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Public Expenditures in the Selected Economic Industries: Policy Implications for the Period of the COVID-19 Pandemic Crisis

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Abstract

The paper presents the constrained multiplier methodology in semi-input-output analysis and quantifies the effect of the government support to the industries mostly affected by COVID-19 pandemic in Slovakia. In contrary to traditional input-output analysis, the methodology in this paper allows to drop assumptions of the unlimited industries' supply. The analysis is conducted for 57 economic industries, households, government, and the foreign using the Global Trade Analysis Project data. The analysis not only identify that the most stricken industry is the Recreation and other services together with the Transport industry, it also enumerates the effects of the government subsidy. Each Euro of the government support to the Recreation sector increases the Gross Domestic Product by 1.21 Euro, to the Transport industry by 0.93 Euro, while to the Automotive industry included to this analysis by 0.54 Euro. The government subsidy should aim the Recreation industry not only for the highest decline of sales during the pandemic, also for the highest number of firms at risk and because of very effective return of the government support which almost triples the total output and generates more than one Euro of the GDP.

Keywords

Semi-Input-Output Analysis, Multiplier, Public Expenditures, COVID-19

JEL Classification

C67

Introduction

In the first wave of European spread of the COVID-19 pandemic, Slovakia was among the countries with the fewest virus deaths mainly thanks to the early restrictions, such as closed shops, factories, schools, borders, and mandatory face masks. Six weeks after the first infected person reported in the country, Slovakia counted 18 deaths for 5.5 mil. inhabitants (Tomek, 2020), compared to Italy with 10 053 deaths for 60.4 mil inhabitants (WorldMeter, 2020).

Such strong restrictions had economic consequences and caused damages to several industries. FinStat made an analysis of the industries at risk by COVID-19 pandemic in Slovakia by total sales divided to NACE[1] categories (FinStat, 2020). The most stricken industry is Gambling and betting activities (see Figure 1) and Other transportation support activities highly exceeding other industries by the sales decrease due to the pandemic. Another point of the view is the total number of stricken firms within the industries with the highest sales drop (see Figure 2): the first three industries belong to recreation and restaurants branch. Unambiguously the highest number of firms is in the Beverage serving activities industry (3933 firms), followed by Restaurants and mobile food service activities (1032 firms) and Hotels and similar accommodation (951 firms).

The aim of this paper is to show the effect of the government support in various industries during the pandemic crisis of COVID-19. The main question is "What happens with one Euro of public expenditure in industries at risk? How do these industries multiply their effect?" In the first part of the paper the industries at risk by COVID-19 pandemic are identified. Next, the methodology of constrained multiplier is derived and used to enumerate the multiplier effect of the government support targeted to those industries. The effects in various industries as well as overall effects on the gross domestic product, output and income are calculated and compared. Finally, the

[1] French term "nomenclature statistique des activités économiques dans la Communauté européenne" - Statistical Classification of Economic Activities in the European Community

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policy implications are formulated based on the exact numerical values for each industry under the study.

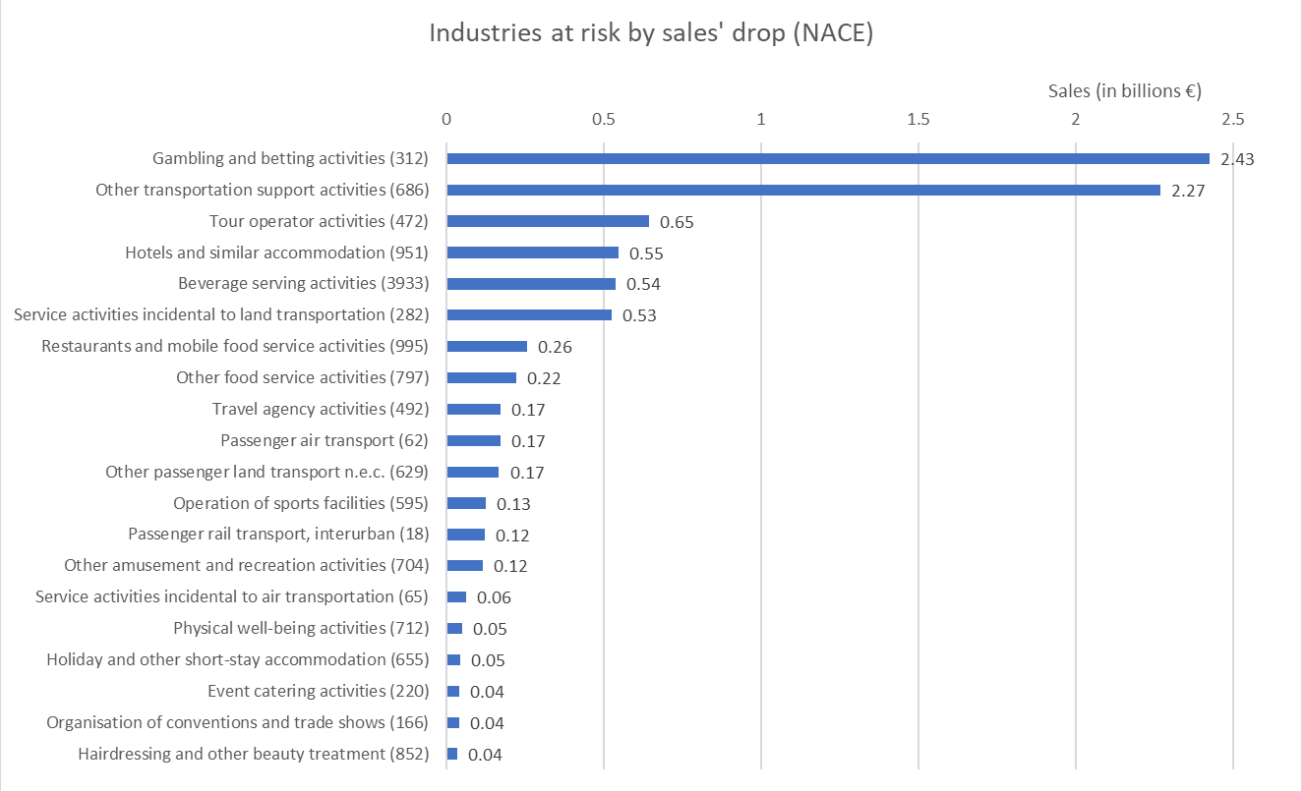

Fig.1. Industries at risk by COVID-19 in Slovakia according to sales' drop in the industry, the first twenty.
Source: FinStat (2020)

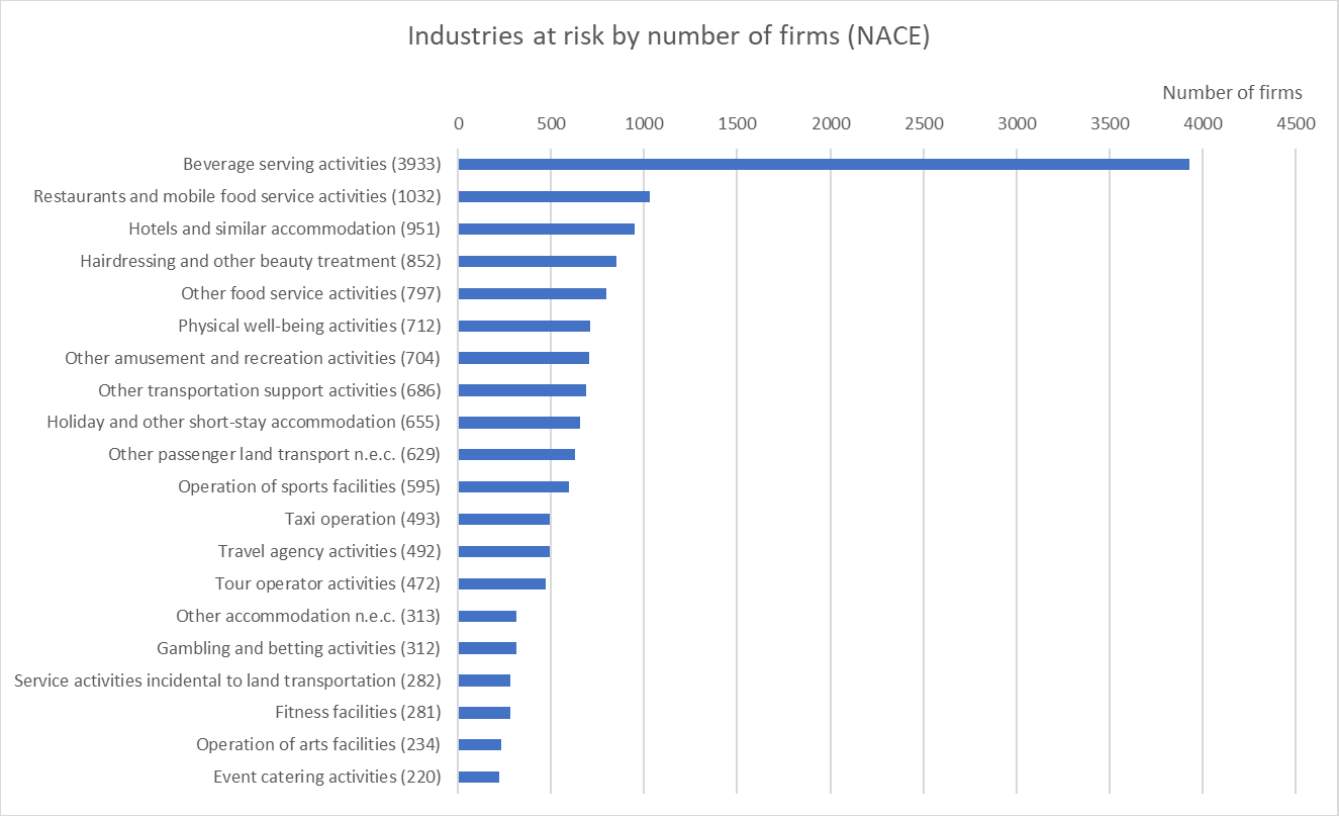

Fig.2. Industries at risk by COVID-19 in Slovakia according to number of firms in the industry, the first twenty.
Source: FinStat (2020)

We use the latest available crisis-year data, 2011, to approximate the current inter and intra industries relationships. The data comes from the Global Trade Analysis Project (GTAP) dataset (Aguiar et al., 2016), which includes a comprehensive set of 57 economic industries, a representative household, savings-investments,

government, and foreign (rest of the world) sectors and their accounts measuring the value of annual flows of goods and services in 2011 market prices for the entire world economy; in this analysis we focus on the Slovak data.

GTAP/NACE	Sum of Sales (€)
Air transport	**174 101 674**
Passenger air transport (62)	174 101 674
Education	**27 814 758**
Driving school activities (187)	11 000 950
Pre-primary education (71)	6 666 970
Sports and recreation education (168)	10 146 838
Human health and social work	**7 552 530**
Child day-care activities (166)	7 552 530
Recreation and other services	**5 369 980 617**
Beverage serving activities (3933)	539 690 759
Botanical and zoological gardens and nature reserves activities (2)	1 555 743
Camping grounds, recreational vehicle parks and trailer parks (22)	1 906 063
Event catering activities (220)	41 167 560
Fitness facilities (281)	19 236 675
Gambling and betting activities (312)	2 426 428 749
Hairdressing and other beauty treatment (852)	37 145 858
Holiday and other short-stay accommodation (655)	46 544 984
Hotels and similar accommodation (951)	549 620 215
Museums activities (2)	49 500
Operation of arts facilities (234)	27 973 362
Operation of historical sites and buildings and similar visitor attractions (3)	31 205
Operation of sports facilities (595)	125 710 949
Organisation of conventions and trade shows (166)	40 588 167
Other accommodation n.e.c. (313)	35 725 632
Other amusement and recreation activities (704)	117 427 363
Other food service activities (797)	221 837 348
Performing arts (39)	2 739 304
Physical well-being activities (712)	51 410 985
Restaurants and mobile food service activities (1032)	263 648 092
Tour operator activities (472)	645 315 166
Travel agency activities (492)	174 226 938
Transport nec	**3 172 999 266**
Other passenger land transport n.e.c. (629)	168 583 126
Other transportation support activities (686)	2 269 690 623
Passenger rail transport, interurban (18)	124 809 750
Service activities incidental to air transportation (65)	63 600 580
Service activities incidental to land transportation (282)	525 464 225
Taxi operation (493)	20 850 962
Water transport	**18 228 909**
Inland passenger water transport (19)	7 967 018
Sea and coastal passenger water transport (2)	550 194
Service activities incidental to water transportation (23)	9 711 697
Total	**8 770 677 754**

Fig.3. Industries at risk according to the sales drop by COVID-19, alphabetically ordered, Slovakia, in brackets there is a number of the firms.
Source: FinStat (2020)

For this research purposes, it is needed to re-code the most stricken industries in NACE categories to the GTAP code system, see Figure 3. The broad categories according to GTAP (Air transport, Education, Human health and social work, Recreation and other services, Transport nec[2]. and Other transport) includes several most hurt NACE industries at risk according to the sales drop during the COVID-19 pandemic crisis. There are two

[2] not elsewhere classified

industries deserving our attention: Recreational and other service with the total sales drop of 5,369,980,617 Euro and 12,789 firms and Transport nec industries (all kinds of transport except of sea and air) with 3,172,999,266 Euro sales drop and 2,173 firms in the industry, see Figure 3. Since Slovakia's production and export is strongly oriented towards the automotive (Chlopcik, 2018), (Masar and Hudakova, 2019), and employs more than 177 thousand people (Kufelová and Raková, 2020) this industry is included to the analysis to compare the effect of the government spending. Also, the input-output analysis of the Slovak economy from 2010 (Kubala et al., 2015) shows that the gross output multiplier for this industry is the highest (2.15).

In the traditional input-output analysis, there is a number of assumptions leading to mostly unrealistic prerequisites and conclusions. One of them is that the supply side of production industries is unconstrained and therefore any change in the demand side, may it be of households, government or foreign, leads to an unlimited reaction in production. This is rarely the case, especially in the industries using special intermediate inputs. On the other side, increasing production in some industries may even cause decline in production within another industries. For that reason, the constrained multiplication model is derived to analyze the demand shocks in this paper, which is based on the semi-input-output models, i.e. (Chen et al., 2016), (Zbranek et al., 2016).

Literature Review

Most of the publications in the field of economics deal with the impacts of the COVID-19 pandemic to the countries' economy on various levels and aggregates. In this review the papers are grouped to three categories: impacts on the industries, the government financial subsidies and the multiplier analysis linked to the pandemic.

The hospitality industry in Slovakia, the Czech Republic, Hungary, and Poland during the COVID-19 pandemic was examined by (Wieczorek-Kosmala, 2021). The study confirms that the financial-slack-driven risk during the crisis is relatively low and firms in this industry are exposed to high liquidity tensions even after the pandemic.

Another short-term analysis (on data from February 24th, 2020 to April 24th, 2020) conducted on hotel companies' stock market returns reacting to the pandemic evolution shows that this industry's profitability is negatively correlated to the COVID-19 growth cases; while positively correlated with the fiscal policies directly impacting balance of the public budget (Anguera-Torrell et al., 2020). The authors recommend the hoteliers to be prepared to lobby governments and public institutions to establish a recovery economic packages based on fiscal measures to enhance the aggregate demand and aggregate level of welfare.

There is an interesting study (del Rio-Chanona et al., 2020), in which the first-order supply and demand shocks for the US economy are estimated. The remote labor index was constructed to express the extent to which workers can perform their work from home (the highest is for finance, insurance, and information industries, while the lowest for agriculture, forestry, fishing, and hunting) and identified the essential (i.e. healthcare and education) and non-essential industries (i.e. restaurants and travel agencies). With the estimated overall employment drop by 23%, wages by 16% and value added by 20%, the authors conclude that the occupations with high wages are not economically vulnerable by the supply and demand shocks, while the occupations with low wages are so.

(Nemec and Špaček, 2020) compare the reaction of the central government during the 2008 – 2010 economic crisis and during the 2020 pandemic crisis. The research concludes that the approach significantly differs, and this difference is not caused by the lack of finance and may be explained by the government orientation.

According to (Ozili and Arun, 2020) the European Central Bank spends 750 billion Euros through Emergency fund for bond purchase program for the EU member countries to stimulate the economy of the European Union member countries.

The multiplier analysis was applied to find the COVID-19 pandemic effects on Myanmar's economy (Diao et al., 2020). On the contrary to our analysis, this one was used to predict the impacts of a two-week-long lockdown of the economy: a 41% fall of the national GDP. The highest fall is in the Hotel, restaurants, and catering industry (-71%), followed by Beverage crops (-69%) and Wholesale and retail (-69%). The Transport industry is predicted to fall by 48%.

The Food Policy Research Institute provides another SAM multiplier analysis devoted to the Malawian economy (Baluch et al., 2020). The study estimates a decline of the GDP by around 16.5% during April and May 2020 due to social distancing measures and between 8.3% and 11.3% over the 2020. Although a lockdown was proposed, it was not implemented thanks relatively low incidence of the COVID-19 cases due to young age structure (according to the Census 2018 5.1% population is older than 59 years and 55.5% is less than 20 years old), low urbanization and poor transport infrastructure and limited mobility.

We offer an important contribution to the existing literature in the form of the exact enumeration of the government subsidy effects in the selected sectors.

Methods

The unconstrained multiplier, derived in the previous research (Breisinger et al., 2009) and (Mitkova, 2018) assumes a fixed price set leading to the changes in output as a reaction to the changes in the demand side of economy. This assumption requires an unlimited supply in each production industry, which is mostly unrealistic prerequisite. The input coefficients are fixed, which means the demand shocks have no influence on the structure and relationships among the industries. In this methodology we extended the model for *n* industries in the matrix form. The constrained multiplier model enriches the unconstrained one by dividing the industries to endogenous and exogenous. The industries that can change the production level – the supply response is unconstrained, are treated as exogenous, and the industries with the supply constraints or a fixed level of output as the endogenous industries.

Total demand of sector *Z* is composed of intermediate demand, final demand, and exogenous demand:

$$\sum_{j=1}^{n} Z_{ij} + C_i + E_i = Z_i \quad i = 1,2,\dots,n \tag{1}$$

where

E_i exogenous component of demand for commodity *i*, *i* = 1,2,…,*n*
X_j gross output of activity *j*, *j* = 1,2,…,*n*
C_i household consumption of commodity *i*, *i* = 1,2,…,*n*
Y total household income (equal to total factor income)
V_j factor income from activity *j*, *j* = 1,2,…,*n*
Z_{ij} intermediate demand for commodity *i* in activity *j*, *i, j* = 1,2,…,*n*
Z_i total demand for commodity *i*, *i* = 1,2,…,*n*
a_{ij} technical coefficients, *i, j* = 1,2,…,*n*
b_i share of domestic output in total demand, *i* = 1,2,…,*n*
c_i household consumption expenditure shares, *i* = 1,2,…,*n*
v_j share of value-added or factor income in gross output, *j* = 1,2,…,*n*

If

$$a_{ij} = \frac{Z_{ij}}{X_j} \quad i = 1,2,\dots,n \tag{1a}$$

$$c_i = \frac{C_i}{\sum_{j=1}^{n} V_j} = \frac{C_i}{Y} \quad i = 1,2,\dots,n \tag{1b}$$

$$b_i = \frac{X_i}{Z_i} \quad i = 1,2,\dots,n \tag{1c}$$

$$v_j = \frac{V_j}{X_j} \quad j = 1,2,\dots,n \tag{1d}$$

$$\sum_{j=1}^{n} a_{ij}X_j + c_iY + E_i = Z_i \quad i = 1,2,\dots,n \tag{1e}$$

Then (1) may be written as

$$\sum_{j=1}^{n} a_{ij}b_jZ_j + c_i\sum_{j=1}^{n} v_jb_jZ_j + E_i = Z_i, \quad i = 1,2,\dots,n \tag{2}$$

$$Z_i - \sum_{j=1}^{n} a_{ij}b_jZ_j - c_i\sum_{j=1}^{n} v_jb_jZ_j = E_i, \quad i = 1,2,\dots,n \tag{3}$$

Let us denote sectors *i*, *i* = 1, 2, …, *k* as exogenous and sectors *i* = *k*+1, *k*+2, …, *n* as endogenous, then system (3) may be divided to exogenous part in equations (4):

$$Z_i - \sum_{j=1}^{k} a_{ij}b_jZ_j - \sum_{j=1}^{k} c_iv_jb_jZ_j - \sum_{j=k+1}^{n} a_{ij}b_jZ_j - \sum_{j=k+1}^{n} c_iv_jb_jZ_j = E_i, \quad i = 1,\dots,k \tag{4a}$$

$$Z_i - \sum_{j=1}^{k}(a_{ij}b_j + c_i v_j b_j)Z_j - \sum_{j=k+1}^{n}(a_{ij}b_j + c_i b_j v_j)Z_j = E_i, \;\; i = 1, \dots, k \tag{4b}$$

and for endogenous part in equations (5):

$$-\sum_{j=1}^{k} a_{ij}b_j Z_j - \sum_{j=1}^{k} c_i v_j b_j Z_j + Z_i - \sum_{j=k+1}^{n} a_{ij}b_j Z_j - \sum_{j=k+1}^{n} c_i v_j b_j Z_j = E_i, \quad i = k+1, \dots, n \tag{5a}$$

$$-\sum_{j=1}^{k}\left(a_{ij}b_j - c_i v_j b_j\right)Z_j + Z_i - \sum_{j=k+1}^{n}\left(a_{ij}b_j - c_i v_j b_j\right)Z_j = E_i, \;\; i = k+1, \dots, n \tag{5b}$$

Let us divide matrices of demand **E** and total demand **Z** to endogenous (EN) and exogenous parts (EX) as follows:

$$\mathbf{E} = \begin{bmatrix}\mathbf{E}_{EX}\\ \mathbf{E}_{EN}\end{bmatrix}, \mathbf{E}_{EX} = \begin{bmatrix}E_1\\ E_2\\ \vdots\\ E_k\end{bmatrix}, \mathbf{E}_{EN} = \begin{bmatrix}E_{k+1}\\ E_{k+2}\\ \vdots\\ E_n\end{bmatrix} \tag{6a}$$

$$\mathbf{Z} = \begin{bmatrix}\mathbf{Z}_{EX}\\ \mathbf{Z}_{EN}\end{bmatrix}, \mathbf{Z}_{EX} = \begin{bmatrix}Z_1\\ Z_2\\ \vdots\\ Z_k\end{bmatrix}, \mathbf{Z}_{EN} = \begin{bmatrix}Z_{k+1}\\ Z_{k+2}\\ \vdots\\ Z_n\end{bmatrix} \tag{6b}$$

Let

$$m_{ij} = a_{ij}b_j + c_i v_j b_j, \;\; i, j = 1, \dots, n \tag{7}$$

and define matrices

$$\mathbf{M} = (m_{ij})_{nxn} \tag{8a}$$

$$[\mathbf{I}_k - \mathbf{M}_{kk}] = \begin{bmatrix}1 - m_{11} & -m_{12} & \cdots & -m_{1k}\\ -m_{21} & 1 - m_{22} & \dots & -m_{2k}\\ \vdots & \vdots & \ddots & \vdots\\ -m_{k1} & -m_{k2} & \dots & 1 - m_{kk}\end{bmatrix} \tag{8b}$$

$$[\mathbf{I}_l - \mathbf{M}_{ll}] = \begin{bmatrix}1 - m_{k+1,k+1} & -m_{k+1,k+2} & \cdots & -m_{k+1,n}\\ -m_{k+2,k+1} & 1 - m_{k+2,k+2} & \dots & -m_{k+2,n}\\ \vdots & \vdots & \ddots & \vdots\\ -m_{n,k+1} & -m_{n,k+2} & \dots & 1 - m_{n,n}\end{bmatrix} \tag{8c}$$

$$[\mathbf{M}_{kl}] = \begin{bmatrix}-m_{1,k+1} & -m_{1,k+2} & \cdots & -m_{1,n}\\ -m_{2,k+1} & -m_{2,k+2} & \dots & -m_{2,n}\\ \vdots & \vdots & \ddots & \vdots\\ -m_{k,k+1} & -m_{k,k+2} & \dots & -m_{k,n}\end{bmatrix} \tag{8d}$$

$$[\mathbf{M}_{lk}] = \begin{bmatrix}-m_{k+1,1} & -m_{k+1,2} & \cdots & -m_{k+1,k}\\ -m_{k+2,1} & -m_{k+2,2} & \dots & -m_{k+2,k}\\ \vdots & \vdots & \ddots & \vdots\\ -m_{n,1} & -m_{n,2} & \dots & -m_{n,k}\end{bmatrix} \tag{8e}$$

where

$l = n - k$

Then equation (3) can by written in matrix form

$$(\mathbf{I} - \mathbf{M})\mathbf{Z} = \mathbf{E} \tag{9}$$

Equations (5a) and (5b) re-written in matrix form

$$\begin{bmatrix} \mathbf{I}_k - \mathbf{M}_{kk} & \mathbf{M}_{kl} \\ \mathbf{M}_{lk} & \mathbf{I}_l - \mathbf{M}_{ll} \end{bmatrix} \begin{bmatrix} \mathbf{Z}_{EX} \\ \mathbf{Z}_{EN} \end{bmatrix} = \begin{bmatrix} \mathbf{E}_{EX} \\ \mathbf{E}_{EN} \end{bmatrix} \tag{10}$$

Then the multiplier is

$$\begin{bmatrix} \mathbf{Z}_{EX} \\ \mathbf{Z}_{EN} \end{bmatrix} = \begin{bmatrix} \mathbf{I}_k - \mathbf{M}_{kk} & \mathbf{M}_{kl} \\ \mathbf{M}_{lk} & \mathbf{I}_l - \mathbf{M}_{ll} \end{bmatrix}^{-1} \begin{bmatrix} \mathbf{E}_{EX} \\ \mathbf{E}_{EN} \end{bmatrix} \tag{11}$$

Results

In this experiment, the government is treated as an endogenous part of the final demand, which means that the increased production in the supported industry increases also production in “pulled and pushed” industries, tax revenues, rises the government spending and stimulates further production in economics. The rounds of the increase repeat across industries until the effect diminishes – this is called multiplication effect.

Design of the experiments: Households, savings, and foreign sector are treated as exogenous, the government as endogenous and the industries in each experiment are unconstrained (endogenous) except for the analyzed industry, which has limited supply: in Scenario 1 the Recreation and restaurants (abb. R), the most stricken industry is supposed to be exogenous, in Scenario 2 the Transport industry (abb. T) has upper limitations in its supply. In Scenario 3 the Automotive industry (abb. A) is treated as exogenous. Now let us suppose the government support of one Euro is simulated in the industries at risk and the multiplier effects on each of 57 industries, labor, capital, household, government, foreign are enumerated. Finally, the total multiplier effect on output, the GDP and income are calculated to compare the overall effect of the government subsidy. The results for three scenarios are shown in Figure 4 and the detailed breakdown by 57 industries is in Appendix A.

Scenario 1 Recreation		**Scenario 2 Transport**		**Scenario 3 Automotive**	
Labor	0.5738	Labor	0.4070	Labor	0.2455
Capital	0.6405	Capital	0.5189	Capital	0.2991
Household	1.0955	Household	0.8730	Household	0.5245
Government	0.3155	Government	0.3452	Government	0.2258
Savings-investment	0.2989	Savings-investment	0.2738	Savings-investment	0.1411
Foreign	0.5489	Foreign	0.3912	Foreign	0.7631
Total multiplier effect					
Output	2.9062	Output	2.8934	Output	2.0651
GDP	1.2143	GDP	0.9259	GDP	0.5446
Income	1.0955	Income	0.8730	Income	0.5245
Sectoral multiplier effects					
Restaurants and other services	1.1467	Transport	1.0856	Motor vehicles and parts	0.7075
Business services nec	0.2948	Petroleum, coal products	0.2637	PubAdmin/Defence/Health/Educat	0.1250
PubAdmin/Defence/Health/Educat	0.2178	Business services nec	0.2290	Machinery and equipment nec	0.1229
Trade	0.1386	PubAdmin/Defence/Health/Educat	0.2233	Transport nec	0.1112
Electricity	0.0980	Trade	0.1283	Business services nec	0.1001
Communication	0.0827	Financial services nec	0.0744	Trade	0.0568

Fig.4. Multiplier Effects in three Scenarios.
Source: Calculations by authors

The total output multipliers add up the effects across all rounds and industries. Number higher than one (2.91 for Recreations, 2.89 for Transport and 2.07 for Automotive) means that the total national output raises more than the initial shock, in this case the government subsidy, and it has a positive multiplicative effect. The GDP multiplier (1.21 for R, 0.93 for T and 0.54 for A) shows the total primary factors effect; in this analysis labor (0.57 for R, 0.41 for T and 0.25 for A) and the capital (0.64 for R, 0.52 for T and 0.30 for A) earnings generated by increased production across all the industries. The income multiplier enumerates the additional income earnings generated by household; in our analysis there is only one representative household owning the primary factors, labor and the capital, for which the household and income multipliers equal (1.10 for R, 0.87 for T and 0.52 for A). The government gains back in the taxes increased from this kind of support with multipliers values 0.32 for the Restaurant support, 0.35 for Transport and 0.23 for Automotives. The multiplier of foreign, or the rest of the world, representing all foreign countries, is the highest for the Automotives (0.76), followed by Restaurants (0.55) and finally the Transport (0.39). The industry multipliers divide the output multiplier effect through all industries.

Figure 4 shows six industries with the strongest effects for each scenario. Unambiguously the strongest is the government subsidy effect in the supported industries themselves (1.15 for R, 1.09 for T and 0.71 for A). Industries raising their production in each scenario are not a surprise: Business services (0.29 for R, 0.23 for T and 0.10 for A), Public administration, Defense, Health and Education (0.22 for R, 0.22 for T and 0.13 for A) and Trade (0.14 for R, 0.13 for T and 0.06 for A).

Discussion

Scenario 1: Some already published researches suggest (Ozili and Arun, 2020), (Dube et al., n.d.), (Fernandez, 2020) that the most affected industry for the social distancing and stay-at-home policies because of the novel corona virus spread appears to be the Recreation and other services industry, which includes all sorts of hospitality firms. For Slovakia proved the same outcomes the study of (FinStat, 2020). As the authors (Anguera-Torrell et al., 2020) consider a negative correlation between the profits and COVID-19 cases and the long-lasting restrictions in this industry all over the world, we considered this industry to be examined as the first one. The scenario confirmed a strong output multiplicative effect in this industry with the total multiplier effect on output 2.91, which means that each Euro of the government subsidy generates the gross output rise by 2.91 Euro and the Gross Domestic Product (GDP) by 1.21 Euro. This effect adds up an overall increase in gross output for each industry, the most considerable in itself (1.15) followed by the increase in Business services nec. (0.29). There is a remarkable effect of the subsidy on households (1.1), each Euro of the subsidy generates more than Euro income rise for households. This income rise comes mostly from the households' capital than the labor ownership in the Recreation industry.

Scenario 2: The government subsidy is directed to the Transport nec. industry - the second most influenced industry by COVID-19 pandemic in Slovakia (FinStat, 2020) and other countries (Nižetič, 2020), (Arellana et al., 2020), (Zhang et al., 2021), (Diao et al., 2020), although (Loske, 2020) states the effect on transport volume does not depend on duration of the pandemic but on the individual strength. The output effect is slightly smaller than in the Recreation industry 2.89 compared to 2.91, nevertheless, this kind of policy almost triples the total output and it numerously influences more industries: the multiplier effect in itself is 1.09, which means that each Euro of the subsidy generates more than one Euro of gross output in that industry; consequently the Petroleum and coal products (0.26) and Business services nec. (0.23). The above-mentioned Public administration, Defense, Health and Education sectors are positively affected with 0.22 Euro increase in output. The GDP (0.93) and household (0.87) multipliers are less than in the Recreations industry. This means that household income effect does not multiply itself in full rate, however, income still rises by 0.87 Euro for each Euro of the government subsidy. The multiplier for the foreign is the lowest (0.39) for the analyzed policies. It means that for each Euro the foreign income increases only by 39 cents, which may be explained by the national ownership of strategic transport firms. The multiplier belonging to the capital (0.52) is not surprisingly higher than the one for the labor (0.41) since the capital constitutes in the main part of the production factors in this industry.

Scenario 3: The third policy of supporting was examined for the Automotive industry, since automotive and its parts construction creates the largest part of the Slovak export (Kufelová and Raková, 2020) and strong orientation of the Slovak economy toward this industry (Hojdik, 2020). This scenario gives an unambiguous result: each Euro embedded to this industry more than a twofold overall increase in the total output (2.07), which is the slowest rate among the examined ones. Research of (Kubala et al., 2015) in 2015 based on the input-output analysis shows slightly higher value of the total output multiplier 2.15 for this industry, which is expected due to the unconstrained analysis. This increase in total output consists of a partial increase in the Automotive industry itself by 0.71, Public administration, Defense, Health and Education (0.13), Machinery and Equipment (0.12) as tightly related heavy industry, Transport nec. (0.11), Business services nec. (0.10) and Trade (0.06). There is a high multiplicative effect for foreign (0.76), the highest among three scenarios, which may be explained by the ownership of the capital production factor by foreign owners. The multipliers for the primary factors are again the lowest among the three scenarios (0.25 and 0.30). The multiplication effect on the GDP is 0.54 and on the income 0.52. Each Euro pushed to this industry increases the gross domestic product and the income of the households by 54, respectively 52 cents, partly because the substantial effect of the subsidy flew abroad, as mentioned above.

For each scenario no industry recorded decline in gross output resulting in the government subsidy, see in

Appendix , which means that there is no "immiserising growth[3]" applied to the industries (Bhagwati, 1958). Each Euro of the government subsidy to each of the presented three industries either increases the total production of the industries or even does not cause production drop (stays zero, unaffected). The figure also presents the total linkage effects for each industry (as row sums), the strongest for Trade and Business services – those industries rise wherever the government subsidy is directed.

Conclusion

In this paper, the industries Recreation and other services and Transport (expect of air and water) were identified, based on sales decline caused by the COVID-19 pandemic, as the industries with the strongest economic impacts. The Automotive industry was also included in this analysis for its importance for the Slovak economy. The constrained multiplier formula, which allows a limited supply of the industries as well as the agents reactions in the economy, and provides more realistic policy implications, was derived. Applying the developed model on the GTAP 2011 crisis data, we can conclude that each Euro of the government support to the Recreation industry gives 1.21 Euro of GDP and reinforces this industry by strong push and pull effects by 1.15 Euro increase, as well as Business services by 0.29 Euro and Public Administration, Defense, Health and Education joint sector by rise of 0.22 Euro. Also, this policy is very supportive for households with more than one Euro increase in income mostly originating in the capital than labor ownership. The policy directed towards the Transport industry shows similar, although smaller outcomes for each studied area: one Euro support increases the GDP by 0.93 Euro, fostering mainly the Transport and Petroleum and coal industries and again, Business services. The effect on households and income is lower, partly because the multiplicative effect rise is absorbed back by the government, which has the highest increase for this scenario; on the contrary to the foreign sector, for which the slowest rise is noticed. The Automotive industry, the strongest Slovak industry, increases the GDP by 0.54 Euro for each Euro of the government support, the lowest rate among examined three. This is caused by low values of labor and the capital multipliers. On the other hand, it has the strongest effect on foreign among three studied policies because of the capital ownership in this industry. Our constrained analysis shows slightly smaller effect as that of (Kubala et al., 2015).

In conclusion, may the government decide which industry to support by subventions during and after the COVID-19 pandemic, it should aim the Recreation and other services industry for three reasons:

- this industry encounters the highest decline of sales during the pandemic caused by social distancing and stay-at-home policy,
- there operates the highest number of firms stricken in the industry, with employees suffering from the huge decline in sales, profits, and wages,
- there is a very effective return of each Euro of the government support generating almost triple of the total output and more than one Euro of the GDP.

There is a scope for further research in this area in the matrix block inversion methodology use with the endogenous and exogenous industries. Such an approach has a potential in final effects decomposition from the point of view of inter-block linkages as well as individual industries linkages included to the various blocks. The analysis may be conducted under various regularity of diagonal sub-matrixes assumptions.

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[3] economic growth which could result in a country being worse off than before the growth

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Appendix A

	Scenario 1 Recreation	Scenario 2 Transport	Scenario 3 Automotive
1 Paddy rice	0.0000	0.0000	0.0000
2 Wheat	0.0037	0.0026	0.0013
3 Cereal Grains nec	0.0043	0.0028	0.0014
4 Vegetables, fruits, nuts	0.0031	0.0024	0.0013
5 Oil seeds	0.0037	0.0024	0.0011
6 Sugar cane, sugar beet	0.0008	0.0007	0.0003
7 Plant-based fibers	0.0000	0.0000	0.0000
8 Crops nec.	0.0031	0.0023	0.0012
9 Cattle, sheep, goats, horses	0.0020	0.0016	0.0008
10 Animal products nec	0.0075	0.0057	0.0029
11 Raw milk	0.0059	0.0046	0.0023
12 Wool, silk-worm cocoons	0.0000	0.0000	0.0000
13 Forestry	0.0097	0.0090	0.0041
14 Fishing	0.0005	0.0003	0.0001
15 Coal	0.0006	0.0009	0.0003
16 Oil	0.0001	0.0004	0.0001
17 Gas	0.0000	0.0000	0.0000
18 Minerals nec	0.0021	0.0024	0.0019
19 Meat: cattle, sheep, goats, horse	0.0106	0.0083	0.0043
20 Meat products nec	0.0508	0.0406	0.0210
21 Vegetable oils and fats	0.0043	0.0034	0.0017
22 Dairy products	0.0586	0.0468	0.0237
23 Processed rice	0.0003	0.0002	0.0001
24 Sugar	0.0085	0.0068	0.0035
25 Food products nec	0.0334	0.0258	0.0129
26 Beverages and tobacco products	0.0110	0.0086	0.0040
27 Textiles	0.0127	0.0103	0.0054
28 Wearing apparel	0.0102	0.0083	0.0042
29 Leather products	0.0127	0.0101	0.0052
30 Wood products	0.0187	0.0157	0.0086
31 Paper products, publishing	0.0470	0.0500	0.0183
32 Petroleum, coal products	0.0696	0.2637	0.0516
33 Chemical, rubber, plastic prods	0.0728	0.0632	0.0405
34 Mineral products nec	0.0183	0.0164	0.0099
35 Ferrous metals	0.0179	0.0273	0.0338
36 Metals nec	0.0100	0.0103	0.0156
37 Metal products	0.0224	0.0214	0.0231
38 Motor wehicles and parts	0.0308	0.0329	0.7075
39 Transport equipment nec	0.0047	0.0070	0.0032
40 Electronic equipment	0.0285	0.0243	0.0322
41 Machinery and equipment nec	0.0439	0.0666	0.1229
42 Manufactures nec	0.0226	0.0143	0.0076
43 Electricity	0.0980	0.0701	0.0372
44 Gas manufacture, distribution	0.0010	0.0008	0.0004
45 Water	0.0170	0.0110	0.0057
46 Construction	0.0544	0.0500	0.0258
47 Trade	0.1386	0.1283	0.0568
48 Transport nec	0.0000	1.0856	0.1112
49 Sea transport	0.0031	0.0103	0.0019
50 Air transport	0.0047	0.0088	0.0030
51 Communication	0.0827	0.0564	0.0245
52 Financial services nec	0.0718	0.0744	0.0287
53 Insurance	0.0199	0.0172	0.0092
54 Business services nec	0.2948	0.2290	0.1001
55 Recreation and other services	1.1467	0.0380	0.0191
56 PubAdmin/Defense/Health/Education	0.2178	0.2233	0.1250
57 Dwellings	0.0885	0.0697	0.0369

Fig.5. Detailed industry multipliers.
Source: Calculations by authors