

A FEW NOTES REGARDING INDUSTRIAL AND SERVICE SECTORS IN SLOVAK REPUBLIC RESULTING FROM INPUT-OUTPUT ANALYSIS

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Abstract

Input-output analysis that this paper harnessed in order to examine the brief evolution of Post and telecommunications (PAT) sector in the Slovak Republic. Slovakia represents an object of investigation as a country of the Central Europe with its specific history. Hereby it is meant that here exist old industrial regions that allowed to give raise of new sector dealing with information and technologies. The input-output analysis is rather quantitative, nonetheless, paper combines it with results of qualitative studies and this blending provides better and complex perspective. Objective and related results provide an evidence on one sector evolution that is established based on cooperation and location. Cooperation among countries, across sectors and location with various distance and heritage. Conclusions are dwelling in sustainability that is pointed out.

Keywords

Input-Output Tables, Sustainability, Value-Added, Regions

I. Introduction

Motivation for writing this paper was to continue the work on searching the sustainability paths with help of intermediate sales that are a part of input-output analysis. This text is original presuming that it follows the work on project “Economic Implications and Perspectives of the Participation of the Slovak Republic in the Process of Production Activities Fragmentation within Global Value Chains” - (referred to as VEGA1/0961/16).

The paper’s object of analysis is Slovak Republic and its sector of Post and telecommunications (PAT). Slovak Republic is located in region of Central Europe and is a member of Visegrad Group. Slovak Republic will be examined as a whole, however, at least for one case, there will be a handful of details to convey the sustainability issue. Here, the sustainability is, in first place, understood as a resilience in evolution. Then it can also have the other connotations linked to environmental issues, for instance.

II. Underneath the input-output analysis

Generally, mankind is looking for directions in life. A “Chain of being” (Kishtainy, 2017, p. 15) was noticed by Niall Kishtainy when examining history, as early as in medieval society. To be precise “communities broke out of their isolation and started trading with each other” (Ibid., p. 17). This evolved to trade among cities and distant lands and even “from world of borders to the world of horizons” (Leśniak, 2001). One possible explanation of the world of horizons is world without limits, where a result of globalization is change from land to science (e.g. introducing internet and other scientific breakthroughs to everyday use). Another explanation of the world of horizons is linked together with future generation that will have to cope with pollution problems of water, air – mind you: these cannot be stopped at the border (Ibid., p. 261), but in a way are frequently exchanged (or exported and re-exported). This was expressed by Peres Shimon when he reflected on global, regional and national economy, in the same book of International Cultural Centre (Cracow) that discusses the new image of Europe and its heritage. Heritage could be positive or negative, such as environmental

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burdens. Thereupon, one of the pressing problems is a sustainability in consumption and production. It is a correct direction in a life to watch for. Among the authors, who thoroughly studied and examined overall development of Slovak fragmentation pathways was Smith (Smith, 1996). One of the concluding remarks Smith makes was: *“More peripheral, late industrialised regions, as well as heavily industrialised engineering and metallurgy areas, have witnessed severe limitations to their abilities to transform existing economic structures into dynamic forms of local capitalism.”* (Smith, 1996, p. 153). Almost quarter of century since this conclusion was derived, areas or regions with heavy industrialized engineering and metallurgy are turning towards the information and communication sector (ICT) as a knowledge based sector (compared to industrial one). An example of such area in Slovak Republic is Košice city and its surroundings. Košice city is well-known especially for the metallurgy plant (VSŽ – Východoslovenské železiarne, i.e. The Eastern Slovak Steelworks since 1959 with little changes existed till 2000, when it was sold to United States Steel Corporation, which is a name of this plant ever since – considering the year of publication of this paper 2018). In the scope of theory of economic basis this company and sector it represents, i.e. metallurgy, would be referred to as dominant sector of Košice region. This company is one of the biggest employers. A sector of information and telecommunication rose based on the departments in this company and is growing with companies such as: Eset (Slovak ownership) in Košice city there is a research center, T-com (German ownership) or Ness Košice Development Center (Slovak ownership) to name but a few.

In Western Slovakia another industry having an environmental burden as a negative stigma and turning it into positive innovative win-win characteristics of a region. It is an industry of Mining. Bovey coal was mined in Handlová since 1854, however the search and discussions began in 1751-1785 (Baláž, 2011; Reiff, 2009). Together with Hoffman (Hoffman, 1995), who declared the damages to freshwater and therefore a changes in consumption, region of Handlová changed not only an industry but a geography of catfish production and consumption culture as well (Reindlová, 2015; Siváková, 2013). The fish farming using geothermal sources, which is the case of Mine Handlová was described by authors dealing either with agro-good industry or emissions (Ambroziak, 2013; Fendek and Fendekova, 2005; Fričovský, Jacko Jr, Chytilová, and Tometz, 2012).

One of the main criticism for theory of economic basis that is linked to IOA and can be inspired by conviction that it is only positive and does not give any normative instructions to practice. The reaction for such a criticism can be derived from the Hoyt's model that is a very basic for identification of dominant sectors (base and non-base sectors, where multiplier arises) and ripple effect itself. Ripple effects are creating and created throughout a network of relations (Wehn and Montalvo, 2018) among suppliers and demanding subjects, also a supply chain network. Most of the networks are dynamic relations and Input-Output Analysis (IOA) cannot give instructions to those, nonetheless, it can help to manage the sectors and regions with its sources.

III. Looking for directions in an industrial, service path after artificial intelligence gets underway

“You must be free, and mobile, and agile, and efficient, and move from place to place because you compete with other regions as well” by Shimon Peres in book titled *From the World of Borders to the World of Horizons* (Leśniak, 2001, p. 262). This quote was made around year 2001, when it was published, ever since people and their work are more and more agile, mobile and free as it is obvious, especially from GDP growths of advanced economies. Also poor economies (the Asian Tigers) joining the new “Chain of Life”, meaning joining a differentiation of production and diversification of product range, through cars to the artificial intelligence gadgets.

An Old industrial region (OIR) heritage can be ascribed to plenty areas all over Europe and other continents (Asia) as well. However some specific features of Central European Countries are present, an interesting comparison is to be found in Lee (Lee, 2010). This case studies of Visegrad Group countries bring to table selling the overpriced inputs and buying of underpriced products. This very

fact is useful for the paper concerning input and output analysis. Although the analysis covers the year 2011, when such a practice revealed by Lee was no longer in existence as we assume. Another similar problem of prices exists in the use of valuation matrices for the very fact that Supply tables (ST) are always at basic price, while Use table (UT) at purchasers' price (Timmer et al., 2012).

Computers and software are helpful in watching for the efficiency in consumption, be it final one or productive one. Concerning the latter, it is being expressed in Leontief inverse function of IOA. Actually the efficiency of production influences the final consumption itself. For the more efficient the production the more there is leftover for final consumption of a given year. Sustainability issues then looks further to the future of such consumption.

In IOA one can notice sectors that are sustainable on its own, most often it is agriculture. We can speculate on phosphorus and its decrements or other minerals, however it seems to be rather sustainable. This can hardly be true about industrial production as once iron ore is processed it can be melted again but with a different procedures necessary. As for information, those should be quite sustainable (again fake news could present an exception here).

Firstly, this paper looks at final demand f , that is a part of UT together with intermediaries and value added. There the Czech Republic appears as the top cooperating country in a sector of Post and telecommunications (PAT). This was a reason to focus on intermediate sales only for this one country, which is an obvious limitation of this paper.

Addressing methods of this paper follows: Data for input-output analysis were retrieved from OECD Inter-country I-O Database 2016 - ICIO. The industry classification of the database (2006 and 2002 editions) is based on the ISIC Rev. 3 systems, meaning that it is compatible with the OECD and its structural analysis (STAN) industry database. Data analysis was enhanced by Eurostat Manual of Supply, Use and Input-Output Tables (Eurostat, 2008). In order to work with data of intermediaries in world ICIO 2016 as the latest to be achieved, one has to know it is a work with data structured into intermediate transactions, value added, output, final demand etc. In this paper the emphasis was given on intermediate transactions, where are available 17 years in 2414 rows of sectors and 2414 of columns sectors, meaning sectors who deliver their output as an input for others. Keeping this in mind even with computing power of software one has to do abstractions for simplification of computation. The efforts to simplify computation are manifold, for instance software such as Python and its programme PyIO2.1, ReaIO developed by University of Illinois at Urbana Champaign. Nonetheless working with slightly over 4 Megabytes needs a either computer with sufficient memory or a software solution, which was the case here. The workload was somewhat heavy as it became obvious also in an electronic communication and work of (Semerák, Zigic, Loizou, and Golemanova-Kuharova, 2010; Semerák, 2018) with Mgr. Ing. Vilém Semerák, Ph.D., who worked on project studying "EU Food Industry Dynamics and Methodological Advances" (see web page: <http://www.eng.auth.gr/mattas/foodima.htm>). Semerák points out using Excel, Matlab and Gauss. This paper will use GNU R (Stallman, 1999) and Excel. Excel was mainly used in previous papers (G. Kolveková, Palascakova, Liptakova, and Ieee, 2017; Gabriela Kolveková and Raisova, 2015; Kolveková and Palaščáková, 2017), where the location quotients were calculated, similarly to Semerák.

As for methodology there are several building blocks for IOA. This paper limits itself on Hawkins-Simon Condition (KATO, MATSUMOTO, and SAKAI, 1972). This can serve, when studying the interdependence of sectors, which is the case here. A simplification for two sectors (2x2) points out fundamentals of Hawkins-Simon Condition. It is non-negativity of all elements in Leontief inverse or total requirements matrix: $(I - A)^{-1}$, where I is identity matrix, A is a technical coefficient matrix. Foremost, the two extreme cases with less interdependence could be of interest, when in 2x2 case it "is to be expected; the gross output necessary from sector 2 depends only on final demand for the output of sector 2, f_2 , and the amount of intraindustry input that sector 2 buys from itself" (Miller and Blair, 1985, p. 94), where f_2 refers to final demand of sector 2 in time equal to zero. More details are explained in Miller and Blair (Miller and Blair, 1985, pp. 58-62). The paper examines fundamental

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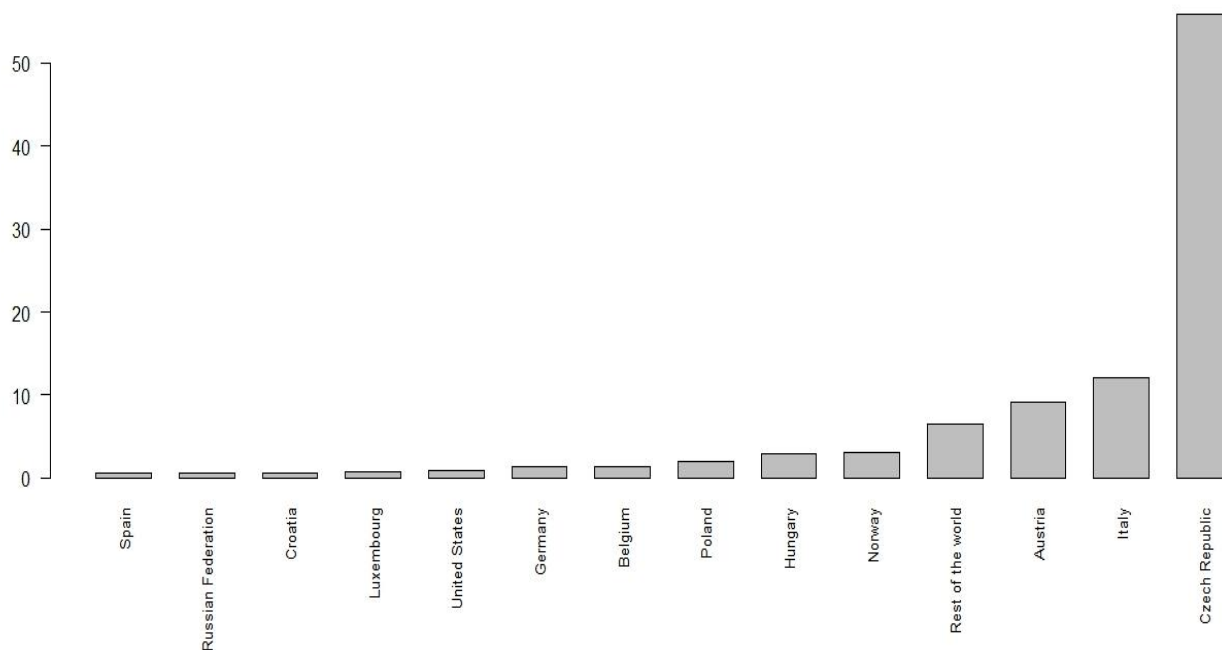
relationships of industries using the interindustry analysis and technical coefficient ratio and its former flow data such as intermediate sales. We reduce the theory needed to one formula:

$$a_{ij} = \frac{z_{ij}}{x_j} = \frac{\text{value of aluminum bought by aircraft producers last year}}{\text{value of aircraft production last year}} \quad (1)$$

First of all, intermediate sales between the two main regions within the sector of Post and telecommunications (PAT). In our case the z_{ij} (pairs of sectors, depended on each other) and x_{ij} , where i is an input of PAT from Czech Republic bought by j , which is PAT in Slovak Republic (could be distinguished by upper symbol of regions). The smaller the value of intermediate sales coefficient the smaller is the dependence and influence of the two sectors in a particular pair. The total output x_i of production of sector i and then f_i the final demand (Miller and Blair, 1985, p. 16).

Firstly, examine the regions, countries exchanging outputs of PAT sector from the Slovak Republic standpoint. The structure of data allows a solid knowledge for examining the final demand of particular industries. As seen in Figure 1 there are details visible after excluding Slovak Republic contribution to the final demand. The linkage of final demand exists with Czech Republic (55.931 Mil. USD), Italy (12.034 Mil. USD) and Austria (9.203 Mil. USD), to name but a few. First one to mention should have been Slovakia itself for providing 1 481.194 Mil. USD of the production to final demand. Russian Federation is responsible for amount of 0.561 Mil. USD and is followed by countries: Spain, Netherland, France, Sweden, China and so forth. The cooperation among countries can be evaluated as developed.

Figure 1 Final Demand proportions of top cooperating countries in Post and telecommunications sector in Slovakia in 2011 (Mill. USD)



Source: own elaboration based on STAN database 2018, available at <http://oe.cd/icio/>. Copyright 2016 by OECD, STAN database.

Secondly, examine the needs of PAT to produce its products and services. The needs or requirements in form of technical coefficients are of importance in interindustrial scope of analysis. The Czech contribution to Slovak industry of Post and Telecommunication (code: C64PTL) was examined in detail, see Table 1.

Table 1 Czech supplies in technical coefficients for C64PTL industry to the Slovak Republic, as of 2011

Supplies of Czech Republic in order of OECD, 2016	Codes of industries	Coefficient
Agriculture, hunting, forestry and fishing	C01T05AGR	0.02717321
Mining and quarrying	C10T14MIN	0.02439088
Food products, beverages and tobacco	C15T16FOD	0.04831318
Textiles, textile products, leather and footwear	C17T19TEX	0.03213914
Wood and products of wood and cork	C20WOD	0.03582968
Pulp, paper, paper products, printing and publishing	C21T22PAP	0.98829844
Coke, refined petroleum products and nuclear fuel	C23PET	1.49570276
Chemicals and chemical products	C24CHM	0.09427004
Rubber and plastics products	C25RBP	0.04913256
Other non-metallic mineral products	C26NMM	0.04995741
Basic metals	C27MET	0.02481070
Fabricated metal products	C28FBM	0.11345078
Machinery and equipment, nec	C29MEQ	0.16891752
Computer, Electronic and optical equipment	C30T33XCEQ	0.50031903
Electrical machinery and apparatus, nec	C31ELQ	2.37609700
Motor vehicles, trailers and semi-trailers	C34MTR	0.16040209
Manufacturing nec; recycling	C35TRQ	0.01546408
Other transport equipment	C36T37OTM	0.35462661
Electricity, gas and water supply	C40T41EGW	0.10470660
Construction	C45CON	0.49552092
Wholesale and retail trade; repairs	C50T52WRT	1.87982461
Hotels and restaurants	C55HTR	0.01211018
Transport and storage	C60T63TRN	1.30562227
Post and telecommunications	C64PTL	28.53451283
Financial intermediation	C65T67FIN	0.04486623
Real estate activities	C70REA	0.44375505
Renting of machinery and equipment	C71RMQ	0.41199205
Computer and related activities	C72ITS	1.78768723
RandD and other business activities	C73T74OBZ	6.04808771
Public admin. and defense; compulsory social security	C75GOV	0.01411176
Education	C80EDU	0.02064395
Health and social work	C85HTH	0.02157779
Other community, social and personal services	C90T93OTS	0.41461031
Private households with employed persons	C95PVH	0.00000000

Source: OECD (2016)

Table one is a close-up of the input-output analysis, particularly the UT and its one third detail of final demand only for one sector PAT. The largest coefficient (value of 28.5) was provided by OECD statistics for the same industry. This means that Czechs forward to Slovaks and thus exchange what they produce. This coefficient describes an intermediate inputs and measures the flow and its influence from Czech post and telecommunication sector to Slovak one. Next sectors were: R and D and other business activities (code: C73T74OBZ) with value of 6.04. This makes perfect sense for recall the Eset company that has got subsidies or other companies that outsource peoples' skills. However, this value 6.04 means the flow towards Slovak Republic and companies operating here,

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although sometimes for foreign owners. Subsequent sector was Electrical machinery and apparatus (code: C31ELQ) with value of 2.37. PAT sector could not work without machinery and apparatus; it is only logical to find it at third place of the most contributing sectors in fulfilling requirements of PAT one. One can speculate about or do the comparison of other countries such as Italy or Australia, which is a fruitful suggestion for thinking also in conjunction with table 2.

Table 2 Italian supplies in technical coefficients for C64PTL industry to Slovak Republic, as of 2011

Supplies of Italy in order of OECD, 2016	Codes of industries	Coefficient
Agriculture, hunting, forestry and fishing	C01T05AGR	12.05852562
Mining and quarrying	C10T14MIN	0.82136151
Food products, beverages and tobacco	C15T16FOD	74.67676307
Textiles, textile products, leather and footwear	C17T19TEX	102.37970074
Wood and products of wood and cork	C20WOD	1.48544890
Pulp, paper, paper products, printing and publishing	C21T22PAP	10.03756805
Coke, refined petroleum products and nuclear fuel	C23PET	7.02751316
Chemicals and chemical products	C24CHM	64.24920638
Rubber and plastics products	C25RBP	7.34060682
Other non-metallic mineral products	C26NMM	5.81986456
Basic metals	C27MET	2.71708568
Fabricated metal products	C28FBM	22.83118525
Machinery and equipment, nec	C29MEQ	157.09046670
Computer, Electronic and optical equipment	C30T33XCEQ	22.98242166
Electrical machinery and apparatus, nec	C31ELQ	27.13537450
Motor vehicles, trailers and semi-trailers	C34MTR	46.35606469
Manufacturing nec; recycling	C35TRQ	2.70168057
Other transport equipment	C36T37OTM	30.68818235
Electricity, gas and water supply	C40T41EGW	0.99517979
Construction	C45CON	0.26710617
Wholesale and retail trade; repairs	C50T52WRT	110.71150557
Hotels and restaurants	C55HTR	153.94597958
Transport and storage	C60T63TRN	54.02379884
Post and telecommunications	C64PTL	12.03368031
Financial intermediation	C65T67FIN	0.68617237
Real estate activities	C70REA	20.84478290
Renting of machinery and equipment	C71RMQ	1.60588090
Computer and related activities	C72ITS	4.38265279
RandD and other business activities	C73T74OBZ	2.37434197
Public admin. and defense; compulsory social security	C75GOV	0.03721250
Education	C80EDU	0.69758299
Health and social work	C85HTH	0.23960208
Other community, social and personal services	C90T93OTS	54.10536046
Private households with employed persons	C95PVH	0.00000000

Source: OECD (2016)

There are sectors with negligible coefficients and the least influence and dependence with values around 0.01, such as: Hotels and restaurants (code: C55HTR) or Public admin. and defense;

compulsory social security (code: C75GOV). That is true for mostly these sectors are not suppliers, they are buyers of the products and services of PAT sector. Rather surprisingly, Italy has got a technical coefficient for Hotels and restaurants (code: C55HTR) the second highest after the Machinery and equipment (code: C29MEQ), i.e. value of 153.94 and 157.09 respectively (see table 2).

IV. Implication of the analysis so far

First implication: OIR heritage convergence was sketched by an example of metallurgy company in Eastern part of Slovakia. Understanding interdependence of sector that is about to either replace or more probably renew and supplement a former one, as presented the metallurgy sector and ICT sector. This could be documented by work of Hudec and Šebová (Šebová and Hudec, 2012), who studied the Evolution of the ICT industry in Košice region. Taking into account that some roots were existing, the main change that afore mentioned authors describe, was a diversification period in a decade of 1990-2000 and Big players' appearance in next decade. This evolution established a cluster at Eastern Slovakia region. All this was possible due to "local buzz" and "global pipelines" (Bathelt, Malmberg, and Maskell, 2004), which are terms that serve to clarify deeply the network of suppliers in their specific quality. While this is done also by backward and forward linkages in IOA, however in more quantitative way than qualitative one. Moreover "buzz", the word "*refers to the information and communication ecology created by face-to-face contacts, co-presence and co-location...*" (Bathelt et al., 2004, p. 12). This only confirms why Czech Republic is the main contributor to the final demand in ICT sector (or code: C64PTL). The local buzz is present there with easy face-to face meetings almost without any language barrier. Similarly, Austria is across the border. Contrary to Italy that is further away. Hungary and Poland being outperformed by Norway and the Rest of the World category. This can be due to fact that plenty of components are produced in Asia.

However, pipelines can be observed also in Figure 1. The pipelines function in a remoted way. Therefore, there are contacts with Italy, Austria and especially Rest of the World. This gives hope that the ICT clusters, be it in above mentioned Košice or Bratislava, will sustain. Although, we can make one more analysis from opposite perspective to confirm this result.

Second implication: Shocks in a sector (Kraftová and Prášilová, 2013; Sed'a, Suchacek, and Friedrich, 2015; Suchacek, 2016) can lead to heritage misuse or overuse that could be the case of Handlová Mining activities that were exploited and due to negative impact on environment not sustainable. Handlová is an example of how innovations can help to overcome a situation of a sector decline. Slovak Republic is not self-sufficient in fish production, therefore there are rather favorable and great expectations for this activity to develop.

As for the curiosity, we tried to look at Italian cities that are a comparable population size to Košice were the first example was identified. The cities are sketched on map (see figure 1 – number in the brackets refers to inhabitants): Venezia (262 254), Verona (253 597 inhabitants according to Eurostat database 2011), Messina (243 846), Košice (240 433), Padova (206 936), Trieste (202 878), Taranto (200 573) and Brescia (189 576).

Abilities to transform the industry is not always so severely limited as Smith (1996) thought. Sometimes the seeds of new ideas are rooting below the ground of soil invisibly as it was the case of VSŽ, USX and the ripple effect of followers such as Ness company and the like.

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Figure 1 Cities in Italy that are of comparable population with Košice



Source: Eurostat (2016)

The Northern Italy is producing textile that has got a favorable technical coefficient as mentioned earlier. One could think of path dependency from the past when the trade routes existed, at the same time with dependency of sectors. This shows consistency with other authors already mentioned and also Garud and Karnoe (Garud and Karnoe, 2013; Suchacek, Sed'a, and Friedrich, 2015).

The main and overall outcome of this paper is a note that IOA technical coefficients have a practical background in innovations carried with people through roads of networks. As seen Input-Output Analysis (IOA) is useful, but has got some limitations that were here outweighed by employing and referring to other studies.

V. Conclusion

By use of Input-output analysis the paper examined briefly the evolution of Post and telecommunications (PAT) in Slovak Republic. Slovak Republic and its trading partners represent an object of investigation as a country of the Central Europe with its specific history. Hereby it is meant that here exist old industrial regions that allowed to give raise of new sector dealing with information and technologies. This sector was built on the foundations of metallurgy. Sector two was Mining sector that was sketched for its seemingly unrelated new activities in agro-food business as well.

Input-output analysis is rather quantitative, nonetheless, paper combines it with results of qualitative studies and this blending provides better and complex perspective. Especially the note of inovations that is reflected in the technical coefficient results. Objective and result as well, was to provide evidence on one sector changes that are established based on cooperation (global pipelines) and location (local buzz). Results showed that cooperation is strong with Italy that is not a neighboring state of Slovakia compared to other states of the top three suppliers, i.e. Czech Republic and Austria. Cooperation among countries, across sectors and location with various distance prove the supplies of Rest of the World category used by OECD statistics. Conclusions are dwelling in sustainability that is pointed out in historical point of view and sustainability point of view.

Afore mentioned reason to focus on intermediate sales only for this Czech Republic and Italy is an obvious limitation of this paper that can also become a future motivation for extending the analysis and enriching results.

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