# First Calibrations of the Multiregional Input-Output Table of Győr and its agglomeration[1]

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## Abstract

Győr and its agglomeration, the so-called Automotive District of Győr has a significant economic potential not only in Győr-Moson-Sopron County but in Hungary too. However, the region is of great interest, knowledge about the regional economy is very scarce. The area in question does not fit any available regional level or statistical units, therefore, data problems arise. Trying to overcome these obstacles this paper presents first estimation and calibraiton attempts to numerate key macroeconomic data, sectoral gross output, value added, interindustry linkages and a simple three-industry input-output table of the region based on national and county level official statistics and financal data of resident firms. The derivation of the two subregion input-output table of Győr and its hinterland was made by a two-stage application of location quotients. Although the results can be considered as first rought estimates, main patterns and attributes of the region are well recognizable.

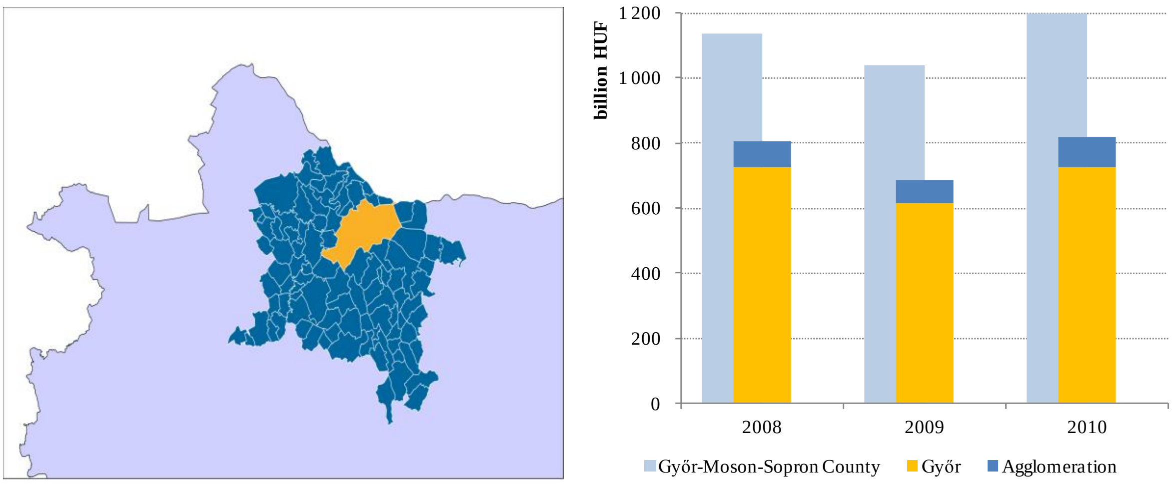
**Keywords**: regional output, location quotients, multiregional input-output table, regional output multipliers

**Main Conference Topic:** Economics

## Introduction

Building a regional macroeconomic model for Győr and its agglomeration have started in the summer of 2013 as part of the "Regional Automotive District of Győr as a New Direction and Tool of Area Development". Tóth (2013) have set out the spatial frontiers of the analysis according to the Local Labour System of Győr, which contains 85 towns and villages from Győr-Moson-Sopron County and 9 from the neighbours (see Figure 1, left).

**Figure 1:** The Regional Automotive District of Győr (left) and its GDP (compared to the county's value added) (right, at basic, current prices)

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## A brief theoretical background

The proposed model to describe economic relations and multiplications processes of the Automotive Regional District of Győr (ARD) consinsts of a regional input-output table (Miller, & Blair, 2009) and a social accounting matrix (Godley, & Lavoie, 2012). For an overview of the related literature and the layout of the model see Koppány (2015) and Koppány, Kovács, & Szabó (2014b, 2014c).

## Regional key figures

The region's total output, final demand and value added disaggregated to sectoral-territorial level are the key elements of the model. The topmost obstacle to get over is that there are no official statistical data collection and publication, hence no structured secondary data available for the variables of this scpecific area. Therefore we have to bulid up our own database through surveys, arrangements and estimates using fractional or higher aggregated information of Central Statistical Office of Hungary, fragmented public regional databases and financial statement data, which we have purchased from Dun&Bradstreet Hungária Kft.

On this basis we have made some estimations on regional sectoral disaggregated GO, GDP and incomes. The region's GDPs for the period 2008-2010 compared to the county's levels can be seen in Figure 1 (right). In 2010 ARD's GDP of circa 820 billion HUFs gives more than two third of Győr-Moson-Sopron County's value added. 90% of ARD's GDP concentrates in the City of Győr. For the methods of disaggregating official county-level GDP's to towns, and setting up ARD's value see Dusek, Koppány, Kovács, & Szabó (2015) and Koppány, Kovács & Szabó (2014a, 2014c).

To go down to sectoral levels (only for three sectors: agriculture, industries, services) we have used firms‘ income statements, and have generated value added estimates as the sum of wages and salaries plus employers‘ taxes on them, local business taxes, depreciations, and firms‘ earnings before taxes. We also made a negative correction of transfer payments to firms, which are not part of the GDP. This detailed calculation can be accomplished only for bigger companies. For private entrepreneurs estimations was made on the basis of company ratios. Total results showed a 164 billion minus in Győr, a 33,2 billion minus in the agglomeration to the GDP generated by disaggregating official county levels. Since income statement database does not contain government (public education, health care and other public services) and financial (banking, insurance etc.) sector, these differences were accounted as parts of the services sector.

The results are presented in Table 1 and Figure 2. In Győr industries are the dominant sector, while in the agglomeration services have the largest proportion in GDP. The sectoral structure of ARD's GDP is different from national texture due to the dominance of automotive industry in the 90% share of Győr in the region.

Table 2 and 3 shows the estimations about sectoral labor costs and their shares in value added. We have again significant differences between Győr and its hinterland, and also between ARD and Hungary. In acgriculture labour costs/value added ratio of firms located in Győr almost meets the national level, while in the agglomeration and – because in the field of agriculture agglomeration is the dominant – in the whole ARD we have much higher rates. In the case of industrial firms the situation is just the inverse. Agglomeration‘s ratio is close to the national one, but Győr's rate is much more lower. The numbers of services are on about national levels.

All these result are strongly affected by the precence of Audi Hungaria in Győr. The company's estimated value added in 2010 is 320,2 billion HUFs and its growth of 77,4 billion form previous year gives almost the half of the GDP-growth of Győr-Moson-Sopron County.

**Table 1:** ARD's sectoral sales and values added, 2010 (billion HUFs)

| Sector | Firms* | | | | Private enterpreneurs* | | | | Value added corrections*** | | Total value added | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Győr | | Agglomeration | | Győr | | Agglomeration | | | | | | |
| | Sales | Value added | Sales | Value added | Sales | Value added** | Sales | Value added** | Győr | Aggl. | Győr | Aggl. | ARD |
| A Agriculture | 14,8 | 4,4 | 39,5 | 4,6 | 2,8 | 0,8 | 10,6 | 1,2 | 0,0 | 0,0 | 5,3 | 5,9 | 11,1 |
| B-F Industries | 1 775,3 | 444,4 | 105,8 | 24,2 | 12,1 | 3,0 | 15,4 | 3,5 | 0,0 | 0,0 | 447,5 | 27,7 | 475,2 |
| G-U Services | 440,2 | 95,2 | 195,3 | 21,1 | 67,5 | 14,6 | 41,9 | 4,5 | 164,0 | 33,2 | 273,8 | 58,9 | 332,7 |
| Sum of all sectors | 2 230,4 | 544,1 | 340,6 | 50,0 | 82,4 | 18,5 | 67,9 | 9,3 | 164,0 | 33,2 | 726,5 | 92,5 | 819,0 |

** Calculations/estimations based on Dun&Bradstreet database.*
*** Estimations based on firms' value added/sales ratios.*
**** GDP components (public and financial services) that can not be calculated based on firms accounting reports.*

**Figure 2:** Comparing sectoral distribution of value added

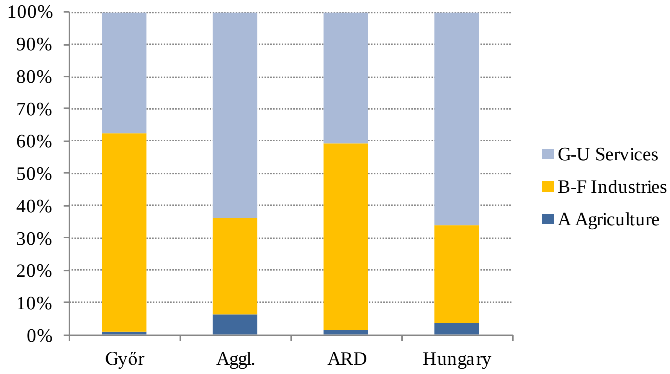



**Table 2:** Labour costs and their share in value added, 2010 (billion HUFs, %)

| Sector | Firms* | | | | Estimated labour costs | | | | Labour costs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Győr | | Agglomeration | | Private entrepreneurs** | | Other GDP producers*** | | | | |
| | Labour costs | Share in value added | Labour costs | Share in value added | Győr | Aggl. | Győr | Aggl. | Győr | Aggl. | ARD |
| A Agriculture | 1,3 | 28,8% | 3,5 | 75,4% | 0,2 | 0,9 | 0,0 | 0,0 | 1,5 | 4,4 | 6,0 |
| B-F Industries | 99,1 | 22,3% | 13,8 | 57,0% | 0,7 | 2,0 | 0,0 | 0,0 | 99,8 | 15,8 | 115,6 |
| G-U Services | 52,6 | 55,3% | 14,1 | 66,9% | 8,1 | 3,0 | 86,9 | 17,6 | 147,7 | 34,8 | 182,4 |
| Sum of all sectors | 153,0 | 28,1% | 31,4 | 62,9% | 9,0 | 6,0 | 86,9 | 17,6 | 249,0 | 55,0 | 304,0 |

** Calculations/estimations based on Dun&Bradstreet database.*
*** Estimations based on firms' labour costs/value added ratios.*
**** Estimations based on labour cost/values added ratio of sectors K-L and O-Q in year 2010 (53%).*

**Table 3:** Comparing total labour cost share in value added, 2010

| Sector | Győr | Aggl. | ARD | Hungary |
|---|---|---|---|---|
| A Agriculture | 28,8% | 75,4% | 53,5% | 32,0% |
| B-F Industries | 22,3% | 57,0% | 24,3% | 47,6% |
| G-U Services | 53,9% | 59,1% | 54,8% | 57,5% |

**Generating first numerical version of GyőRIO**

I used a common nonsurvey method to generate a three sector regional input-output table for Győr and its agglomeration (GyőRIO). Using labour cost based location quotients (LQs) I have adjusted direct requirement coefficients of Hungary's national input-output table compiled by Central Statistical Office for year 2010 (the last available when doing the analysis, www.ksh.hu).

Regional input-output tables that are based on national relationships need to make adjustments to account for regional supply conditions. The basic idea behind these is that industries in a region are not likely to produce all of the intermediate inputs required to produce the change in final demand. In these cases, local industries must purchase intermediate goods and services from producers outside of the region, thereby creating leakages from the local economy. If the LQ for an industry is one or greater, then the industry's national coefficients are used for the region. If the LQ for an industry is less than one, then the national coefficients are reduced by the ratio to account for leakages (Ambargis, & Mead, 2012, Bess, & Ambargis, 2011).

LQs used here consist of the ratio of an industry's share of regional labour costs to the industry's share of national labour costs. As Table 4 shows I have calculated these LQs in three relations: ARD to Hungary, Győr to ARD and agglomerations to ARD. With these numbers I have generated direct requirements of the two subregions in two steps. First I used the numbers in the first column to get technology matrix of the whole ARD from national table, kept Győr and its agglomeration together temporarily (Table 5). In step two I have broken the matrix into four submatrix by calculating shadowed areas with the numbers of column 2 and 3 of Table 4 and the direct ARD requirements of Table 5, and the others as residuals (Table 6).

**Table 4:** Location quotients

| | ARD-Hungary | Győr-ARD | Aggl.-ARD |
|---|---|---|---|
| Agriculture | 0,9096 | 0,3100 | 4,1214 |
| Industries | 1,4038 | 1,0540 | 0,7559 |
| Services | 0,8482 | 0,9883 | 1,0527 |

Aggl.-ARD:

$$\frac{\text{labour cost of sector } i \text{ in the agglomeration / total labour cost in the agglomeration}}{\text{labour cost of sector } i \text{ in ARD / total labour cost in ARD}}$$

Győr-ARD:

$$\frac{\text{labour cost of sector } i \text{ in Győr / total labour cost in Győr}}{\text{labour cost of sector } i \text{ in ARD / total labour cost in ARD}}$$

ARD-Hungary:

$$\frac{\text{labour cost of sector } i \text{ in ARD / total labour cost in ARD}}{\text{labour cost of sector } i \text{ in Hungary / total labour cost in Hungary}}$$

**Table 5:** Direct requirement coefficients of ARD

| | Agriculture | Industries | Services |
|---|---|---|---|
| Agriculture | 0,1996 | 0,0211 | 0,0035 |
| Industries | 0,1517 | 0,1375 | 0,0746 |
| Services | 0,0944 | 0,0877 | 0,1976 |

**Table 6:** Direct requirement coefficients of Győr and its agglomeration

| | | Győr | | | Agglomeration | | |
|---|---|---|---|---|---|---|---|
| | | Agriculture | Industries | Services | Agriculture | Industries | Services |
| Győr | Agriculture | 0,0619 | 0,0065 | 0,0011 | 0,0000 | 0,0000 | 0,0000 |
| | Industries | 0,1517 | 0,1375 | 0,0746 | 0,0370 | 0,0336 | 0,0182 |
| | Services | 0,0933 | 0,0867 | 0,1952 | 0,0000 | 0,0000 | 0,0000 |
| Aggl. | Agriculture | 0,1377 | 0,0145 | 0,0024 | 0,1996 | 0,0211 | 0,0035 |
| | Industries | 0,0000 | 0,0000 | 0,0000 | 0,1147 | 0,1039 | 0,0564 |
| | Services | 0,0011 | 0,0010 | 0,0023 | 0,0944 | 0,0877 | 0,1976 |

The product of the coefficients in Table 6 and sectoral gross outputs give hypothetic direct requirements from regional production in billion HUFs. The column sums of these numbers and values added substracted from sectoral GOs result in imports form other regions and countries. Thus we already have the whole left part of regional input-output table (Table 7).

Observing the numbers one can realize the outstanding values of industrial production in Győr. In addition to these we must remark that 1 300 out of 1 787 billion industrial GO are Audi's sales revenues, and 320 out of 447.5 billion industrial GDP is Audi's estimated value added. We do not know the sum of the company's puchases from abroad and other domestic regions, but the whole sector's assumed imports are double of Győr's industrial GDP.

**Table 7:** Simplified three sector input-output table for Győr and its agglomeration (billion HUFs)

| | | Győr | | | Agglomeration | | | Domestic final use | | Exports to other regions/ countries | **Final use** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Agriculture | Industries | Services | Agriculture | Industries | Services | Consumption of households | Other | | |
| Győr | Agriculture | 1,1 | 11,7 | 0,8 | 0,0 | 0,0 | 0,0 | 0,9 | 0,1 | 3,1 | **4,1** |
| | Industries | 2,7 | 245,8 | 56,6 | 1,9 | 4,1 | 5,2 | 41,1 | 47,2 | 1 383,0 | **1 471,2** |
| | Services | 1,6 | 154,9 | 148,1 | 0,0 | 0,0 | 0,0 | 168,4 | 149,4 | 136,2 | **454,0** |
| Aggl. | Agriculture | 2,4 | 26,0 | 1,8 | 10,0 | 2,6 | 1,0 | 2,3 | 0,2 | 3,8 | **6,3** |
| | Industries | 0,0 | 0,0 | 0,0 | 5,7 | 12,6 | 16,2 | 6,0 | 6,9 | 73,6 | **86,6** |
| | Services | 0,0 | 1,8 | 1,7 | 4,7 | 10,6 | 56,9 | 78,7 | 69,9 | 63,7 | **212,3** |
| Total intermediate consumption from ARD's output | | 7,9 | 440,2 | 209,1 | 22,3 | 29,8 | 79,4 | | | | |
| Imports from other regions/countries | | 4,5 | 899,7 | 275,9 | 21,9 | 63,6 | 149,9 | | | | |
| **Value added** | | **5,3** | **447,5** | **273,8** | **5,9** | **27,7** | **58,9** | | | | |
| *of which* labour incomes | | 1,5 | 99,8 | 147,7 | 4,4 | 15,8 | 34,8 | | | | |
| **Gross output** | | **17,7** | **1 787,4** | **758,7** | **50,1** | **121,2** | **288,1** | | | | |

For getting the numbers of final use I have calculated in a way little bit unusal in input-output analysis. The question is about the regional-sectoral final uses that can be satified with the total outputs in the bottom line of Table 7. So now the unkown was not **x** (vectors of gross outputs), but **y** (vector of final uses) in the basic input-output equation, so I have used it as $\mathbf{y} = (\mathbf{E}\text{-}\mathbf{A})\mathbf{x}^T$ (where **A** is the matrix of technology or direct requirement coefficients and **E** is the identity matrix). The solution is in the last column of Table 7.

To make the picture more complete I have tried to pick apart final use to households' consumption, other domestic final use and exports based on assumed ratios of Table 8. I have taken into consideration national sectoral proportions of domestic to total use, household consumption to domestic use from national input-output table and domestic to total sales from firms financial reports.

**Table 8:** Assumed ratios of final use

| National | | | ARD | | | | |
|---|---|---|---|---|---|---|---|
| | Domestic / total use | Household consumption / domestic use | | | Domestic sales / total sales | Domestic / total final use | Households' consumption / domestic use |
| Agriculture | 36,6% | 90,3% | Győr | Agriculture | 34,8% | 25,0% | 90,3% |
| Industries | 23,7% | 46,6% | | Industries | 17,1% | 6,0% | 46,6% |
| Services | 79,5% | 53,0% | | Services | 83,8% | 70,0% | 53,0% |
| | | | Aggl. | Agriculture | 73,4% | 40,0% | 90,3% |
| | | | | Industries | 43,3% | 15,0% | 46,6% |
| | | | | Services | 88,0% | 70,0% | 53,0% |

In the case of national and company data based domestic use ratios I have accepted the lower ones, and what is more, I have reduced even the latter. For example, national domestic use ratio of agriculture is 36,6%, wich is only 34,8% based on data from firms of Győr. Domestic sales in financial reports can go not only to ARD, but other Hungarian regions too, and can be products also for intermediate consumption (we have no information about these), so I have used a smaller rate of 25%. The lowest domestic use ratio was assumed to the industry of Győr. It is beacuse near 1 300 out of 1 447 billion HUFs final use are Audi's exports, so that ratio must be really low.

National ratios were used for regional households' consumption/domestic use. With these numbers I have got the left side of Table 7.

### ARD multipliers

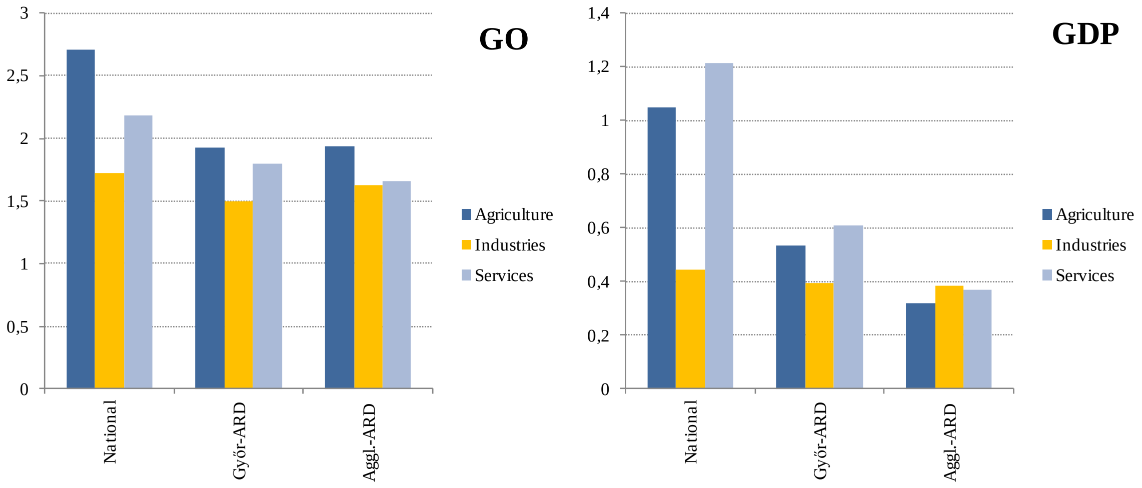
With the LQ-based regional direct requirement coefficients and the assumed consumption values I have counted out multipliers that involve multiplication processes through production, incomes and local household spending (Type II multipliers according to RIMS II terminology, Ambargis, & Mead, 2012). Income leakages and flows between the city and its hinterland along with relations managed in the SAM (see Koppány 2015) are ignored at this point.

Paradoxically GO multipliers of ARD show the highest levels in agriculture both in Győr and its agglomeration (Figure 3, left). Services take second palce, and industries only third. However, you must remembert that regional technology matrix was derived from national input-output data where the situation is the same. The results seemed to be striking at first glance are the heritage of the national table.

Assumptions used here explicitly lead to the lowest production multipliers in industries. Industrial production depends upon local suppliers with the smallest proportion and have the highest import quota. Technological coefficients between the city and the hinterland also seem to be pretty low. Note that calculations based on LQ's have generated zero interregional coefficients in many cases. If we have doubts about the numbers (by right!), we should use a survey method based on a representative local sample, which gives a specified data of regional purchaser-supplier relations, that is, intermediate consumptions and imports.

In the case of GDP multipliers (Figure 3, right) we have a "services, agriculture, industries" order in Győr, and "industries, services, agriculture" in the agglomeration. Strange results again, which can be explained by the LQ-based technological coefficients. Note that not only in GDP, but also in GO multiplication outskirts industries have a larger effect to ARD's economy than city: 1 HUF increase in final demand for the suburban firms generates higher effects on ARD's production than if it happened to the firms resident in the city. That's also because of the coefficients, which imply that highly concentrated industries in Győr impede any effects from the city's sector to the agglomeration's industries. On the other hand, agglomeration's industry depends upon the city with much higher requirement coefficients, thus, has a greater economy-making power.

**Figure 3:** Comparing national and ARD production-income (Type II) GO (left) and GDP (right) multiplicators




Higher values of GDP multipliers of agriculture and services in Győr can be explained by the same reasoning, on one hand. These two sectors in the city count on the agglomeration more than hinterlands agriculture and services count on Győr. On the other hand, one can notice significant sectoral differences in GDP/GO ratios between Győr and its agglomeration.

We can not wonder at regional multiplier values lower than national levels in general. It is always the situation: the smaller the analyzed area is, the lower the regional multipliers are. Thus industrial multipliers are necessarily are lower than national ones. But note that the least differences between regional and national levels we have in industries! Industrial dominance of Győr and its agglomeration reveal itself in these results.

## Conclusions and further research

In this paper I have presented a simple three-industry, two subregion multiregional input-output table of the Regional Automotive District of Győr based on national and county level official statistics and financal data of resident firms by a two-stage application of location quotients. Although the results can be considered as first rough estimates, main patterns and attributes of the industrial region are well recognizable.

The agenda for further research includes expanding the number of industries to 25-30 in the input-output table, calibrating both I/O and SAM blocks of the model based upon an own-developed hybrid technique, working out the behavioural equations, performing a thorough mathematical analysis of the system, and develop the computer programs and sites that provides data suppliers to use the model to detect and forecast their regional economic effects in Győr and its agglomeration.

## Brief biographies of the author

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