Regional input-output table - The case of Eastern Slovenia

Die regionale Input–Output-Tabelle – Beispiel Ostslowenien

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Zusammenfassung

Ziel des Beitrags ist es, die Wirtschaft Ostsloweniens mit den quantitativen Zusammenhängen zwischen den einzelnen Sektoren darzustellen. Die angewandte Methodologie basiert auf der Entwicklung eines regionalen Input-Output-Modells. Die Bewertung von Modellparametern wird indirekt mit der Anwendung der modifizierten Version der GRIT-Methodik durchgeführt. Im Modell entwickelte Input- und Outputmultiplikatoren dienen der Identifizierung der Hauptwirtschaftssektoren in der Region. Das Regionalmodell könnte auch eine Basis für weitere empirische Forschung über den Einfluss verschiedener Wirtschaftspolitiken auf die ökonomischen Zusammenhänge und die Entwicklung Ostsloweniens sein.
Schlagworte: Regionalökonomik, Input-Output-Analyse, GRIT-Methode, Slowenien

Summary

The work presented attempts to provide insight into the economic performance of the Eastern Slovenia region by presenting quantitative relationships between the sectors in the regional economy. Methodological approach is based on estimation of the regional Input–Output model. Estimation has been carried out indirectly by applying a slightly modified GRIT methodology. Input and output multipliers derived from the model enable to identify the key economic sectors in the region. The model also provides a starting point for the

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development of an empirical tool to assess the effects of various policies affecting economic development of Eastern Slovenia.
Keywords: regional economics, Input-Output analysis, GRIT method, Slovenia

1. Introduction

In the last few years, Slovenia is witnessing an accelerated institutional up-building and extension of the scope of regional policy instruments, which is in a great part driven by the EU-accession. Conditions for a faster economic convergence of the lagging regions are gradually being created. Nevertheless, despite high position of balanced regional development in the policy agenda, Slovenia records significant regional differences in economic development, which are increasing even further.

Apart from this fact, a lack of empirical tools to investigate and model economic performance of the regions in Slovenia can be perceived. We have seen this situation as an incentive to empirically investigate the economic structure of the region of Eastern Slovenia. The reason for choosing the Eastern part of Slovenia as object of research lies in the fact that economic disparities are mainly exhibited in the west – east manner. The central part of Slovenia – around the capital Ljubljana – is developing much faster, while Eastern Slovenia is mostly lagging behind. GDP per capita (in PPS) in Eastern Slovenia is about 16 percentage points under the national average. Increased competition due to the accession to the EU might cause further negative effects on the regional disparities, since the regions lagging behind have significantly weaker competitive capacity. Due to the poorer economic performance, Eastern Slovenia will also be eligible for the bulk of regional structural support after the accession to the EU.

The paper intends to provide a quantitative insight to the characteristics of economic structure of Eastern Slovenia. This would enable to estimate existing linkages between various sectors in the region. The information bears its significance especially with regard to the likely economic performance of the region in the changed economic and policy environment after the accession to the EU. Results obtained therefore bear some policy relevance.

The paper is organised as follows. It starts with a brief presentation of some main socio-economic characteristics of the region. It continues with the description of methodological approach: presentation of the main

attributes of the national Input-Output (I-O) table, followed by description of steps undertaken in derivation of the regional I-O table for Eastern Slovenia. Description of results provides an insight to the structure of economic activities and linkages between sectors in the regional economy. Main virtues of the research undertaken and its methodological implications are discussed in the final part of the paper.

2. Some general characteristics of the region

Eastern Slovenia occupies about 55% of the country's territory and provides residence for about 54% of Slovene population. Over the last decade the number of inhabitants has been almost stagnating in Eastern Slovenia. The population is ageing quickly and ageing index is above national average. In terms of settlement distribution, the region is characterised by several villages and small towns, and only a few mid-size towns that are the main generators of economic exchange and entrepreneurship. The share of people, who live in rural municipalities (68%) is higher than its national counterpart (55.3%).

Table 1: Eastern Slovenia: some main socio-economic characteristics

	Slovenia	Eastern Slovenia
Area (km^2)	20,273	11,227
Population (in thousands)	1,992	1,080
GDP (Million €, current prices)	21,829	9,937
GDP per capita (€ PPS)	16,829	14,132
Unemployment rate index	6.7	7.9

Source: SORS (2003)

According to data for the year 2000, the region contributed around 46% of national GDP. The region's GDP per capita was lagging behind the national average by 16% and amounting to 61% of the Community average, respectively. The taxable earnings per capita in the region have been weaker than national ones for a number of past years - they reached 13% of national average in 2000.

Although the registered annual unemployment rate is gradually reducing, it still remains higher than the national one (by 1.2 percentage points in 2001) and differences at the sub-regional level in unemployment growth have not been increasing with the same intensity lately. The ratio between the sub-region with lowest and the highest registered unemployment rate was 1:1.8 in the year 2001.

Despite the region's relatively successful economic recovery after the transition shocks, the divergence in level of economic growth compared to the capital is continuous. This can be attributed to various reasons, e.g. a less favourable sectoral structure (additionally impaired by harsh market conditions), uncompetitive firm structure, out-migration and consecutive languishment of human capital. The period has been also characterised with growing disparities among individual sub-regions (NUTS 3 level) in the region in respect to economic infrastructure available and even more so with respect to their labour and employment indicators. Most of the socio-economic indicators of the region reveal worse results than the country average. There can still be found highly agriculture-dependent or declining industrial areas with the lack of working places and low educational level of population. The jobs in the industry prevail and the number of working places is falling. Expressive and lasting migration is typical for those areas, especially near the state border. Economic development of Eastern Slovenia is lagging behind.

3. Empirical approach: regional I-O-model

3.1 Data

The empirical work described in the paper was derived from the national 60 sector input-output table for the year 2000, estimated by the Statistical Office of Slovenia. Two symmetric, commodity-commodity tables in current basic prices with total and domestic flows were available. Assumption used by Statistical Office had been commodity-technology assumption, but this was combined to a great extent with expert knowledge to approximate the true values of transactions between sectors in the economy.

In addition to this, some other statistical data was employed. The following data sources should be pointed out: (i) data on employment at the national and regional level with the structure of activities identical to the national input-output table; (ii) some superior data on agricultural sector within the region (derived from the Agricultural Census 2000) and (iii) some additional socio-economic indicators, such as e.g. income tax base and percentage of the national value added produced within the region.

Aggregation of sectors in the original I-O table was carried out with regard to the regional structure of economic activities. Size of the region, its significance in national economic terms and diversified industry mix were the main reasons behind the decision to analyse a relatively broad set of 29 sectors. Agriculture and forestry were disaggregated into two sectors, description of other sectors remained at the 1st level of the Standard Classification of Activities, while the manufacturing sector remained disaggregated at the 2nd level of this nomenclature.

In evaluating economic performance of the analysed region, we have decided for the methodological approach of a derivation of regional I-O table, which provides a detailed snapshot of the I-O linkages that exist within the region. This can be used for predicting the consequences of any planned and potential changes in the demand for the region's outputs.

In estimation of the regional I.O table, and especially in the interpretation of results, all the 'classical' drawbacks of the I-O approach (static, linear production function, no substitution or scale economy effects, infinite elasticity of supply) were taken into consideration.

3.2 Regionalisation procedure

Due to lack of primary survey data the regional I-O table was derived from the national one. This indirect approach was undertaken by the GRIT methodology (Jensen et al., 1979), which was in some cases slightly modified. The modification was done by having in mind the objective of producing a satisfying level of accuracy of the regional I-O table and the availability and quality of superior statistical data.

Let us continue with a brief presentation of the regionalisation process. We can divide it into five stages.

- Adjustment to a national I-O table
- Adjustment for regional technical coefficients
- Aggregation of regional sectors
- Derivation of a prototype transactions table
- Final checks and balancing

3.2.1 Adjustment to a national I-O table

A starting point for regionalisation was the national input-output table as described above with total flows. The national flows matrix was converted to a technical coefficient matrix as follows:

$$A = Z\hat{X}^{-1} \quad (1)$$

where A represents the matrix of technical coefficients, Z the matrix of intersectoral transaction flows and X^{-1} the inverse of diagonal output matrix derived from output vector.

Since the I-O table was expressed in total flows, no adjustment for international trade was needed.

It is argued in the literature that transactions which appear as intrasectoral transactions at national level in majority of cases become imports when one turns to the regional economy (Morrison and Smith, 1974; Jensen, 1978; Jensen et al., 1979; Johns and Leat, 1987). In order to tackle the problem Morrison and Smith (1974) suggested the elimination of the diagonal elements and their decision in fact yielded results closer to a survey-based regional table. However, they only did so for sectors for which the above mentioned feature was expected to prevail (i.e. secondary sectors) and they warned that such modifications were not necessary justifiable in all contexts, depending on the nature of the region being analysed.

Given the nature of our region, which is large compared to the national economy, elimination of the elements on main diagonal was not carried out. Elimination would mean that although Eastern Slovenia creates 46% of the national GDP all intrasectoral flows exist only within the economically more vibrant part of the country – Western Slovenia. In fact, comparing national input-output table of domestic flows with one of total flows reveals that indeed on average the share of imports is the greatest on the diagonal elements.

3.2.2 Adjustment for regional technical coefficients

To estimate the regional technical coefficients, a non-survey method of Simple Location Quotients (SLQ) was used as follows.

$$A^R = \hat{q}\ A^N \quad (2)$$

Regional technical coefficients are denoted by subscript R and national ones by N. The vector of simple location quotients is denoted by q. Simple location quotients are derived from the relevant secondary

statistical data (e.g. breakdown of employment data by sectors, E). Simple location quotient for sector *i* can therefore be calculated.

$$q_i = \frac{E_i^R / E^R}{E_i^N / E^N} \tag{3}$$

The method used implies that sectors whose relative importance at a regional level is equal or greater than at a national level ($q_i \geq 1$) are able to satisfy intermediate demand within the region and coeficients therefore remain same as national ones. Otherwise, the sector is supposed not to be self-sufficient and the corresponding national coefficient is multiplied by q_i.

3.2.3 Aggregation of sectors

In the next stage we have aggregated the original table to the sectors relevant for the regional economic structure.

Before proceeding to the aggregation, the regional matrix of technical coefficients was modified as follows.

$$A_{(1)}^R = A_{(0)}^R \, \hat{w} \tag{4}$$

The original technical coefficients are adjusted by the vector of employment weights w, by which approximation towards the regional structure of economic activities is made. If this had not been done, the structure of intermediate consumption in the region would be the same as the national one. The weights were additionally adjusted with regard to the structure of the economic activities from the original national I-O table, which inevitably implies assumption that there are no differences in sector productivity between the regional and national economy.

3.2.3 Derivation of a prototype transactions table

As Jensen et al. (1979) point out the aim of this phase is the conversion of coefficient tables into prototype transactions table for the chosen region.

The first step towards achievement of this aim is estimation of regional output. Regional output was calculated by multiplying the elements of each column by estimates of output for each sector. These estimates were determined by using employment ratios.

$$X_i^R = X_i^N \frac{E_i^R}{E_i^N} \tag{5}$$

The tables produced provide estimates of regional intermediate flows, gross value added at basic prices and first estimate of imports. Because

no further data on value added and its structure was available it was decided to retain this estimate as a final result, at least regarding its internal structure and relation towards intermediate consumption and imports.
Final value added was obtained from the national one by adjusting it for industry structure differences (weighting) and multiplying it by the value of regional outputs.
The second step towards derivation of the prototype transactions table was represented by the estimation of final demand. With available data and with nature of the region in mind we were able to estimate or at least check the three components of final demand to the level of reasonable accuracy. Household consumption from the national table with total flows was corrected by multiplication (uniformly along sectors) by the share of regional income tax base in the national income tax base (47.1%). Since final regional table includes only flows of regional produce this had to be adjusted downward by the imports of products by households. Percent of imports was taken from the national table, i.e. the same percent of imports in the household expenditures as at the national level for each product. Such treating of household demand implicitly assumes that expenditure patterns of regional households are the same as that of national household. As far as adjusting for imports is concerned, for majority of sectors the downward adjustment was probably too small (regional household does not import only from abroad, but from other regions of a residing country as well), thus we can see the estimated household expenditures on regional products as an upper limit of the true value.
The estimate of household consumption was taken as the most reliable component of the final demand. The other two (exports and other final demand) were estimated simultaneously with balancing of intermediate consumption. Shaffer and Chu (1969) noted that location-quotient procedures require balancing corrections. In our case, when national table of total flows instead of domestic was used this was even more so. On many occasions the row vector of intermediate consumption was reduced uniformly along the row, except for diagonal elements which were usually reduced at most. Correspondingly, reduction of the intermediate flows was followed by increase in imports of the using sector. This was done to the extent that exports and other final demand reached the values which seemed reasonable in light of national values and expert knowledge of the region.
Starting values of exports and other final demand (comprised of government expenditures, gross capital formation, expenditures by non-

profit institutions and changes in inventories) were derived from the national figures. These values were adjusted downwards using employment and location quotients. All elements within the transaction matrix were treated equally and thus reduce the on or off-diagonal elements according to the value of output, final demand, share of imports in every cell of the national table and expert knowledge. Intermediate consumption rows of 12 sectors were reduced (one primary (fishing) and 11 secondary sectors) and 16 on-diagonal elements of primary and secondary sectors were reduced as well. Thus, the whole input-output table was balanced.

3.2.5 Final Checks and Balancing

A thorough check of the regional input-output table compared to the national table of domestic flows was carried out. Some inconsistencies and errors were discovered. Output multipliers were calculated and on average found to be too high and thus it was decided to further adjust the regional table in order to get more reasonable and acceptable results.

The column of the most problematic sector, mining and quarrying, was corrected since it was found that methodology based on employment data created nonsense results for that sector. After that, elements of the intermediate flows table which make for technical coefficients greater than 1 % were checked and compared with national ones. Percentage of imports at national level for each cell was also checked. Adjustments were made, in majority of cases downwards, which thus implies that imports and exports were increased as well. On rare occasions it was found that uniform reduction of intermediate rows described above resulted in too small a transaction and thus upward adjustment took place. Overall, of 841 values (29x29) in the intermediate flows matrix 417 were adjusted from the value calculated by simple location quotient technique in the process of checking and balancing.

Finally, the value of regional value added was calculated using the regional share of gross value added in national gross value added, therefore the whole table was inflated by approximately 1% to reach this value of the regional gross value added at basic prices. Balanced input-output table which was believed to be a more realistic presentation of the economy of Peripheral Slovenia and which should result in the multipliers without ‘significant errors’.

4. Results

4.1 Main macroeconomic aggregates

Derivation of the regional I-O table enables us to get a better insight to the structure of the regional economy. Let us first present this structure by some key macroeconomic variables, which are readily computable from the regional I-O table (Table 2).

Table 2: Eastern Slovenia: comparative overview of some key macroeconomic aggregates

		Slovenia	**Eastern Slovenia Region**
Gross Value Added	million EUR	17,813	8,136
Gross Output	million EUR	42,052	19,933
Structure of Gross Vallue Added			
Agriculture	%	3.3	4.8
Mining, manuf. & constr.	%	34.7	39.4
Services	%	62.0	55.8
Structure of Gross Output			
Agriculture	%	2.7	3.9
Mining, manuf. & constr.	%	50.2	55.6
Services	%	47.1	40.5

As it can be seen from comparison with the national economy, the structure of GVA and gross output, the region can be broadly characterised by a higher representation of agriculture and manufacturing, and lower representation of services.

The structure of value added in the region is somehow less favourable than the national average as agricultural and industry shares remain relatively high. Share of services in the region's value added is 6.6 percentage points lower than at national level which results in much greater gap in value added. Since this sector is the greatest producer of value added, smaller share means almost 59% lower value added, while agricultural and industry gaps are 32% and 48%, respectively.

4.2 Model multipliers

The main virtue of the I-O model is its ability to provide the multipliers presenting the linkages between the sectors within the regional economy. Nevertheless, these results have to be taken with certain caution due to restrictive assumptions underlying to the I-O technique (static character, linear production function, no impact of scale economies, no substitution, infinitely elastic supply).
By applying the corresponding ranks to calculated multipliers and comparing this with the national I-O table, we can see the differences in the relative importance of a sector comparative to the national economy.

Table 3: Comparative overview of I-O multipliers for Eastern Slovenia for 29 analysed sectors

	Backward linkages (=Output multipliers)		Forward linkages (= Input Multipliers)	
	Slo	East Slo	Slo	East Slo
Agriculture, hunting and forestry	1.64	1.60	2.21	1.98
Forestry, logging and related service activities	1.59	1.55	1.94	1.79
Fishing	1.80	1.66	2.13	2.14
Mining and quarrying	1.57	1.51	2.90	2.50
Manufacture of food products; beverages and tobacco	1.91	1.88	1.81	1.82
Manufacture of textiles and textile products	1.41	1.36	1.44	1.35
Manufacture of leather and leather products	1.37	1.32	1.40	1.38
Manufacture of wood and wood products	1.76	1.72	1.62	1.53
Manufacture of pulp, paper and paper products; publishing and printing	1.56	1.42	1.84	1.54
Manufacture of coke, refined petroleum products and nuclear fuel	1.39	1.34	1.55	1.29
Manufacture of chemicals, chemical products and man-made fibres	1.33	1.27	1.20	1.21
Manufacture of rubber and plastic products	1.36	1.31	1.59	1.60
Manufacture of other non-metallic mineral products	1.59	1.55	1.94	1.76
Manufacture of basic metals and fabricated metal products	1.63	1.58	1.80	1.67
Manufacture of machinery and equipment not elsewhere classified	1.53	1.47	1.19	1.14
Manufacture of electrical and optical equipment	1.48	1.38	1.33	1.34
Manufacture of transport equipment	1.42	1.37	1.12	1.08
Manufacturing not elsewhere classified	1.64	1.59	1.12	1.12
Electricity, gas and water supply	1.61	1.61	2.06	1.92
Construction	2.03	1.98	1.63	1.56
Wholesale & retail; repair motor vehicles, personal & household goods	1.70	1.59	1.67	1.66
Hotels and restaurants	1.90	1.82	1.50	1.44
Transport, storage and communication	1.88	1.68	2.04	1.89
Financial intermediation	1.43	1.35	2.36	2.27
Real estate, renting and business activities	1.55	1.47	1.86	1.77
Public administration and defence; compulsory social security	1.53	1.45	1.19	1.19
Education	1.30	1.26	1.09	1.08
Health and social work	1.39	1.35	1.19	1.19
Other community, social and personal service activities	1.58	1.45	1.35	1.35

As the first observation, it can be stated that no considerable differences exist in relative significance of sectors with respect to the corresponding regional and national multipliers. There are no large differences in the ranks of sectoral multipliers between the regional and the national I-O table.

Output multipliers (or backward linkages) illustrate change in total output as a consequence of a change in the final demand within the chosen sector. Which ones? High output multipliers are characteristic for construction, food processing, and hotels and restaurants. Eastern Slovenia exhibits relatively higher output multipliers with regard to the national economy in manufacturing of wood products, and in electricity, gas and water supply sectors. The opposite holds for the wholesale and retail sector, together with personal and household goods.

Input multipliers (or forward linkages) reveal the situation if we transpose the whole I-O system. It depicts changes in output of the whole economy as a consequence of a change in added value within the chosen sector. If the value added changes within the sector this inevitably affects its output. Since the chosen sector produces inputs for other sectors, it implies that output of other sectors is affected as well (direct and indirect impacts). Input multipliers can be used as an insight to the dependence of a sector from other sectors within the region. The results imply that high dependence from other sectors within the region is characteristic for mining, financial intermediation, fishing and agriculture. The region exhibits relatively higher input linkages in manufacturing rubber and plastic products and relatively lowers in the manufacturing of other non-metallic mineral products.

It is desirable for a regional economy that the sectors are characterised by strong both backward and forward linkages. Such sectors are regarded as the key sectors for regional economy. In this respect, it can be pointed out that sectors hold these desirable characteristics.

5. Discussion

Motivation for carrying out the presented research was twofold. The immediate aim was to provide an insight to the economic performance of the Eastern Slovenia region by presenting the quantitative relationships between the sectors in the regional economy. This was carried out by having in mind the successive aim of developing the analytical base for a policy analysis tool, which would be able to assess the effects of policies affecting economic development of Eastern Slovenia.

When evaluating the virtues of the presented research, it is appropriate to examine, to what extent have the research aims been addressed.

The immediate aim of the paper was accomplished successfully. By the use of indirect approach – GRIT methodology (Jensen et al., 1979), a regional input-output table of Eastern Slovenia has been estimated identifying the structure of regional economy and quantifying the inter-industry flows. Key economic sectors were identified by estimating the corresponding input and output multipliers from the regional I-O model.

In order to make the best use of available data and to take into consideration some characteristics of the region analysed, the GRIT methodology (Jensen et al., 1979) was slightly adapted. This applies especially to (i) allowing for intra-sectoral flows and (iii) adjusting for external trade based upon superior data and expert knowledge rather than assuming maximum interregional trade. The main argument in favour of these modifications is linked with the objective of maximising the reliability of the regional table.

However, what is presented in this paper as results can also be regarded as the start towards achieving the second aim of the research, i.e. developing a policy analysis tool. The derived regional I-O table can serve as a solid quantitative basis for simulating exogenous shocks to the regional economy.

The analysed exogenous shocks would apply primarily on various policies affecting economic development of Eastern Slovenia, such as e.g. Structural Funds expenditure, Cohesion policy or Common agricultural policy.

When applying the I-O methodology to investigate issues of such complexity, one has to keep in mind the assumptions underlying the

methodology and limiting its analytical capability. The model performs well in straightforward situations, such as exogenous shocks that can be presented as changes in the final demand sector. But it is not so straightforward how to go about simulation of e.g. investments, whose impact on final demand is only indirect.

The I-O approach is also inherently static, which creates additional limitations in assessing dynamic impacts of exogenous shocks to the economy.

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