

SOURCES OF GVA GROWTH IN DIVISIONS OF MANUFACTURING SECTOR AFTER CRISIS PERIOD

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Abstract

The basic indicator for measuring of manufacturing sector performance is gross value added (GVA). The sources of growth GVA can be divided into extensive or intensive sources. The dynamics of GVA in manufacturing is influenced by the business cycle. The paper deals with the analysis of source of GVA growth in manufacturing of the Czech Republic. The manufacturing sector is divided in many different branches - divisions. The article identifies the importance of extensive and intensive sources in the economic growth of manufacturing divisions. The analysis focuses on divisions with the highest growth of GVA after crisis period. Data sources were taken from the Czech Republic national accounts in the period of 2009-2013. It was found that source of economic growth are not the same in all divisions of manufacturing. The analysis found that the main source of GVA growth in the post-crisis period was intensive growth for most divisions of manufacturing. On the contrary, the extensive growth prevailed in the automotive industry and manufacture of rubber and plastic products.

Key words: economic growth, gross value added, manufacturing, crisis period

JEL Code: D24, E01, E23

Introduction

At present time manufacturing is not uniform sector. Manufacturing consists of different divisions with different development of economic performance. The most significant factor that affects these divisions of manufacturing can be considered business cycle (Marchetti, 2002). Cyclical impact of the economy on the divisions performance is in some sections more some less. Different reaction of sections we can expect especially in crisis or post-crisis period. The aim of the paper is to identify the main sources of growth in the individual divisions of manufacturing in the post-crisis period with focusing on divisions with high growth.

The performance of economy is usually measure by the gross domestic product. The performance of individual sectors of the national economy is better to expressed by gross value added (GVA) (Sixta et al., 2011). Sources of growth in gross value added can be divided into extensive resources then we talk about the extensive growth or can be intense, then talk about intensive growth. If we talk about the extensive and intensive growth is the result of qualitative and quantitative changes in factors productivity (Hájek&Mihola 2009).

The basis for measuring sectors performance is sectorial production function. In its simplest version, the neoclassical growth model assumes that the economy has one sector producing national product Y with a production function $Y(t) = F(L(t), K(t))$ where $L(t)$ is labour, $K(t)$ is capital and t denotes time (Matsumoto&Szidarovszky, 2011). Modern growth theory builds on the neoclassical model of exogenous growth which views the accumulation of physical capital, associated with a permanent flow of technical progress. The production function takes the form $Y(t) = F[K(t), L(t), T(t)]$. $Y(t)$ is the flow of output at time t . Capital, $K(t)$, represents the durable physical inputs such as machines, buildings and so on. Labour, $L(t)$, represents the inputs associated with human body. The third input is the level of knowledge or technology, $T(t)$ (Barro&Martin,2004). It is necessary to take into production function the business cycle. The augmented production function which captures efficiency changes during the business cycle can be written as: $Y = Y(K, L, HK, U)$ where HK is human capital per worker and U is an indicator of the business cycle (Smolny, 2000).

Economic growth of economy or sectors is influenced by many factors as business cycle. The basic theory is now a real business cycle theory. The main authors of the theory of real business cycles (real business cycles - RBC) are Kydland, Prescott (1982), whose model is considered as a standard RBC model. This concept is focused on explain economic fluctuations. A important general characteristic of business cycles appears to be the tendency of outputs in different branches to move together. This hypothesis was confirmed by Long and Plosser (1987). They told, that some sectors displays less coherence with other sectors (agriculture,...). On the other hand Bhattacharjee, de Castro and Jensen-Butler (2009) showed that development of productivity in business cycle has showed substantial variation in sectors. The business cycle affects not only output of sectors but also sectors productivity in the short run and in the long run (Smolny, 2000). The business cycle also affects other economic indicators such as unemployment (Pavelka&Loester, 2013) or the size of investments (Halova&Alina, 2014).

1 Data and methodology

The paper deals with the analysis of source of gross value added (GVA) growth in manufacturing divisions of the Czech Republic. Our research project is focused on the post-crisis period and on analysis of the divisions that have managed to start economic growth. The aim was to discover which divisions have achieved growth through extensive (extensive factor) or intensity way (increasing the efficiency of utilization of factors of production). The analysis focuses on the Czech Republic. Data were collected from the national accounts published by the Czech Statistical Office within the period 2009-2013. The basic year for analysis was chosen year 2009 when economy and Manufacturing were affected by the global economic crisis. The selected indicators were: labour productivity – LP (ie. gross value added/hours worked, the capital productivity – CP (ie. gross fixed capital formation/gross value added), nominal unit labour costs – NULC (ie. employees compensation at current prices/gross value added in constant price in 2010). Indicators mentioned above (excluding employees' compensation) were measured as real indicators ie. at comparable prices in 2010. From the database of the national accounts were used volume indices in constant price of previous year. One of which was found a geometric mean of the average growth rate. The Total factor productivity (TFP = Total Factor Productivity) found out the growth of productivity in 2013 (current period) compared to 2009 (basic period).

$$\frac{A_1}{A_0} = \frac{Y_1}{Y_0} \cdot \left(\frac{C_1}{C_0} \right)^{-\alpha_{Ct}} \cdot \left(\frac{L_1}{L_0} \right)^{-\alpha_{Lt}} \quad (1)$$

Where:

Y_1/Y_0 is the index of real output (gross value added in constant price in 2010),

C_1/C_0 is the index of real gross stock of long-term property (index of gross fixed capital formation in constant prices in 2010)

L_1/L_0 is the index of number of hours worked off

α_{Lt} is the arithmetical mean from the compensation of employees' ratio in GVA in the basic and current period

α_{Ct} is the arithmetical mean from the gross operating surplus in GVA in the basic and current period, thus it applies that $\alpha_{Lt} + \alpha_{Ct} = 1$.

When calculated the Tornquist formula of discrete approximation of Divisioiv's integral index was used, namely:

$$\ln A_t - \ln A_{t-1} = (\ln Y_t - \ln Y_{t-1}) - \alpha_{C_t}(\ln C_t - \ln C_{t-1}) - \alpha_{L_t}(\ln L_t - \ln L_{t-1}). \quad (2)$$

It follows:

$$(\ln Y_t - \ln Y_{t-1}) = [(\ln A_t - \ln A_{t-1})] + [\alpha_{C_t}(\ln C_t - \ln C_{t-1}) + \alpha_{L_t}(\ln L_t - \ln L_{t-1})] \quad (3)$$

The first square bracket of the formula represents the intensive factor of the real product (i), the second square bracket is the Extensive Growth Factor (e).

The influence of the extensive factor can be further divided into the labour impact (the first summand of the formula 4) and the capital impact (the second summand of the formula) ie:

$$e = \frac{\alpha_{C_t}(\ln C_t - \ln C_{t-1}) + \alpha_{L_t}(\ln L_t - \ln L_{t-1})}{|(\ln A_t - \ln A_{t-1})| + |\alpha_{C_t}(\ln C_t - \ln C_{t-1}) + \alpha_{L_t}(\ln L_t - \ln L_{t-1})|} =$$

$$\frac{\alpha_{C_t}(\ln C_t - \ln C_{t-1})}{|(\ln A_t - \ln A_{t-1})| + |\alpha_{C_t}(\ln C_t - \ln C_{t-1}) + \alpha_{L_t}(\ln L_t - \ln L_{t-1})|} + \frac{\alpha_{L_t}(\ln L_t - \ln L_{t-1})}{|(\ln A_t - \ln A_{t-1})| + |\alpha_{C_t}(\ln C_t - \ln C_{t-1}) + \alpha_{L_t}(\ln L_t - \ln L_{t-1})|} \quad (4)$$

2. Results

2.1. Manufacturing

The manufacturing plays a very important role in Czech economy. Manufacturing makes up 24.7% of Czech Republic gross value added. The development of manufacturing was affected by the global crisis (decline of GVA in 2009 was 12.1%) as well as in all economy of the Czech Republic (decline of GVA 5.5%). The performance of manufacturing was increased in the next period after 2009. In last analysed years 2012 and 2013 the physical volume of production in manufacturing was reduced. If we compare the selected indicators evaluating the effectiveness of factors of production in 2013 compared to 2009 (Table 1) we can found followed facts. One-factor productivity indicators (labour productivity and capital productivity) indicate growth in manufacturing and in the whole Czech economy. Single-factor productivity grows faster in manufacturing then in total economy. Total factor productivity is a positive (its value is greater than 1) and also there are higher levels of manufacturing. If the value of TFP > I GVA then extensive source of economic growth is negative (Novotna&Volek, 2014). Nominal unit labour costs in the whole economy increased and their growth was higher than growth in labour productivity, which means that wage growth has not been supported by growth in labour productivity. Nominal unit labour costs in

manufacturing decreased by 3.2% in comparison with 2009 and labour productivity in the same period increased by 10%.

Tab. 1: Development of selected indicators (2013/2009)

	Czech Republic – Total	Manufacturing
extensive factor	-0.362	0.160
intensive factor	0.638	0.840
index GVA	1.035	1.178
TFP	1.083	1.148
labour productivity (LP)	1.017	1.101
capital productivity	1.145	1.248
nominal unit cost	1.048	0.968

Source: Czech Statistical Office - National account

2.2. Divisions of manufacturing

Manufacturing is divided into 24 divisions. The most important divisions are Manufacture of motor vehicles, trailers and semi-trailers (18% of GVA Manufacturing) and Manufacture of fabricated metal products, the except machinery and equipment (11% of GVA Manufacturing). What was the reaction of the individual divisions on the economic crisis in 2009? Most divisions have re-growth and performance has exceeded the level of 2009. Some divisions of Manufacturing (Manufacture of tobacco products, Manufacture of textiles and Manufacture of wearing apparel) are still unable to get their initial performances before the crisis.

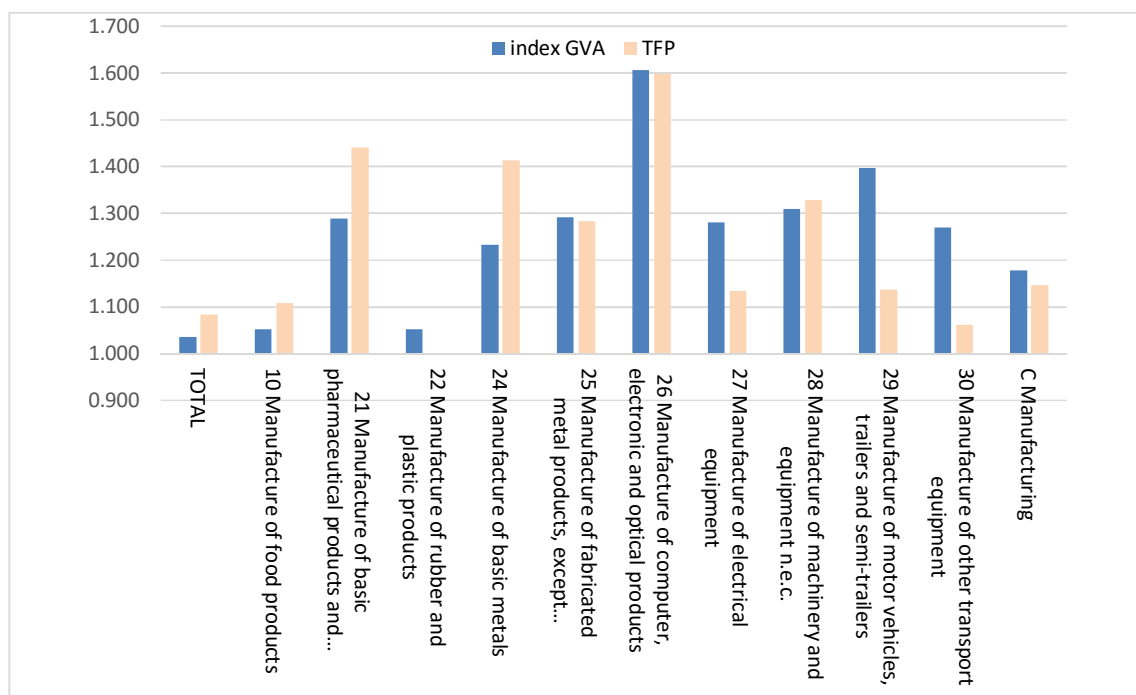
For manufacturing was found annual growth rate of gross value added (GVA) by volume indices in the prices of the previous (previous years) period. It is a chain index of physical volume of GVA. It was subsequently found average growth rate (average chain Index) for the period 2009-2013 and were selected only divisions where the average growth exceeding 100% (73 % of all divisions). Table 2 shows those sections of the manufacturing. Paper is focused only on those sections that have had since the crisis of 2009 growth (100 % and more). The most affected divisions by the global crisis in 2009 were divisions 29 and 28 with a decrease in production volume by more than 20%. Considerable decline in production was observed in divisions 25, 26 and 27, by more than 10%. All mentioned divisions have succeeded in starting grow again over the coming years. Some divisions were not affected by the crisis development, even with a delay. This is a division 21, 22. 10, where the annual volume index has not fallen in almost all periods below 100%.

Tab. 2: Gross Value Added – divisions of manufacturing (volume indices - p.y.=100%)

NACE – divisions of manufacturing	2009	2010	2011	2012	2013	Ø growth
26 Manufacture of computer, electronic and optical products	84.7	147.9	104.3	109.1	95.5	106.4
21 Manufacture of basic pharmaceutical products and pharmaceutical preparations	100.6	109.8	107.7	100.7	108.4	105.4
30 Manufacture of other transport equipment	90.6	109.5	130.9	92.5	95.7	102.8
24 Manufacture of basic metals	92.4	101.5	117.6	93.3	110.7	102.6
27 Manufacture of electrical equipment	89	118.4	121.4	97.5	91.3	102.6
22 Manufacture of rubber and plastic products	104.5	106.7	104.1	92.3	102.6	101.9
25 Manufacture of fabricated metal products, except machinery and equipment	84.8	118	104.1	102.6	102.5	101.8
29 Manufacture of motor vehicles, trailers and semi-trailers	77.6	130.3	124.3	94.2	91.5	101.6
10 Manufacture of food products	102.7	106.2	106	91.6	102.1	101.6
C Manufacturing	87.9	111.2	110.1	98.6	97.6	100.7
28 Manufacture of machinery and equipment n.e.c.	76.8	115.7	113	103.2	97	100.1
TOTAL	94.5	102.9	102	99.3	99.4	99.6

Source: Own calculations based on the data National account

If is analysed the growth of gross value added it is also necessary to look at development total factor productivity (TFP). The following Figure 1 shows the change in GVA and TFP compared with 2009. It is obvious that in most cases are the growth rate of GVA same or higher than TFP. On the other hand, there will be some divisions where TFP growth exceeds the growth of gross value added as in the Manufacture of basic metals and Manufacture of food products.

Fig. 1: Change in GVA and TFP


Source: Own calculations based on the data National account

Further analysis was focused on the analysis of the main sources of growth GVA in the divisions of manufacturing with GVA growth. The aim was to determine whether the growth of these divisions after the crisis period was started through an extensive factor (factors of production labour and capital) or through intensive factor (growth of technical progress).

Tab. 3: Sources of GVA growth 2013 in a comparison with 2009

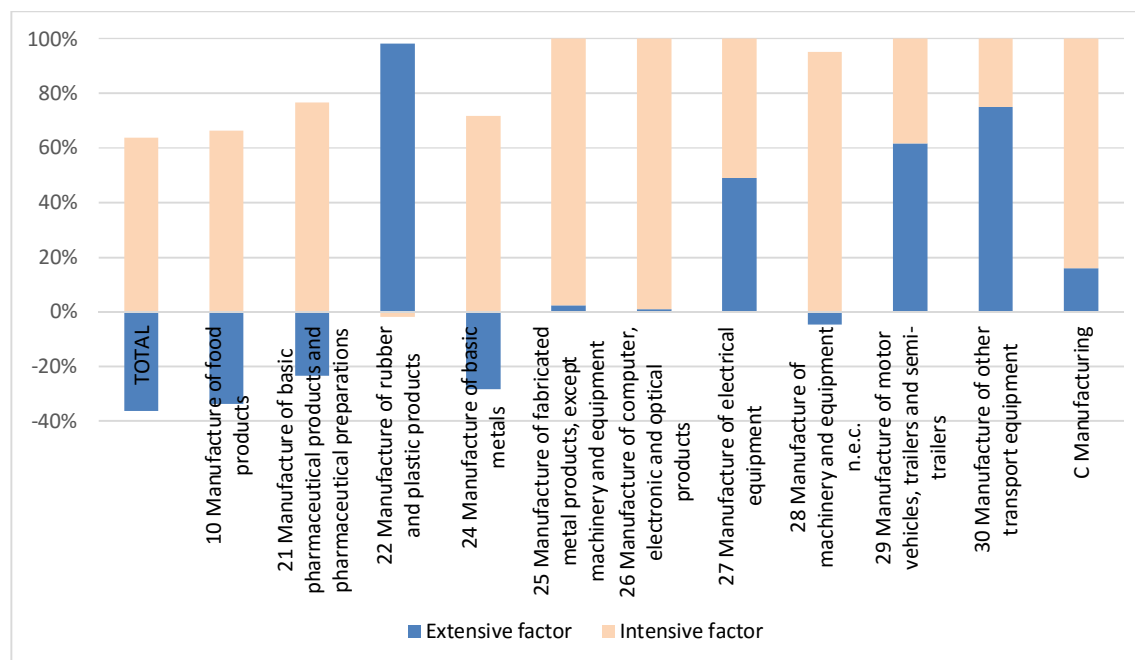
NACE – divisions of manufacturing	Extensive factor	Intensive factor	index GVA	TFP
TOTAL	-0.362	0.638	1.035	1.083
10 Manufacture of food products	-0.337	0.663	1.052	1.109
21 Manufacture of basic pharmaceutical products and pharmaceutical preparations	-0.234	0.766	1.289	1.441
22 Manufacture of rubber and plastic products	0.982	-0.018	1.052	0.999
24 Manufacture of basic metals	-0.283	0.717	1.233	1.413
25 Manufacture of fabricated metal products, except machinery and equipment	0.024	0.976	1.291	1.284
26 Manufacture of computer, electronic and optical products	0.010	0.990	1.606	1.599
27 Manufacture of electrical equipment	0.491	0.509	1.281	1.134
28 Manufacture of machinery and equipment n.e.c.	-0.047	0.953	1.309	1.328
29 Manufacture of motor vehicles, trailers and semi-trailers	0.615	0.385	1.396	1.137

30 Manufacture of other transport equipment	0.751	0.249	1.269	1.061
C Manufacturing	0.160	0.840	1.178	1.148

Source: Own calculations based on the data National account

Table 3 illustrates the main sources of growth for the individual divisions of manufacturing. The economic growth of some divisions are mainly driven by extensive growth or by intensive growth. Among the divisions, which are driven by extensive growth are mainly Manufacture of rubber and plastic products, Manufacture of motor vehicles, trailers and semi-trailers and Manufacture of other transport equipment. Conversely, between divisions with the prevailing intensive growth are Manufacture of fabricated metal products, except or machinery and equipment, Manufacture of computer, electronic and optical products and Manufacture of machinery and equipment. Also we can find division where resources of growth are balanced - Manufacture of electrical equipment. This situation is illustrated in Figure 2, which are clearly indicated sources of economic growth for the individual divisions of manufacturing.

Fig. 2: Source of growth in divisions of manufacturing



Source: Own calculations based on the data National account

The last part is focused on divisions of manufacturing which had the biggest decline in performance in 2009 (decrease more than 10%). The analysis found that the main source of growth for these divisions is intensive growth except the automotive industry.

Conclusion

The global the crisis in 2009 very affected manufacturing but individual sections of manufacturing were affected with different degrees. The biggest fall in economic performance was observed in the Manufacturer of motor vehicles, trailers and semi-trailers (- 22 % of GVA). Detailed analysis of the economic development from 2009 to 2013 has showed that more than 73% of the manufacturing divisions (measured by share of GVA) had high growth since the crisis of 2009. The biggest growth of gross value added (2013/2009) achieve the Manufacture of computer, electronic and optical products (growth more than 60%) and Manufacture of motor vehicles, trailers and semi-trailers (growth 40%).The analysis of manufacturing divisions has showed that the dominant source of growth in divisions with high GVA growth has been intensive growth. The extensive growth prevails in divisions Manufacture of rubber and plastic products, Manufacture of motor vehicles, trailers and semi-trailers and Manufacture of other transport equipment. The last part was focused on sections where there was the largest annual decline in performance in 2009. It was found that the main source of growth in these divisions except automotive industry is intensive growth. Haugh, Mourogane and Chatal (2010) also attach high importance to extensive growth for the automotive industry.

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