Analysis of Productivity Trends in 'Manufacture of motor vehicles' Industry in Hungary

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Abstract: *Hungary being a small, open economy, its 'Manufacture of motor vehicles' industry is also exposed to global trends. National accounts data show growing importance of this industry within the whole economy, so the analysis of productivity measures is in the spotlight of policymakers, scientists, economists. This paper aims at determining and analysing labour productivity, multi-factor productivity to better understand the development of productivity in the chain of industries led by 'Manufacture of motor vehicles' industry in the last decades. Using the available methodology, productivity measures have been determined, and our results are expected to show that the appearance of multinational corporations influences the run of productivity in the whole value-chain of industries (for example in 'Manufacture of rubber and plastic products').*

Introduction

The Manufacture of motor vehicles has significant role in the Hungarian economy. In 2014 it had 3.7 percent share in the GDP, employed 3.2 percent of the full-time workers and produced 25 percent of the output of Manufacturing. This industry exports 20 percent of the total Hungarian exports and 86 percent of its exports goes to EU28. The basic pillars of the Hungarian automotive industry are the multinational companies, like Audi Hungaria Motor Ltd., Mercedes Benz Manufacturing Ltd., Opel Szentgotthárd Automotive Ltd. and Magyar Suzuki Corporation. Many of the world's top suppliers are also present in Hungary, like Bosch, LUK, Continental, Denso, Delphi, Lear, Hankook Tires, Michelin and Bridgestone. Hungarian small and medium-sized companies supply these multinational companies, and it is characteristic that SMEs supply several multinational automotive companies or produce not only automotive parts and components, but other industrial goods as well.

The question is how to measure the positive impact of the presence of multinational companies on the Hungarian economy? Could they accelerate the domestic economy, and the improvement in productivity of which industries is attributable to the development of Manufacture of motor vehicles?

The organisation of this papers as follows; Section 1 describes the data and the methods used, Section 2 focuses on the results gained by the analysis of the Leontief-inverse matrix, and

finally Section 3 discusses the implications of this study and the answers to the aforementioned questions.

1.1 Methodology

Input-Output table for domestic output, the Leontief inverse matrix from the Input-Output table, the quarterly gross value added at constant and current prices and the quarterly working hours by industries have been used to analyse the role of Manufacture of motor vehicles in the Hungarian economy. The Input-Output tables are available for years 2005 and 2010. The time series of gross value added and working hours by industry are quarterly starting in the first quarter of 2008. The Input-Output table of industry by industry is provided in NACE Rev.2, A64 breakdown.

The Leontief-inverse matrix is suitable to describe the multiplicative effects of the change of final output on particular industries. The effects of output change on imports, the wages, the intermediate consumption from domestic sources, and the gross value added have been calculated.

The calculation of the labour productivity change is based on the gross value added and the working hour's data. In the first step the volume indices of gross value added compared to the previous quarter were calculated from the constant price data. In the next step the change of working hours was calculated by the Tornquist-index formula. The ratio of gross value added and working hours indices describes the change of labour productivity compared to the previous period. This data include significant seasonal effects, so it was adjusted seasonally. The X11 method with airline model and logarithmic transformation was applied for the seasonal adjustment. In order to analyse the trends of labour productivity the seasonally adjusted indices compared to the previous quarter were transformed to fix-based indices.

The SAS and EVIEWS programs were used for the analysis.

1.2 Scheme of the analysis

The recent studies pointed out that Hungary is significantly integrated within global-value chains, with nearly half of the total value of exports reflecting foreign content. Over 80% of total domestic value-added was driven by foreign final demand in 2011. (OECD 2015)

In Hungary the market entry of multinational companies promoted that view, that their presence accelerates the production of domestic value-chain industries. The aim of this study is to investigate this statement in case of Manufacture of motor vehicles industry using the national accounts data. For these reasons at the beginning of the research the following hypotheses have been set:

Figure 1
Hypotheses of research
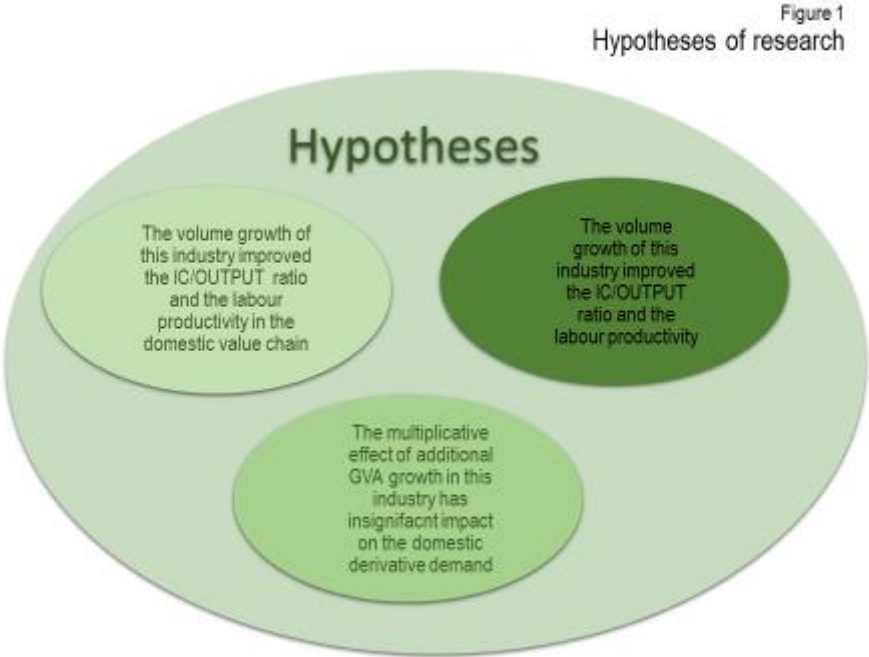
In the national accounts the ratio of intermediate consumption and output (IC/output) is the indicator of the technology used in an industry, as the remarkable and important technology changes can be reflected in this ratio as well. The development of the IC/output ratios have been analysed in the Manufacture of motor vehicles and its related value-chain industries, on one hand to investigate if the impact of multinational companies is traceable in this ratio and to explore potential correlations between the industries' IC/output ratios.

The ratio of GDP and hour worked indices is a measure of labour productivity. It measures how efficiently labour input is used in the production process.(OECD 2011) Our questions are if there is any improvement in the labour productivity in Manufacture of motor vehicles and its related value-chain industries and whether there is any causality between them.

To capture the multiplicative effects of Manufacture of motor vehicles industry, the Leontief inverse matrix based on the Input-Output table (IOT) for year 2010 was calculated. It can reveal

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the measure of additional resources (imports or domestic sources) required in the total economy to produce one unit more of output or gross value added (GVA).

To investigate our hypotheses there are several research schemes, of which that on the Figure 2 has been chosen into our research.

Figure 2
Scheme of research
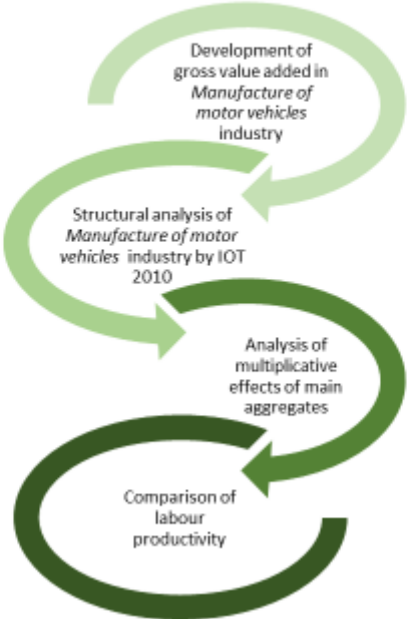
2.1 Development of GVA in *Manufacture of motor vehicles* industry

In the last decades the share of Manufacture of motor vehicles of the total gross value added was growing, while it was only 1.2 percent in 1995, in 2014 it reached 4.4 percent. Except for the year 2008 crisis the volume growth of this industry's GVA was above the one of the total economy. The average yearly growth was 14 percent in Manufacture of motor vehicles while in case of the total Hungarian economy it amounted to 2.2 percent only.

Figure 3
Development of *Manufacture of motor vehicles* industry's GVA in Hungary
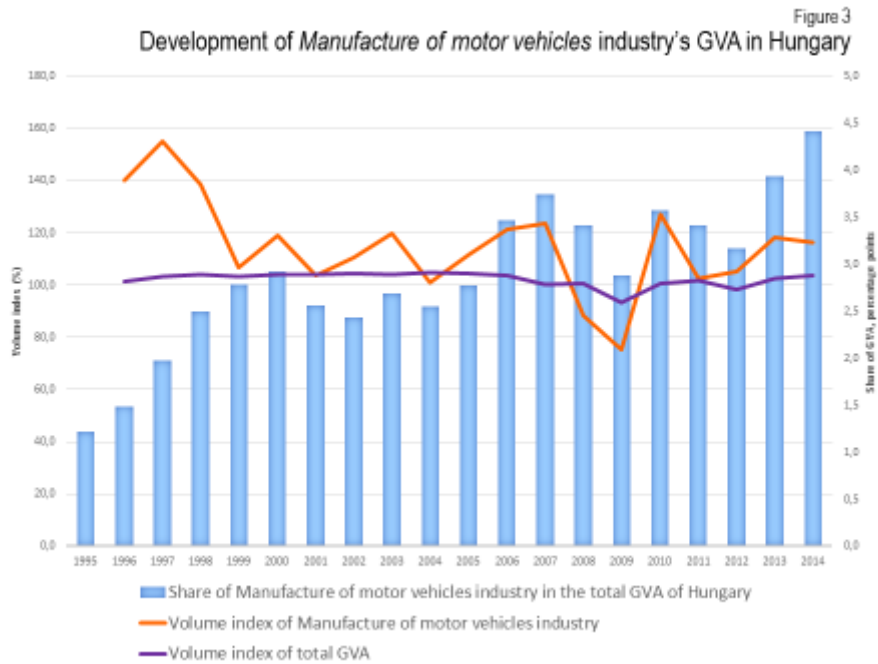
The share of Manufacture of motor vehicles has been increasing of the total Hungarian exports and imports. In 2014 its share was 17.7 percent of total imports and 20 percent of the total exports of Hungary. This industry's integration to German value-chains is stronger than one of the total Hungarian economy. While in 2014 Germany supplied 25 percent of the total Hungarian imports and used 27 percent of its exports, in case of this industry these figures were 51 and 54 percent, respectively.

2.2 Structural analysis of *Manufacture of motor vehicles* industry by IOT 2010

In the next step our research focused on the Input-Output tables to determine the main supply sources of the Manufacture of motor vehicles.

Figure 4
Structure of *Manufacture of motor vehicles* industry's GVA in Hungary (2010)
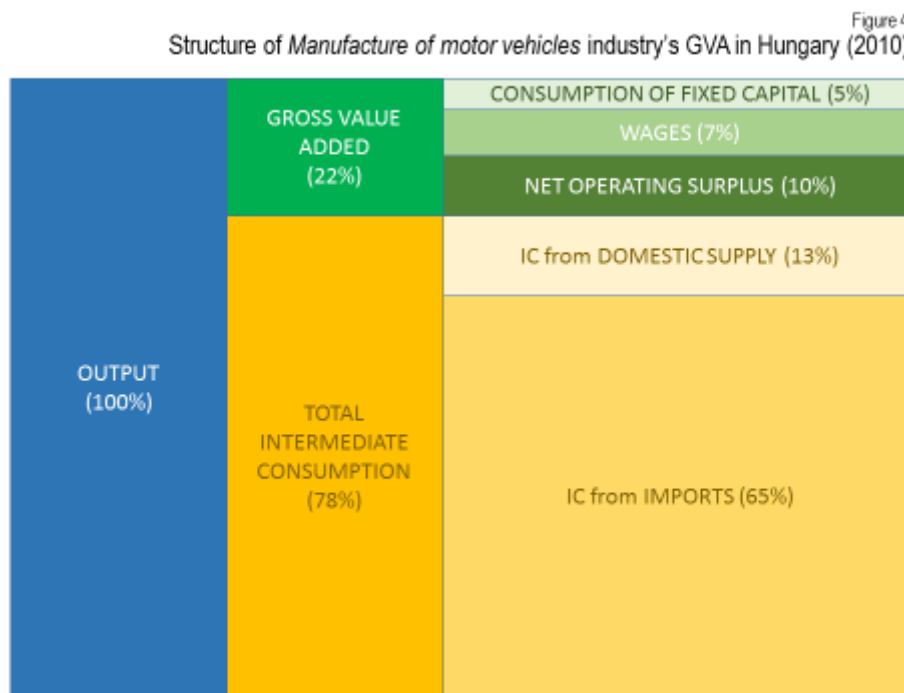
Source: HCSO, IOT2010

The IOT for year 2010 shows that the majority of this industry`s intermediate consumption comes from imports (83 percent of the total IC). As regards the domestic supply, its largest suppliers within Manufacturing are the following industries: Manufacture of machinery and equipment, Manufacture of rubber and plastic products and Manufacture of fabricated metal products. It has strong connections to such industries like Wholesale trade or Electricity, gas, steam and air conditioning supply, but these industries were out of the scope of our research. (Table 1)

Manufacture of machinery of equipment was subtracted from the research, because the company-level analyse showed that the large multinational company entering into this industry in 2009 significantly changed the characteristic of this industry, and it is not connected directly to the manufacture of motor vehicles.

Table 1

The distribution of intermediate consumption in Manufacture of motor vehicles industry, 2010

NACE REV.2.	Intermediate consumption at basic prices in Manufacture of motor vehicles, 2010	
	Million HUF	%
Agriculture, forestry and fishing	1 421	0.29
Mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities	303 102	62.85
Of which:		
Manufacturing	271 812	56.36
Manufacture of food products, beverages and tobacco products	1 500	0.31
Manufacture of textiles, apparel, leather and related products	2 369	0.49
Manufacture of wood and paper products, and printing	4 136	0.86
Manufacture of coke, and refined petroleum products	4 478	0.93
Manufacture of chemicals and chemical products	6 142	1.27
Manufacture of pharmaceuticals, medicinal chemical and botanical products	1 099	0.23
Manufacture of rubber and plastics products, and other non-metallic mineral products	24 087	4.99
Manufacture of basic metals and fabricated metal products, except machinery and equipment	44 801	9.29
Manufacture of computer, electronic and optical products	18 588	3.85
Manufacture of electrical equipment	17 673	3.66
Manufacture of machinery and equipment n.e.c.	27 463	5.69
Manufacture of transport equipment	116 035	24.06
Other manufacturing, and repair and installation of machinery and equipment	3 441	0.71
Construction	2 261	0.47
Services, total	175 479	36.39
Of which:		
Wholesale and retail trade; repair of motor vehicles and motorcycles; accommodation and food service activities	50 225	10.41
Transportation and storage	22 183	4.60
Information and communication	9 447	1.96
Financial and insurance activities	10 817	2.24
Real estate activities	14 771	3.06
Professional, scientific and technical activities; administrative and support service activities	59 514	12.34
Public administration and defence; compulsory social security; education; human health and social work activities	6 948	1.44
Arts, entertainment and recreation, repair of household goods and other services	1 574	0.33
Intermediate consumption from domestic supply, total	**482 263**	**100.00**
Intermediate consumption from imports	**2 418 563**	

Source: HCSO, IOT2010

Table 2
Distribution of output in Manufacture of motor vehicle, 2010

| NACE REV.2.	Output at market prices of Manufacture of motor vehicles, 2010	
	Million HUF	**%**
Agriculture, forestry and fishing	1 105	0.50
Mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities	162 343	73.97
Of which:		
Manufacturing	157 791	71.89
Manufacture of food products, beverages and tobacco products	2 690	1.23
Manufacture of textiles, apparel, leather and related products	375	0.17
Manufacture of wood and paper products, and printing	1 136	0.52
Manufacture of coke, and refined petroleum products	659	0.30
Manufacture of chemicals and chemical products	904	0.41
Manufacture of pharmaceuticals, medicinal chemical and botanical products	240	0.11
Manufacture of rubber and plastics products, and other non-metallic mineral products	5 219	2.38
Manufacture of basic metals and fabricated metal products, except machinery and equipment	9 711	4.42
Manufacture of computer, electronic and optical products	3 817	1.74
Manufacture of electrical equipment	5 152	2.35
Manufacture of machinery and equipment n.e.c.	9 239	4.21
Manufacture of transport equipment	115 738	52.73
Other manufacturing, and repair and installation of machinery and equipment	2 911	1.33
Construction	20 447	9.32
Services, total	35 589	16.21
Of which:		
Wholesale and retail trade; repair of motor vehicles and motorcycles; accommodation and food service activities	12 214	5.56
Transportation and storage	7 434	3.39
Information and communication	1 327	0.60
Financial and insurance activities	810	0.37
Real estate activities	4 328	1.97
Professional, scientific and technical activities; administrative and support service activities	6 261	2.85
Public administration and defence; compulsory social security; education; human health and social work activities	2 193	1.00
Arts, entertainment and recreation, repair of household goods and other services	1 022	0.47
Output for domestic intermediate consumption, total	**219 484**	**100.00**
Output for exports	**3 375 525**	

Source: HCSO, IOT2010

In case of total Manufacturing 53 percent is the share of import supply from the total output and 69 percent of the total intermediate consumption. The Manufacture of motor vehicles is the second largest importer in Manufacturing, it represents 22 percent of the Manufacturing`s imports for intermediate consumption.

As Table 2 shows the majority (72 percent) of the industry's output for domestic intermediate consumption goes to Manufacturing. Construction and total services use 25 percent of the output. The output for exports is 15 times greater than the domestic demand for intermediate use.

According to IOT 2010 the ratio of imports and output is 64 percent, the ratio of wages and output is 7 percent and ratio of consumption of fixed capital and output is 4.8 percent in the Manufacture of motor vehicles.

In the next step the intermediate consumption/output ratio of the main domestic suppliers of the Manufacture of motor vehicles has been analysed.

Figure 5
Development of the IC / OUTPUT ratio between 1995 and 2014 in Hungary

Source: HCSO
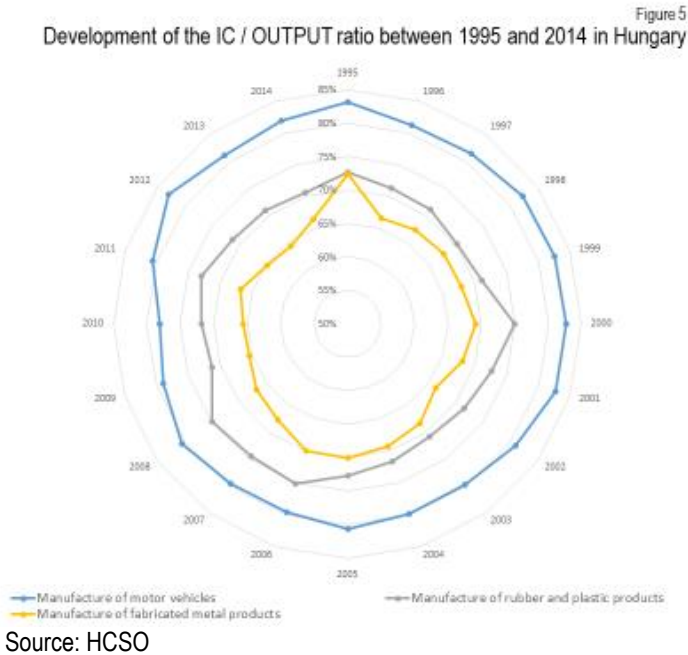
According to Figure 2 it would be assumed that the IC/output ratio has been improving in Manufacture of fabricated metal products, but the further analysis could not discover the presence of significant improving (or deteriorating) trends in these industries. In Manufacture of machinery and equipment the remarkable change in 2009 was due to the entry of a large multinational company to this industry.

The constant IC/output ratios indicate that probably in these industries revolutionary technological progress has not been made in the last decades.

2.3 Analysis of multiplicative effects of main aggregates

The Leontief inverse matrix is a useful tool to explore the multiplicative effects in an economy, how the production of an additional output unit in a given industry boosts the total domestic economy

According to the Leontief inverse matrix the output growth in the Manufacture of motor vehicles results the highest imports growth among the analysed industries. If the GVA is taken into account, the differences are even higher, the production of an additional unit of GVA generates 3.22 additional unit of imports growth in this industry. The relatively high IC/output ratio explains these results (see Table 3).

In the Manufacture of motor vehicles the production of additional 1 Million HUF of GVA generates demand for the labour of 0.14 person, which is relatively low.

Table 3
Analysis of derivative demand (2010)

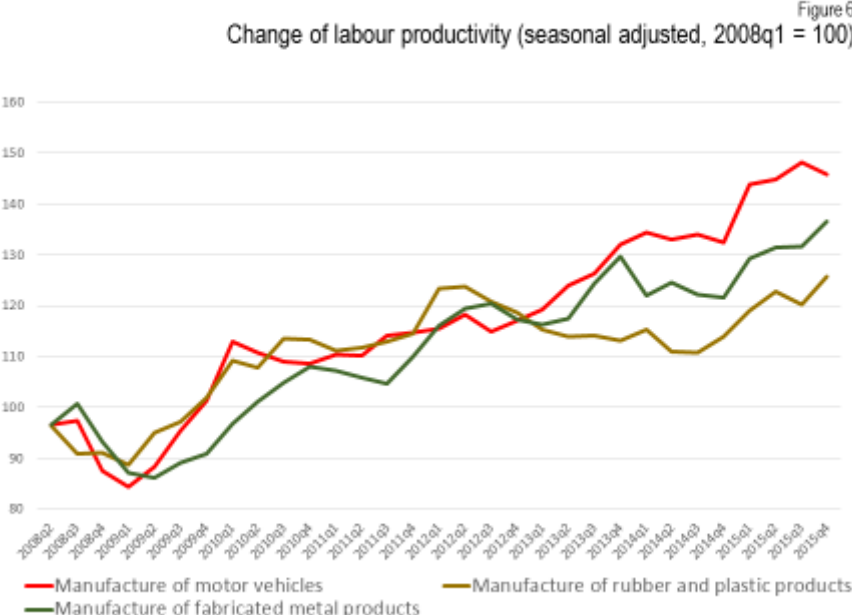|	Manufacture of motor vehicles	Manufacture of rubber and plastic products	Manufacture of fabricated metal products
Derivative demand for a unit of output (million HUF)			
imports	0,71	0,54	0,43
labour input (persons)	0,03	0,07	0,11
fixed capital	0,06	0,09	0,07
wages	0,11	0,22	0,32
IC/output ratio	0,78	0,72	0,66
Derivative demand for a unit of gross value added (million HUF)			
imports	3,22	1,92	1,25
labour input (persons)	0,14	0,25	0,33
fixed capital	0,28	0,32	0,21
wages	0,49	0,78	0,92

Source: HCSO, IOT2010

Among the analysed industries the IC/output ratio is the highest in the Manufacture of motor vehicles, so the GVA/output ratio is only 0.22. If the additional production accelerated by this industry in the total economy is also taken into account, an additional unit of output produced

by Manufacture of motor vehicles requires the production of 0.29 unit of GVA in the total economy. It results that only 0.07 additional unit of GVA is produced by other industries. It is the smallest among the analysed industries and one of the smallest in the total economy. The high import exposure of Manufacture of motor vehicles and its value-chain industries is in the background of these figures.

2.4 Comparison of labour productivity

The analysis of labour productivity was also in the focus of the research. The improvement of the labour productivity is one of the most important indicators of a given country's comparative advantages and has significant impact on its international competitiveness.

Figure 6
Change of labour productivity (seasonal adjusted, 2008q1 = 100)

Source: HCSO, own calculation

All of the industries reported improving labour productivity compared to the 1st quarter of 2008. Since this quarter the average annual growth of labour productivity in Manufacture of motor vehicle was 5.5 percent, in the same period it was 3.3 percent in Manufacture of rubber and plastic products, and 4.5 percent in the Manufacture of fabricated metal products.

The cross-correlation of Manufacture of motor vehicles with the other two industries is significant, so the question is if the causality between the industries' labour productivity improvements is detectable by statistical tests or it is explained by external factors.

The causality between the time series was examined by Granger causality test. According to the results we accept the hypotheses that the change of the labour productivity in the Manufacture of motor vehicles provokes the labour productivity change in the Manufacture of fabricated metal products. Causality is not significant between the other time series.

As regards the Manufacture of rubber and plastic products the derivative demand of Manufacture of motor vehicles has less influence, because in this industry there are large production capacities which are not connected to the automotive industry and the contracted export work has high importance as well.

Manufacture of fabricated metal products industry includes several domestic suppliers of large automotive multinational companies and their top suppliers in the value-chain.

3. Conclusion and future works

Our results show that the volume growth in the Manufacture of motor vehicles does not improve significantly the IC/output ratio in this industry or its related value-chain industries. On the other hand, its positive impact on the labour productivity change in the Manufacture of fabricated metal products is probable. As regards the other two value-chain industries the causality is not significant, the companies in these industries have strong connections to other areas not related to the automotive production.

The domestic derivative demand of the additional gross value added growth in Manufacture of motor vehicles on the total economy level is low-scale, because of the high import exposure of this industry and its related value-chain industries as well. In addition the industry's GVA/output ratio is relatively low and it requires relatively small labour input to produce a unit of GVA.

This analysis has been prepared as part of a pilot project aiming to build a comprehensive system measuring the productivity change of the Hungarian economy. In addition to the labour productivity the long-term goal is to prepare multi-factor productivity figures for all the industries.

4. References

OECD (2001): Measuring Productivity OECD Manual, Measurement of Aggregate and Industry-level productivity Growth https://www.oecd.org/std/productivity-stats/2352458.pdf

OECD (2015): Trade-in value added: Hungary https://www.oecd.org/sti/ind/tiva/CN_2015_Hungary.pdf