KRISZTIÁN KOPPÁNY[1]

Macroeconomic Impacts of the University and Industry Cooperation Centre of Győr

Some Methods of Aalysis with Input-Output Tables and the SZEconomy-GyőRIO Model[2]

Győr is one of the locations of the Hungarian higher education system where a University and an Industry Cooperation Centre (UICC) are to be established. UICC enables Széchenyi István University to operate as a regional hub and economic catalyst beyond, but in close relation with its basic educational and research mission. Supporting suppliers and buyers to intensify their cooperation means catalysing input-output relations along the value chains. Methods, based on input-output tables, provide an effective toolkit in practice in order to analyse potential macroeconomic impacts. This study presents some examples of augmenting cross-industry data with individual company information to obtain more precise results. These hybrid techniques are going to be utilized in the SZEconomy portal, which is an important part of the proposed development programme. SZEconomy is a bunch of interconnected economic models that can help UICC to fulfil its mission offering a forecasting, planning and monitoring system for regional improvements. In order to o investigate national level effects, the updated versions of the input-output table of the official Central Statistical Office can be used. To quantify local impacts, we have developed the regional input-output model of the Győr Industrial Area, called GyőRIO. For GyőRIO, the UICC impact analysis is the first and probably also the primary application in the future.

The paper unravels as follows: after a short introduction the first and second sections discuss the aims and relating features of UICC and SZEconomy in more detail; the third section justifies why the input-output model is a feasible framework for analysing UICC impacts; from the fourth to seventh sections it demonstrates the use of the input-output tables for this specific purpose through simplified examples; the eighth section concludes and flashes the detailed database and tools for real analyses and the methods for future researches and applications.

[1] Associate professor, Széchenyi István University, Faculty of Economics, Department of International and Theoretical Economics, (koppanyk@sze.hu).
[2] This research was supported by the Bolyai János Research Scholarship of Hungarian Academy of Sciences and the Pallas Athéné Domus Scientiae Foundation.

INTRODUCTION

The topic of this study can be circumscribed as an economic impact analysis: not in general and theory, but rather in practice. The paper overviews some opportunities of the application for a particular case, which is one of the recently proposed and hopefully upcoming new development projects our university. Maybe, the most important one of them is the University and Industry Cooperation Centre (UICC). With this project we would like to expand, enhance, deepen and institutionalize our function of organizing, affecting and catalysing local economic and social networks and processes.

WHAT'S THIS COMPLEX PROJECT ABOUT? WHAT IS UICC?

Universities have two major traditional interrelated tasks: research and higher education. Beyond. but in close relation with them, a university must be an integrated agent of the regional and national economy and society as well, serving their needs, not in a passive, but a proactive way, giving them a leverage by the knowledge disseminated.

This task conventionally is performed by the primary output of the university, i.e. the graduates, who have the skills and competencies that fit the needs and provide for the progress of the region. In the 21th century, it has to be augmented with direct services, consultancy, company trainings, development activities and research capacities to the local agents, such as the Management Campus, the Supplier Qualification Centre, the Incubation Programme, the Open Labs, etc., in the UICC project, that can help them to intensify their cooperation and also boost the local and national economy.

The economy of the Győr region is very concentrated. Firstly, it is due to the biggest motor manufacturer of the world and other highly-developed, world-standard, large international companies located in the city and its hinterland. They give more than 60% of the total output of the agglomeration.[3]

The local economy is not only concentrated but very bipartite, too. There's a significant gap between these big firms and the small- and medium-sized entrepreneurships. Differences can be found in the fields of hard and soft factors as well, such as the financial background, technology, efficiency, as hard factors, and soft skills and competencies, like communication, corporate culture, marketing, management, and ownership.

These gaps impede an effective cooperation between the local SMEs and large companies. That's why the latter operate with very high import rates and pretty low GDP multipliers. The manufacturing of motor vehicles, which is a key-growth industry in both the Hungarian and Győr region economy, has the 3rd

[3] Dusek T. – Koppány K. – Kovács N. – Szabó D. R. (2015): *A győri járműipari körzet hozzáadott értékének becslése.* Területi Statisztika, 1. 76–87.

and 4th lowest value added multipliers out of the 64 industries of the national input-output table.[4] One can easily realize and say that great further-unexploited opportunities are hidden even in the growth industries.

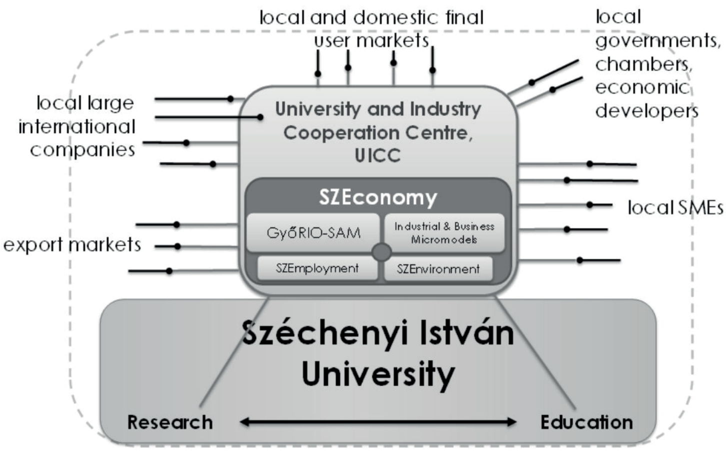
SMEs, of course, would like to reach international standards and want to be the suppliers of the local, large international companies, and penetrate the new export, domestic, and the local intermediate and final user markets. For this, they may need to detect their customers' needs more precisely, redefine or improve their products, services, technology, management, marketing, public relations, communication and so on.

Large companies would like to purchase guaranteed quality materials and components from guaranteed quality and flexible local suppliers in large quantities and at competitive prices. They also want to deepen their R&D cooperation with the university and increase the local value-added ratio of their operations.

The University and Industry Cooperation Centre can help these ambitions on the basis of our research, the educational core competencies and capacities, and the opportunities carried by a multi-way knowledge transfer between regional agents, which, in return, can give precious inspirations and contributions for the research and education. This process works as cross-fertilization.

UICC enables Széchenyi István University to operate as a regional hub that can support the connections between the incoming cables. With its assistance, UICC can catalyse both the regional and national economies. That is what the national and local governments and chambers are also interested in, so they are all partners in this development endeavour. Figure 1 shows the relations discussed above.

Figure 1: Széchenyi István University as a regional hub and an economic catalyst



Source: own figure.

[4] Koppány K. (2016): *Magyarország feldolgozóipari exportteljesítményéből és ágazati szerkezetéből fakadó növekedési lehetőségei és kockázatai 2010–2014.* Közgazdasági Szemle, forthcoming.

WHAT IS SZECONOMY?

The tasks of the UICC bear a great amount of responsibilities. We need to measure and plan the potential effects of our efforts in case of every single company and on the whole, too. This assignment is not only a duty but also a challenging economic project, which is an important part of the proposed wide and complex UICC programme. This subprogram was labelled SZEconomy, coining from the acronym “SZE”, the Hungarian name of our university, and the term “economy”.

SZEconomy is going to operate as a portal with user friendly graphical interfaces, clear-cut reports, tables and diagrams, and a bunch of interconnected economic models, a regional and national economic database behind them.

SZEconomy will not be an exclusive toy for the developers, modellers and university analysts. It will be an open toolkit for all invited and registered local data suppliers with which they will be able to detect the macroeconomic effects of the expected variations or planned steps of their own company businesses. Terms and policies of use are under development.

The concept of SZEconomy stems from a preceding research project, called Győr Industrial Area, in which the foundations of the GyőRIO regional input-output model of the city and its agglomeration was laid down.[5]

In SZEconomy the impact analyses are going to be accomplished at three territorial levels (Figure 2). In the SZEconomy model Győr Industrial Area will be level 1. Level 2 for Middle and West Danubia Region is a subject of future research and it needs an expansion of the GyőRIO. Level 3 is the whole country. GyőRIO and the updated national input-output tables will be the main data background and macroeconomic impact models for the SZEconomy portal.

[5] Koppány K. – Kovács N. – Szabó D. R. (2014): *Város és vonzáskörzete: gazdasági kapcsolatrendszer és növekedés. Vázlat a győri járműipari körzet regionális makromodelljének kidolgozásához.* Tér és Társadalom, 2. 128–158., Koppány K. (2015a): First Calibrations of the Multiregional Input-Output Table of Győr and its agglomeration. In: Radek Kratochvíl – Jiří Vopava – Vladimír Douda (ed.): *Proceedings of The 4th MAC 2015*, Prague, 2015.02.20-2015.02.21.; Koppány K. (2015b): First Drafts for the Regional Macroeconomic Model of Győr and its Agglomeration. In: Karlovitz János Tibor (ed.): *Some Current Issues in Economics, 2015.* International Research Institute, Komárno. 319–334.

Figure 2: UICC economic impacts at different regional levels

Source: own figure.

WHY INPUT-OUTPUT ANALYSIS?

Because what UICC aims is exactly the catalysing of the input-output relations through the company value chains. Backward cumulative effects can originate from the endpoints; in this case they run through the whole value chain probably with greater effect, or somewhere from the middle.

Consider Figure 3 and a local original equipment manufacturer (OEM) company! This OEM produces final products for households, other companies, the government, or export markets. The question is what will happen if it can increase its sales regarding these final users. The overall macroeconomic effect, of course, depends on whether it crowds a local competitor out or not and whether domestic or foreign suppliers are involved or not. However, in any case, the chain-reaction goes through the whole supply chain.

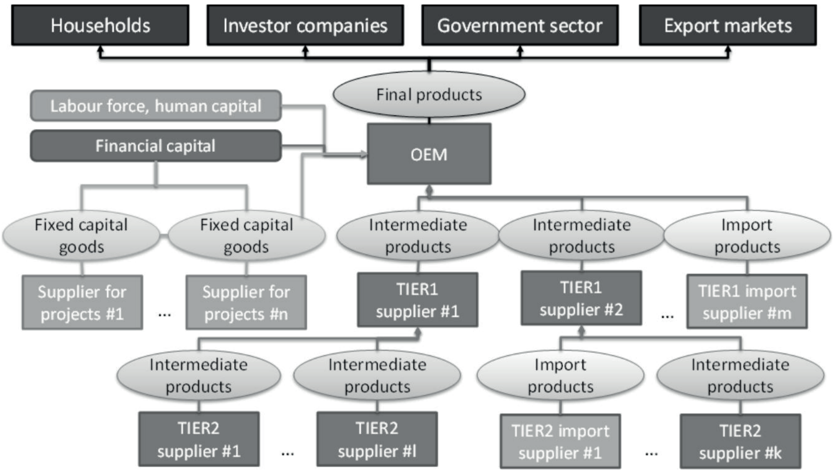
Or, some steps back can be taken, assuming no final demand changes but structural variations. In both cases, we should analyse the input side of the company businesses, which is, in turn, the output side for some other agents.

What resources does a company need as inputs? First of all, labour force and human capital for which one of the regional suppliers is SZE itself. That's why SZEmployment is defined as a module for the SZEconomy system. SZEmployment is going to analyse the labour demand and the supply of the region, including SZE's own course and graduate structure, thus it helps to harmonise the labour-force output of the university with its demand.

A company needs financial capital, as well. Micro models, that can help to assess the market and industry position, financial conditions, risks and creditworthiness of a firm, are also beyond the topic now.

The financial capital turns into fixed real capital goods and these investments mean final demand changes for the project suppliers. Big investment projects are usually carried out with intercurrence, not in every single year. Now we focus on changes in the value chains that endure for several years, for example, a technology, and thus an intermediate input structure-change that an overall investment project can bring. Of course, modifications of materials and components, i.e. the intermediate goods, and their suppliers, can be made with other considerations in the background, for example, turning to a more competitive price, better quality, more flexible alternatives, and/or shifting from import to local suppliers.

Figure 3: Catalysing Input-Output Relations along Value Chains



Source: own figure.

Initial changes can occur in any suppliers' tier. We are focusing on the multiplication processes that can be made by them. The data for these analyses, albeit a bit obsolete but updatable, as we will see soon, is available in national aggregates, at a sector, industry and inter-industry level. We can simply assign the micro categories to macroeconomic counterparts, as gross output, intermediate consumption, value-added, household consumption, investment, government spending, exports, and imports.

READING INPUT-OUTPUT TABLES[6]

For the sake of simple demonstrations, consider the following three-industry input-output table (Table 1). The rows show the sales of industries to other industries for intermediate use, and to final demand sectors for final purposes. The agricultural firms, for example, sell the amount of HUF 462 billion to other agricultural firms, HUF 530 billion to manufacturing companies, and so on. Total sales of agriculture are HUF 2100 billion. Households' consumption was separated because we will make this column soon endogenic. The other components of the domestic final demand and the exports will remain exogenous all the time.

In the columns the inputs of each industry can be seen. The agricultural businesses use intermediate products of other agricultural enterprises in the amount of HUF 462 billion, as we know, from manufacturing they buy HUF 315 billion, from service HUF 231 billion, and from abroad or from out of the region HUF 273 billion. The sum of these four items adds up the value of the intermediate consumption of the agriculture. Then come the components of the value added, the incomes of the factors of production, i.e. labour and capital incomes, HUF 420 and HUF 399, respectively. The sum total of the first column shows the total value of production of agriculture, 2 HUF 100 billion. The gross outputs, seen from the input and output sides, must be equal, so the row and column sums need to be the same for every industry.

Table 1: Input-output table: a simplified example

billion HUFs

Industries	Intemediate Use			Final Use			Total Use
	Agricul-ture	Manufac-turing	Services	Household's consumption	Other domestic final use	Exports	
Agriculture	462	530	265	300	150	393	2 100
Manufactur-ing	315	3 710	1 855	2 000	1 980	16 640	26 500
Services	231	2 650	6 095	7 000	4 600	5 924	26 500
Imports	273	12 720	3 445	3 575	4 160	765	24 938
Labour-incomes	420	3 180	9 275				12 875
Capital incomes	399	3 710	5 565				9 674

[6] Detailed discussion of input-output tables and models can be found in Zalai E. (2012): *Matematikai közgazdaságtan II. Többszektoros modellek és makrogazdasági elemzések*. Akadémiai Kiadó, Budapest.; Miller, R. E. – Blair, P. D. (2009): *Input-Output Analysis. Foundations and Extensions.* Second Edition, Cambridge University Press, Cambridge.

Industries	Intemediate Use			Final Use			Total Use
	Agricul-ture	Manufac-turing	Services	Household's consumption	Other domestic final use	Exports	
Gross output / total comsump-tion	**2 100**	**26 500**	**26 500**	**12 875**			**55 100**
Employers (thousand people)	288	1 170	2 543				4 001
Greenhouse Gas (thou-sand tons CO^2 equiva-lent)	7 510	37 940	10 270	19 620			75 340

Source: own table.

Each industry column includes the number of employers and a number for greenhouse gas emission. Both of them can be incorporated into the calculations. As you may remember from Figure 1, SZEconomy will contain SZEmployment, and an environmental block, called SZEnvironment, as well.

One more column must be mentioned in detail; the consumption of households. In our simple model, the total consumption equals to the labour income, thus the agents of the economy spend all their labour income on consumption and save all of their capital yields. HUF 200 out of HUF 12 875 billion is spent on agricultural products, HUF 2000 on manufacturing products, HUF 7000 on services, and HUF 3575 billion on import goods.

GENERATING INDUSTRY MULTIPLIERS[7]

After some matrix algebra,[8] we will get the following multiplier values for gross output, imports, value added, and so on. As Table 2 shows, every HUF 1 billion increase in the final demand for agricultural products results in a HUF 1,75 billion growth in the total gross output of the economy, 0,31 in imports, 0,69 in value-added, and 0,36 in labour incomes. 209 more people are employed, and 5 thousand extra tons of greenhouse gas is emitted through this change.

All these numbers involve the impacts occurring not only in agriculture but also in other industries, thus, they deliver the sum of direct and all indirect effects. Only one group of impacts is ignored here, the so-called induced consumption effects of the growing household incomes. That's why these multipliers are called Type 1.

[7] For detailed discussion of different types of input-output multipliers see Ambargis, Z. O. – Mead, C. I. (2012): *RIMS II. An essential tool for regional developers and planners,* Bureau of Economic Analysis.
[8] See Appendix 1.

Table 2: Type 1 final demand multipliers

	Agriculture	Manufacturing	Services
Gross Output	1,75	1,37	1,45
Imports	0,31	0,59	0,23
Value Added	0,69	0,41	0,77
Household (Labour) Incomes	0,36	0,20	0,48
Employment (thousand people per billion HUF's)	0,21	0,07	0,13
Greenhouse Gas (thousand tons per billion HUF's)	5,05	1,87	0,74

Source: own calculations.

Table 3: Type 2 final demand and direct multipliers

		Agriculture	Manufacturing	Services
Final Demand Multipliers	Gross Output	2,29	1,67	2,16
	Industrial Imports	0,43	0,66	0,38
	Value Added	0,95	0,55	1,11
	Household (Labour) Incomes	0,52	0,29	0,68
	Employment (thousand people per billion HUF's)	0,57	0,74	0,57
	Industrial Greenhouse Gas (thousand tons per billion HUF's)	0,25	0,10	0,19
	Total Greenhouse Gas (thousand tons per billion HUF's)	6,26	2,55	2,33
Direct Multipliers	Household (Labour) Incomes *total (direct, indirect and induced) household incomes impact of 1 HUF increase in labour incomes in the final demand industry*	2,59	2,42	1,95
	Employment *the total change local jobs perchange in jobs in the final demand industry*	1,86	2,21	2,03

Source: own calculations.

Type 2 multipliers involve induced consumption of households as well. In Table 3, Type 2 values are somewhat higher than Type 1 counterparts for this reason.[9] One can find also four more rows in the Type 2 multiplier table. Two of them are for comprising not just industry but also household impacts of induced consumption on imports and carbon-dioxide emission. The others are direct multipliers of household incomes and employment.

How can these numbers be used to show the effects of the final demand change of a specific individual company on the whole national or regional economy? If we can say that the company that is under investigation is an average of its industry, we can use the numbers of Table 3 to multiply the final demand changes. If not, because of the fact that the average company in reality usually doesn't exist, we can try to express individual company multipliers using financial report and survey data.

GENERATING AND USING COMPANY MULTIPLIERS FOR QUANTIFING FINAL DEMAND IMPACTS[10]

Now consider a very large manufacturing company with a HUF 1,800 billion total and HUF 1,500 billion export sales. These numbers can be picked out from the financial reports of the firm, however, the composition of the remaining, the mix of the domestic sales for the intermediate and final uses, as usual, is not available from these public sources. We can make a shift with the average industry shares, so as holds in the manufacturing industry, we assume that in the case of our company in the example, 3,2%, 37,6%, 18,8%, 20,3%, and 20,1% of its domestic output is for the intermediate use of the agriculture, manufacturing and services, for final household consumption, and for other final demand users, i.e., 10, 113, 56, 61 and HUF 60 billion, respectively (Table 4).

[9] For calculating Type 2 multipliers see Appendix 2.

[10] For enterprise input-output models and multipliers see for example Tiebout, C.M. (1967): *Input-output and the firm: a technique for using national and regional tables.* Review of Economics and Statistics, 49. 260–262.; Billings, R. B. – Katz, J. L. (1982): *A technique to obtain accurate impact multipliers for individual firms by means of existing input-output models.* Environment and Planning A, 14. 739–744. and Polenske, K.R. (1997): Linked system of enterprise, regional and national input-output accounts for policy analysis. In: M. Chatterji (ed.): *Regional Science: Perspectives for the Future.* Macmillan Press Ltd., Houndmills, Basingstoke. 26–42.

Table 4: Final demand impacts of a company with public company information: company sales and expenditures

billion HUFs

Outputs	Total Output	Sales for intermediate use to...			Sales and output for final use to...		
		Agricul-ture	Manufac-turing	Services	Household's consumption	Other domestic final use	Exports
Company	1 800	10	113	56	61	60	1 500
Manufacturing	26 500	315	3 710	1 855	2 000	1 980	16 640
		3,2%	37,6%	18,8%	20,3%	20,1%	

Inputs	Company		Manufacturing		
Agriculture	26	1,5%	530	2,7%	2,0%
Manufacturing	185	10,3%	3 710	18,9%	14,0%
Services	132	7,4%	2 650	13,5%	10,0%
Imports	636	35,3%	12 720	64,9%	48,0%
Total intermediate consumsption	980	54,4%	**19 610**	**100,0%**	74,0%
Labour incomes	340	18,9%	3 180		12,0%
Capital incomes	480	26,7%	3 710		14,0%
Gross output	**1 800**	**100,0%**	**26 500**		**100,0%**
Employers (thousand people)	10		1 170		
Greenhouse Gas (thousand tons CO^2 equivalent)	1 000		37 940		

Source: own calculations.

We can replace the missing information in the same way on the input side as well, supposing that the purchase of our company from the agriculture, manufacturing, service, and import industries is, as in the whole manufacturing industry, 2,7%, 18,9%, 13,5%, and 64,9% of its total material cost, HUF 980 billion, i.e., 26, 185, 132, and 636 billion, respectively. The incomes, the gross output, the number of employers and greenhouse gas emission can be known from public reports.

In view of the individual data above, we can now separate our company from its industry, give it its own row and column in the input-output table (Table 5), and calculate its own multipliers (Table 6).

To demonstrate the use of multipliers for final demand change impact analyses, assume a 10% export growth rate for the company for next year. This growth is equal to HUF 150 billion final change of demand. Multiplying it by 0,74 gives a HUF 111 billion value added impact, which is a 0,49% growth of GDP in the whole economy.

Table 5: Final demand impacts of a company with public company information: separating company in the IO table

billion HUFs

Inputs	Intermediate Use				Final Use			Total Use
Company	Company	Agricul-ture	Manufac-turing	Services	House-holds' consump-tion	Other domestic final use	Exports	
Agriculture	0	10	113	56	61	60	1 500	1 800
Manufacturing	26	462	504	265	300	150	393	2 100
Services	185	305	3 412	1 799	1 939	1 920	15 140	24 700
Imports	132	231	2 518	6 095	7 000	4 600	5 924	26 500
Total intermedi-ate consumsp-tion	636	273	12 084	3 445	3 575	4 160	765	24 938
Labour incomes	340	420	2 840	9 275				12 875
Capital incomes	480	399	3 230	5 565				9 674
Gross output	**1 800**	**2 100**	**24 700**	**26 500**	**12 875**			**55 100**
Employers (thousand people)	10	288	1 160	2 543				4 001
Greenhouse Gas (thousand tons CO2 equivalent)	1 000	7 510	36 940	10 270	19 620			75 340

Source: own calculations.

Table 6: Company final demand multipliers and impact analysis with public company information

		Company	Agriculture	Manufacturing	Services
Final Demand Multipliers	Gross Output	1,65	2,29	1,68	2,16
	Industrial Imports	0,52	0,43	0,67	0,38
	Value Added	0,74	0,94	0,54	1,11
	Household (Labour) Incomes	0,36	0,52	0,29	0,68
	Total Imports	0,62	0,57	0,75	0,57
	Employment (thousand people per billion HUF's)	0,06	0,26	0,10	0,19
	Industrial Greenhouse Gas (thousand tons per billion HUF's)	1,18	5,48	2,18	1,30
	Total Greenhouse Gas (thousand tons per billion HUF's)	1,72	6,27	2,62	2,34

Export growth rate	10%
Export (final demand) growth (billion HUFs)	150

Value added impact (billion HUFs)	111
Value added impact/growth rate	0,49%

Source: own calculations.

Having the option to get detailed and superior information through a survey, more precise distinctions can be made from the industry average output and input shares, and of course, more precise multiplier values and analytical results can be gained. The steps of the operations are the same as shown above.

ANALYSING STRUCTURAL CHANGES

Consider now the following two-company example to show the method of analysing a structural change in the upstream value chain of the former large company. Let it be company#1, which makes a HUF 200 billion shift from a foreign to a domestic supplier, company#2. They have had no purchaser-supplier relation before. Tables 7-8 show the changes from the aspect of the two companies. To produce more output, Company#2 needs more purchases from domestic and foreign companies, and more employers, as well. The post-change numbers are based on the operational and financial plans.

Table 7: Analysing structural changes with survey:
a two-company example, company#1 sales and expenditures

billion HUFs

Outputs	Company#1 total output	Sales for intermediate use to...			Sales and output for final use to...			
		Company#2	Agri-culture	Manu-factur-ing	Services	House-holds' consump-tion	Other domes-tic final use	Exports
Before	1 800	0	0	100	50	50	100	1 500
After	1 800	0	0	100	50	50	100	1 500

Inputs	Before	After
Company#2	0	200
Agriculture	80	80
Manufacturing	200	200
Services	100	100
Imports	600	400
Labour incomes	340	340
Capital incomes	480	480
Gross output	**1 800**	**1 800**
Employers (thousand people)	10	10
Greenhouse gas (thousand tons CO2 equivalent)	1000	1000

Source: own calculations.

Table 8: Analysing structural changes with survey:
a two-company example, company#2 sales and expenditures

billion HUFs

Outputs	Company#2 total output	Sales for intermediate use to...				Sales and output for final use to...		
		Company#1	Agri-culture	Manu-factur-ing	Services	House-holds' consump-tion	Other domes-tic final use	Exports
Before	270	0	50	150	10	10	20	30
After	470	200	50	150	10	10	20	30

Inputs	Before	After
Company#1	0	0
Agriculture	25	44
Manufacturing	70	125
Services	50	85
Imports	70	120
Labour incomes	45	77
Capital incomes	10	19
Gross output	**270**	**470**
Employers (thousand people)	1,4	2,05
Greenhouse gas (thousand tons CO2 equivalent)	110	167,15

Source: own calculations.

Table 9 represents the initial economy status before the structural changes with the two separated and highlighted firms and the input-output tables after the shift.

Table 9: Analysing structural changes with survey: a two-company example, IO tables

Before Structural Changes billion HUFs

Industries	Intermediate Use					Final Use			Total Use
	Company #1	Company #2	Agricul-ture	Manu-factur-ing	Services	House-holds' consump-tion	Other domes-tic final use	Exports	
Company#1	0	0	0	100	50	50	100	1 500	1 800
Company#2	0	0	50	150	10	10	20	30	270
Agriculture	80	25	462	425	265	300	150	393	2 100
Manufacturing	200	70	265	3 190	1 795	1 940	1 860	15 110	24 430
Services	100	50	231	2 500	6 095	7 000	4 600	5 924	26 500
Imports	600	70	273	12 050	3 445	3 575	4 160	765	24 938
Labour incomes	340	45	420	2 795	9 275				12 875
Capital incomes	480	10	399	3 220	5 565				9 674
Gross output / total consump-tion	**1 800**	**270**	**2 100**	**24 430**	**26 500**	**12 875**			**55 100**
Employers (thousand people)	10,0	1,4	288,0	1 158,6	2 543,0				4 001,0
Greenhouse gas (thousand tons CO2 equivalent)	1 000	110	7 510	36 830	10 270	19 620			75 340

After Structural Changes, Default Position billion HUFs

Industries	Intermediate Use					Final Use			Total Use
	Company #1	Company #2	Agricul-ture	Manu-factur-ing	Services	House-holds' consump-tion	Other domes-tic final use	Exports	
Company#1	0	0	0	100	50	50	100	1 500	1 800
Company#2	200	0	50	150	10	10	20	30	470
Agriculture	80	44	462	425	265	300	150	393	2 119
Manufacturing	200	125	265	3 190	1 795	1 940	1 860	15 110	24 485
Services	100	85	231	2 500	6 095	7 000	4 600	5 924	26 535
Imports	400	120	273	12 050	3 445	3 575	4 160	765	24 788
Labour incomes	340	77	420	2 795	9 275				12 907
Capital incomes	480	19	399	3 220	5 565				9 683
Gross output / total consump-tion	**1 800**	**470**	**2 100**	**24 430**	**26 500**	**12 875**			**55 300**
Employers (thousand people)	10,0	2,1	288,0	1 158,6	2 543,0				4 001,7
Greenhouse gas (thousand tons CO2 equivalent)	1 000,0	167,2	7 510,0	36 830,0	10 270,0	19 620,0			75 397,2

Final Table

Industries	Intermediate Use					Final Use			Total Use
	Company #1	Company #2	Agriculture	Manufacturing	Services	Households' consumption	Other domestic final use	Exports	
Company#1	0	0	0	100	50	50	100	1 500	1 801
Company#2	200	0	51	151	10	10	20	30	472
Agriculture	80	44	469	427	266	302	150	393	2 131
Manufacturing	200	125	269	3 202	1 804	1 954	1 860	15 110	24 525
Services	100	85	234	2 510	6 125	7 052	4 600	5 924	26 630
Imports	400	120	277	12 097	3 462	3 601	4 160	765	24 883
Labour incomes	340	77	426	2 806	9 321				12 970
Capital incomes	480	19	405	3 233	5 592				9 729
Gross output / total consumption	**1 801**	**472**	**2 131**	**24 525**	**26 630**	**12 970**			**55 559**
Employers (thousand people)	10,0	2,1	292,3	1 163,1	2 555,5				4 022,9
Greenhouse gas (thousand tons CO2 equivalent)	1 000,5	167,7	7 621,6	36 973,2	10 320,4	19 764,6			75 848,0

Source: own calculations.

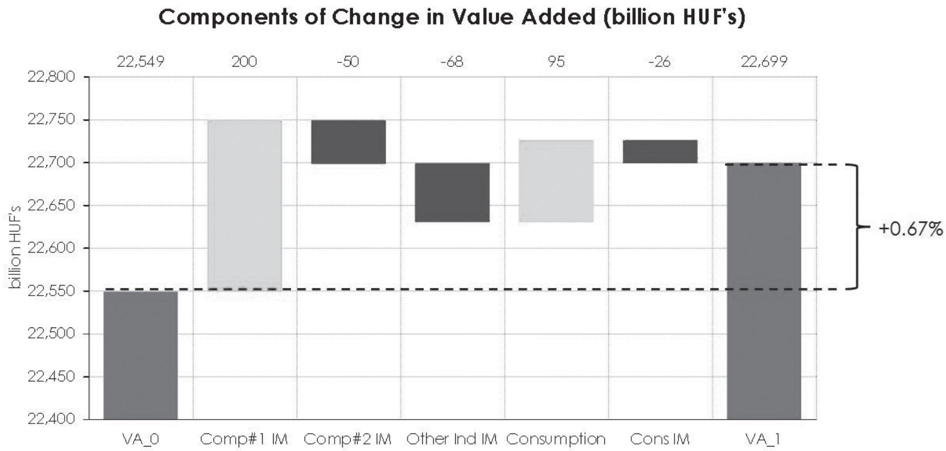
After accounting the modified sales and purchase values for our two directly concerned agents, first we suppose no changes implicated in the remaining parts of the economy. This assumption, of course, must be resolved. Since our companies have relations to other firms and industries, too, the changes between them must have an effect on third parties. This is also reflected by the inequalities of the row and column sums for the three industries. Further alignments must occur to equilibrate the economy, which have repercussions to Company#1 and #2. After several iterations, the final equilibrium table, which can be generated by the standard input-output methods,[11] shows a slight increase in the production of Company#1's and Company#2, too.

[11] See Appendix 3.

As a result of the above changes, the value added of the whole economy rises from HUF 22,549 to 22,699 billion, thus by 0,67%. If we would like to get to the bottom of the causes, by performing a variance analysis and drawing a waterfall chart (Figure 5) we could realize that

- replacing Company#1's imports with Company#2's product increases value added by 200 billion HUFs;
- expanding Company#2's production needs HUF 50 billion more imports, which is a negative factor to GDP growth;
- increasing imports of all upstream links to Company#2's value chains deliver also a negative partial effect of 65 billion;
- endogenous household incomes and consumption give a HUF 95 billion rise; and finally
- import content of increased consumption decreases value added by HUF 26 billion.

Figure 4: Components of change in value added (billion HUFs)



Source: own calculations.

BEYOND THE EXAMPLES

The examples presented here describe the main points of a macro or a regional economic impact analysis. For real cases, of course, an actual and more detailed database is needed. In the SZEconomy model, at national level, updated versions of official input-output tables of Hungarian Statistical Office will be used.[12] At the regional level, GyőRIO[13] will provide the basis for the calculation.

[12] Koppány (2016): op. cit.
[13] Koppány (2015a): op. cit., Koppány (2015b): op. cit.

GyőRIO now is a full non-survey regional input-output table of Győr and its agglomeration, assembled for the year 2010, detailed in 20 industries. In the SZEconomy both national and regional tables will be constantly updated and balanced by company survey data.[14] This way we can get a good hybrid database and model depicting a more realistic current state of the regional economy and impacts that can evolve in it.

The applications can cover not only the assessing impacts of the final demand and the structural changes of industries and individual companies, but also selecting key industries for UICC, continuous monitoring of regional industry portfolio by assessing its expected growth, risks, shock resistance, and so on.

REFERENCES

- Ambargis, Z. O. – Mead, C. I. (2012): *RIMS II. An essential tool for regional developers and planners,* Bureau of Economic Analysis.
- Billings, R. B. –Katz, J. L. (1982): *A technique to obtain accurate impact multipliers for individual firms by means of existing input-output models.* Environment and Planning A, 14. 739–744.
- Dusek T. – Koppány K. – Kovács N. – Szabó D. R. (2015): *A győri járműipari körzet hozzáadott értékének becslése.* Területi Statisztika, 1. 76–87.
- Koppány K. – Hajba T. (2015): *Hibrid regionális input-output modellek kiegyensúlyozási problémái: Lehetséges megoldások a GyőRIO modellben.* XXXI. Magyar Operációkutatási Konferencia, Cegléd, Magyarország, 2015.06.10-2015.06.12., 51.
- Koppány K. – Kovács N. – Szabó D. R. (2014): *Város és vonzáskörzete: gazdasági kapcsolatrendszer és növekedés. Vázlat a győri járműipari körzet regionális makromodelljének kidolgozásához.* Tér és Társadalom, 2. 128–158.
- Koppány K. (2015a): First Calibrations of the Multiregional Input-Output Table of Győr and its agglomeration. In: Radek Kratochvíl – Jiří Vopava – Vladimír Douda (ed.): *Proceedings of The 4th MAC 2015,* Prague, 2015.02.20-2015.02.21.
- Koppány K. (2015b): First Drafts for the Regional Macroeconomic Model of Győr and its Agglomeration. In: Karlovitz János Tibor (ed.): Some *Current Issues in Economics, 2015.* International Research Institute, Komárno. 319–334.
- Koppány K. (2016): *Magyarország feldolgozóipari exportteljesítményéből és ágazati szerkezetéből fakadó növekedési lehetőségei és kockázatai 2010–2014.* Közgazdasági Szemle, forthcoming.
- Miller, R. E. – Blair, P. D. (2009): *Input-Output Analysis. Foundations and Extensions.* Second Edition, Cambridge University Press, Cambridge.
- Polenske, K.R. (1997): Linked system of enterprise, regional and national input-output accounts for policy analysis. In: M. Chatterji (ed.): *Regional Science: Perspectives for the Future.* Macmillan Press Ltd., Houndmills, Basingstoke. 26–42.
- Tiebout, C.M. (1967): *Input-output and the firm: a technique for using national and regional tables.* Review of Economics and Statistics, 49. 260–262.

[14] Koppány K. – Hajba T. (2015): *Hibrid regionális input-output modellek kiegyensúlyozási problémái: Lehetséges megoldások a GyőRIO modellben*. XXXI. Magyar Operációkutatási Konferencia, Cegléd, Magyarország, 2015.06.10-2015.06.12., 51.

• Zalai E. (2012): *Matematikai közgazdaságtan II. Többszektoros modellek és makrogazdasági elemzések.* Akadémiai Kiadó, Budapest.

HUNGARIAN SUMMARY

Győr egyike azoknak az egyetemi városainknak, ahol a következő években Felsőoktatási és Ipari Együttműködési Központot (FIEK) hozhatnak létre. A FIEK lehetővé teszi, hogy a Széchenyi István Egyetem kiteljesítse térségi hub és gazdasági katalizátor szerepét. A helyi szereplők támogatása vevő-beszállító kapcsolataik kialakításában, értékláncaik összefűzésében és együttműködésük elmélyítésében az input-output relációk katalizálását jelenti. Az input-output táblákon alapuló elemzési módszerek hatékony eszközöket biztosítanak a potenciális hatások elemzéséhez. Ez a tanulmány néhány példát mutat arra, hogy miként juthatunk az ágazati aggregátumok egyedi vállalati adatokkal való kiegészítésével még pontosabb eredményekhez. A FIEK program szerves részét képező SZEconomy portál kidolgozásakor ilyen hibrid technikák alkalmazását tervezzük. A SZEconomy nem egyetlen modell, hanem egymással összehangolt és összekapcsolt makro- és mikro-modellek komplex együttese, a Széchenyi István Egyetem és a FIEK gazdaságelemző, előrejelző, tervező és monitoring rendszere. A tervezett kutatási-szolgáltatási infrastruktúra fejlesztés lehetséges országos szintű gazdasági hatásait a Központi Statisztikai Hivatal aktualizált input-output tábláival, a térségieket pedig a győri ipari körzetre kidolgozott GyőRIO regionális modellel igyekszünk számszerűsíteni, amelynek a FIEK hatáselemzés jelenti az első és várhatóan a jövőben is elsődleges gyakorlati alkalmazását.

APPENDIX 1

A_1 =	0.22	0.02	0.01	y =	843	x =	2,100
	0.15	0.14	0.07		20,620		26,500
	0.11	0.1	0.23		17,524		26,500
im =	0.13	0.48	0.13				
va =	0.39	0.26	0.56				

E_1 =	1	0	0
	0	1	0
	0	0	1

$$A_1 x + y = x$$
$$y = x - A_1 x$$
$$y = (E_1 - A_1) x$$
$$(E_1 - A_1)^{-1} y = x$$
$$x = (E_1 - A_1)^{-1} y = R_1 y$$

R_1 =	1.29	0.03	0.02
	0.24	1.18	0.11
	0.22	0.16	1.32
GO mltplrs	1.75	1.37	1.45
IM mltplrs	0.31	0.59	0.23
VA mltplrs	0.69	0.41	0.77

APPENDIX 2

A_2 =	0.22	0.02	0.01	0.02
	0.15	0.14	0.07	0.16
	0.11	0.10	0.23	0.54
	0.20	0.12	0.35	0

E_2 =	1	0	0	0
	0	1	0	0
	0	0	1	0
	0	0	0	1

R_2 =	1.31	0.05	0.05	0.07
	0.37	1.25	0.28	0.36
	0.60	0.37	1.82	1.06
	0.52	0.29	0.68	1.43
GO mltplrs	2.29	1.67	2.16	
IM mltplrs	0.43	0.66	0.38	
VA mltplrs	0.95	0.55	1.11	

APPENDIX 3

A_2 =

0.00	0.00	0.00	0.00	0.00	0.00
0.11	0.00	0.02	0.01	0.00	0.00
0.04	0.09	0.22	0.02	0.01	0.02
0.11	0.27	0.13	0.13	0.07	0.15
0.06	0.18	0.11	0.10	0.23	0.54
0.19	0.16	0.20	0.11	0.35	0.00

E_2 =

1.00					
	1.00				
		1.00			
			1.00		
				1.00	
					1.00

Exogenous final demand

y =

1,600.00
50.00
543.00
16,970.00
10,524.00
0.00

R_2 =

1.00	0.01	0.00	0.01	0.01	0.01
0.12	1.01	0.03	0.01	0.00	0.01
0.10	0.15	1.32	0.04	0.05	0.07
0.28	0.47	0.34	1.24	0.27	0.34
0.44	0.66	0.61	0.37	1.83	1.07
0.42	0.48	0.52	0.28	0.68	1.43

x =

1,800.88
471.52
2,131.22
24,524.98
26,630.07
12,970.05

x^T =

1,800.88	471.52	2,131.22	24,524.98	26,630.07	12,970.05