COMBINATION OF REGIONAL AND WORLD INPUT-OUTPUT TABLES: A CZECH CASE OF TERRITORIAL EXPORT AT THE REGIONAL LEVEL

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Abstract

Since 2008, when the Czech Statistical Office stopped publishing the territorial structure of Czech regional export, there has not been any other source of these data. This paper focuses on methodology of estimating Czech territorial export at the regional level through a combination of two other data sources: Czech regional input-output tables and world input-output tables for the year 2013 in current prices (in millions of dollars). These two data sources are combined by an adjusted cross-entropy method and other information provided by official statistics. The final figures showed that the overall structure is similar at the regional level. However, the regional detail differs between regions and there are some special examples of connections, which are not as strong in other regions. Moreover, the presented paper is strongly connected with the methodology supporting the data sources. The presented methodology can be used for estimating model application data, e.g. computable general equilibrium and others.

Keywords*: regional input-output tables, world input-output tables, international trade*

JEL Codes*: C67, R15, F17*

1. Introduction

The structure of international trade is important for any economic application. In recent years, the demand for regionally structured applications has risen. However, the Czech Statistical Office stopped publishing a territorial structure of Czech regional export in 2008, which is a crucial data source for CGE/DSGE models at the regional level.

The aim of this paper is to describe a methodological approach on how to estimate the territorial structure of Czech regional export at the product level. The product classification is CPA 2008 in 56 commodities. Nevertheless, the territorial structure covers only 44 states (listed in the appendix), although the most important countries are included.

The final estimate is based on a two-step approach, which lies in an adjusted cross-entropy method, combined with the world input-output tables and the regional input-output tables for the Czech Republic for the year 2013.

The following chapter covers the background methodology of the estimate. The methodology section describes the basic relationships in the world input-output tables and in

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the regional input-output tables. The second part of the methodology covers the two-step approach and an adjusted cross-entropy minimization. The final estimate on the case of regional and product export is presented in the Results chapter.

2. Ideas behind the estimation procedure

Generally, missing data in international trade are estimated by gravity-based methods. These methods are used in many applications and they are implemented in several datasets as are international input-output tables and other databases. One of the first applications of this approach was done by Tinbergen in 1962. Since then, a dozen applications have been implemented and there are several approaches and equations based on this idea. The key ideas and approaches are covered in a comprehensive manual from the United Nations composed by Shepherd (2012).

International trade statistics can be viewed from three perspectives in the Czech Republic. The first is the statistic in the cross-border concept. The cross-border concept covers all goods that cross the borders of the Czech Republic. This concept is known as the external trade in goods according to the movement (CZSO, 2018).

The cross-border concept (based on the principle of movement) covers all goods, which are exported to / imported from the Czech Republic. However, this concept is not in line with the standards on balance of payments and national accounts. The reason for this lies in the possibility of the re-export of imported goods by a foreign entity, for despite any change of ownership. This statistic covers both the country of origin and product types (in SITC classification or in the harmonized classification system)

The second concept is the national concept. The national concept is based on a change of ownership and is also known as external trade in goods according to the change of ownership. This statistic covers the country of origin, but the product types (in SITC/CPA classification) are published only on at the basic level of classification.

The third possible source of international trade statistics is the national accounts. The data source for the national account aggregates are in the national concept of international trade.

The world input-output (I-O) tables (World Input-Output Database, 2018) describe the global economy (as well as the national) in the concept of input-output tables in current prices (in millions of dollars). The database provides information about 28 EU member states and about 15 major non-EU countries. This database is based on data from EUROSTAT, national I-O tables and other data sources (Timmer *et al.*, 2015). These tables play an important role in any international model application and a significant number of models and other data sources are based on them (e.g. global value chain estimations). Tables are estimated from the national data concept.

Another possible data source for estimates is the EU inter-country supply, use and input-output tables (EU-IC-SUIOTs). These tables are generally called FIGARO tables. The key application objective of these tables ranges from environmental applications to socio-economic applications (EUROSTAT, 2018). The compilation methodology differs from the WIOT database, and it is predominantly based and focused on EU countries.

The methodology of RAS and cross-entropy application has a long history in the input-output area. The first application in the national account was made by Stone (Stone *et al*., 1942) in 1942 and in 1961 in the input-output area (Stone, 1961). Bacharach (Bacharach, 1970) showed that the RAS method has the same properties as cross-entropy optimization (based on the Kullback-Leibler divergence function). A more precise proof was later presented by several authors, e.g. McDougall, 1999; Fofana *et al.*, 2005; Lemelin *et al.*, 2013 – these authors described why these two different approaches have the same solution.

3. Methodology

The methodology of this paper is based on disaggregating national figures into regional figures. This process can be divided into two stages:

- incorporating the core of RIOT tables into WIOT tables,
- dealing with import and export.

In the first stage, a RIOT table is incorporated into a WIOT table. In this stage, the WIOT regional figures are calculated from the structure of the regional input-output matrices. This estimate is based on cross-entropy minimization. In the second stage, import and export is estimated by the structure of regional import/export at the level of each product. The discrepancies are balanced by the RAS method.

3.1 WIOT tables

WIOT tables come from the World Input-Output Database (WIOD, 2018). These databases are in millions of dollars and cover the years 2000 to 2014. The WIOT tables follow the same logic as the national I-O table. So, we can write:

$$\sum_{r}^{R}\sum_{j=1}^{n} z_{ij}^{pr} + \sum_{r}^{R}\sum_{m=1}^{M} y_{m,i}^{pr} = x_i^r, \tag{1}$$

where x_j^r is the total output of *r*-th country, z_{ij}^{pr} is the intermediate use from *p*-th to *r*-th country of *i*-th good to use in the intermediate use and $y_{m,j}^{pr}$ is the final use from *p*-th country, used in *r*-th country of *j*-th good. Index *m* covers all elements of use. Generally, elements of use are:

- final consumption expenditure by households,
- final consumption expenditure by non-profit organizations serving households (NPISH),
- final consumption expenditure by government,
- gross fixed capital formation,
- changes in inventories and valuables.

The second way how to look at these tables is the "source" view:

$$\sum_{p}^{P}\sum_{i=1}^{n} z_{ij}^{pr} + \sum_{q=1}^{q} w_{q,j}^{r} + t_j^r = x_j^r, \qquad \forall\, j, r \tag{2}$$

where $w_{q,j}^r$ is the element of value added and t_j^r is the international transport margin. The sums (x_j^r – total output) should be the same.

3.2 RIOT tables

The RIOT table follows the same logic as a WIOT table. The only difference is that the national figures are split into regional sub-aggregates (Miller and Blair, 2009). This can be written as:

$$\sum_{h}^{H}\sum_{f}^{F} z_{i,j}^{r,r,f,h} = z_{i,j}^{r,r}, \qquad \forall\, i, j \tag{3}$$

where $z_{i,j}^{r,r,f,h}$ is the intermediate use in *r*-th country, from region *f* to region *h* (of product *i* to product *j*). This procedure can be applied on $y_{m,i}^{r,f,h}$, $x_{m,i}^{r,h}$ and so on.

3.3 Incorporating the core of RIOT tables into WIOT tables

The WIOT table represents the national figures of I-O tables in one framework. However, the number of countries is limited and there are several adjustments. The discrepancies between these two sources should be minimized. This can be done through an adjusted cross-entropy method (or a RAS method). We minimize the distance between regional intermediate use ($\hat{z}_{i,j}^{r,r,f,h}$ - estimate) and known RIOT figures of the intermediate use ($z_{i,j}^{r,r,f,h}$) as a relative structure ($\hat{p}_{i,j}^{r,r,f,h}, p_{i,j}^{r,r,f,h}$):

$$\min_{\hat{p}_{i,j}^{r,r,f,h}} \sum_{f}^{F}\sum_{h}^{H}\sum_{i}^{n}\sum_{j}^{n} log\left(\hat{p}_{i,j}^{r,r,f,h}\right) log\left(\frac{\hat{p}_{i,j}^{r,r,f,h}}{p_{i,j}^{r,r,f,h}}\right). \tag{4}$$

The known figures are:

$$p_{i,j}^{r,r,f,h} = \frac{z_{i,j}^{r,r,f,h}}{T}, \qquad \forall\, f,h,i,j \tag{5}$$

$$T = \sum_{f}^{F}\sum_{h}^{H}\sum_{i}^{n}\sum_{j}^{n} z_{i,j}^{r,r,f,h}$$

The equations for unknown variables ($\hat{p}_{i,j}^{r,r,f,h}, \hat{z}_{i,j}^{r,r,f,h}$) should be the same:

$$\hat{p}_{i,j}^{r,r,f,h} = \frac{\hat{z}_{i,j}^{r,r,f,h}}{\hat{T}}, \qquad \forall\, f,h,i,j \tag{6}$$

However, the total sum is known ($\hat{T}$) because it is the same as well as the core of the WIOT:

$$\hat{T} = \sum_{f}^{F}\sum_{h}^{H}\sum_{i}^{n}\sum_{j}^{n} \hat{z}_{i,j}^{r,r,f,h} = \sum_{i}^{n}\sum_{j}^{n} z_{i,j}^{rr} \tag{7}$$

on s.t.:

$$\sum_{h}^{H}\sum_{f}^{F} p_{i,j}^{r,r,f,h} = \bar{p}_{i,j}^{r,r}, \qquad \forall\, i,j \tag{8}$$

where $\bar{p}_{i,j}^{r}$ is known as the sums of the intermediate use structure – from WIOT tables. The structural consistency trough regions which supply can be written is:

$$\frac{\sum_{j}^{n} \hat{z}_{i,j}^{r,r,f,h}}{\hat{T}} = \frac{\sum_{j}^{n} z_{i,j}^{r,r,f,h}}{T}, \qquad \forall\, f,h,i \tag{9}$$

The structural consistency trough regions who demand is:

$$\frac{\sum_i^n \hat{z}_{i,j}^{r,r,f,h}}{\hat{T}} = \frac{\sum_i^n z_{i,j}^{r,r,f,h}}{T}, \qquad \forall\, f, h, j \tag{10}$$

These conditions (eq. 9 and 10) can be called "structure consistency" trough regions. These condition help fix the structure of regional intermediate use from the RIOT table. They can be easily transformed into more optimization efficient boundaries. These equations can be written in the same structure sense as the optimization formula. The structural consistency trough regions which supply is:

$$\sum_{j=1}^{n} \hat{p}_{i,j}^{r,\mathrm{r},f,h} - \sum_{j=1}^{n} p_{i,j}^{r,r,f,h} = 0, \qquad \forall\, \mathrm{f, h, i.} \tag{11}$$

And the structural consistency boundaries for regions which demand is:

$$\sum_{i=1}^{n} \hat{p}_{i,j}^{r,\mathrm{r},f,h} - \sum_{i=1}^{n} p_{i,j}^{r,r,f,h} = 0, \qquad \forall\, \mathrm{f, h, j.} \tag{12}$$

The optimization problem can be summarized by minimizing eq. 4 on constraints: equations 8, 11 and 12. This optimization is a version of the standard cross-entropy method, which is generally used in the input-output analysis. It can be shown that these boundaries (equations 11 and 12) are only a detailed (regional) version of a standard cross-entropy problem. The standard cross-entropy problem in the context of RIOTs will hold:

$$\sum_{j=1}^{n}\sum_{h=1}^{H} \hat{p}_{i,j}^{r,\mathrm{r},f,h} - \sum_{j=1}^{n}\sum_{h=1}^{H} p_{i,j}^{r,r,f,h} = 0, \qquad \forall\, \mathrm{j,} \tag{13}$$

$$\sum_{i=1}^{n}\sum_{f=1}^{F} \hat{p}_{i,j}^{r,\mathrm{r},f,h} - \sum_{i=1}^{n}\sum_{f=1}^{F} p_{i,j}^{r,r,f,h} = 0, \qquad \forall\, \mathrm{i.} \tag{14}$$

The standard cross-entropy method hold only these last two boundaries (min. eq. 3 on s.t.: eq. 13 and 14). This would have caused the problem with the structure of regional sums. Ignoring equation 8 would have caused problems with national sums at the level of each flow – national figures would have differed from the regional sums of these figures.

The known figures of export (from RIOT) can be used as proxy structures for estimates of international export from Czech regions. These estimates can be shown as:

$$\hat{z}_{i,j}^{r,p,f,*} = z_{i,j}^{r,p} \frac{\sum_{p=1}^{P} z_i^{r,p,f,*}}{\sum_{p=1}^{P}\sum_{f=1}^{F} z_i^{r,p,f,*}}, \qquad \forall\, \mathrm{i, j, p, f.} \tag{15}$$

where $\sum_{p=1}^{P} z_i^{r,p,f,*}$ are known sums of regional export from the country. Imports can be estimated by this way as well:

$$\hat{z}_{i,j}^{r,p,*,h} = z_{i,j}^{r,p} \frac{\sum_{r=1}^{R} z_i^{r,p,*,h}}{\sum_{r=1}^{R}\sum_{h}^{h=1} z_i^{r,p,*,h}}, \qquad \forall\, \mathrm{i, j, r, h.} \tag{15}$$

3.4 Dealing with inconsistencies/discrepancies

Inconsistencies or discrepancies are easy to produce in this procedure. They should have to be balanced to consistent figures. It was decided to keep these sums of a world input-output tables than figures of regional input-output tables (adjusted by the same exchange rate). The general approach for this is the standard RAS/CE method. However, the core of the country's world input-output tables is based on the national figures. It should be easy to assume that the structure of the RIOT will not change dramatically because the RIOT is based on a national I-O table as well as the WIOT. On the other hand, it should be mentioned that the overall level of RIOT will be changed proportionally – due to the exchange rate.

4. Data

The data for the world input-output tables was taken from the World Input-Output Database (WIOD, 2018). This database covers 44 areas (43 countries and the rest of the world) in current prices (millions of dollars). The regional input-output table was estimated and published by the Department of Economic Statistics of the University of Economics in Prague (Department of Economic Statistics, 2018). The used interregional RIOT table was compiled by the interregional structures (Department of Economic Statistics, 2018) and by the regional I-O tables (Department of Economic Statistics, 2018). The interregional structures are estimated by the gravity approach (Šafr and Sixta, 2017) and the regional I-O tables were compiled by the hybrid approach. This approach combines several data sources in order to maximize the lowest possible detail of estimate (Sixta and Vltavská, 2016).

5. Results

The following tables (Tab.1 and Tab.2) summarize the results of estimates of international export and import into intermediate use to/from the Czech Republic. The following tables are in millions of USD (in current price of the year 2013).

The country with the highest export (as well as import) to (and from) the regions of the Czech Republic is Germany (DEU code). The second highest territories of Czech export/import are Poland and Slovakia. The sums of the territorial export are given by the WIOT table and the presented figures follow this structure (at sums of all regions).

The capital city Prague is the second highest importer and exporter of Czech goods. However, the top exporter and importer is the Central Bohemian region. The import and export flowing to and from the capital city can easily be explained by the nature of the capital city. There are several reasons that the Central Bohemian region has the highest import and export. This region is strongly connected with Prague and has the highest storage capacity in the Czech Republic.

Readers can see that the region of Karlovy Vary has the lowest exports/imports. The strong connection between the South Moravian region and Germany is also interesting. The strong connection between the Moravian-Silesian region and the rest of the world is caused by products in CPA – C (industry products).

Table 1: Regional territorial export from the Czech Republic

	Jhc	Jhm	Kar	Krh	Lib	Mrs	Olm	Par	Pha	Plz	Stc	Ust	Vys	Zln
AUS	12	26	4	12	9	25	10	13	27	15	32	15	15	19
AUT	281	550	134	235	181	846	235	228	718	332	721	527	254	341
BEL	172	316	48	138	97	335	95	129	697	150	391	225	130	150
BGR	14	37	6	15	11	46	14	19	45	18	42	32	13	26
BRA	14	33	5	15	14	49	17	17	26	22	50	28	13	27
CAN	15	37	5	15	13	68	14	15	46	21	44	22	13	31
CHE	56	135	19	51	40	108	50	57	226	67	113	80	53	86
CHN	63	142	17	68	60	145	65	75	169	85	191	82	61	92
CYP	3	8	1	2	2	8	3	4	22	4	6	4	2	3
DEU	1431	2998	423	1580	1253	4091	1249	1649	2538	1797	5442	2488	1369	2196
DNK	26	86	9	27	20	90	25	56	84	39	74	42	23	51
ESP	85	178	21	123	93	269	65	129	125	112	436	124	78	125
EST	5	13	2	5	4	14	5	6	17	6	13	10	5	9
FIN	23	68	7	21	18	68	22	43	98	35	54	35	21	36
FRA	210	539	61	238	197	557	207	351	563	311	689	303	193	338
GBR	114	365	33	129	108	307	113	350	428	219	396	175	103	209
GRC	5	11	2	4	4	14	5	7	13	6	11	8	5	8
HRV	11	22	4	8	7	30	9	8	31	11	27	22	9	16
HUN	141	286	52	136	108	436	113	156	333	160	506	306	123	209
IDN	9	11	2	8	8	19	10	8	9	9	18	26	6	10
IND	15	34	4	18	16	58	18	19	27	27	71	27	15	21
IRL	15	51	5	12	11	31	14	31	131	23	36	20	11	20
ITA	159	379	53	161	125	496	134	210	394	195	434	272	146	230
JPN	19	53	5	18	15	53	18	41	35	32	57	27	26	31
KOR	23	54	9	22	20	52	24	26	41	32	62	33	22	39
LTU	9	21	4	7	7	28	10	14	19	15	26	20	8	19
LUX	6	21	3	6	5	15	6	6	83	8	14	9	5	7
LVA	5	13	3	5	4	23	6	6	16	8	15	12	5	10
MEX	18	42	5	23	20	50	18	25	25	27	68	25	18	36
MLT	1	4	0	1	1	2	1	3	11	2	2	1	1	1
NLD	90	267	28	81	68	202	85	210	329	146	205	144	83	160
NOR	18	49	6	17	15	62	20	31	35	30	45	27	18	32
POL	252	536	121	229	186	1079	226	248	586	293	819	589	214	397
PRT	10	21	3	13	10	27	8	14	16	13	40	12	9	16
ROU	40	98	14	44	35	132	40	62	93	52	129	76	36	77
RUS	152	289	36	218	163	452	104	153	251	180	802	200	138	136
SVK	287	579	125	330	261	1193	240	305	605	355	1249	669	265	461
SVN	20	41	7	18	14	70	16	19	60	24	56	36	20	27
SWE	61	156	17	65	52	175	51	119	155	91	203	84	55	92
TUR	58	129	18	75	60	228	52	69	80	78	243	93	55	95
TWN	2	7	1	2	2	6	2	7	4	4	6	5	2	6
USA	96	246	33	99	91	374	109	122	308	153	326	170	90	171
ROW	323	803	119	329	261	824	303	398	1292	416	837	475	269	455

Source: Author's work.

Table 2: Regional territorial import into the Czech Republic

	Jhc	**Jhm**	**Kar**	**Krh**	**Lib**	**Mrs**	**Olm**	**Par**	**Pha**	**Plz**	**Stc**	**Ust**	**Vys**	**Zln**
AUS	8	14	3	6	4	12	6	6	28	8	19	9	7	10
AUT	214	409	77	196	169	505	155	189	701	226	708	301	191	307
BEL	103	199	42	93	81	221	75	91	375	107	322	145	86	170
BGR	13	25	5	12	10	30	9	12	55	13	40	17	11	15
BRA	4	6	2	3	2	6	3	3	12	3	10	5	3	4
CAN	7	14	3	6	5	14	5	8	30	8	19	11	6	8
CHE	57	102	28	48	42	104	41	55	206	57	152	72	40	73
CHN	178	622	55	174	149	473	165	566	699	361	593	289	155	313
CYP	3	7	1	2	2	6	2	3	24	3	7	4	2	3
DEU	1343	2706	456	1411	1178	3442	973	1488	3748	1572	5497	1835	1198	2068
DNK	20	40	8	18	15	43	15	23	59	23	62	27	17	32
ESP	63	113	23	72	58	158	42	56	169	66	285	80	53	91
EST	2	4	1	2	2	5	2	2	8	2	7	3	2	3
FIN	13	27	5	13	12	33	10	13	43	15	48	19	12	21
FRA	157	329	56	164	137	395	115	197	446	191	630	221	135	251
GBR	78	166	32	75	64	172	59	89	324	88	245	106	65	120
GRC	4	8	1	4	3	12	3	3	10	4	14	5	4	4
HRV	6	11	2	5	4	12	4	5	19	6	17	8	6	9
HUN	121	226	42	126	104	299	85	118	330	133	498	157	106	176
IDN	4	8	1	4	3	8	3	5	12	4	13	4	3	5
IND	18	36	6	19	15	42	12	16	53	18	69	23	15	27
IRL	23	55	10	20	18	46	18	32	118	28	64	33	18	39
ITA	174	349	63	188	157	452	128	170	449	194	682	230	155	259
JPN	49	124	15	52	44	135	40	89	138	75	199	68	45	76
KOR	70	141	16	98	73	219	44	105	158	91	450	89	62	87
LTU	9	16	3	8	7	17	6	7	23	9	28	14	8	20
LUX	12	25	5	10	10	29	10	11	61	13	33	15	10	15
LVA	3	5	1	2	2	6	2	2	10	3	8	4	3	3
MEX	9	19	3	8	7	20	7	13	25	11	31	11	8	12
MLT	7	15	3	5	5	13	5	6	50	7	16	9	6	8
NLD	110	286	39	95	83	263	88	208	412	162	345	194	95	192
NOR	8	15	2	7	6	21	6	7	23	8	27	12	7	9
POL	421	811	133	423	350	1149	296	410	1177	467	1731	637	387	555
PRT	11	23	4	12	10	26	8	12	33	13	44	14	10	16
ROU	32	57	9	39	30	91	21	29	88	34	165	39	29	36
RUS	359	368	88	168	98	796	108	223	1159	191	1369	1511	254	206
SVK	292	561	98	294	241	782	210	271	940	322	1167	401	270	363
SVN	18	34	6	18	15	48	13	16	50	20	67	23	16	24
SWE	49	101	17	50	43	131	39	47	145	56	170	65	45	68
TUR	31	63	12	38	29	79	22	30	74	33	128	38	28	44
TWN	22	76	6	21	19	61	21	68	76	45	75	36	20	42
USA	72	156	31	61	54	148	57	88	381	84	189	101	58	97
ROW	468	850	140	331	244	1054	254	602	1695	466	1635	1312	368	467

Source: Author's work.

6. Conclusion

The presented methodology shows the way how regional export and import can be estimated. All estimated numbers should be consistent with WIOT and RIOT tables due to the same data sources and other mentioned reasons. On the other hand, it should be stated that this methodology rests in the adjustment of the RIOT table. The data is estimated from several data sources; therefore, the final produced numbers inherit the assumptions upon which the regional input-output tables are based.

The final figures show a logical structure, which is observed at the national level as well as on regional. However, there are some important heterogeneities at the regional level, e.g. Central Bohemian region (overall import and export) or a surprisingly strong connection with the rest of the world in the Ustecky region. Nevertheless, many of the surprising relationships can be explained easily, e.g. Central Bohemia has many warehouses and large car production, the Moravian-Silesian region produces special industry products (CPA B and C – connection with the rest of the world) and many firms have their headquarters in the capital city of Prague.

Generally, there are several ways how to estimate the inter-regional figures in RIOT tables. Further research should be aimed at the sensitivity of data compilation and the sensitivity in model application at the level of each product.

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References

[1] Bacharach, M. 1970. Biproportional Matrices & Input-Output Change. University of Cambridge, Department of Applied Economics, Monographs, Cambridge University Press.

[2] Czech Statistical Office 2018. External trade – methodology. [cit. 14-5-2018] https://www.czso.cz/csu/czso/whatisexternal_trade.

[3] Department of Economic Statistics, 2018. Results of the Funding Projects: Regionalization of GDP Estimate by the Expenditure Approach & Regional Statistical Structure (year 2013). University of Economics, Prague. [cit. 20.4.2018] https://kest.vse.cz/english/science-research/results-of-the-funding-projects/

[4] European Commision 2018. EU INTER-COUNTRY SUPPLY, USE AND INPUT-OUTPUT TABLES (FIGARO PROJECT) Methodological note. Directorate C: National Accounts, Prices and Key Indicators / DG JOINT RESEARCH CENTRE. [cit. 28-4-2018] http://ec.europa.eu/eurostat/documents/7894008/8749273/Methodological_note.pdf.

[5] Fofana, I. Lemelin, A, Cockburn, J. 2005. Balancing A social Accounting Matrix: Theory and application. Ville de Quebec: CIRPEE Working paper, Centre Interuniversitaire sur le Risque les Politiques Economiques et L'Emploi (CIRPEE), Université Laval, ville de Québec, August 2005, [cit. 4-5-2018] www.pep-net.org/sites/pep-net.org/files/typo3doc/pdf/sambal.pdf.

[6] Lemelin, A. Fofana, I., Cockburn, J. 2013. Balancing a Social Accounting Matrix: Theory and Application (Revised Edition), Partnership for economic policy (PEP), Working paper. [cit. 4-5-2018] https://ssrn.com/abstract=2439868.

[7] McDougall, R. 1999. Entropy Theory and RAS are Friends. GTAP Working Paper, no. 06. [cit. 10-5-2018] www.gtap.agecon.purdue.edu/resources/download/10.pdf.

[8] Miller, R. E., Blair, P.D. 2009. Input-Output Analysis Foundations and Extensions, 2nd ed., New York: Cambridge university press.

[9] Šafr, K, Sixta, J. 2017. Methods for the Estimates of Regional Economic Structures. In Applications of Mathematics and Statistics in Economics (AMSE 2017). Wroclaw: Publishing House of Wrocław University of Economics, 2017, pp. 401–418.

[10] Shepherd, B. 2012. The Gravity Model of International Trade: A User Guide. ESCAP/ARTNeT, Thailand: United Nations publication.

[11] Sixta, J., Vltavská, K. 2016. Regional Input-output Tables: Practical Aspects of its Compilation for the Regions of the Czech Republic. Ekonomický časopis. 2016, vol. 64, n. 1, pp. 56–69.

[12] Stone, R. 1961. Input-Output and National Accounts,Organisation for economic co-operation and development: OECD, Paris.

[13] Stone, R., Champernowne, D. G., Meade, J. 1942. The Precision of National Income Estimates. Review of Economic Studies, vol. 9, n. 2, pp. 111-125.

[14] Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R. and de Vries, G. J. 2015. An Illustrated User Guide to the World Input–Output Database: the Case of Global Automotive Production, Review of International Economics., vol. 23. pp. 575–605

[15] Tinbergen, J. 1962. Shaping the World Economy: Suggestions for an International Economic Policy. New York: The Twentieth Century Fund.

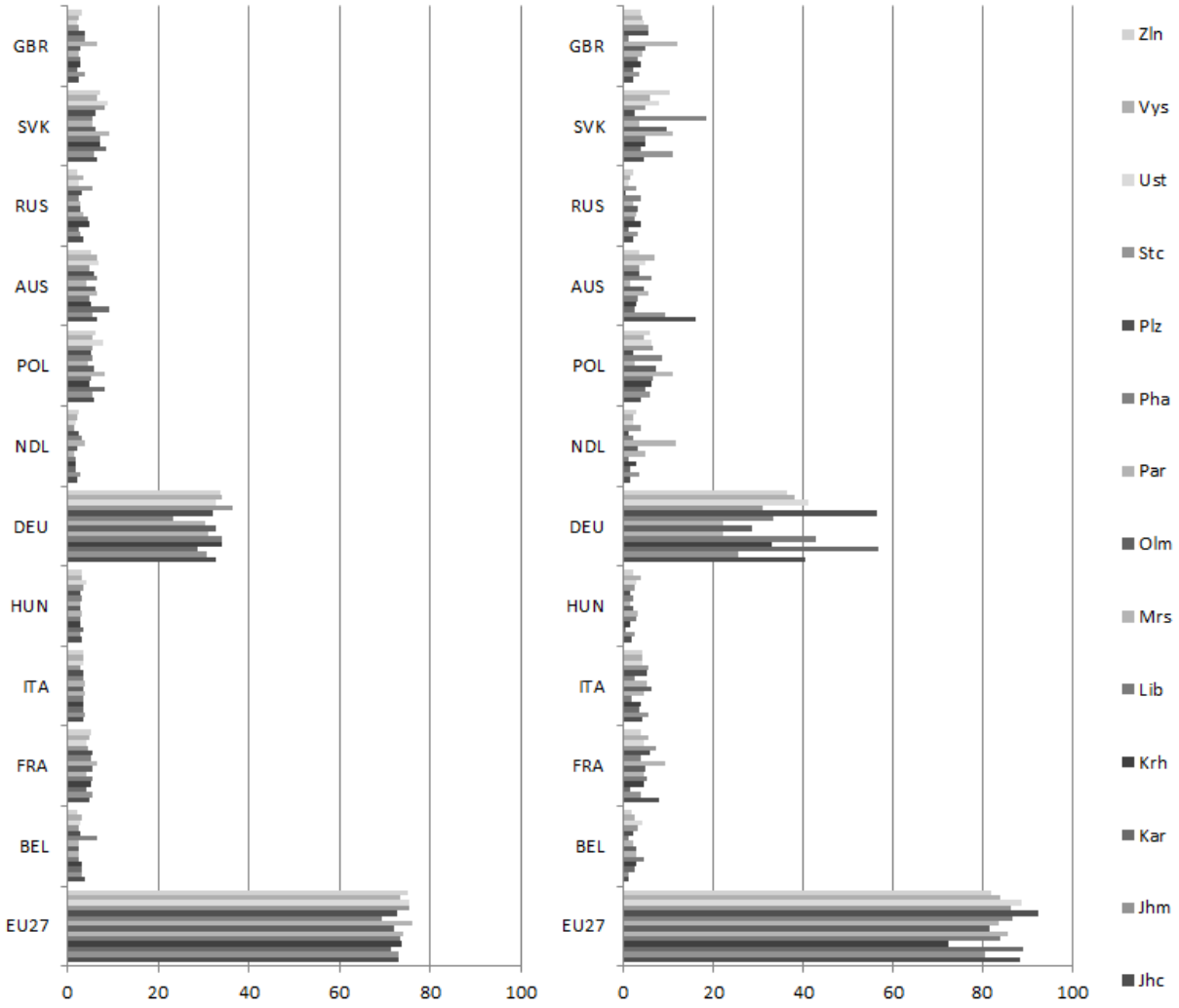
[16] World Input-Output Database, 2018. World Input-Output Tables. [cit. 8-5-2018]. http://www.wiod.org/home.

Appendix

Table 3. Abbreviations and Full names of Czech regions

Abbreviation	Full name
Jhc	South Bohemian Region
Jhm	South Moravian Region
Kar	Karlovy Vary Region
Krh	Hradec Králové Region
Lib	Liberec Region
Mrs	Moravian-Silesian Region
Olm	Olomouc Region
Par	Pardubice Region
Pha	Prague
Plz	Plzeň Region
Stc	Central Bohemian
Ust	Ústí nad Labem Region
Vys	Vysočina Region
Zln	Zlín Region

Figure 1: Comparison of Czech regional export: estimates for the year 2013 at the left side, surveyved figures at the right side.



Source: Author's work.

Table 4: Structure of Czech territorial export of product "Mining and quarrying".

	Jhc	Jhm	Kar	Krh	Lib	Mrs	Olm	Par	Pha	Plz	Stc	Ust	Vys	Zln
AUS	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AUT	8	12	46	5	6	192	8	3	6	12	13	95	3	3
BEL	0	0	2	0	0	7	0	0	0	0	0	3	0	0
BGR	0	0	0	0	0	1	0	0	0	0	0	0	0	0
BRA	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHE	0	0	0	0	0	1	0	0	0	0	0	1	0	0
CHN	0	0	1	0	0	2	0	0	0	0	0	1	0	0
CYP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEU	1	2	7	1	1	30	1	0	1	2	2	15	1	1
DNK	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ESP	0	0	0	0	0	1	0	0	0	0	0	0	0	0
EST	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FIN	0	0	0	0	0	1	0	0	0	0	0	0	0	0
FRA	0	0	1	0	0	5	0	0	0	0	0	2	0	0
GBR	0	0	0	0	0	1	0	0	0	0	0	1	0	0
GRC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HRV	0	0	1	0	0	2	0	0	0	0	0	1	0	0
HUN	2	2	10	1	1	42	2	1	1	3	3	21	1	1
IDN	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IRL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ITA	0	0	1	0	0	5	0	0	0	0	0	3	0	0
JPN	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KOR	0	0	0	0	0	1	0	0	0	0	0	0	0	0
LTU	0	0	0	0	0	2	0	0	0	0	0	1	0	0
LUX	0	0	0	0	0	1	0	0	0	0	0	0	0	0
LVA	0	0	1	0	0	2	0	0	0	0	0	1	0	0
MEX	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MLT	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NLD	0	0	0	0	0	1	0	0	0	0	0	0	0	0
NOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0
POL	7	10	38	4	5	160	7	2	5	10	11	80	3	3
PRT	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROU	0	0	1	0	0	3	0	0	0	0	0	2	0	0
RUS	0	0	0	0	0	2	0	0	0	0	0	1	0	0
SVK	7	10	41	5	6	172	7	2	5	10	12	86	3	3
SVN	0	0	1	0	0	4	0	0	0	0	0	2	0	0
SWE	0	0	1	0	0	3	0	0	0	0	0	1	0	0
TUR	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TWN	0	0	0	0	0	0	0	0	0	0	0	0	0	0
USA	0	0	0	0	0	1	0	0	0	0	0	1	0	0
ROW	1	2	8	1	1	33	1	0	1	2	2	17	1	1
sum:	26	38	160	17	20	675	26	8	19	39	43	335	12	12

Source: Author's work.