2006) created the supply driven input-output model which is completely reverse of the traditional demand driven input-output models, but it is used to estimate the economic impact by analyzing the forward instead of backward industrial linkages.

The (I/O) model provides a means to capture and measure the economic effects of the industry's activities to national economy. It uses three effects to measure economic impact: direct, indirect and induced effects, Richardson (1985).

- Direct effects refer to production change associated with a change in demand for the good itself. It is the initial impact to the economy, which is exogenous to the model.
- Indirect effects refer to the secondary impact caused by changing input needs of directly affected industries (e.g., additional input purchases to produce additional output).
- Induced effects are caused by changes in household spending due to the additional employment generated by direct and indirect effects.

The assessment of the multiplicative effects of steel industry to national economy includes the estimation of several multipliers such as: output multiplier (every dollar change in direct output caused changes in the total value of output in all sectors), employment multiplier (every dollar change in direct output caused changes in number of jobs in the economy), personal income multiplier (every dollar change in direct output caused changes in income received by households), and business taxes multiplier (every dollar change in direct output caused changes in indirect business taxes), Miller and Blair (1985).

The input - output model assumes a linear production function, which means constant returns to scale and constant production functions for each firm within an industry, Grady et al. (1988). For example, the model assumes that a small mill would use the same inputs, in the same proportion, as large production mill. Furthermore, the model assumes that the percentage of those inputs that are purchased locally is constant from one firm to the next, Mills (1993). The input-output models incorporate several important assumption, Hughes (2003):

- Output is also assumed to be homogenous. In other words, the assumption is that the production mills would produce the same percentage of lumber, wood chips, and other outputs.
- It assumes that there are no constraints on the supply of any commodity.
- It assumes that increases or decreases in employment cause in- or out-migration from the state modeled, so that "full employment" is maintained.

1.1. Economic impact analysis of steel industry

The economic impact of any industry is not limited to the employment, compensation, and other economic activity directly related to the industry's business operations. Actually, the steel industry stimulates large number of related sectors as inputs suppliers. It creates and supports jobs in related industries through its supply chain. Similarly, the wages paid to employees working within the industry and its supply chain has an effect on the broader economy as employees use their income to buy goods and services.

The steel industry production process is complex including a lot of business operations. Some of that operations, inputs and production services are provided at the local markets by the local firms. These firms as suppliers of the steel industry in order to satisfy the steel industry's needs make their own purchases and hire employees (indirect). Employees within the steel industry and those employed in the supply chain companies use their salaries and wages to purchase goods and services (induced spending). A chain reaction of indirect and induced spending continues, with subsequent rounds of additional spending gradually diminished through savings, taxes and expenditures made outside the state, Hall (2009). This economic ripple effect is measured by IMPLAN and other input-output economic models, using a series of multipliers to provide estimates of the number of times each dollar of input, or direct spending, cycles through the economy in terms of indirect and induced output, or additional spending, personal income and employment.
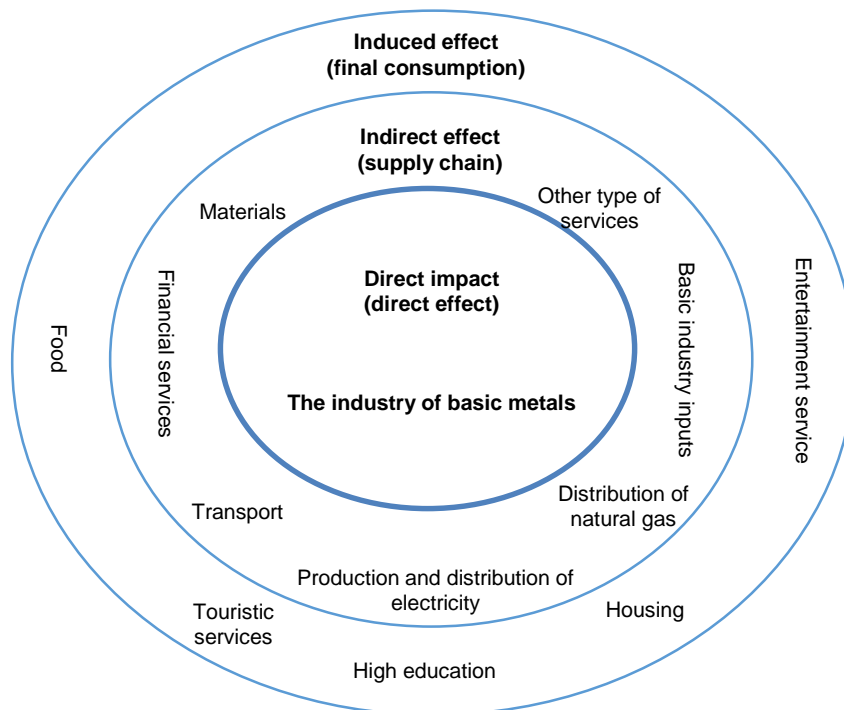

Figure 1. Direct, indirect and induced effects of basic metal industry

Figure 1 presents an illustration of direct, indirect and induced impacts of the steel industry. The steel industry spent materials, basic industry inputs, electricity, natural gas, and transport, financial and other services. On the other side, the main induced effects are created through the wholesale and retail sector, housing, entertainment service, housing, education, tourism and other sectors.

2. EMPIRICAL ESTIMATION OF THE ECONOMIC IMPACT OF STEEL INDUSTRY IN REPUBLIC OF MACEDONIA

The economic contribution of steel industry to the Macedonian economy, however, goes beyond these sector specific measures because steel companies purchase from many other sectors of the Macedonian economy. Moreover, the steel industry contributes to household incomes, which then induces additional rounds of stimulus to the economy as households spend its income on goods and services. It is obvious that this industry supports lot of businesses and jobs in many sectors in the economy and contributes to many sectors through the consumption channels.

Type I multiplier (the sum of a direct and indirect effects divided by the direct impact and measure the effect of the production of basic metals industry on total output in the national economy through the supply chain of the industry) shows that the production and sales of companies within the industry for basic metals for 1 denar (according to the official exchange rate, 1 euro=61.7 denars) generate additional production in the economy of 0.41 denars (this type of multiplier measures the economic impact of the industry for basic metals to the national economy only through the stimulation of production of the companies that appear in the industry's supply chain).

Type II Multiplier (the sum of a direct, indirect and induced effects divided by direct effect and measures the economic impact of the industry's production on the national economy) shows that the production of the industry for basic metals 1 denar generate additional economic impact from 1.33 denars (this type of multiplier measures the overall economic impact of the basic metals industry in the national economy as a sum of the indirect effects produced by the supply chain and induced effects which are constructed by consumption effects). The table below shows a general overview of the estimated economic multipliers that steel industry generates in the national economy derived by the empirical estimations.

Table 1. Economic multipliers for steel related manufacturing sectors, in 2007 and 2014

Multiplier	Direct	Indirect	Induced	Total	Type I*	Type II**
Output	1.00	0.41	0.92	2.33	1.41	2.33
Labor income	0.03	0.20	0.30	0.53	7.66	17.66
Employment	1.00	2.27	0.83	4.10	2.27	4.10
Total added value	0.31	0.24	0.75	1.30	1.77	4.19
Employment and taxes per million denars of output						
Employment	8.82					
Total taxes	24,089					

* When the sum of direct and indirect will be divided by direct effects
**When the sum of direct, indirect and induced effects will be divided by direct effects
Source: Authors' calculations based on the date from the survey analysis done in this study

The general overview of the multiplicative effects that the basic metal industry generates within the Macedonian economy will be decomposed by studying the individual multipliers in total value added, taxes, employment, and labor income. The estimated results of the empirical analysis and the quantification of multiplicative effects (indirect and induces) show that any increase in the production of steel industry for one denar, contributes a significant increase in the total output in the Macedonian economy for approximately 2.33 denars, 1denaris a direct impact, the additional increase in output of 0.41 denars is a result of indirect impact by stimulating the output of the companies in the supply chain of the basic metal industry (this effect actually indicates how many denars will be created in form of production and sales of the companies in the supply chain for each denar rise manufacture of basic metal industry), and the rest of the growth in total output of 0.92 denars are generated through induced impact which is reflected by additional spending in the economy of the workers in the steel industry and employees in supply chain companies.

The greater practical importance of this study is transformation of the estimated coefficients of multiplication in the absolute numbers and values. The total value of production and revenues generated by the companies within the industry for basic metals that are part of this study is 58.609 million denars in 2007 and 38.983 million denars in 2014. But through its multiplicative effects industry for basic metals encourages additional production in the national economy of a total 77.950 million denars in 2007, or the total value of the realized production was 136.559 million denars. One part of this additional production generated by encouraging the production of supply chain companies is approximately 24.030 million denars (indirect channels), while the rest of the 53.920 million denars are generated indirectly through labor income of the employees and corporate profits of the owners of steel companies and through the salaries and profits of the workers and owners of the supply chain companies, and through the government spending generated by collecting taxes form steel companies and companies related to the industry induced channels). In 2014, the value of realized production with induced production through the chain of suppliers (15.983 million denars) and final consumption (35.864 millions) is total of 90.830 million denars.
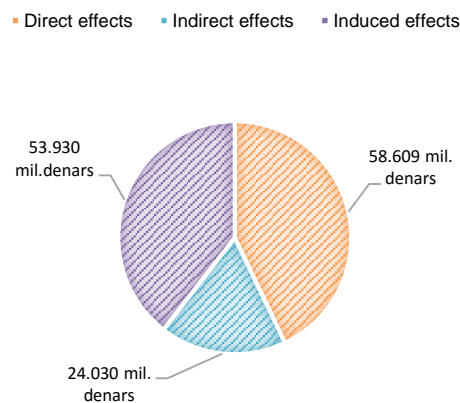

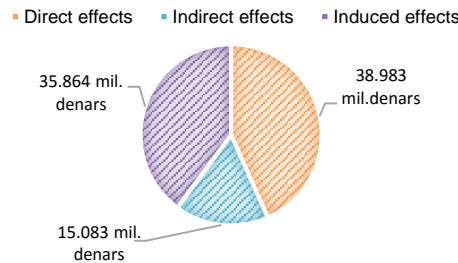**Figure 2.** Output multiplicative effects, in 2007

Figure 3. Output multiplicative effects, in 2014

The employment multiplier reported below measures a direct effect in generating jobs through the number of employees in companies that are part of the basic metal industry, and it is derivate in million of total output. The employment rate of the basic metal industry as the ratio between the total revenues of the companies and the total number of employees shows that every employee within the steel industry year generated 8.82 million on average, annually. On the picture above we can see that in 2007 the total number of employees in companies that are part of this study is 6.642 employees, while in 2014 that number is somewhat lower because of the economic crisis impact. The total number of employees in 2014 is 6.393 jobs. This actually measured a direct impact of the industry analyzed through the number of jobs created from the steel industry.

According to the estimated relationship between total revenues and number of employees, it is obvious that the total number of employees which is included in the production process and the labor income created within the industry are expected according to the fact that the steel industry is capital intensive which means that its production process is characterized with the large amount of physical capital (machinery and equipment) compare with the number of workers.

Much more significant is the multiplicative effects of the steel industry in terms of job creation in the national economy, indirectly. Namely, the steel industry through its supply chain creates and supports about 15.107 jobs (indirect multiplier is 2.27) and through induced effects relating to the consumption of employees in the industry and its supply chain this industry indirectly creates and supports about 5.522 employees (induced multiplier is 0.83). The total number of employees that the industry directly or indirectly generates or supports the national economy according to our calculations is 27.271 jobs and 26.211 jobs, in 2007 and 2014, respectively.
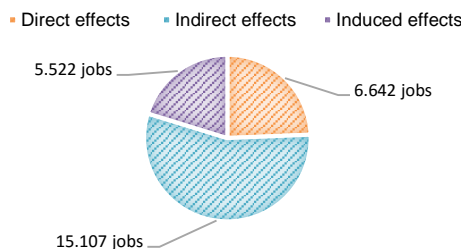

Figure 4. Employment multiplicative effects, in 2007

When it comes to the multipliers in total value added, the results of the analysis show that the steel industry in 2007 through additional indirect and induced effects generated and encouraged the creation of additional value added in the economy of 14.255 million and 44.482 million, respectively, which goes to the conclusion that the total gross value added generated by the steel industry for the national economy, directly or through its multiplicative effects (indirect and induced) is approximately 77.150 million denars.

The analysis of multiplicative effects of the steel industry in generating the total value added for 2014 shows that the industry through its supply chain (4.693 million) and by consumption channels (14.750 million denars) encouraged the creation of additional gross value added of 19,443 million denars, or total economic impact (direct and a indirect) about 25.538 million denars.
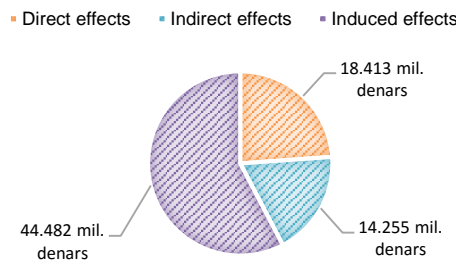

Figure 5. Total Added Value Multiplicative effects, in 2007
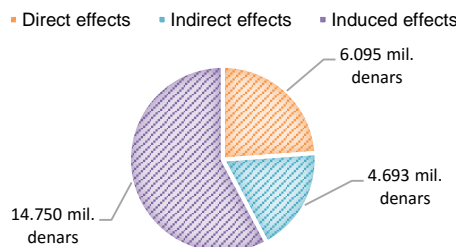

Figure 6. Total Added Value Multiplicative effects, in 2014

The largest multiplier effects of the total industry's supply chain in terms of total added value is in the sector for collecting scrap metal and iron, industries that appear as providers of spare parts and materials, sector for production, transmission and distribution of natural gas and electricity, wholesale and retail sector and service sector understood in the broadest sense (finance, insurance, business sector and others).

Additionally, our goal in this section besides the analysis of net effects generated directly or indirectly by the steel industry is to quantify the relative size of the steel industry to national economy by calculating relative industry's contribution as a

percentage of GDP. The estimated results indicate that the relative share of steel industry to national GDP is 24% and 5.7%, in 2007 and 2014, respectively. This is a clear argument that the steel industry is the main pillar and one of the most important sectors in Republic of Macedonia.

The direct and indirect tax impacts associated with steel industry is not neglected for the national economy and especially for the central and local government. Actually, tax revenues are paid from contributions to social security, proprietor income, indirect business taxes, household income and corporate profits. According our estimations, the steel sector paid a total of 2.433 and 1.338 million denars in 2007 and 2014, respectively. Additionally, the estimations relating to the rate of taxes show that companies in steel industry pay taxes to the government and to the state funds approximately 24.000 denars for every million revenues.

CONCLUSION

The economic contribution of steel industry to the Macedonian economy, however, goes beyond its direct economic impact. Actually, the companies within the steel industry by purchasing production inputs and services from many other sectors stimulate and support the whole economy. Moreover, the steel industry contributes to household incomes, which then induces additional rounds of stimulus to the economy as households spend its income on goods and services. It is obvious that this industry supports lot of businesses and jobs in many sectors in the economy and contributes to many sectors through the consumption channels. Therefore, to assess the role and importance of the steel industry to the Macedonia economy besides the direct impact, it is necessary to estimate the multiplicative effects (indirect and induced) that the industry generated through the supply chain and consumption channels and multipliers.

The estimated results based on the date collected from the survey analysis done within the empirical research by applying the economic impact and input – output methodology showing that the type I output multiplier (the sum of a direct and indirect effects divided by the direct impact which measures the effects of the production of the industry on total output in the national economy through the supply chain) is 1.41. This indicates that for every denar increase in sales of steel industry, total output of the Macedonian economy increases by 1.41 denars, 1 denars is direct sales increase, another 0.41 denars arise from indirect or supply chain impacts. On the other side, the type II output multiplier (the sum of a direct, indirect and induced effects divided by direct effect which measures the total economic impact of the industry within the national economy) is 2.33. This indicate that for every denars increase in steel industry, the total economic impacts is 2.33 denars (1.41 denars from direct and indirect or supply chain effects) and 0.92 denars contributed by induce or consumption effects.

If we transform the estimated multiplicative coefficients presented above in the absolute numbers and values, the additional output of the steel industry generated through the indirect and induced channels is 77.950 million denars in 2007. One part of this additional production is generated by encouraging the production of supply chain companies (indirect channels). According to the estimations, this part is approximately 24.030 million denars, while the rest of the 53.920 million denars are generated indirectly through the labor income and the corporate profits, through the salaries and profits of the

workers and owners of the supply chain companies, and through the government spending generated by collecting taxes form companies in the steel industry and companies related to the industry (induced channels). In 2014, the value of realized production with induced production through the chain of suppliers (15.983 million denars) and final consumption (35.864 millions) is total of 51.847 million denars.

According to the estimations of the multipliers in terms of total value added, the results of the analysis show that the steel industry in 2007 through additional indirect and induced effects generated and encouraged the creation of additional value added in the economy of 14.255 millions and 44.482 millions, respectively, which goes to the conclusion that the total gross value added generated by the steel industry for the national economy, directly or through its multiplicative effects (indirect and induced) is approximately 77.150 million denars.

The analysis of multiplicative effects of the steel industry in generating the total value added for 2014 shows that the industry creates indirectly additional 4.693 millions through its supply chain and 14.750 millions through the final households consumption channels. Actually, according to our estimations, the steel industry encourages the creation of additional gross value added of 19.443 million denars, or its total economic impact (direct and indirect) is approximately 25.538 million denars.

The employment multipliers indicate that the steel industry through its supply chain creates and supports approximately 15.107 jobs (indirect multiplier is 2.27) and through induced effects relating to the consumption of employees of the industry and its supply chain this industry indirectly creates and supports about 5.522 employees (induced multiplier is 0.83). The total number of employees that the industry directly or indirectly generates or supports the national economy according to our calculations is 27.271 jobs and 26.211 jobs, in 2007 and 2014, respectively.

The largest multiplier effects through the supply chain channels in terms of total added value are in the sector for collecting scrap metal and iron, industries that appear as providers of spare parts and materials, the sector for production, transmission and distribution of natural gas and electricity, the wholesale and retail sector and the service sector including finance, insurance, business sector and other service sectors.

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