Construction of Regional Input-Output Tables in Practice[1]

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Abstract

The paper illustrates our methodology for construction of regional input-output tables in practice. It combines existing national input-output tables, sector accounts and regional accounts. The methodology is illustrated on the Czech example and provides a practical guide how to construct the tables from officially published input-output tables. General procedures are theoretically very well described in input-output devoted literature but there is still a long way to get useful results and construct regional tables with consistent and comprehensive data. The key approach lies in a practical compromise between regional accounts, sector accounts and input-output tables. The core of the method lies in splitting SNA 93 / ESA 95 input-output tables into directly separable and non-separable items. Then there is found a link between regional accounts and non-separable items with respect to current practise and quality of kind-of-activity unit definition. The paper illustrates the methodology from the construction of regional output matrices to the complete and balanced set of symmetric input-output tables for 14 regions of the Czech Republic. The aim of the paper was also to provide hints and explanation of obstacles found out in the construction of regional input-output tables

1. Introduction

There are lots of discussions and debates about regional input-output tables dealing with this issue from several perspectives. There is a satisfactory availability of theory including examples. Actually, there are only few practical cases where Regional Input-Output Tables (RIOTs) are used. Existence of pure regional models respecting specific structure of a particular region is very scarce. In fact, lots of existing regional input-output tables represent rather countries or states than regions. That is a pity because some regions within even medium size country can be very different. High quality regional models are very demanding on statistical information and since regional structures are not usually known, they are based on country averages. Availability of national Symmetric Input-Output Tables (SIOTs) figures on aggregated level (usually CPA 2 digits) does not provide sufficient information necessary for good regional models. Unfortunately, compilation of input-output tables is still on the edge of interest of official statistical agencies[2]. Moreover, regional extension of SIOTs is completely missing. Unluckily, researches do not play key role among the users of statistics or their demand are not known. Regions and their connections between each other should be on top of interest in current unpleasant economic situation in Europe.

Regional input-output analysis can be used for preparing plans for regions suffering with high unemployment and low demand, planning infrastructure, tax incentives for investors etc. When preparing regional analyses, the lack of information is always present. Standard statistical data covering regional labour force, unemployment and gross value added is not enough. Theoretical approach rarely used in official statistics lies in the breakdown of enterprises into local kind of activity units (LKAU). LKAU is defined by ESA 95 and should represent the pure regional unit. The practise and the theory are usually not fully in line and therefore it is not easy to find a suitable solution when combining official regional accounts and national input-output tables.

From regional perspective, we can identify at least two factors that play very important role. The first represents the structure of regional output and its customers. The second constitutes the connection between the regions that is transformed into units' cost.

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[2] The Czech case is described in Sixta (2013).

The principles and some results are presented within this paper but detailed description exceeds the possibilities of conference paper and it is being prepared for the journal Economic Systems Research. The methodology that we prepared for the compilation of regional input-output tables is tested on the example of Czech economy for 2011.

2. Data Sources

Construction of RIOTs requires a lot of different data sources. The main data sources are taken over from national accounts and regional accounts. These data sources do not cover complete production approach and only value added is used. From expenditure approach, gross capital formation (GCF) within regional accounts and non-market output as a part of government and non-profit institution consumptions are published. These data sources have to be combined with other information from social statistics, transport statistics etc. The following Table 1 describes key data sources.

Table 1 Data sources for compilation regional input-output tables

	Name	Use
1	Regional Accounts	Structure of value added that represents a framework for the region, additional data sources for estimates of output (structure of estimated production from SBS data for S.11 and S.14, compensation of employees for S.13, S.12 and S.15), structure of GFCF
2	Symmetric input-output tables	Technical coefficients for intermediate consumption matrices
3	Transport statistics	National GDP, regional GDP, distance between regions
4	External estimates of expenditure approach	Households (see Musil and Kramulová, 2013), government and non-profit institutions consumption

Source: Own elaboration

The correct combination of data sources is crucial when compiling RIOTs. Key question about consistency has to be placed. Standard procedures relating to modern regional accounts lies in top-down approach. It means that national accounts aggregates are distributed into regions by some auxiliary indicator, usually wages etc.

What is reliable for value added need not be reliable for output. Suppose a big electricity company with many local units (power plants) and headquarter in the capital. We have to take into account that LKAUs are not correctly defined as it is assumed in the theory and we focus on the reality. The distribution of company value added by wages can be justified even if it fixes the rate of profit (operating surplus) to wages. But the output of company's headquarter is not production of electricity, it is a production of accounting, legal and management services. Actually, there cannot be identified transaction between regional local kind of activity units and headquarter. LKAUs pay neither externally nor internally for management services. In this case there are two options. The first consists in imputation of output (product management etc.) of headquarter and intermediate consumption of LKAUs and total output will be lower than the sum of regional output. The second option represents an assumption that the producer in the capital produces main products (electricity) with respect to its weight. The problem in the second option lies in the fact that the production will remain without appropriate inputs. The cost of headquarter in the capital are composed from renting services, accounting services, advertisement costs etc. Coal and gas are consumed in the LKAU that actually produces electricity. This issue needs correct interpretation. Electricity company produces electricity in LKAUs but the sales and customer oriented operations can be done from the capital only. The output created by headquarter has a nature similar to margin, added value for the provision of the business. From this perspective, the most important is to associate costs to obtain reliable regional intermediate consumption matrices. We consider the quality of output measurement as secondary.

3. Principles of Compilation

There are described several procedures in the literature but unfortunately they seem to be far from practical statistics. A reasonable combination of data sources (see section 2) including the appropriate method has to be found. Usually there are three main methods used for regional accounts (EU, 2013):

a. Bottom-up method lies in compilation of regional aggregates directly from LKAUs. It is rarely used in its pure form.
b. Top-down method supposes that national aggregates can be distributed into the regions according to auxiliary indicators.
c. Mixed method using a pseudo-bottom-up and/or top-down approach.

All three methods can be easily used for regional accounts where regional gross value added is estimated but they cannot be used for regional input-output tables. When solving these issues, we decided to keep following principles that make our results more useful for users. Let's assume:

a. Published regional value added should be in line with regional value added from RIOTs.
b. Sum of RIOTs correspond to the national SIOT. It means that transactions within the enterprise with more LKAUs are measured only partly according to their addition to value added.
c. Regional production approach is preferred and expenditure approach is subordinated to production approach especially for regional imports and exports.
d. Transactions recorded for all regions are designed to fulfil criteria of Multiregional models (see Miller, Blair, 2009).

The decision about the procedures directly influences the quality of resulting RIOTs. All the mentioned steps (a. – d.) represent a decrease of the quality nevertheless the results should more satisfy users' needs. Assumption b. corresponds to the example described in section 2 for electricity company. Practically it means that the consumption of coal is in the power plant (outside of the capital) and both headquarter and LKAU (power plant) produce electricity. In input-output analysis it means that the increase of final demand for electricity in the capital will cause higher output of headquarter (production of the region) and imports from the power plant (in a given proportion of original data). Electricity in the capital is interpreted as product consisting of "pure" electricity plus services necessary for selling (management, accounting etc.).

Regionalised output is obtained from national aggregates in two steps. Firstly, the known regional figures are allocated directly to regions where they belong to (like non-market output). Secondly, the remaining part of output is allocated via several criteria, mainly wages and number of employees.

The most important is the structure of intermediate consumption matrix (ICM). ICM is estimated by application of technical coefficients (based on national SIOT) on regionalised output. Resulting figures have to be carefully checked with respect to the LKAU issue. Therefore final ICMs have to be manually adjusted with respect to the regions' specifics. Finally, the ICM has to be splinted between the use of domestically produced products (in that specific region) and imported products (both from other regions and abroad).

4. Regional Expenditure Approach

Regional expenditure approach consists of separately estimated indicators covering household consumption, government, non-profit institutions' consumption and gross capital formation including valuables. Regional net export is estimated by combination of independent estimates and balancing of all regional input-output tables, see below. Final consumption expenditures were prepared according to Musil, Kramulova (2013) methodology. Gross capital formation is taken over from published regional accounts.

The foundation for the calculation of interregional trade represents the gravity model. The key idea lies in the fact that the flow of good *i* from region *r* to region *s* can be looked upon as a function of some measure of the total output of *i* in *r*, some measure of the total purchases of *i* in *s*, and the distance between two regions (Miller, Blair, 2009, p. 365). The first reference of the gravidity model in input-output framework was indicated by Leontief and Strout (1963). They outlined simplified formula

$$z_i^{rs} = \frac{x_i^{r\cdot} x_i^{s}}{x_{i\cdot\cdot}} Q_i^{rs} \qquad (1)$$

where $x_i^{r\cdot}$ represents so called supply pool of good *i* in region *r*, x_i^{s} is demand pool of good *i* in region *s*, total production of commodity *i* in the system is presented by $x_{i\cdot\cdot}$ and Q_i^{rs} is a parameter. In the most optimistic way, all the parameters needed for the estimation of Q_i^{rs} are known. In the practise it is necessary to estimate it. In this case it is important that cross-hauling is allowed. It means that good *i* can be transported concurrently from region *r* to region *s* and vice versa.

Commuting to work is a crucial part for the estimation. In the Czech Republic, there is the phenomenon of inhabitants from Středočeský region who commute to the capital city of Prague for work. The structure of workload shows Table 2.

Table 2 The structure of commutation to work (%)

NUTS 3 residence	Total	NUTS 3 - work place													
		PHA	STR	JHC	PLZ	KV	UST	LIB	KH	PAR	VYS	JHM	OLO	ZLN	MS
PHA	13.2	79.6	3.5	0.1	0.0	0.2	0.2	0.1	0.0	0.0	0.0	0.1	0.2	0.0	0.2
STR	12.8	15.4	93.1	0.5	0.3	0.0	0.5	0.4	0.2	0.4	0.2	0.1	0.0	0.0	0.0
JHC	6.0	0.5	0.2	97.1	0.1	0.2	0.0	0.0	0.0	0.0	0.5	0.1	0.0	0.0	0.1
PLZ	5.6	0.3	0.4	0.9	98.5	0.7	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
KV	2.8	0.2	0.0	0.0	0.6	98.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UST	7.2	0.9	0.3	0.1	0.3	0.6	98.8	1.0	0.1	0.2	0.0	0.0	0.0	0.0	0.1
LIB	4.0	0.3	1.0	0.0	0.1	0.0	0.2	97.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0
KH	5.2	0.6	0.5	0.0	0.0	0.0	0.1	0.4	96.7	1.6	0.0	0.1	0.0	0.0	0.0
PAR	4.9	0.3	0.3	0.1	0.0	0.0	0.1	0.1	1.7	96.9	0.5	0.4	0.3	0.0	0.0
VYS	4.8	0.4	0.2	0.9	0.0	0.0	0.0	0.0	0.2	0.3	96.7	1.2	0.1	0.0	0.1
JHM	11.0	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.1	0.2	1.9	96.1	0.4	1.2	0.2
OLO	5.9	0.3	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.0	1.0	97.0	1.0	0.4
ZLN	5.5	0.3	0.2	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.8	1.0	97.0	0.4
MS	11.1	0.5	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.2	1.0	0.8	98.3

Note: explanation of abbreviations of regions can be found in Annex
Source: Czech Statistical Office, Labour Force Survey 2011

Commutation to work deeply influence regional trade with services. Workers who commute, spend some part of their income for transport, catering and they usually do some shopping. In combination with large shopping malls located on the edges of big cities, regional import and export of services (conventionally covering also purchases of goods by non-residents) it has important effects on regional estimation of export and import for households. Table 2 and information about local distribution of shopping malls are going to be used for advanced estimation of regional export and import.

5. Results

We prepared regional input-output tables for 14 regions of the Czech Republic (based on NUTS 3) for 2011. These tables are symmetric fully in line with published figures. The following Table 3 describes intermediate consumption broken down by products (CPA) and regions of the Czech Republic in 2011.

Table 3 Regional Technical Coefficients, 2011

Region	Total CZ-CPA	Agriculture, forestry and fishery	Manufacturing, mining, energy		Construction	Trade, transport,catering	IT and telecommunication	Banking and insurance	Real estate activities	Business services	Public services	Other services
			Total	of which manufacturing								
Code	Code	A	B+C+D+E	C	F	G+H+I	J	K	L	M+N	O+P+Q	R+S+T+U
CZ	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
PHA	21.9%	3.5%	8.9%	6.3%	25.4%	32.7%	62.4%	66.4%	38.6%	50.0%	22.1%	34.2%
STR	13.2%	15.5%	17.0%	18.6%	9.5%	11.7%	4.1%	3.0%	9.8%	6.6%	9.3%	8.6%
JHC	4.8%	10.3%	4.9%	4.3%	5.7%	4.8%	2.0%	2.4%	4.0%	2.9%	6.5%	4.3%
PLZ	4.8%	7.8%	5.4%	5.7%	4.4%	4.4%	2.2%	2.5%	3.7%	3.5%	4.9%	3.9%
KV	1.6%	2.0%	1.4%	1.2%	1.7%	2.0%	0.5%	0.9%	1.9%	1.2%	3.8%	2.4%
UST	7.2%	5.2%	9.2%	8.7%	6.5%	5.3%	3.3%	2.1%	4.9%	4.0%	7.3%	4.9%
LIB	3.1%	2.2%	3.6%	3.9%	3.0%	2.7%	1.2%	2.2%	2.8%	1.9%	3.6%	3.1%
KH	4.4%	6.9%	5.2%	5.4%	3.5%	3.8%	2.5%	2.2%	3.1%	2.4%	5.0%	4.0%
PAR	5.2%	6.6%	7.0%	7.7%	3.7%	3.3%	3.0%	3.5%	2.9%	2.4%	4.3%	2.8%
VYS	4.1%	9.5%	4.7%	4.5%	4.8%	3.1%	1.1%	1.1%	3.3%	1.7%	3.7%	2.1%
JHM	9.6%	12.4%	8.5%	8.4%	14.0%	9.6%	9.0%	6.8%	10.2%	10.3%	9.2%	10.7%
OLO	4.1%	6.7%	4.1%	4.5%	4.4%	4.3%	1.8%	1.8%	3.5%	2.9%	5.8%	4.5%
ZLN	4.7%	4.8%	5.6%	6.2%	4.6%	3.7%	1.5%	1.5%	3.5%	3.0%	4.6%	5.6%
MS	11.2%	6.6%	14.5%	14.5%	8.9%	8.5%	5.4%	3.6%	7.7%	7.0%	9.8%	8.7%

Source: Own elaboration

Differences between Czech regions are clearly seen from Table 3. When we focus on Prague (PHA), the average share of manufacturing is about 6.3% that is in comparison with neighbouring Středočeský Kraj (STR) with about 18.6% strongly different. The differences between regions even in the Czech Republic are very high. Similar effects have coal power plants and refineries located in the north of the Czech Republic – Ústecký Kraj (UST) where the share of manufacturing, mining and energy products takes about 9.2% of total intermediate consumption in that region.

6. Conclusion

The paper briefly described our approach to compilation of regional input-output tables. This topic is not new although a little progress was done. Deep description of the methodology and elaboration of results exceed possibilities of conference papers. Provisional results can be found in Kahoun and Sixta (2013) and we are currently preparing paper to Economic Systems Research journal where we would like to present detailed methodology step by step.

Current results indicate that the regions within the Czech Republic are very different. It means that when using input-output analysis on region level, some misinterpretation can be concluded. The key input - intermediates and their composition of domestically produced and imported will determine results more than the regional breakdown of final use.

Usually, official statistical agencies are flooded by key tasks that consist in a very deep measurement of government deficit and debt, quarterly estimates of gross domestic product, annual sector accounts, national income and lots of administrative works. The output of official statistics is in line with the users' demand and its possibilities. Historically, statistical agencies were on the edge of interests of governments in comparison with ministries, banks etc. A lot of detailed data sources can be used in advanced analyses with possible practical impact on the policy. Among these data sources, detailed regional accounts including data regional input-output tables should play an important role. These data are available after users will increase their demands instead of reconciliation with the situation.

7. References

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8. Annex

Table 4 Classification of Czech Regions

NUTS	Abbreviation	Label
CZ010	PHA	Hlavní město Praha
CZ020	STR	Středočeský kraj
CZ031	JHC	Jihočeský kraj
CZ032	PLZ	Plzeňský kraj
CZ041	KV	Karlovarský kraj
CZ042	UST	Ústecký kraj

CZ051	LIB	Liberecký kraj
CZ052	KH	Královehradecký kraj
CZ053	PAR	Pardubický kraj
CZ063	VYS	Vysočina
CZ064	JHM	Jihomoravský kraj
CZ071	OLO	Olomoucký kraj
CZ072	ZLN	Zlínský kraj
CZ080	MS	Moravskoslezský kraj