MAGYAR NEMZETI BANK

GROWTH REPORT

2017

'The true power of a nation is the number of scientifically educated citizens.'

Hitel (Credit) 178.
Count István Széchenyi

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Pursuant to Act CXXXIX of 2013 on the Magyar Nemzeti Bank, the primary objective of Hungary's central bank is to achieve and maintain price stability. Low inflation ensures higher long-term economic growth and a more predictable economic environment, and moderates the cyclical fluctuations that impact both households and companies. Without prejudice to its primary objective, the MNB supports the maintenance of the stability of the financial intermediary system, the enhancement of its resilience, its sustainable contribution to economic growth; furthermore, the MNB supports the economic policy of the government using the instruments at its disposal.

The growth trends of the economy may influence, both directly and indirectly, the ability of monetary policy to reach its objectives set out in the MNB Act and consequently the conduct of monetary policy. Changes in the dynamics and structure of economic growth may determine the evolution of short-run inflation trends, while the longer-term growth potential and its factors may have a fundamental impact on the assessment of the financial stability of the economy. With that in mind, the Magyar Nemzeti Bank will provide an annual overview of the most important trends shaping economic growth over the short, medium and longer term, presenting its assessments to members of the profession at home and abroad in its Growth Report.

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The analyses in this Report were prepared under the direction of Barnabás Virág, Executive Director of the Executive Directorate Monetary Policy and Economic Analysis. The Report was prepared by staff at the MNB's Directorate Economic Forecast and Analysis, Directorate Monetary Policy and Financial Market Analysis and Research Directorate. The Report was approved for publication by Dr György Matolcsy, Governor.

The Report incorporates valuable input from other areas of the MNB.

Contents

Summary of key findings

The Growth Report presents a comprehensive picture of the development path of the Hungarian economy over a longer-term horizon and the most important factors determining this path.

The Magyar Nemzeti Bank analyses trends in economic growth in several regular publications, such as the Inflation Report, the Report on the Balance of Payments and the Financial Stability Report. These publications typicaly focus on the business cycle, specifically analysing changes in variables which determine the stance of monetary policy. The objective of the annual Growth Report is to directly present the longer-term trajectory of Hungarian economic variables, sometimes over an entire business cycle, and the related critical factors, using both standard and alternative indicators. In addition to a detailed examination of the available domestic data, we supplement our analyses with international and historical comparisons.

Section One of this Growth Report examines the changes in the macro-level income ratios observed over the past decades. The ratio of labour incomes and the related employer burdens measured as a proportion of GDP, i.e. the wage share, show a substantial, widespread decrease in a number of countries globally, as well as in most industries.

Classical macroeconomic theory was hardly able to explain the process and also failed to explore the consequences of the falling wage share. At present, there is no consensus among economists in respect of the reasons for the declining trend. In his bestseller, Piketty (2013) comes to the conclusion that it is a feature of capitalism that the wage share moves on a declining path, unless it is interrupted by some external effect (war or state intervention). Although leading economists welcomed his analysis, the calculations involve significant presumptions that are not supported by empirical findings. As a consequence, Piketty's distinct conclusions and extrapolations have failed to have a resounding success.

There is also no consensus among economists in respect of the impact of technological progress on the wage share. Based on the IMF's calculations, technological progress and rising productivity reduced the wage share in countries where the initial exposure to automation was high. According to other analyses, it was actually the deceleration in productivity that caused the wage share to decrease. However, economists agree that globalisation in the broad sense of the word, i.e. the cross-border movement of final goods, services and factors of production, had a downward effect on the wage share in certain countries, particularly in the case of developing economies. The wage share of foreign-owned companies falls substantially short of that registered at domestic companies, and this is also the case in Hungary. Institutional factors, such as the decline in trade unions' coverage and outsourcing were important factors that caused the wage share to decrease.

The decrease in the wage share has a number of negative consequences for economic growth and the structure thereof, and for economic stability and social inequalities.

The decrease in the wage share reduced consumption in all countries under review. In terms of aggregate demand, the impact of the simultaneous increase in the share of profit on investments was not sufficient to offset the fall in consumption. The lower wage share improved export competitiveness and the volume of exports, but this has not compensated for the drop in domestic demand: according to the calculations, in the EU15 as a whole a decline of one percent in the wage share caused GDP to decrease by 0.3 percent. Several international institutions found a connection between changes in the wage share and the rise in inequality. In their paper, Berg and Ostry (2011), concluded that the countries that develop with smaller inequalities are generally able to achieve more stable growth path.

In addition to income distribution, another question related to distribution is the heterogeneity of the economy's enterprises. These problems are concealed by the macroeconomic aggregates, but it is important to understand the underlying processes.

The Hungarian economy has a dual structure. For this reason, it is important to outline the growth strategies that support SMEs' productivity growth. One such strategy for SMEs could be entering external markets, which is discussed in detail in Section 2 of the Report.

After starting to export, enterprises increase their number of employees, their capital intensity and improve their labour and total factor productivity. Improved performance may manifest itself via several channels during exporting. For example, enterprises improve their products to satisfy demand differing from that in Hungary. New competitors force enterprises to implement additional innovations and technological knowledge is transferred from large corporations to small and medium-sized enterprises as a result of the supplier relations. On the whole, exporting may be regarded as a learning process in the lifecycle of enterprises.

Our results show that the performance of exporting SMEs exceeds that of non-exporter SMEs in several dimensions.

Exporting SMEs also usually outperform non-exporters in terms of capital intensity, investments and value added, with companies exporting services taking the lead in productivity. Even considering initial corporate characteristics, it can be demonstrated that exporting firms increase their productivity faster than their non-exporting peers and that the export of goods together with services occasionally generates even more advantages for the exporting SMEs than the export of goods only.

Despite the fact that exporting generates a number of benefits for SMEs, only a small number of SMEs participate in exports, which is mostly attributable to the fact that – compared to large corporations –they face more obstacles when entering external markets.

Based on the results, the export performance of Hungarian small and medium-sized enterprises lags behind the EU average. Although SMEs play an important role in external trade within the EU, it can be concluded that they export to a relatively small number of countries. In terms of their number, merely 5 percent of SMEs export, and their exports are mostly goods. Micro and small enterprises are not active on the external markets, while on average 50 percent of medium-sized enterprises do export. The smaller an enterprise is, the longer it takes it to enter the export market after the establishment of the company. Most of the factors that complicate exports arise from enterprise size and can be linked to the absence of adequate human resources, financing, regulation and the high cost of adopting standards, as well as limited access to information. The removal of such obstacles facilitates more intensive participation of SMEs in export markets. The diversification of export by destination and product or service types is expensive for SMEs. Services exports provide SMEs with a new opportunity to join international trade.

Sections 3, 4 and 5 of the Growth Report, and its Special Topic deal with the impacts of technological progress, presenting and analysing these impacts on the basis of international and domestic data.

In Section 3, we examine the impact of technological progress on the labour market. Section 4 discusses the distortions appearing in the measurement of GDP as a result of digitalisation. Section 5 presents the evolution of economic sectors on the development path of the economy, while the Special Topic provides insight into the spread of electromobility and the expected macroeconomic effects thereof.

From the 1980s on, substantial polarisation took place in the US labour market, where technological progress and the spread of ICT tools played a significant role.

During the transformation of the labour market, the wage and employment ratio of low-skilled workers, typically providing personal services (drivers, cleaners, cosmetologists) and that of highly qualified, well-paid employees rose substantially from the beginning of the 1980s. By contrast, the wage level of middle-skilled employees, who are mostly skilled workers employed in factories, fell short of the earnings of other employees. Analysing the presence of such employees in the labour market, we found that over time not only their wages, but also their share within employment decreased.

Industrial robots, which have become increasingly affordable, were able to perform the tasks of middle-skilled workers more cost-efficiently. Conversely, the skills of high-skilled employees complement the new technology, which makes them more productive and increases demand for their work.

This mechanism increased the wages of higher-skilled employees despite the fact that in the meantime, as a result of the expansion in higher education in the USA, the supply of such employees also rose significantly. The wage increase in the lower segment of the wage distribution is a result of the dynamic growth in the demand of higher-skilled employees for services that accompanied the increase in their real incomes, which in turn increased demand for employees working in the services sector, and consequently their wages as well.

The polarisation of labour demand can be also seen in the Hungarian labour market, while convergence took place in the case of wages.

After the turn of the millennium, similar trends as those seen in the USA developed on the Hungarian labour market: both low-skilled and high-skilled workers increased their share in employment at the expense of the middle-skilled. However, wages did not become polarised. Between 2000 and 2015, the wages of low-skilled employees rose faster than those of higher-skilled employees, for two possible reasons. One of these is the significant increase in the minimum wage in this the period. The other is the expansion in higher education, which moderated the wages of high-skilled employees, despite the rising demand for such workers.

In the future, the professions and activities that so far have not been affected by the rapid expansion of the ICT sector may also be exposed to automation. It should be ensured that labour market policies and education are prepared for this challenge.

The spread of ICT must be treated as a fact, but there are ways for the government to mitigate the negative impact on the labour market. The most important of these include providing efficient support for the innovation activities of small and medium-sized enterprises, as well as the transformation and extension of the educational system. As many people should learn as much as possible: the ratio of secondary school graduates and higher education students, as well as the number of participants in life-long learning should be increased. It is also important to improve the quality of education, to provide skills that make employees flexible and thereby able to switch profession when needed.

Quantifying economic activity poses new challenges for statisticians in the ICT age. There are numerous factors that may cause a downward distortion in the volume of GDP.

The methodology used to measure economic activity has been disputed by economists and statisticians for ages, particularly in light of the dynamic digitalisation currently taking place and structural changes in the economy. Based on a review of the literature, the main sources of the distortion appearing in the volume of GDP (and thereby in productivity) are: measurement errors of qualitative changes, incorrect treatment of the increased role of services, ignoring free contents in the statistics, underestimating the role of the “sharing economy”.

A moderate downward distortion resulting from digitalisation can be shown in the volume of GDP. However, the volume of this alone does not explain the deceleration in productivity, which has been registered in the past decade.

Based on our estimations, the consumption of free digital contents – which is essentially left out from the quantification of GDP – may have distorted the level of domestic output by up to 2-3 percent in 2012 compared to 2004. The same values for the USA are substantially higher, according to the available estimations. The distortions affecting the ICT sector, existing mostly in terms of prices, may raise the GDP level by 0.5-1.5 percent.

On the economic growth path, the weight of certain sectors within GDP and employment may substantially change.

In the case of agriculture, both demand and supply effects contributed to the decline in the weight of this sector. Agriculture was characterised by a rapid increase in productivity, and in addition to this, the income elasticity of agricultural products (i.e. the ratio used for agricultural products from one unit of surplus income) was also low. As regards the weight of industry, the decline in prices caused by the expansion in productivity initially entailed a rise in sales revenues and thus in the weight of the sector. However, as demand has started to respond to price cuts to a decreasing degree, the economic weight of this sector has started to decline. This could not be offset

even by the high income elasticity of industrial products. This is how the inverted U curve, characterising the weight of the industrial sector, has developed. In the case of services, productivity expansion was also relatively moderate, while the income elasticity of demand is also high, i.e. the weight of this sector increased. Looking ahead, there are two important messages. On the one hand, the share of sectors which can be described with very high, but rapidly declining prices will increase. On the other hand, the sectors where demand does not increase in proportion to income growth will represent a decreasing weight in production and employment.

However, the weight of a sector is not the only factor that can describe its economic significance. There are some industries with low weight, which produce the general-purpose technologies (GPT) of the given era.

The wide-ranging spread of the general-purpose technology of the given technological age is responsible for the growth in productivity and the impact thereof on several industries. Such general-purpose technologies included steam power during the first industrial revolution and electric energy from the end of the 19th century. The appearance of GPTs is accompanied by two phenomena. On the one hand, at the time of introducing the new technology the expansion in productivity growth is usually lower. However, later on, productivity growth once again accelerates. On the other hand, the creation of new combinations ousts previous solutions and skills, making them superfluous; in fact, a creative destruction takes place in the innovation processes of market economies, which demolishes the previous structures. The GPT of this age is, beyond doubt, infocommunication technology.

The most important technologies of the near future are essentially linked to electromobility, the storage of electric energy, communication equipment and environmental protection.

In addition, great potential can be identified in the automation of work procedures representing higher knowledge, in the Internet of things, cloud technology, robotics and autonomous cars. According to certain analyses, the extensive application of artificial intelligence will change the economy and our daily life to such a degree that it will represent a new technological age.

Of the key megatrends, the spread of electromobility is supported by environmental protection, the changing energy mix, as well as by Industry 4.0.

The automotive industry is near a turning point, where e-mobility and digitalisation may be defining factors. At present, the market of electric cars lags behind that of traditional cars, but in parallel with falling production and investment costs, this market may grow dynamically in the coming decades. The evolution of production may reshape the geographic configuration of commodity supply; demand for lithium and cobalt – which are relatively scarce in volume and exhibit highly concentrated extraction in geographic terms – may increase significantly.

The turning point in the automotive industry is particularly important for Hungary, in line with the high economic weight of the sector, even in a regional comparison.

The strategy of the car manufacturers, which is relevant for Hungary, focuses on electric drive; however, as a result of the smaller number of components, supplier networks may contract, which may complicate entering the evolving production chains. Developed education and infrastructure, as well as an increase in the importance of creative industries and services, are key for the shift towards the production of higher value added.

1 Causes and consequences of the declining wage share

According to the common interpretation, the wage share is the ratio of total macroeconomic wage costs (gross wages and social security contributions paid by employers) to the gross domestic product (GDP). In past decades, until the 1980s, the wage share was more or less steady, which was in line with the prevailing growth theory of that period and left economists in a convenient position. The distribution of income was taken off the agenda: research essentially focused on growth and the smoothing of business cycles. Important changes occurred from the end of the 1970s: wage shares gradually decreased, which could not be explained by the prevailing income distribution theory. The phenomenon could not be attributed to technical impacts (restructuring), and thus there was an increasing demand among economists to understand the phenomenon more deeply.

In his bestseller, Piketty (2013) comes to the conclusion that it is a feature of the capitalist economy that the wage share moves on a declining path, unless it is interrupted by some external effect (war or state intervention). He ascribes the decrease in the wage share to the two basic laws of capitalism, formulated by him, according to which capital incomes inevitably rise faster than the national income. Although the profession welcomed the book, in the analytical part a number of problems were revealed, as a result of which Piketty's distinct conclusions and extrapolations have failed to gain widespread acceptance. There is no consensus among economists in respect of the impact of technological progress on the wage share. Based on the IMF's calculations, technological progress and rising productivity reduced the wage share in countries where the initial exposure to automation was high. According to other analyses, it was actually the deceleration in productivity that caused the wage share to decrease. However, economists agree that globalisation in the broad sense of the word, i.e. the cross-border movement of final goods, services and factors of production, had the effect of lowering the wage share in certain countries, particularly in the developing economies. The wage share of foreign-owned companies lags substantially behind that registered at domestic companies, and this is the case in Hungary as well. Institutional explanations include the fall in trade union coverage and outsourcing as factors causing the wage share to decrease.

The decrease in the wage share reduced consumption in all countries under review. In terms of aggregate demand, the impact of the simultaneous increase in the share of profit on investments was not sufficient to offset the decrease in consumption. The decrease in the wage share improved export competitiveness and the volume of exports, but this has not offset the decrease in domestic demand: according to the calculations, in the EU15 as a whole a fall of one percent in wage share caused GDP to decrease by 0.3 percent. Several international institutions found a connection between changes in the wage share and the rise in inequality. In their paper, Berg and Ostry (2011), concluded that countries that develop with smaller inequalities are generally able to achieve more sustainable growth. Naturally, it would be a mistake to conclude that the change in the wage share alone explains the change in inequality, but it plays an undisputable role due to the unequal distribution of capital incomes. In addition, the wage share also influences a country's economic stability.

1.1 The Wage share and its historic interpretation

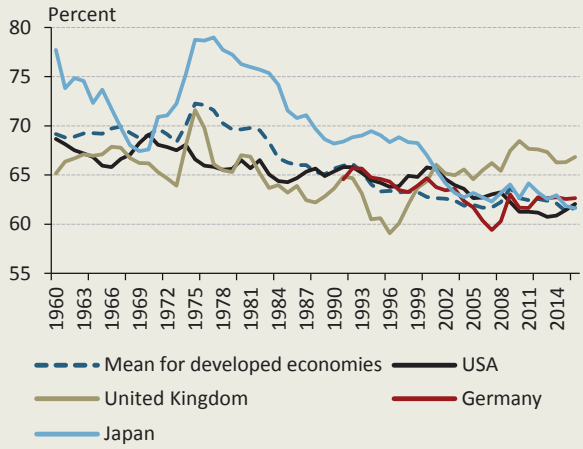
According to the common interpretation, the wage share is the ratio of total macroeconomic wage costs (gross wages and social security contributions paid by employers) to the gross domestic product (GDP). Within the framework of the primary distribution of incomes, total GDP can be divided into capital and labour income, i.e. the wage share is weighed against an indicator that approximates profit.[1] Some of the fathers of economic thought (Smith, Ricardo, Malthus) were strongly concerned about the way incomes or goods were distributed between capital owners and workers. Marx also regarded the question of income distribution as a central element. His approach had set out from the social classes' relative position of strength.

After World War II, economists developed a framework for the modern growth theory and economic policy. The previous "watchman" state, which mostly confined itself to providing the framework for the economy, was replaced by an active, intervening modern state.[2] In this environment, the questions of income distribution would require the development of proper macroeconomic statistical systems and data collection, and generally the elaboration of basic macroeconomic indicators, such as the gross domestic product (GDP),[3] as well as the regular monitoring, assessment and analysis of macroeconomic developments.

In the course of developing the system of national accounts, economists were able to increasingly accurately quantify the gross domestic product, and the distribution thereof between labour and capital income. **It was Arthur Bowley who used British data to first demonstrate that the amount spent on wages is constant within the national income, and hence the constancy of the wage share is often referred to as Bowley's Law. Later, a similar principle was observed in the United States as well, which served as a basis for the Cobb-Douglas production function developed by Charles Cobb and Paul Douglas**. The phenomenon became so generally accepted that in the mid-20th century, Nicholas Kaldor, a Hungarian by birth, included the constancy of the wage share in the stylised facts of economic growth (1961).

The result put the economist profession in a convenient situation. **The constancy of the wage share was fully in line with the Solow (1956) model, considered as the cornerstone of the growth theory of that age.** In the model, the remuneration for the factors of production is determined by their marginal product, i.e. the factors of production receive their due compensation based on their contribution to the final good: wage or capital income. Accordingly, economists need only focus on economic growth and the smoothing of business cycles, while income distribution is ensured, more or less automatically, by market mechanisms. In addition, in order to reduce poverty, redistribution by the state is also necessary. Branko Milanovic (2003) notes that illustrious economists (Martin Feldstein or Robert Lucas) had a strongly negative attitude even to the economic analysis of income distribution.

Chart 1-1:
Evolution of the wage share for 20 developed economies (average, 1960–2016)



Source: AMECO, MNB calculations.

Important changes occurred from the end of the 1970s: the wage share gradually decreased in many countries around the world, which could not be explained by the prevailing income distribution theory. This decrease could be seen generally, irrespective of the

1 We can talk about a more accurate, adjusted wage share of labour, which also contains, in addition to those with formal employee status, entrepreneur incomes that formally cannot be regarded as wages (but in terms of content can be regarded as such), as well as the share of sole traders and the self-employed.

2 In countries that became industrialised earlier, this process started already after World War I, which was stimulated, in addition to the war economy, also by the global crisis of 1929-1933, but it really started to spread only after World War II.

3 Coyle (2014). Tily (2009) describes the role of Keynes in the elaboration of the national accounts.

economic development.[4] Since the wage share obviously behaved contrary to Bowley's Law, there was renewed demand to examine income distribution. This demand was particularly strengthened by the economic crisis of 2008–2009, which showed that social inequalities significantly influence economic stability. The stimulus threshold was broken by the book of Thomas Piketty (2013),[5] a French social scientist using a holistic approach, which once again shifted the focus of discussions to income distribution. In addition, international institutions, such as the International Monetary Fund (IMF) or the central banks, also started to deal with the topic.[6]

1.2 Factors underlying the decrease in the wage share

The decrease in wage share has given economists plenty to think about. Initially, they tried to explain the process based on technical factors. One potential answer of this nature is that – due to the structural transformation taking place in the economic growth path (see Section 5 of this publication) – the decrease in the wage share can be purely attributed to the composition effect. However, examining 20 industries in 26 countries, it has been demonstrated that the **decrease in the wage share can only be explained by the change in the economic sectors' weight to a small degree** (OECD, 2012). Another important conclusion of the paper is that the **decrease in the wage share is a general phenomenon and can be identified in almost all sectors.** Hence, the decrease in the wage share cannot be explained purely by the composition effect, and it is important to understand the underlying factors more thoroughly. **Economists at the IMF (2017) also drew similar conclusions: Having examined 10 industries in 27 developed and 13 developing economies, they concluded that the composition effect was significant only in the case of the Chinese economy.**

1.2.1 RELEVANCE OF PIKETTY'S "BASIC LAWS"

In his bestseller, Piketty (2013) comes to the conclusion that it is a feature of the capitalist economy that the wage share moves on a declining path, unless it is interrupted by some external effect (war or state intervention). He ascribes the fall in the wage share to the two **basic laws of capitalism which he formulates**, according to which capital incomes inevitably rise faster than the national income. The same with symbols

$$\alpha = r\beta$$

where α is the profit share (from the total value added), r is the profit rate (profit compared to the value of capital) and β is the capital/value added (output) and

$$r > g;$$

where g is the growth rate of the national income. This is on a par with the fact **that the capital share in the national income is continuously increasing**. However, according to the critics, this correlation is a mere accounting relation rather than a basic law (Boushey et al., 2017; Rowthorn, 2014; Pettifor – Tily, 2014; Seccareccia – Lavoie, 2016). Another difference with significant consequences, criticised by almost all reviewers, is that instead of capital **he often used "wealth" in the production function**. However, Piketty also includes such financial and real estate assets in wealth which – in the usual sense – do not participate in the production of the national income: securities receivables for productive capital or income, or exist-

4 Naturally, there were some exceptions, such as the United Kingdom, where the wage share was more or less steady over a long horizon.

5 Even Piketty began dealing with the topic before the crisis and started to publish papers on it well before the crisis together with other specialists, including the doyen of the topic, Atkinson (Atkinson and Piketty 2007). James Galbraith launched a research programme from the end of the 1980s and created a new database for the more thorough analysis of the topic. See (1998, 2001).

6 See e.g. Andrew, B. and Ostry in IMF Staff Discussion Notes (2011), or IMF (2017).

ing non-productive assets (Moseley, 2015; Rognile, 2014; Rowthorn, 2014).

It can be mentioned as a further criticism that he calculated these **assets in value**, contrary to the real approach implied by the theory. This difference is highly significant, because, as shown for example by Rognile (2014), the correlation referred to by Piketty as a basic law is fulfilled for the USA, if the price developments of the properties are taken into consideration. **However, if – as suggested by the original concept of the production function – we only take into consideration the productive capital elements, the relation no longer exits, as the capital/national income ratio has hardly increased**: Of the growth, 84 percent is attributable to the appreciation of other, non-productive assets and only the remaining part can be attributed to the accumulation of productive capital. Rowthorn (2014) notes that when considering **the productive capital only the ratio of capital to output tended to decrease**. This observation is in line with the fact that fixed capital formation activity was weaker in recent decades, and in his view it is actually the appreciation of the non-productive property components that also explains the rise in the profit share within the national income in the USA.

Piketty accepts the presumption of decreasing factor return, and hence needs to answer the question of why **decreasing return**, despite the accumulation of the capital stock, will not stop the increase in the share of capital. For this, Piketty needs to rely on another assumption: he assumes that the elasticity of substitution between capital and labour is larger than one: according to his calculations, it is between 1.3 and 1.6.[7] In this case, the profit share increases even despite the decrease in the profit rate, as the ratio of capital increases faster compared to the value added. **This hypothesis, which is logically essential for Piketty, is refuted by almost all empirical works: most estimates identify an elasticity of substitution much lower than one.[8]**

Another difference is that he used **nominal profit** for the calculation of the profit rate, contrary to the real variables implied by the theory. The marginal productivity theory uses the capital "unit" price to show the impact of such price change in the substitution between capital and labour. If the price of capital falls, then more of it is used at the expense of labour. **However, Piketty's** profit rate is not a price like that, **but rather an income** and the decrease in it represents the decrease in the profitability of capital rather than a decrease in the cost of capital. The decrease in profitability cannot serve as an incentive for the substitution of labour with capital. **Based on the foregoing, we can agree with the conclusion of Moseley (2015), according to which Piketty applied an erroneous theory[9] incorrectly to explain the change in income distribution.** Responding to the criticism, Piketty stated that he had used the explanation based on the production function only to facilitate the dialogue with the mainstream economists and his empirical results are independent of that (Dolcerocca – Terzioglu, 2015). Due to the aforementioned problems, it is questionable whether this experiment reached its goal, as a large part of the criticism objected exactly to this, while he received substantially higher recognition for the empirical works independent of that.

7 The elasticity of substitution is the ratio at which the ratio of the factors of production changes to relative factors of production prices.

8 Rowthorn (2014) refers to one his earlier working paper articles, where he reviews the results of 33 empirical studies.

9 For the theoretical problems related to the production function, see the Box entitled "Theoretical reservations related to functional income distribution".

Box 1-1:
Theoretical reservations related to functional income distribution

Severe theoretical objections were already raised at the end of the 1950s in relation the neoclassic explanation of income distribution, based on the production function. It was regarded as a fundamental conceptual problem that for the determination of the income it would be necessary to **aggregate** heterogeneous factors – capital and labour – and the products constituting the output. The expenses incurred should be deducted from the output and the difference would constitute the income. However, this cannot be measured in natural indicators, because the expenses comprise of different physical factors than the output.

Under modern industrial and **multi-sector economic conditions**, it is not possible to aggregate these heterogeneous factors in a way the makes sense in economic terms into physical attributes (mass, etc.). In practice, the factors can be **aggregated only in money**. However, aggregation in money already assumes prices, which **generates logical difficulties**, since it was exactly the definition of prices and incomes that the aggregation would have been needed for. If we use prices, we already assume a kind of distribution of prices, and through that, of incomes as well. Thus, the explanation becomes **circular**: prices are not independent of the distribution. It complicates the matter further that the analysis cannot be extended even to models that already contain two products, which would be a minimum requirement for describing the operation of an economy that involves a market economy and exchange of goods. This leads to the "two Cambridges debate", which broke with the production function, as a tool, since it is not suitable for explaining the distribution observed in a modern market economy producing masses of products.

The "two Cambridges" capital controversy was instigated by the paper of Joan Robinson (1953) and over the years many expressed an opinion on it, including the most illustrious economists of the age, such as Samuelson, Sraffa, Kaldor, Pasinetti, etc.[10] The debate made it evident that if certain products serve as inputs for other products, also produced by capital and labour, but their manufacturing processes can be characterised by different capital and labour ratio, the changes in the distribution between capital and labour will change the relative price of the products, and thereby the capital and labour demand, differently and in an unforeseeable manner. That is, the decrease in wage share may as well reduce, and not only increase, labour demand, contrary to our expectation developed on the basis of the single-product or microeconomic model.

For example, Weeks (1989) and (2005) wrote in a multi-product model on the general unsuitability of the production function for explaining distribution. See also Bober (1988), Cohen and Harcourt (2003), Kregel (1976), Han – Schefold (2006), Harcourt (1972), Kregel (1978), Lavoie (2014), Lazzarini (2011), Marglin (1994), Petri (2011), Schefold (2005).

10 The debate is described in the works of Harcourt (1972), Cohen and Harcourt (2003) and Lazzarini (2011).

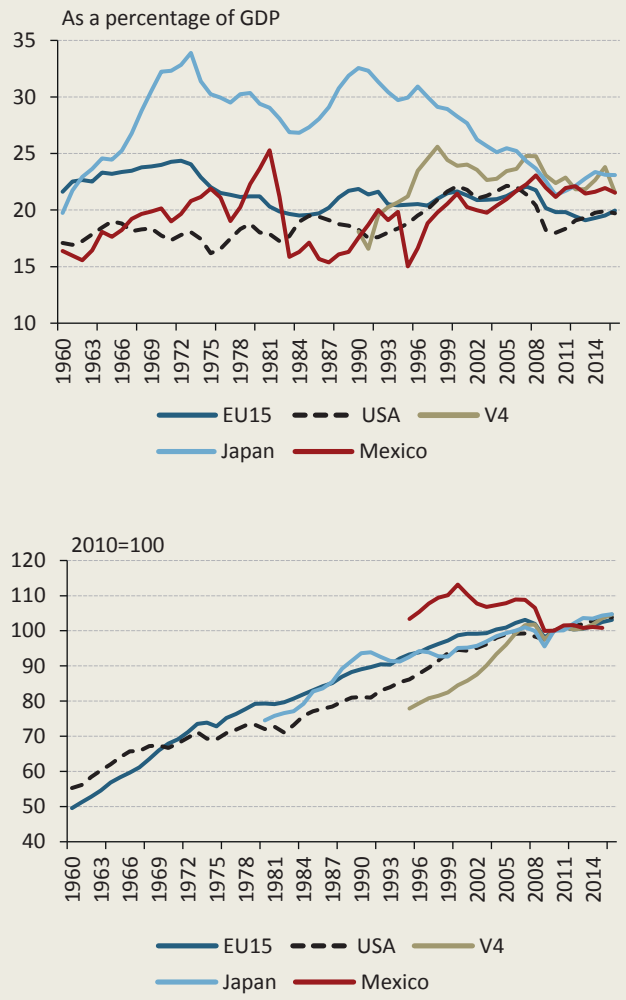
1.2.2 ROLE OF TECHNOLOGICAL PROGRESS

There is no consensus among economists in respect of the impact of technological progress on the wage share. According to IMF (2017), **technological progress is reflected primarily in the decrease in the relative price of investment goods**. Since the relative price of capital decreases, companies use more capital and the economy moves on a more capital intensive path. According to the IMF's analyses, a good part of the decrease in wage share is attributable to technological progress in the developed countries.

As Section 3 of the Report presents, **technological progress or productivity growth at an aggregated level typically has no effect on employment**, but it may impact employees with different qualifications and incomes differently. **Blue-collar, industrial jobs are indeed exposed to the negative employment impact of technological progress, while the number of jobs with high and low income typically increases in parallel with productivity growth.** Based on the IMF's calculations, a 15 percent decrease in the price of investment goods reduces the wage share by 0.4 percentage point in any country where the initial automation exposure[11] is low and by 1.5 percentage points in the countries of high initial automation exposure.

11 Based on the sectoral structure of the individual economies, theoretically an initial automation exposure can be assumed. The starting point is that the possibility of automating the individual jobs is of different degree. In theory, the automation exposure of the developed countries is higher due to the fact that there the tasks are much more standardised.

Chart 1-2:
Evolution of the investment rate and total factor productivity in selected advanced economies and Mexico



Source: AMECO, MNB calculations.

There are a number of significant objections to this logic. The first one is that **technological progress was also significant in the period when the wage share was constant. On the other hand, the growth in productivity** (defined either as GDP per working hour, or the total factor productivity controlling the change in capital intensity) **decelerated** compared to the 1970s, and thus it is not very intuitive to use this as an explanation for the deceleration in wage share ensuing since then. Thirdly, **investment ratios have also decreased in recent years**, that is the capital intensive turning point, cited by the IMF experts as an explanation, is not reflected in the data. **Although the theory can be applied to certain areas, regions or countries, it is not able to explain the general decrease in wage share.**

According to Grossman et al. (2017), it was actually the deceleration in productivity that caused the wage share to decrease. They use a neo-classical, calibrated growth model for their calculations. According to their model, the productivity of employees depends not only on the capital per employee, but also on the volume of accumulated human capital. **Physical and human capital supplement each other in the model** (Section 3 of the Report also draws a similar empirical conclusion). According to their results, the **deceleration in productivity explains at least half of the decrease in the factors underlying the fall in the wage share in the USA.**[12]

1.2.3 ROLE OF GLOBALISATION – EXTERNAL TRADE AND FOREIGN DIRECT INVESTMENT

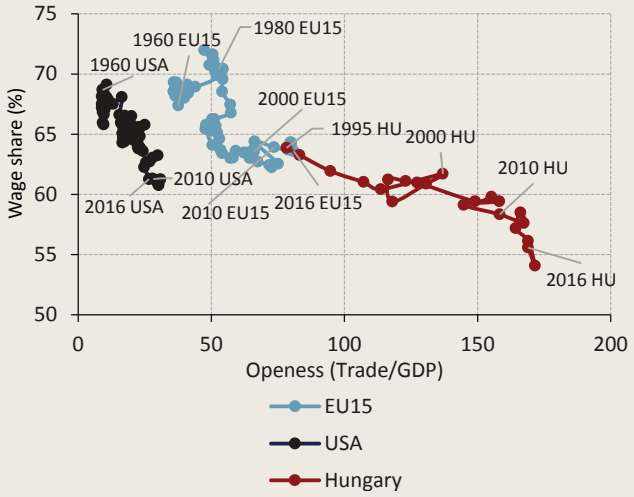
The international literature states relatively consistently that globalisation in the broad sense, i.e. the cross-border movement of final goods, services and factors of production, had a decreasing impact on the wage shares observed in certain countries.

Wage share proved to be susceptible to external trade in several analyses. Hobijn, Elsby and Sahin (2013) demonstrated that the wage share decreased primarily in the **sectors with high import use** (mostly manufacturing and commerce). According to their explanation, this is due to the fact that in the case of high import content it is necessary to compete with countries producing with lower labour costs (formerly typically China). Based on the analyses performed by the authors, the US **growth in imports can explain 85 percent of the fall in the US wage share** between 1993 and 2010. Raval, citing the study of Bernard et al. (2006), points out that growth – and within that particularly growth in employment – was lower in sectors where the Chinese import competition was higher. **Import competition also encourages companies mainly engaged in manufacturing to change over to capital intensive production, thereby reducing the wage share**. Bloom et al. (2015) came to the conclusion that **the growth in Chinese imports increased productivity in the US industries exposed to imports**, as well as the ratio of IT investments, and the volume of innovation activities also rose. As evidenced by Chart 2-2, **the trend decrease in the wage share took place simultaneously with a rise in the openness of external trade, which confirms the importance of external trade processes and globalisation in the**

12 The impact essentially appears through the optimal schooling channel. The lower growth reduces the real interest rate, which increases individuals' investment in human capital. Higher human capital means higher capital absorption, which entails a decrease in the capital-to-labour ratio. In turn, this increases the ratio of capital income, if substitution between capital and labour is less than one unit.

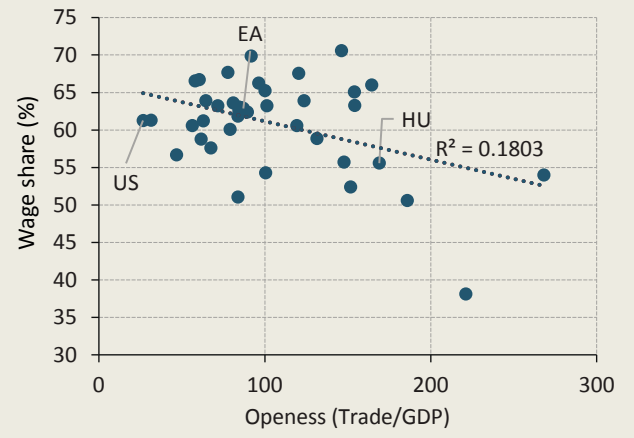
development of the wage share. The hypothesis is also supported by cross-sectional data, i.e. the more open economies typically have a lower wage share than the closed economies.

Chart 1-3:
Wage share and trade openess (1960–2016)



Source: AMECO, MNB calculations.

Chart 1-4:
Wage share and trade openess (2016)

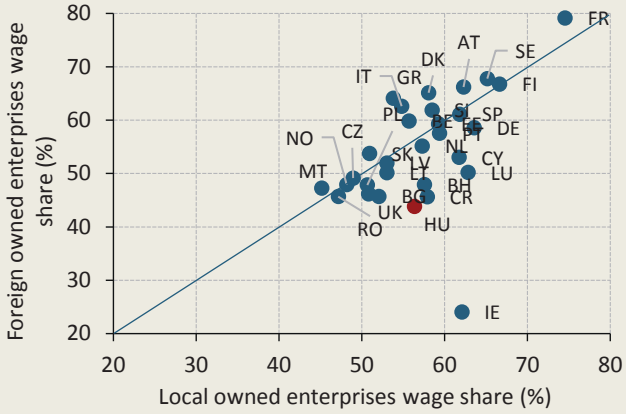


Source: AMECO, MNB calculations.

In the case of the small, open economies, the analysis of the free cross-border flow of the factors of production is also inevitable. The rise in foreign direct investments is one of the most important features of globalisation and at the same time it is also the source of the further deepening thereof. Capital flows into the developing economies due to the higher returns and lower wage costs, as a result of which the productive capacities of the host countries typically expand, but at the same time **the role of FDI is not fully straightforward in terms of income distribution** (for more details on this, see Balatoni and Pitz (2012)). The return on FDI, as on all international capital flows, leaves the host country, and thus the gap between the gross domestic product (GDP) and the gross national income (GNI) typically widens.

Companies with foreign ownership interest are usually much more productive and capital intensive than domestic companies. Accordingly, one important question is whether the productivity surplus indeed reaches the employee and is reflected in wages. According to Chart 2-4, no general trend can be observed in this regard; there are certain countries with a lower wage share and others where it is higher than that of companies with foreign ownership background. Thus, the income distribution may also be influenced by the role of FDI.

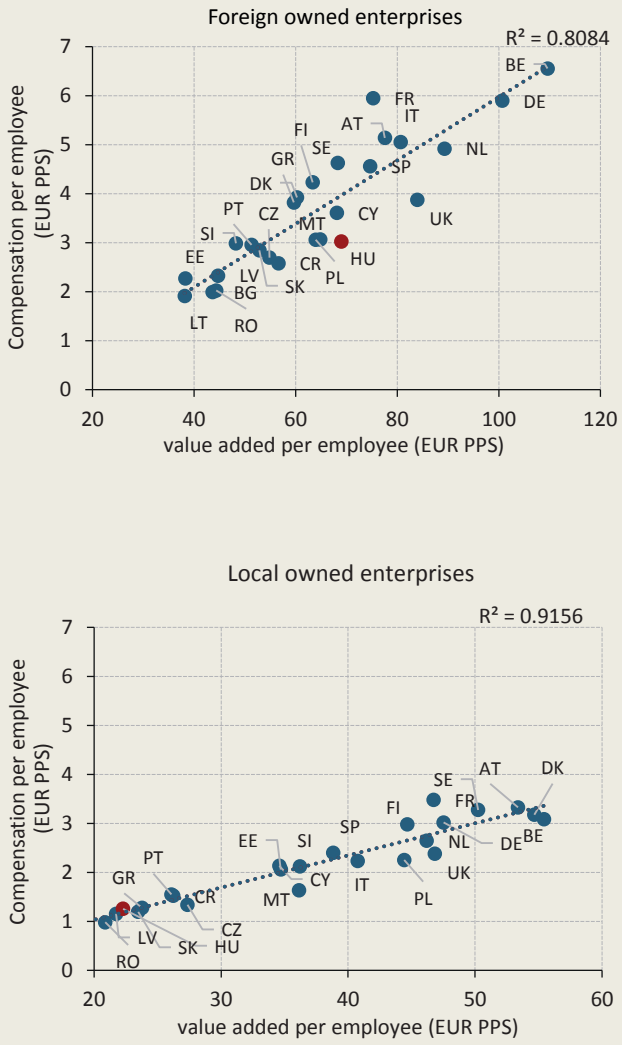
Chart 1-5:
Wage share (unadjusted) at foreign owned and locally owned enterprises



Note: A 45 degree line has been added to help relativization.
Source: Eurostat (FATS), MNB calculations.

In the case of Hungary, there is a significant difference between the wage share of domestic and foreign-owned companies. In an international comparison, it is clear **that it is the wage share of Hungarian-owned companies that can be regarded as being in a state of equilibrium**, as it is line with the productivity level registered for the given range of enterprises. **By contrast, in the case of foreign-owned companies, the wage level falls substantially short of productivity.**

Chart 1-6:
Compensation of employees and productivity in the European private sector



Source: Eurostat (FATS), MNB calculations.

When examining the changes in Hungary based on time series, it is clear that the productivity of non-resident companies[13] exceeds the level registered for Hungarian-owned companies 2.5–3.0 times, while there is only a 2.1–2.3-fold difference in wages. Moreover, this difference used to be higher in the previous period, i.e. the differences were even more distinct in the past in the case of the wage share of foreign and Hungarian-owned companies.

Chart 1-7:
Lead of foreign-owned enterprises over Hungarian-owned companies based on two factors

Note: Proportions (foreign/national).
Source: NAV, MNB calculations.

Confirming the role of FDI in the income distribution processes, in its quantitative analysis covering a number of countries, the International Monetary Fund specified participation in global value chains (GVC) as the factor that has the highest impact on inequalities (IMF 2017).[14] This proved true mainly in the case of the developing economies, where the degree of participation in GVCs proved to be more important in the econometric analysis than all other factors combined.

1.2.4 INSTITUTIONAL EXPLANATIONS

Additional important factors underlying the decline in the wage share can be understood by analysing institutional processes. These explanations are usually not based on quantitative foundations, as the prevailing norms or rules within a society may only be quantified subject to major limitations. **The explanations of this nature deem the bargaining position of the individual social groups particularly important.** Baker (2016) argues **that** income **inequalities** are not unavoidable technological processes, but **rather are widened as a result of a series of trade and social policy choices**, and if there were political intent, they would be reversible.

In the 1970s, an economic policy shift took place as result of the inflation that developed under stagnation. Monetarism gained headway against the former, Keynesian[15] approach. The rate of inflation, unprecedented before in peacetime, pushed the fight against price increases to the forefront, with the central banks

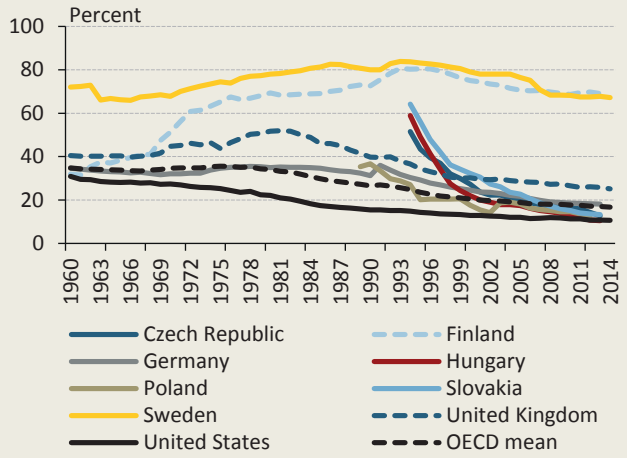
13 In this case we regard those companies as non-resident, where the share of foreign ownership exceeds 50 percent.

14 IMF (2017)

15 The economic policy that followed World War II is usually referred to as Keynesian. In professional terms this is not accurate, since the views of Keynes only partially appeared in it, but they are there indeed. These include the efforts towards full employment or the emphasis on the stabilisation role of fiscal policy.

playing a key role in this by actively using the central bank rates. Curbing wage demands, and through that the restoration of the correlation between productivity and wage growth rate, was a declared goal.

Chart 1-8:
Trade union density

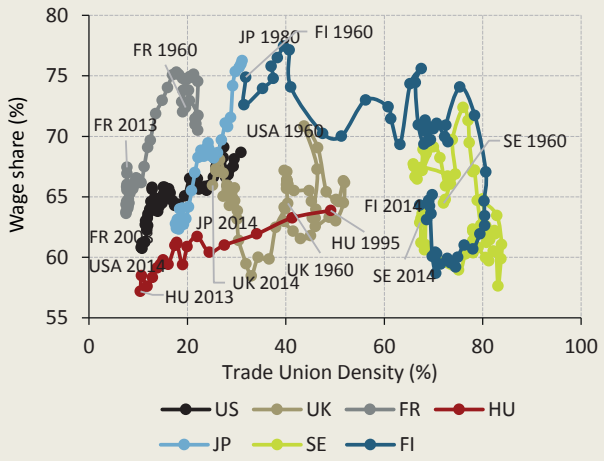


Source: OECD.

According to the popular analyses of that time this was necessary, because **in the developed countries the wage bargainers continued to strive for the maintenance of the previous wage growth rate**, while the terms of trade deficit, suffered as a result of the rise in oil world prices, would have required quite the opposite. This is also confirmed by the fact that around the mid-1970s a significant, but temporary rise in the wage share was registered in the OECD countries.[16] The earlier, consensus-seeking wage bargaining started to involve conflicts, and strikes became more common, responded to by governments measures aimed at the restriction of trade union rights. The high, often double-digit inflation declined slowly in the developed countries, together with a gradual decrease in inflation expectations and wage demands. **In this period, the decrease in the coverage of trade unions and generally of the employees' wage bargaining institutions, accelerated**, labour market rules became more liberalised and company-level wage bargaining gained importance as opposed to sectoral or national wage bargains.

The listed key trends appear with important deviations in the individual countries, and the baseline situations were also very different. The application of market mechanisms was the most far-reaching in the USA and the United Kingdom, while those affected the continental and northern countries, with traditionally corporative and extensive welfare states, the least. The **economic policy model of the northern countries** represented an interesting hybrid solution in the period of market liberalisation. **Market deregulation took place without weakening the role of trade unions**, and thus productivity did not significantly exceed the growth in wages. For this, in addition to widening the taxation base, in the Scandinavian states it was necessary to preserve the high tax rates, at the same time the state made high investments in social welfare services (education, social insurance). Despite the criticism formulated in Washington institutions, the northern states insisted on the Scandinavian welfare model; moreover, the achievements of the Scandinavian model in the area of education serve an example worldwide even now. The persistence of the Scandinavian welfare model is also shown by the fact that in these countries the fluctuations in the wage share can be regarded more as a cyclical factor, while in the rest of the world there is trend decrease in the wage share and it can be linked with the change in the wage bargaining positions.

Chart 1-9:
Evolution of the relationship between trade union density and the wage share



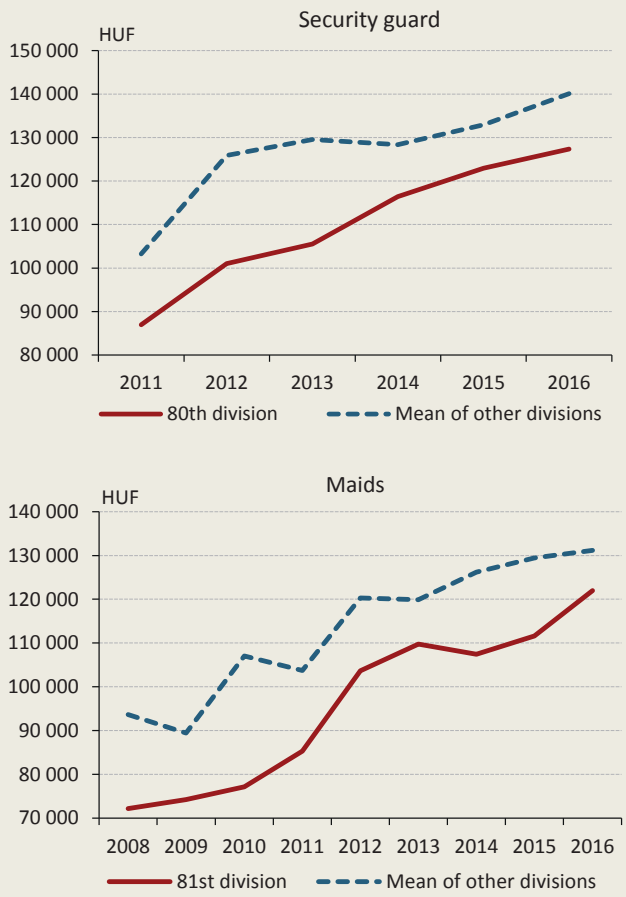
Source: AMECO, OECD.

Another important institutional factor that has substantially influenced wages in the past decade is the institution of outsourcing (Weil, 2017). It is long known from the business economics literature **that organisations can reduce labour costs by outsourcing the tasks of lower value added**.[17] In the case of the outsourced activities, the hourly rate is lower than when using own resources for the performance of the activity. Thus, the company reduces its costs, but does not have to face the deterioration of its reputation or the resistance of trade unions due to wage cuts or the failure to raise wages.

16 An analysis of the longer time series shows that the wage share moves together with the change in output in an anticyclical manner. That is, cyclical fluctuations in national income tend to be reflected to a larger degree in the changes of the profit share in the shorter run, while wages are more stable.

17 In this case we make no differentiation whether the activities are outsourced inland or across the border.

Chart 1-10:
Mean wages without personal allowance of distinct occupations based on employer's statistical division



Source: National Employment Service (Statistic for Individual Earnings), MNB calculations.

We examined this theory for Hungary in respect of the two typically outsourced works – security guards and cleaners – by highlighting those two service sectors that perform the given activity as a service, on business basis (in the case of security guards: NACE code 80 – "Security and investigation activities", and in the case of cleaners: NACE code 81 – "Services to buildings and landscape activities"). It is clear that **in the case of both activities, wages are lower for the outsourced activities** (otherwise it would make no sense to outsource) by 8-15 percent. Thus, outsourcing may have contributed significantly to the decline in the wage share.

1.3 Consequences of the decrease in the wage share

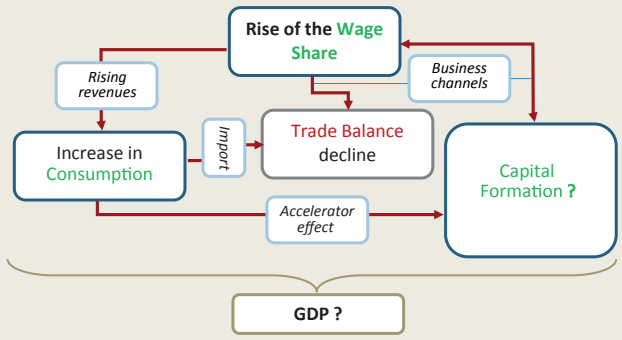
The decrease in the wage share may have a number of undesirable economic effects, which should be also monitored by monetary policy. In this section, we examine the impact on economic growth, inequalities and the financial stability in more detail.

1.3.1 WAGE SHARE AND GROWTH – WAGE-LED AND PROFIT-LED ECONOMIC SYSTEMS

The demand effect of the decline in the wage share is influenced by the way that the main national income components react to the change in the income distribution. Consumption is typically affected negatively by the decline in the wage share, as the disposable income as a percentage of GDP decreases in the households. On the other hand, the rise in the profit share provides enterprises with the opportunity to implement investments from their own resources. However, it should be emphasised that demand may also have repercussions on investment activity.[18] A rise in capacity utilisation typically also increases investment demand. Thus, the impact of the decrease in the wage share on investments depends on which channel is stronger. The third important factor is the net exports channel. The rise in the wage share typically lowers cost competitiveness, and hence curbs the contribution of net exports to growth.

18 The accelerator mechanism can be found, for example, in the introductory level textbook of Bessenyei (2007).

Chart 1-11:
Demand channels of the wage share rise



Source: MNB.

The post-Keynesian[19] model of Bhaduri-Marglin (1990a), (1990b) provides an excellent framework for the quantification of the wage share's impact on economic growth. Originally, the elaboration of the Bhaduri-Marglin model was motivated by the fact that from the 1960s the previous close relation between productivity and the growth rate of wages loosened in the developed countries.

The Bhaduri-Marglin model is a modified version of the analytical framework based on a usual, value added circular flow, where the distribution between capital and labour, and the investment decisions play an important role in the medium-term economic growth trends. The model focuses on the determinants of the demand side, and hence the exact form of the supply side is not important for the main message. Income distribution plays a role to the extent that a smaller ratio of the wages is saved than of profits, while profits serve as a source of investment. This also means that when the wage share decreases, aggregate saving increases, and thus there is a negative correlation between the two variables. However, savings do not automatically become investments: savings are accumulated not by the same group that makes the investments, and hence there is no guarantee that two intentions will meet. In the open economy version of the model (Bhaduri-Marglin, 1990b), the foreign markets may represent an additional source and at the same time also the necessary condition for the aggregate demand compared to the closed economy version. Due to this, the impact of the changes in the wage share on aggregate demand is further complicated by the price and volume flexibility of exports and imports.

19 It is rather difficult to follow the terminology: the school now referred to as post-Keynesian formerly was referred to as neo-Keynesian, since they wanted to the differentiate themselves from Samuelson's mainstream neoclassical synthesis, which was a dominant theory in that age.

A wage-led and profit-led regime can be differentiated in the model's open and closed economy versions as well. In the **wage-led regime it is the growth in the wage share, while in the profit-led regime it is the growth in the profit share that gives rise to national income.** External economic relations may change a country's wage-led regime, if the factors affecting net exports offset the effect of the aggregated demand's domestic components: the decrease in the wage share may reduce domestic demand, but by improving wage competitiveness it may increase aggregate demand. On the other hand, in a wage-led regime the increase in the wage share may reduce wages' domestic demand-increasing effect or turn it in the opposite direction, through the decrease in the wage competitiveness of exports, and change the regime into a profit-led one. However, if the global economy is wage-led, the improvement in the individual countries' wage competitiveness may offset each other, if it is practiced simultaneously by enough countries, and may also make the domestic economies wage-led, if the domestic component of demand is wage-led.

It is an empirical question whether an economy is wage-led or profit-led and a number of studies tried to examine this empirically. A number of summary essays were also prepared to synthesise the results. The results are not always concordant, which is partly explained by the different data sources, the periods under review and the geographic areas. From time to time, contradictory results are obtained even for the same country. The differences may also be attributable to the fact that the individual analysts controlled for different factors. Naastepad and Strom (2006) **having examined eight larger OECD countries** for the period 1960–2000 **found that aggregate demand was wage-led in six of them (France, the Netherlands, Germany, Italy, Spain and the United Kingdom). The USA and Japan proved to be profit-led. According to the estimate of Onaran and Obst (2016), the EU15 countries together are wage-led**. They found certain smaller countries to be profit-led, but the impact of net exports is offset by the fact they mostly trade with each other. **The decrease in the wage share reduced consumption in all countries under review. The impact of the simultaneous increase in the profit share on investments was not sufficient in terms of aggregate demand to offset the decrease in consumption. Finally, the decrease in the wage share improved export competitiveness and the volume of exports, but this has not offset the decrease in domestic demand: in the entirety of the EU15 a fall of one percent in wage share caused GDP to decrease by 0.3 percent.**

Examining the countries one by one in isolation, only four of them proved to be profit-led (Ireland, Austria, Denmark and Belgium). Since the EU is dominated by internal trade over external trade, the EU15 tends to operate as a large, closed wage-led economy. This finding is in line with earlier analyses, according to which the wage moderation pursued for many years, together with restrictive fiscal resulted in persistently slow economic growth (Fitoussi, 2001).

In our opinion, due to non-linearities the effect of changes in wage share on economic growth depends on the current level of the wage share. If the wage share is low in a historic comparison, economic growth may be boosted at the expense of the profit share, i.e. the economy has wage-led features. However, if the profit share falls below a critical level, it may substantially curb investments and thus the economy once again becomes profit-led. Since in the past decades the wage share decreased on a continuous and general basis, falling to a historic low, we may assume that the economies have become increasingly wage-led.

Although the supply side i.e. the long-term impacts, are not elaborated in the Bhaduri-Marglin model, the **increasing hysteresis and the technical literature on the high-pressure economy provide plenty of evidence that demand significantly influences supply as well** (Growth Report 2016, Section 1). In addition to McCombie et al. (2002), the empirical studies recently performed by Storm and Naastepad (2012) and in Chapter 4 of Lavoie – Stockhammer (2013) for OECD countries also concluded that **potential output and productivity are not independent of aggregate demand**. The higher aggregate demand also results in productivity growth through learning, better capacity utilisation and investment growth.[20] **On the other hand, the rise in the wage share may also reduce productivity, if the economy is profit-driven, as it reduces output and the resources available for labour substituting, productivity-increasing investments.**

1.3.2 IMPACT OF WAGE SHARE ON INEQUALITIES

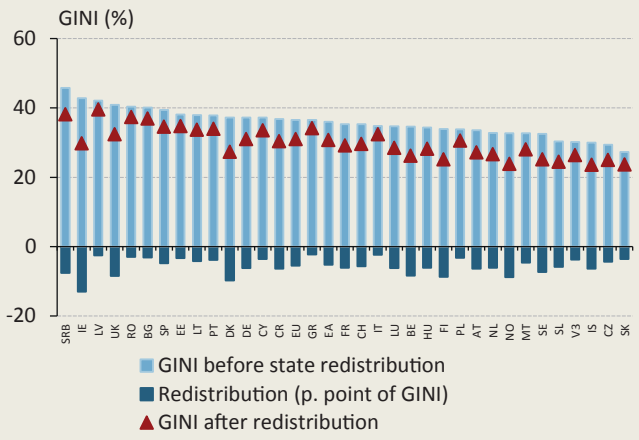
Several international institutions have found a connection between the change in the wage share and the rise in inequality (OECD – ILO, 2015; IMF, 2017). The economists of the International Monetary Fund attribute the existence of this connection to two reasons. On the one hand, to the observation that the decrease in the wage share took place in the case of the middle-skilled labour force (see Section 3 of the Growth Report). According to the other explanation (Wolff, 2010), capital earnings can be allocated to those on the right side of the income distribution, and therefore, if the wage share decreases, it also means an increase in the profit share, which consequently increases inequalities. Naturally, it would be a mistake to draw the conclusion that the change in the wage share alone explains the change in the inequality. Piketty noted indirectly in his empirical work as well that the evolution of income distribution depends at least as much on institutional factors as those derived from production processes.

In the past, in the mainstream approach economists attributed only as much importance to the generation of inequalities that in extreme cases they may lead to social tensions, which reduces the economic growth potential.[21] According to the reasoning that prevailed until the crisis, the generation of inequalities is essentially a natural attribute of the system, or it may even be regarded as an essential component of economic development. Today, this approach is referred to as meritocratic approach. **The meritocratic argument is that recognising and awarding talent and efforts may increase inequalities in the short run, but in the longer run the entire society benefits from the results. According to the supporters of the equalising, solidarity solutions, extreme inequalities often lead to dysfunctions** (instead of creating goods making efforts to obtain booty and to hunt for yield) and to the wasting of resources.

20 "Kaldor-Verdoorn" Law. For more details see the original paper of Verdoorn, and then his distancing himself from his own result, as well as the modern applications of the law in: McCombie et al. (2002)

21 On the other hand, Aghion et al. (1999) demonstrate that financial inequalities have adverse effect on growth. At the same time, wage inequality tends to appear as a consequence rather than a reason.

Chart 1-12:
State redistribution expressed in GINI percentage point (2015)



Source: Eurostat, MNB calculations.

The picture should be qualified further by **state redistribution**, which contributes substantially to keeping inequalities in Europe at a moderate level (compared to the United States). The chart below compares the difference in the value of GINI before and after state redistribution, thereby providing a view on the potential role of the government in the mitigation of inequalities.

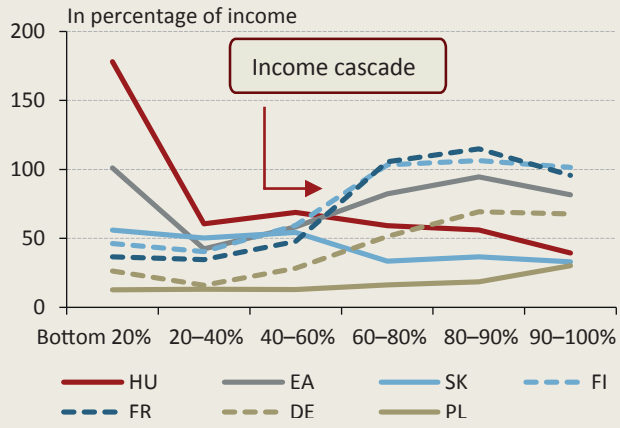
It is clear that a number of countries, including Hungary, belong to the states that are strong on redistribution, which sheds light on the role of fiscal redistribution in the mirror of wage share processes. The more diverging the distribution of income is, the higher the redistributing state's dead-weight loss may be, which appreciates the generation of income inequalities due to their impact on fiscal processes. **Due to this, the decrease in the wage share highlights the importance of adequate fiscal policies.**

1.3.3 WAGE SHARE AND ECONOMIC STABILITY

From a monetary policy point of view, the stability consideration is of outstanding importance: in the case of recession, under high exposure (e.g. indebtedness, loss of jobs), the households of the lower quantile curb their expenditures, while the households of the top quantile reduce their risk-taking. In certain economies – including Hungary – the indebtedness of households took place simultaneously with the fall in the wage share, which may have exacerbated recovery from the crisis (insufficient demand).

The decline in wage share and the mass presence of lending opportunities alone does not explain why households become indebted. The reasons may be explained by the **expenditure cascade** (Frank et al., 2014) The essence of this is that the lower quantiles consume more than their budget constraint due to positioning reasons, and therefore the income position of the quantile one level higher may have a significant impact on the indebtedness of a household. If the theory is correct, then **the lowest decile should show the highest indebtedness, which – due to the peaked distribution of the wages towards the more modest income categories – highlights the importance of the wage share.**

Chart 1-13:
Median Debt-to-Income ratio of households (2014)



Source: ECB.

Without wishing to prove the universal nature of the cascade, it is obvious that **in the case of certain countries, but particularly in Hungary, this observation may bear significance.** Determination of the appropriate wage level is an important, but at the same time almost impossible exercise, since – as we presented in the foregoing – the income distribution is not solely the result of the supply processes satisfying the neoclassic theory, as demand and institutional factors are equally important. On the other hand, looking forward, the decrease in the wage share has its limits: it is difficult to imagine an economy, where the share of wages in production is lower than that of capital, without generating significant social tensions.

In their paper, the economists of IMF (Berg and Ostry, 2011), **concluded that countries which develop with smaller inequalities are generally able to achieve more consistent growth**. In a society that can be characterised by a more balanced wage share, the income of those in the high-income category may also rise faster and the general condition of society may also improve. **Acceptable inequality varies in time and space, and beyond the objective processes, it also greatly depends on the social groups' perception of reality, hence it is impossible to determine the rate thereof on a theoretical or scientific basis.**

References:

Aghion P., Caroli E., García-Penalosa C. (1999): Inequality and economic growth: The perspective of the new growth theories. Journal of Economic Literature 37 (4) (December): 1615–1660.

Baker, D. (2016): Rigged: How Globalization and the Rules of the Modern Economy Were Structured to Make the Rich Richer, Center for Economic Policy Research, Washington.

Balatoni, A. – Pitz, M. (2012): A működőtőke hatása a bruttó nemzeti jövedelemre Magyarországon (The effect of Foreign Direct Investment on National Income in Hungary). Közgazdasági szemle, LIX. évf., pp. 1–30.

Berg, A. G. and J. Ostry (2011): Inequality and Unsustainable Growth: Two Sides of the Same Coin?, IMF Staff Discussion Note 11/08 International Monetary Fund, https://www.imf.org/external/pubs/ft/sdn/2011/sdn1108.pdf

Bernard, A., Bradford, J., Peter K. Schott (2006): Survival of the best fit: Exposure to low Wage Countries and the Uneven Growth of US Manufacturing Plants, Journal of International Economics 68, no. 1, pp. 219–237.

Bessenyei, I. (2007): A makroökonómia és a makrogazdasági politika újabb elméletei (New Theories of Macroeconomics and Macroeconomic Policies). PTE KTK, Pécs.

Bhaduri, A. – Marglin, S.A. (1990a): Profit Squeeze and Keynesian Theory, in: Marglin, S. A. and J. Schor, (1990): The Golden Age of Capitalism, OUP, Oxford, pp. 153-186. DOI:10.1093/acprof:oso/9780198287414.003.0004.

Bhaduri, A. – Marglin, S.A. (1990b): Unemployment and real wage: the basis for contesting economic ideologies. Cambridge Journal of Economics, Cambridge J Econ (1990) 14 (4): 375–393. https://academic.oup.com/cje/article-abstract/14/4/375/1677414/Unemployment-and-the-real-wage-the-economic-basis?redirectedFrom=PDF

Bhaduri, A. – Raghavendra, S. (2017): Wage- and profit-led regimes under modern finance. Review of Keynesian Economics, Vol. 5 No. 3, Autumn 2017, pp. 426-438, https://www.elgaronline.com/view/journals/roke/5-3/roke.2017.03.05.xml

Bloom, N.– Draka, M. – Reenen, J. (2015): Trade Induced Technical Change? The impact of Chinese imports on Innovation, IT and Productivity, Review of Economic Studies 83, pp. 87-117

Bober, S. (1988): Modern Macro-economics: A Post-Keynesian Perspective. Croom Helm, London, Cambs, United Kingdom

Boushey, H. – de Long, J. B. – and Steinbaum, M. (eds) (2017): After Piketty. The Agenda for Economics and Inequality, HUP, Cambridge

Cobb, C. – Douglas, P. (1928). A Theory of Production. American Economic Review 18 (Supplement): 139–165. Retrieved 26 September 2016.

Cohen, A.J. – Harcourt, G.C. (2003): Whatever Happened to the Cambridge Capital Theory Controversies? Journal of Economic Perspectives, 17(1), Winter 2003, 199–214.

Coyle, D. (2014): GDP: A Brief but Affectionate History. Princeton University Press.

Dolcerocca, A. – Gokhan Terzioglu, G. (2015): Interview: Thomas Piketty Responds to Criticisms from the Left. Potemkin Review, Jan., http://www.potemkinreview.com/pikettyinterview.html

Elsby, M. – Hobijn, B. – Sahin, A. (2013): The decline of the U.S. Labor Share. Brookings Papers on Economic Activity.

European Central Bank (2017): The Household Finance and Consumption Survey Wave 2 Statistical Tables April 2017. https://www.ecb.europa.eu/pub/economic-research/research-networks/html/researcher_hfcn.en.html

European Commission (2017): Annual macro-economic database (AMECO), https://ec.europa.eu/info/business-economy-euro/indicators-statistics/economic-databases/macro-economic-database-ameco_en

Eurostat (2017): Foreign Affiliates Statistics – FATS. http://ec.europa.eu/eurostat/statistics-explained/index.php/Foreign_affiliates_statistics_-_FATS

Fitoussi, J.P. (2001): Monetary policy and the macroeconomics of the soft growth. Leijonhufvud, A (2001): Monetary Theory as a Basis for Monetary Policy, pp 215–254. www-ceel.economia.unitn.it/events/monetary/fitoussi9.pdf.

Frank, R. – Levine, A. – Dijk, O. (2014). Expenditure Cascades. Review of Behavioral Economics. 1 (1-2): pp. 55–73.

Galbraith, J. (1998): Created Unequal. The Crisis in American Pay, The University of Chicago Press

Galbraith, J. (2001): Macroeconomics of Income Distribution. Galbraith, J. and M. Berner (eds): Industrial and Inequality Change, ch. 1. A Global View, Cambridge University Press, Cambridge, 4. pp.

Grossman, G. – Helpman, E. – Oberfield, E. – Sampson, T. (2017): The productivity slowdown and labour's income share. VOX. http://voxeu.org/article/productivity-slowdown-and-labour-s-income-share

Han, Z. – Schefold, B. (2006): An empirical investigation of paradoxes: reswitching and reverse capital deepening in capital theory. Cambridge Journal of Economics, 30(5), pp. 737–765.

Harcourt, G.C. (1972): Some Cambridge Controversies in the Theory of Capital. Cambridge University Press 1972.

International Monetary Fund (2017): Understanding the Downward Trend in Labour Income Share, World Economic Outlook April, ch 3, pp. 121–172. http://www.imf.org/en/Publications/WEO/Issues/2017/04/04/world-economic-outlook-april-2017

Kaldor, N. (1961) Capital Accumulation and Economic Growth, Hague D.C. (eds) The Theory of Capital. International Economic Association Series. Palgrave Macmillan, London.

Kregel, J.A. (1976): Theory of Capital. MacMillan.

Kregel, J.A. (1978): Post-Keynesian Theory: Income Distribution. Challenge.

Lavoie, M. (2014): Post-Keynesian Economics: New Foundations. Cheltenham, UK: Edward Elgar.

Lavoie, M. – Stockhammer, E. (eds.) (2013): Wage-led Growth: An Equitable Strategy for Economic Recovery, Basingstoke, UK: Palgrave Macmillan.

Lazzarini, A. (2011): Revisiting the Cambridge Capital Theory Controversies: A Historical and Analytical Study. Pavia University Press. http://archivio.paviauniversity-press.it/pdf-oa/lazzarini-revisiting-2011.pdf

Marglin, S.A. (1994): Growth, Distribution and Prices, Harvard University Press.

McCombie, J., – Pugno, M. – Soro, B. (2002): Productivity Growth and Economic Performance: Essays on Verdoorn's Law. Springer Verlag.

Mihályi, P. – Szelényi, I. (2017): Wealth and capital: a critique of Piketty's conceptualisation of return on capital. *Cambridge Journal of Economics,* Volume 41, Issue 4, 1 July 2017, Pages 1237–1247. https://doi.org/10.1093/cje/bew054

Milanovic, B. (2003): The Two Faces of Globalization: Against Globalization as We Know It, World Development, Volume 31, Issue 4, April 2003, pp. 667–683

Milanovic, B. (2013): Why Inequality is here to stay, Harvard Business Review, 3. January. https://hbr.org/2013/01/why-income-inequality-is-here

Milanovic, B. (2016): Global Inequality, A New Approach for the Age of Globalization. HUP. http://www.hup.harvard.edu/catalog.php?isbn=9780674737136

Moseley, F. (2015): Piketty and Marginal Productivity Theory. International Journal of Political Economy Vol. 44, Iss. 2, 201. http://www.tandfonline.com/toc/mijp20/44/2

Naastepad, C.W.M. – Storm, S. (2006): OECD demand regimes (1960–2000), in: Journal of Post Keynesian Economics / Winter 2006–7, Vol. 29, No. 2 213.

National Employment Service (2016): Statistic for Individual Earnings. http://nfsz.munka.hu/engine.aspx?page=full_afsz_egyeni_berek_es_keresetek_statisztikaja

OECD (2012): The Decline of the Labour Share in OECD countries, 1990–2009, OECD Employment Outlook 2012. http://dx.doi.org/10.1787/empl_outlook-2012-graph38-en

OECD – ILO (2015): The Labour Income Shares in G20 Economies, Report prepared for the G20 Employment Working Group. https://www.oecd.org/g20/topics/employment-and-social-policy/The-Labour-Share-in-G20-Economies.pdf

OECD (2017): OECD. Stat. http://stats.oecd.org/

Onaran, Ö. (2016) Wage- versus profit-led growth in the context of globalization and public spending: the political aspects of wage-led recovery. Review of Keynesian Economics. Edward Elgar Publishing. pp. 458-474. ISSN 2049-5323 ISSN 2049-5323.

Onaran, Ö. – Obst, T. (2016) Wage-led growth in the EU15 member states: the effects of income distribution on growth, investment, trade balance, and inflation. Cambridge Journal of Economics. Oxford University Press. ISSN 0309-166X ISSN 0309-166X.

Onaran, Ö. – Stockhammer, E. (2017): Policies for wage-led growth in Europe. FEPS Policy Report, February, http://www.feps-europe.eu/assets/ea50ecd6-6ff5-4922-be9a-ffb770f8664e/policies-wage-led-up-growth-europepdf.pdf

Palotai, D. – Virág, B. (2016): Competitiveness and Growth. MNB.

Pettifor, A. – Tily, G. (2014): Piketty's Determinism? Prime economics, real-world economics review, issue no. 69. http://www.paecon.net/PAEReview/issue69/PettiforTily69.pdf

Petri, F. (2011): On the likelihood and relevance of reswitching and reverse capital deepening. Salvadori, N. and C. Gehrke (eds) (2011): Keynes, Sraffa, and the Criticism of Neoclassical Theory: Essays in Honour of Heinz Kurz, pp. 380–418.

Piketty, T. (2013): Le Capital au XXIe siècle, Éditions du Seuil, Paris.

Raval, D. (2017): What's wrong with C21's model? After Piketty (Boushey, Delong, Steinbaum eds.), pp. 75–98.

Robinson, J. (1953): The Production Function and the Theory of Capital. The Review of Economic Studies, Vol. 21, No. 2. (1953–1954), pp. 81-106.

Rognile, M. (2014): A note on Piketty and diminishing returns to capital. http://gabriel-zucman.eu/files/teaching/Rognlie14.pdf

Rowthorn, R. (1982): Demand, real wages and economic growth. Thames Papers in Political Economy Autumn, 1981 TP/PPE/81/3, http://www.gre.ac.uk/__data/assets/pdf_file/0010/1192573/TP_PPE_81_3F.pdf

Rowthorn, R. (2014): A note on Piketty's Capital in the Twenty-First Century. Cambridge Journal of Economics, Volume 38, Issue 5, 1 September, 2014, Pages 1275–1284. https://doi.org/10.1093/cje/beu031

Solow, R. (1956): A contribution to the theory of economic growth. Quarterly Journal of Economics, Oxford Journals 70 (1): pp. 65–94.

Schefold, B. (2005): Reswitching as a Cause of Instability of Intertemporal Equilibrium. Metroeconomica 56:4.

Seccareccia, M. – Lavoie, M. (2016): Income Distribution, Rentiers and their role. A Capitalist Economy: A Keynes-Pasinetti Perspective, International Journal of Political Economy Vol. 45: 3, 2016.

Stockhammer, E. (2013): Why have wage share fallen? A panel analysis of the determinants of functional income distribution. ILO, Geneva http://dl.kli.re.kr/dl_image/IMG/03/000000012927/SERVICE/000000012927_01.PDF

Stockhammer, E. (2017): Wage-led versus profit-led demand: what have we learned? A Kaleckian–Minskyan view. Review of Keynesian Economics, Vol. 5 No. 1, Spring 2017, pp. 25–42. https://www.elgaronline.com/abstract/journals/roke/5-1/roke.2017.01.03.xml

Stockhammer, E. – Wildauer, R. (2015): Debt-driven Growth? Wealth, Distribution and Demand in OECD Countries. Post Keynesian Economics Study Group Working Paper https://www.postkeynesian.net/downloads/working-papers/PKWP1503.pdf

Storm, S. – Naastepad, C.W.M. (2012): Macroeconomics Beyond the NAIRU. Cambridge, MA: Harvard University Press.

Tily, G. (2009): John Maynard Keynes and the Development of National Accounts in Britain, 1895-1941. Review of Income and Wealth, Series 55, Number 2, June. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.654.7667&rep=rep1&type=pdf

Weeks, J. (1989): A Critique of Neoclassical Macroeconomics. Macmillan, London.

Weil, D. (2017): Income Inequality, Wage Determination, and the Fissured Workplace. After Piketty (Boushey, Delong, Steinbaum eds.), pp. 209-231

Wolff, E. (2010): Recent Trends in Household Wealth in the United States: Rising Debt and the Middle-Class Squeeze. Levy Economics Institute, Working Papers Series No. 159. https://ssrn.com/abstract=1585409 or http://dx.doi.org/10.2139/ssrn.1585409

Zandi, M. (2017): What Does Rising Inequality Mean for the Macroeconomy? After Piketty (Boushey, Delong, Steinbaum eds.), Harvard University Press pp. 384–412.

2 Participation of the domestic SME sector in exports

The SME sector is key to the productivity growth and technological progress of the economy. Small and medium-sized enterprises account for a substantial weight in employment, but their productivity falls behind that of large corporations, thus they have a significant growth potential.

This section assesses the participation of the Hungarian SME sector in exports. Foreign market entry represents a potential growth strategy for SMEs: after starting to export, enterprises increase their number of employees, boost their capital intensity and improve their total factor productivity. Improved performance can manifest itself via several channels during exporting, for example enterprises may enhance their products to satisfy demand differing from that in the domestic market. New competitors may force enterprises to implement additional innovations or technological knowledge may pass through from large corporations to small and medium-sized enterprises as a result of supplier relations. On the whole, exporting can be regarded as a learning process in the lifecycle of enterprises.

Based on our results, the export performance of Hungarian small and medium-sized enterprises falls short of the EU average. Although these SMEs play an important role in international trade within the EU, it can be concluded that they export to relatively few countries. The diversification of export by destination and product or service types may be expensive for SMEs.

The corporate-level data available to us permit an accurate categorisation of exporters by size, as well as an analysis of service exports in addition to the export of goods, which offers new opportunities for the SME sector in the expansion in external markets. Roughly 20 percent of both goods and services exports can be linked to micro, small or medium-sized enterprises. Within this, the largest portion of exported value can be attributed to medium-sized enterprises (15 percent of total exports) both for goods and services. In terms of their number, a mere 5 percent of SMEs export, and they mostly export goods. Micro and small enterprises are less active in the external markets, while on average 50 percent of medium-sized enterprises export. The smaller an enterprise, the longer it takes for it to enter the export market after the establishment of the company.

In respect of both goods and services, entering the export market offers a significant growth opportunity for Hungarian SMEs. The performance of exporting SMEs exceeds that of non-exporter SMEs several times. Exporting SMEs outperform their non-exporting counterparts in terms of capital intensity, investments, value added and productivity, with service exporters being the most productive. Even controlling for initial firm-level characteristics, it can be shown that exporting enterprises increase their productivity faster than their non-exporting peers, and exporting services or goods together with services occasionally generates even more advantages for the exporting SMEs than the export of goods only.

Almost three-quarters of SMEs' manufactured exports can be linked to enterprises related to industries of medium-level technology. The exports of enterprises of medium-to-low technology represent the highest share within manufactured exports. Exports of market services represents a somewhat lower value, which is mostly less knowledge-intensive. The production of higher quality, more technological or knowledge-intensive products or services would provide SMEs with additional growth opportunities.

Despite the fact that exporting generates a number of benefits for SMEs, only a small number of SMEs participate in exports, which is mostly because– compared to large corporations – they face more obstacles when entering external markets. Most of the factors that hamper exports arise from the enterprise size and are related to the absence of properly qualified human resources, financing, regulation and the high cost of adopting standards, and to the limited access to information. The removal of such obstacles facilitates more intensive participation of SMEs in export markets.

2.1 Introduction

Their employment and growth potential, small and medium-sized enterprises (SMEs) play an outstanding role in the economy. However, in terms of productivity these enterprises fall behind large corporations and their convergence is substantially hindered by the low level of innovation and corporate R&D, the lack of properly qualified labour force, and the absence of production processes or enterprise organisation experience (Eurostat, 2011).

Foreign market entry and joining international production chains represent important breakout points for SMEs. In relation to exporting, we tend to think of large corporations, but SMEs also participate in international trade. Numerous studies have highlighted the fact that participation in international trade is accompanied by higher corporate employment, labour productivity and total factor productivity. Exporting and importing enterprises are more competitive, both in the external and domestic markets.

Upon entering the external market, enterprises face higher costs, due to the exploration of new export opportunities or purchasing new inputs (Kraay et al., 2002). Enterprises often enhance their products or organise their production processes more efficiently, which may necessitate additional investments in production lines or software (Castellani et al., 2008). These extra costs can be covered by the enterprises with the highest productivity, and thus it is usually large corporations that participate in international trade, rather than the SME sector.

At the same time, by participating in external trade, firms can grow further and increase their productivity. This is attributable to several factors. When exporting, enterprises will be present with their products in larger markets and higher levels of output may help them reduce fixed production costs (Van Biesebroeck, 2005). Since enterprises meet different demand in the external markets than in the domestic market, they must enhance their products and may also need to introduce new products. This often leads to an improvement in the quality of goods. Competitors in the external markets may force enterprises to implement additional innovation and introduce new technologies, which may increase the enterprises' labour productivity (Verhoogen, 2008; Bustos, 2011; and Lileeva and Trefler, 2010). In light of the foregoing, exporting can be regarded as a learning process in the lifecycle of enterprises. Although it is less likely that a similarly high ratio of SMEs will export as in the case of large corporations, exporting should be regarded as a growth and development strategy for SMEs.

In the past decades, the improvement in export conditions and transformation of production structures have been also favourable for SMEs' foreign market entry. External trade is costly, time-consuming and risky, and it is typically the large corporations that are able to cover the losses arising from this. However, tariffs and non-tariff trade barriers have decreased substantially, and with the development of information technology the large distance between trading partners has become surmountable, thereby making exports cheaper and easing market entry for SMEs. The organisation of production into cross-border chains also supports the more intensive presence of SMEs in the export markets: a large part of global exports is represented by intermediate products, providing SMEs with room for participation, which thus may become suppliers to large corporations even if their product is very specialised (WTO, 2016). With the spread of global production chains, services supporting industrial production – such as logistics, transportation, repair and other business services – have also become increasingly widespread. Since services are less capital intensive, the export of these also favours SMEs. The weight of services in external trade increases dynamically due to the spread of information and communication technology, and SMEs may soon play an important role in services export.

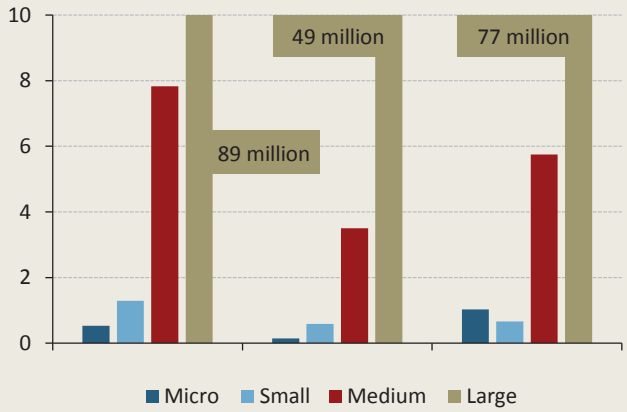
On the whole, it can be stated that there is a close link between foreign market entry and the increase in enterprise productivity. In the case of enterprises, since exporting can also be regarded as a learning and development process, it is important to understand the position of SMEs in the export market and their subsequent performance, which increases the competitiveness of SMEs in the long run. Later in this section, using aggregate international and Hungarian firm-level data, we examine the position of Hungarian SMEs in external trade, the trends in the productivity of exporting SMEs and other features, also touching upon the difficulties in exports perceived by SMEs.

2.2 International comparison

In the EU, SMEs play an important role in international trade. In some countries, it is the high number of exporting SMEs, while elsewhere it is the exported value attributable to SMEs that is outstanding. *On the whole, however,* **in 2015 more than 1.3 million SMEs (85 percent of enterprises) exported in the EU with a value of EUR 1,600 billion, which accounts for more than 40 percent of total exports (Eurostat).** It should be noted here that the EU-level data available for international comparison allocates the enterprises to the micro, small, medium-sized or large enterprise category based on the number of employees.[22] This does not correspond to the official SME definition, but approximates it relatively well (for the exact categorisation of enterprises based on size, see Box 2-1).

In the European Union, a large difference can be observed in the export value per enterprise based on size categories (Chart 2-1). Of the SMEs, medium-sized enterprises export the most intensively, with the micro and small enterprises lagging well behind them. However, for the purpose of comparison, the exports of medium-sized enterprises amount to less than one-tenth of the exports of an average large corporation.

Chart 2-1
Average value of exports for exporting firms by size class (2015)

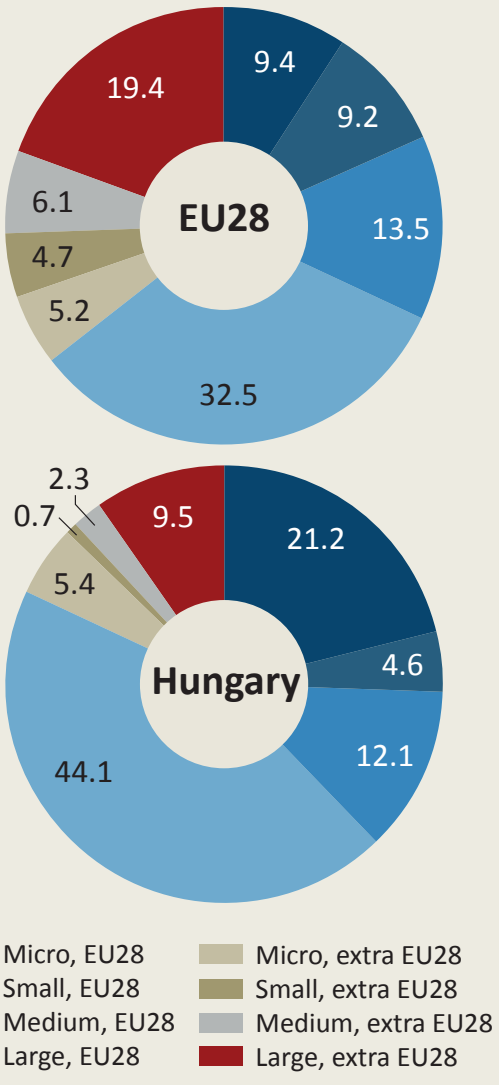


Note: Countries from the region are Poland and Slovakia.
Source: MNB calculations based on Eurostat data.

The export performance of Hungarian small and medium-sized enterprises falls short of the EU average. Nonetheless, the average Hungarian medium-sized enterprise exports 60 percent more than its Polish or Slovakian peer. Surprisingly, the exports of Hungarian micro enterprises surpass both the EU and the regional average.

SMEs play an outstanding role in exports within the European Union. In terms of breakdown by size, when examining exports by destination market, it can be stated that the primary destination of the EU enterprises is the internal market (65 percent of total exports) and one half of the exports to this market is linked to micro, small and medium-sized enterprises (Chart 2-2). Of this, the largest part can be attributed to medium-sized enterprises (13 percent), while the export share of the micro and small enterprises is both around 9 percent in the internal EU market.

Chart 2-2:
Exports by size class and destination in the EU and Hungary (2015)

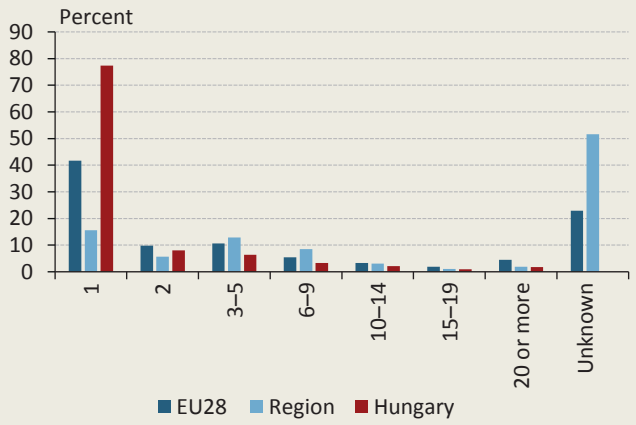


Source: MNB calculations based on Eurostat data.

22 In the case of micro enterprises the number of employees is below 10, it is between 10 and 49 in the case of small enterprises and between 50 and 249 in the case of medium enterprises.

The distribution of the export value by enterprise size differs from this somewhat in Hungary. The destination country of four fifths of the exports of Hungarian enterprises is an EU Member State, with large corporations accounting for the largest export market share, followed by micro enterprises (21 percent) in exports within the EU. Hungarian micro enterprises also play an important role in external trade outside the EU and compared to SMEs, they account for a larger export share.

Chart 2-3:
Number of export destination countries (2015)



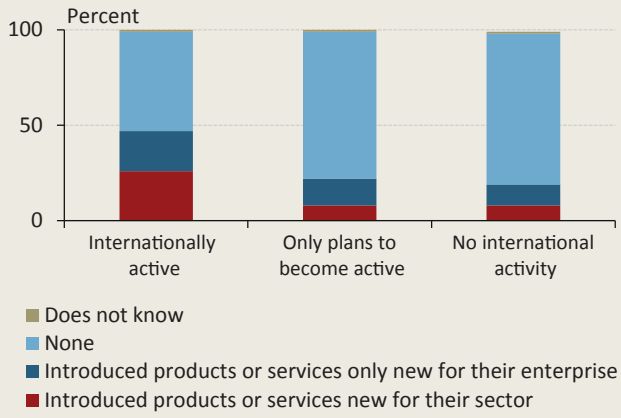
Note: Countries from the region are Poland and Slovakia.
Source: MNB calculations based on Eurostat data.

Altogether, the larger portion of SMEs' export is directed to the EU internal market, which is explained by the costs incurred in relation to exporting. Access to more distant destinations, outside the EU, entails higher transportation and other costs of an administrative nature, which tend to pay off only in the case of large corporations, and hence SMEs are less interested in exports to more distant countries.

The available data provides us information on the number of destinations for the entire corporate sector, but not by enterprise size class. Almost 80 percent of Hungarian enterprises exported to a single country in 2015 (Chart 2-3). Although the distribution by the number of EU and regional partner countries is somewhat distorted by the lack of size classification of the enterprises, Hungarian exports are less diversified in terms of destination. **Since a large part of the companies are micro, small or medium-sized enterprises, it is likely that the low diversification of the export portfolio by partner country mostly impacts this enterprise category.**

In order for enterprises to be successful in foreign markets, they need to innovate and enhance their product portfolio. According to a questionnaire-based survey covering the SME sector of the EU, enterprises not participating in international trade are the least innovative, **while enterprises planning to participate in and those already pursuing international trade are both more innovative (Chart 2-4).**

Chart 2-4:
Exporting and introduction of new products



Source: Based on Internationalisation of European SMEs Survey, 2009, European Commission, p. 48.

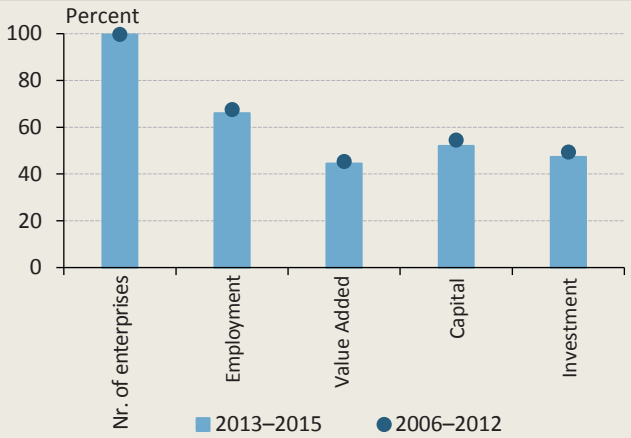
Compared to non-trading enterprises, a larger ratio of SMEs which plan to enter foreign markets in the future have introduced new products or services relative to their own portfolio. Almost half of the enterprises already pursuing international trade produced new products or services. The portfolio of these enterprises contains new goods/services compared to their own products and own industry in proportions of roughly half-and-half. The latter assumes substantial innovation activity and according to the comparison, the presence of this factor does make a difference between exporting and non-exporting SMEs.

2.3 International trade by enterprise size based on Hungarian data

The previous subsection provided a general picture on the participation of SMEs in global markets in a European Union comparison. However, the available enterprise-level data permit us to conduct a thorough examination of the participation of the Hungarian SME sector in international trade. On the one hand, we can define SMEs precisely and allocate enterprises to additional micro, small and medium categories, based on the number of employees, turnover and balance sheet total. The SME categorisation used by us is detailed in Box 2-1. On the other hand, in addition to the goods export, we can also analyse services export, which provides SMEs with additional opportunity to enter international markets.

We first examine the weight represented by SMEs in the Hungarian economy (Chart 2-5). In terms of their number, almost 100 percent of the enterprises belong to the SME sector, while their share in total capital stock, investment and value added is close to 50 percent. SMEs **account for about 70 percent of employment**. These ratios have been more or less steady in the periods before and after 2013.

Chart 2-5:
The economic importance of SME-s (period averages)



Note: The chart shows the share of SMEs in the corporate sector for the listed variables.
Source: MNB calculations based on NTCA and HCSO data.

Box 2-1:
SME DEFINITION

According to the official definition, small and medium-sized enterprises are enterprises with less than 250 employees. In addition, the turnover of the enterprise should be below EUR 50 million or the balance sheet total should not reach EUR 43 million. Within SMEs, the threshold values for the specific size categories are included in the table below.

Table 2-1: SME definitions

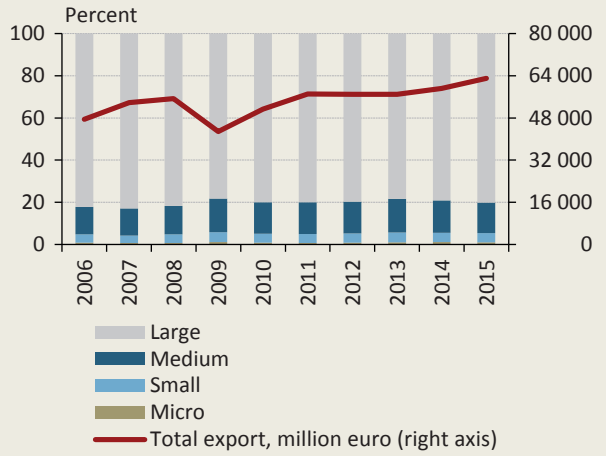
Classification	Employment (capita)	Turnover (million euro)	OR	Balance sheet total (million euro)
Medium	< 250	≤ 50		≤ 43
Small	< 50	≤ 10		≤ 10
Micro	< 10	≤ 2		≤ 2

Source: Eurostat.

The SME definition we use differs somewhat from the official definition: if the enterprise exceeds the official threshold of any one of the indicators, it is allocated to the larger size category. This modification results in a more accurate classification, preventing the erroneous classification of new entrants (for example, it can occur that an enterprise in the year of entry, i.e. upon launching its investments, would be allocated to the micro enterprise category, because although its balance sheet total is high, its sales turnover and headcount is low, since in the period of initial investment it has no output yet.)

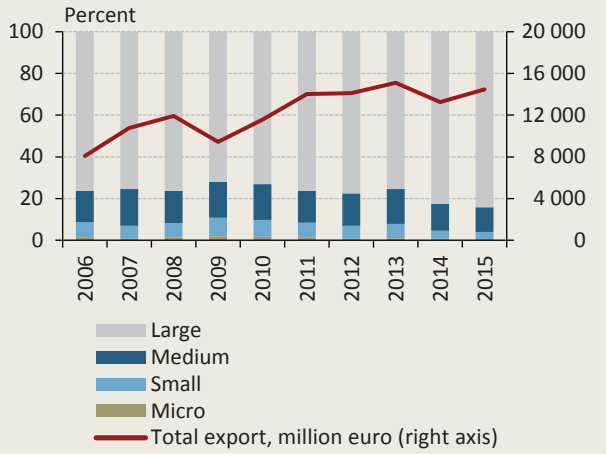
It should be noted that there is no major difference in our results depending on the use of the official or our customised definition of SME. One of the shortcomings of our database is that in the classification of the SMEs we cannot take into consideration the ownership structure, which may give rise to problems in the case of the small subsidiaries of large corporations.

Chart 2-6:
Goods export by enterprise size class



Source: MNB calculations based on NTCA and HCSO data.

Chart 2-7:
Services export by enterprise size class



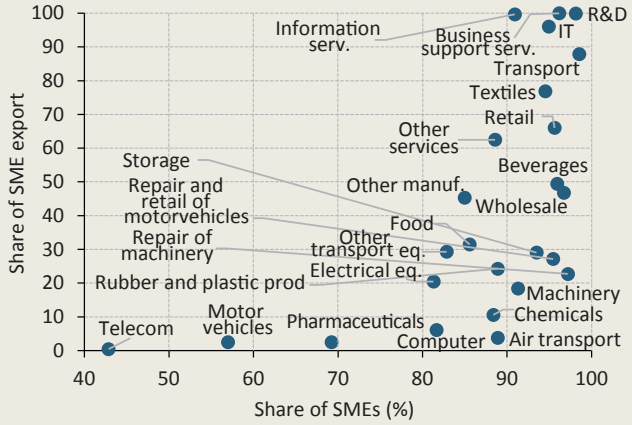
Note: Due to an upgrade in services trade data compilation, as of 2014 the structure of services trade has changed, some items being registered as goods trade (for example, processing trade or maintenance). Our version of the database does not take this change into account, thus the dynamics and aggregate values might be slightly different form the official statistics.
Source: MNB calculations based on NTCA and HCSO data.

Based on the firm-level data available, about 20 percent of the value of Hungarian goods exports can be linked to the SME sector (Chart 2-6). Within this, the largest part of the exported value can be mostly attributed to medium-sized enterprises, i.e. 15 percent of total exports, while small enterprises account for less than 5 percent of total exports, and the value of aggregate exports of micro enterprises is negligible. The distribution of exported value by enterprise size has not changed in recent years.

By also considering services exports we can obtain an overall picture of exports by SMEs. Although services exports account for less than one fourth of the value of goods exports, **similarly to goods exports, about 20 percent of services exports can be attributed to SMEs (Chart 2-7).** This ratio fell slightly in recent years, which can be attributed to both small and medium-sized enterprises. Similarly to goods exports, micro enterprises have a low share in services exports as well.

In our analysis, we focus on SMEs belonging to the manufacturing and market service sector, broken down further by industries. **Many industries can be allocated to the bottom right corner of Chart 2-8 along the two dimensions, representing low exported value and a relatively high number of SMEs.**

Chart 2-8:
Average value of exports for exporting firms by size class (million euro, 2015)

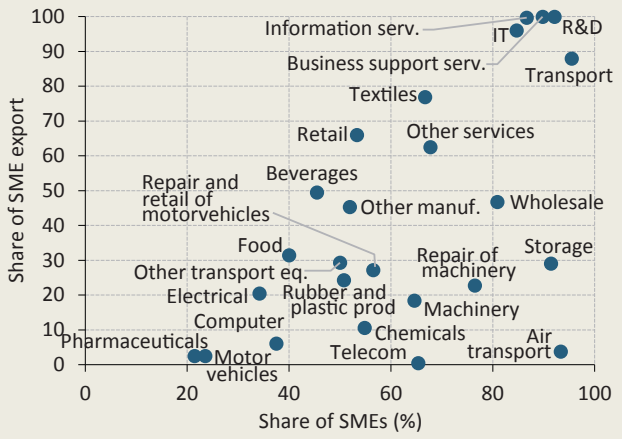


Source: MNB calculations based on NTCA and HCSO data.

Typical goods exporting enterprises are active in the manufacturing sector, a large part of which consists of SMEs. For example, almost 60 percent of enterprises participating in exports related to vehicle manufacturing are SMEs, while the value of the goods exported by SMEs accounts for less than 5 percent of the industry. The value of goods exported by SMEs is also low in other important industries, such as pharmaceuticals, computers and electronics. This suggests that in the manufacturing sector SMEs tend to export small-value goods, which presumably serve as components for higher-value final products. Some of the typical service industries export goods as well, which can be linked almost exclusively to SMEs (e.g. IT or R&D).

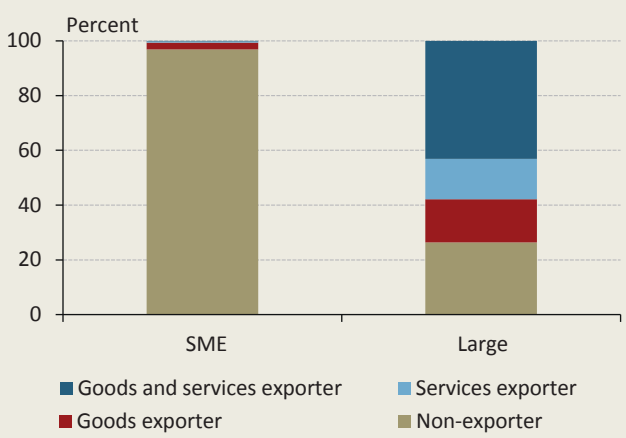
The number and exports of SMEs participating in service exports are shown in Chart 2-9 with an industry breakdown. **In the IT, R&D and business consultancy industries, services exports – similarly to goods exports – can be attributed almost exclusively to SMEs.**

Chart 2-9:
Average value of services exports for exporting firms by size class (million euro, 2015)



Source: MNB calculations based on NTCA and HCSO data.

Chart 2-10:
SME-s and large enterprises by exporter status (2015)



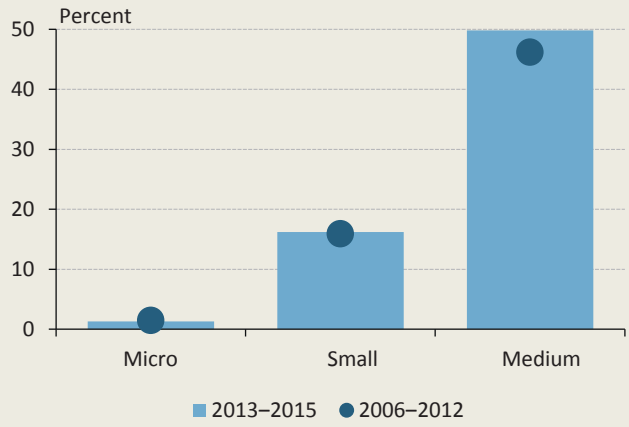
Source: MNB calculations based on NTCA and HCSO data.

Manufacturing enterprises also export services. About 20 percent of exporting firms are SMEs in the pharmaceutical and vehicle manufacturing sectors, and about 40 percent in the manufacturing of electronic equipment, while only 20 percent or even less of the exported value can be attributed to these enterprises.

With the commencement of services exports, manufacturing companies become more profitable and significantly expand their product portfolio by bundling goods and services (Crozet and Milet, 2015). In addition, services increase the performance of exporters; manufacturing firms that export services in addition to goods, become the largest exporters (Lodefalk, 2015) and in most cases, services increase the enterprises' chances of survival and also represent additional growth opportunities (better qualified labour force, higher sales revenue) for the enterprises (Bernard et al., 2016). In the manufacturing sector, services contribute to the more efficient organisation of production, as a result of which firms can advance in global value chains (Passadilla and Wirjo, 2014), or services such as repair and maintenance, can be connected with the final products to facilitate the build-up of long-term relations with the customer.

75 percent of large companies export, with the lion's share of them exporting both goods and services. SMEs fall well behind this, as only 5 percent of them export, and this is mostly restricted to goods (Chart 2-10). In the case of both goods and services, entering the export market presents significant growth opportunities for Hungarian SMEs. It is mainly micro and small enterprises that are not active in the external markets, while on average 50 percent of medium-sized enterprises export (Chart 2-11).

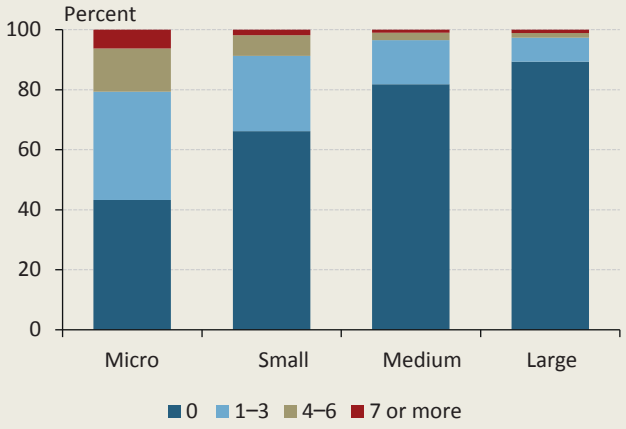
Chart 2-11:
Share of exporters by size class



Note: Compared to the number of firms in own size class.
Source: MNB calculations based on NTCA data.

Compared to large corporations, entering the export market is more time consuming for SMEs. About 40 percent of micro enterprises export upon entering the market, while the rest of the exporting micro enterprises typically venture into external markets 1-3 years after entry (Chart 2-12). 60 and 80 percent of small and medium-sized firms, respectively, also export from the very start of their operation, while the rest of the exporters typically enter the external market in 1-3 years after incorporation. The slower foreign market entry of SMEs also suggests that the incidental costs of exporting represent a higher burden for smaller enterprises.

Chart 2-12:
Time spent between the setup of the company and its export market entry



Source: MNB calculations based on NTCA data.

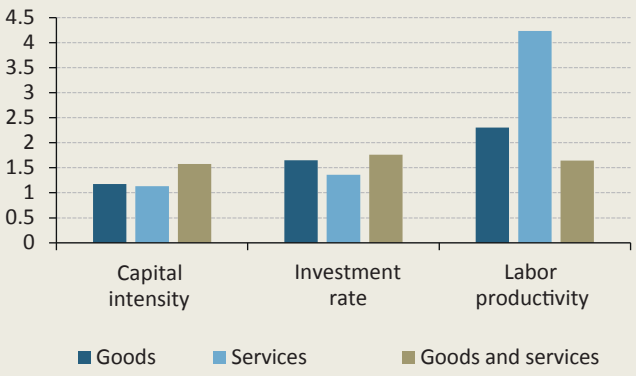
2.4 SME exporting and firm performance

In the foregoing, we presented the role of SMEs in exports, the industries in which they are present and their export activities by size category. In this subsection, we examine the relation between SMEs' foreign market entry and other corporate characteristics.

Exporting SMEs are differentiated on the basis whether they export goods or services, or both, as these are related to different corporate profiles. Enterprises that export goods only are usually manufacturing companies, those that export services are typically market service companies, but some of manufacturing firms supplement their goods exports with services.

The performance of exporting SMEs exceeds that of non-exporter SMEs several times. Exporter SMEs slightly outperform non-exporter SMEs in terms of several corporate characteristics, with the performance of enterprises that export services or both services and goods being outstanding among them (Chart 2-13). The capital intensity of SMEs exporting goods and services is similar to that of non-exporter SMEs, but **there is a major difference between them in terms of labour productivity.** The productivity of a goods exporter SME is more than twice and that of a services exporter is four times larger than that of a non-exporter SME, while a goods and services exporter SME is 1.5 times more productive than a non-exporter SME. The capital intensity of enterprises exporting both goods and services exceeds that of non-exporter firms 1.5 times, with a similar difference in their investment rate compared to non-exporter SMEs.

Chart 2-13:
Performance of exporting SME-s compared to that of non-exporting ones



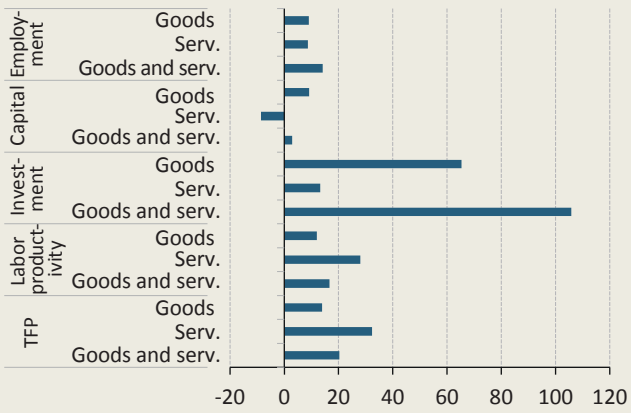
Note: Average exporting SME performance relative to that of non-exporting ones.
Source: MNB calculations based on NTCA data.

We know from several earlier studies that goods exporting firms perform better than non-exporter firms in respect of several performance indicators: they are larger, with higher investment, capital and productivity (Bernard and Jensen, 1999; de Loecker, 2007; van Biesebroeck, 2003). According to a study examining companies in several EU Member States, services exporters are even better than goods exporters (Breinlich and Criscuolo, 2012; Ariu, 2012).

However, the listed enterprise characteristics may influence firms' foreign market entry from the outset, as enterprises that were already successful are more likely to decide to enter foreign markets. At the same time, foreign market entry may help enterprises develop further and as a result of exporting, their investments, capital and productivity may increase. Additionally, enterprise characteristics may be also influenced by other industry specific or cyclical factors.

The correlation between exports and enterprise characteristics changes somewhat if we consider the enterprises' earlier characteristics, industry and time period which captures economic developments. The difference between exporting and non-exporting SMEs is smaller, but still significant. Chart 2-14 shows these values for exporting and non-exporting SMEs in terms of size, capital, investment, labour productivity and total factor productivity. **The labour and total factor productivity of services exporters is outstanding, surpassing that of non-exporters by roughly 30 percent.** The productivity gap is somewhat smaller compared to goods and services exporters and is the smallest in the case of goods exporters. The difference between exporting and non-exporting SMEs is also high in the relation to investments: the investments of goods exporters exceed those of non-exporting SMEs by 60 percent, while the investments of goods and services exporters are more than twice as high as those of non-exporters. Irrespective of the type of exports, exporters are larger than their non-exporter peers by at least 10 percent.

Chart 2-14:
Exporting and firm level characteristics
(% difference relative to non-exporting SME-s)

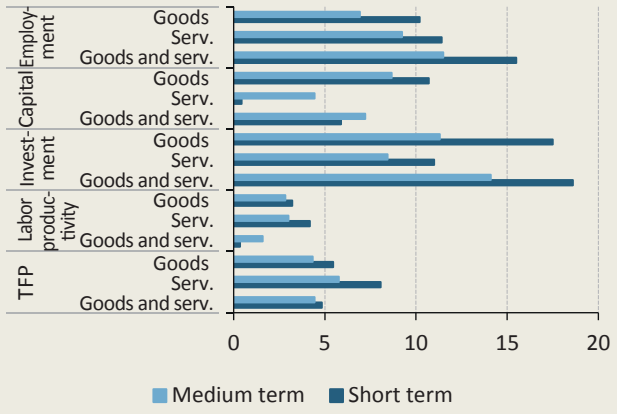


Note: Bars show the difference in performance between non-exporter and exporter SMEs. Ours estimations take into consideration the industry of the firm, year and past firm level characteristics. All coefficients significant at 1%.
Source: MNB calculations based on NTCA and HCSO data.

One possible explanation for the described correlation between exporting and better corporate performance is that enterprises which are larger, have higher capital and are more productive from the outset opt to enter the export market, as these companies are able to cover the costs of exporting.

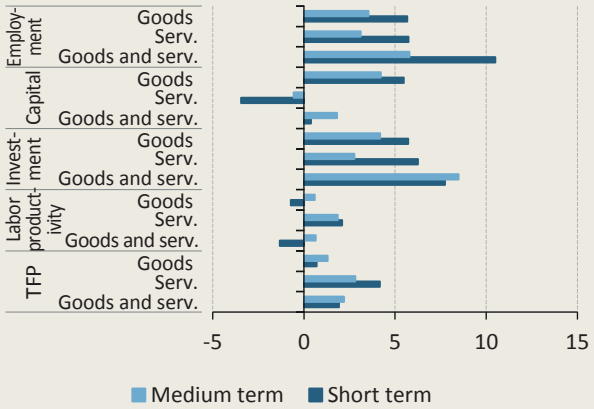
Chart 2-15 presents the difference in the growth of exporting companies before entering foreign markets compared to the growth of non-exporter SMEs. **It can be stated that most exporters grow at a much higher rate in the year preceding the start of exporting compared to non-exporters.** Regarding total factor productivity, services exporters register the strongest growth compared to non-exporters, both in the short term (6 percent higher) and in the medium term (8 percent higher). Prospective exporters substantially increase both the number of employees and their investments before entering the export market. The largest difference in the case of goods and services exporters compared to non-exporter SMEs is experienced in the short run. This is attributable to the aforementioned introduction of new export market products.

Chart 2-15:
Change in firm level characteristics before exporting (% difference relative to non-exporting SMEs)



Note: Bars show the difference in performance between exporter and non-exporter SMEs in the year (short term) or in the five years (medium term, yearly average growth) prior exporting. Our estimations take into consideration the industry of the firm, year and past firm level characteristics. All coefficients significant at 1%.
Source: MNB calculations based on NTCA and HCSO data.

Chart 2-16:
Change in firm level characteristics after exporting (% difference relative to non-exporting SMEs)



Note: Bars show the difference in performance between exporter and non-exporter SMEs in the year (short term) or in the five years (medium term, yearly average growth) after the start of exporting. Our estimations take into consideration the industry of the firm, year and past firm level characteristics. All coefficients significant at 1%.
Source: MNB calculations based on NTCA and HCSO data.

At the same time, exports may help enterprises develop further. The difference between the performance of exporting and non-exporting SMEs can be also perceived if we consider the differences between the enterprises before starting to export (Chart 2-16).

Over the short term, after entering the export market, enterprises grow strongly, particularly exporters of goods and services, which outstrip the growth of non-exporting SMEs by 10 percent one year after starting to export. Investment growth at goods and services exporters also substantially exceeds investment growth at non-exporters, and although their labour productivity declines right after the start of exports, it rises thereafter in the medium run. Their total factor productivity grows 2 percent faster compared to non-exporters both over the short and medium term. However, among exporting SMEs, the fastest growth is seen in the productivity of services exporters, both immediately after starting to export and in subsequent years.

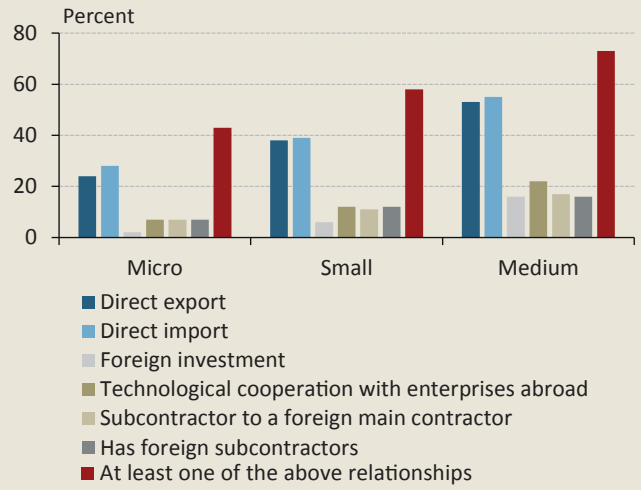
On the whole, it can be stated that even when considering the enterprise characteristics in the pre-export period, exporting enterprises perform better compared to non-exporting enterprises, and services exports or services and goods exports occasionally offer even more advantages for exporter firms than goods exports. In preparing our estimates, we took into consideration the enterprise characteristics that may influence corporate performance simultaneously with exports. We are, however, unable to control for a number of other factors, such as the enterprises' additional international activity and the resulting advantages, in relation to which we have no information.

Box 2-2:
International market entry of SMEs and their role in global value chains

In this study, we analyse the participation of the SME sector in exports and the corporate characteristics related to exports. However, enterprises may be related to their external markets in other ways as well. Imports may help enterprises improve significantly their productivity: for example, as a result of a foreign equipment investment or the high quality and diversity of intermediate products. Engagement in global value chains may represent additional productivity enhancing knowledge and technological progress for SMEs, as well as the more efficient organisation of production processes.

Chart 2-17 summarises the modes of European SMEs' participation in international markets. The ratio of enterprises with foreign relations is higher in the medium-sized category than in the small enterprise category. Irrespective of the size category, the most common form of foreign market entry is exporting and importing. In addition, some enterprises are engaged in technological cooperation with foreign enterprises or have some sort of sub-contractor relation with them. On the whole, more than 40 percent of micro enterprises, almost 60 percent of small enterprises and 70 percent of medium-sized enterprises have some sort of international relations.

Chart 2-17:
SME's presence on international markets by size class



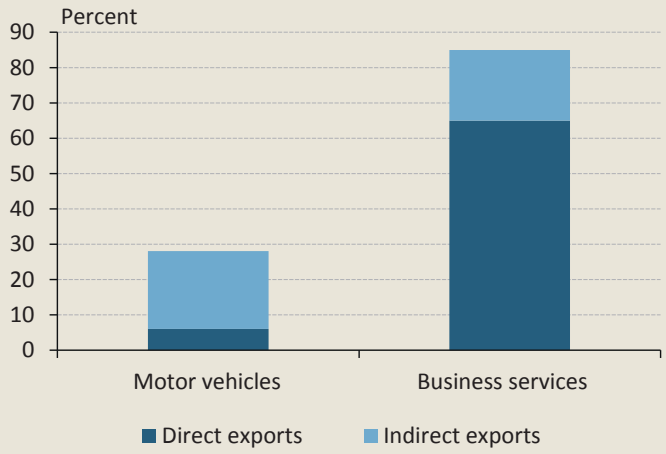
Note: The origin of the data is a survey targeted at almost ten thousand European SMEs in the period 2006–2008.
Source: MNB calculations based on European Commission (2015), p. 17.

It is also important to consider the role of SMEs in global value chains (GVCs), but we have no direct metrics in this respect. By participating in global value chains, SMEs can get closer to larger corporations and may become suppliers, as a result of which the knowledge and technology represented by the larger corporations may spill over to small firms. The GVC measures based on the domestic value added of exports, calculated from the input-output tables, may yield a good approximation of the level of integration into global value chains, but these data are available with a large lag and typically not by enterprise size categories.

Using input-output tables and considering the heterogeneity of the corporate sector, the OECD calculated an estimate for the domestic value added content of the direct and indirect exports of the vehicle industry and market services sector in the case of SMEs (Chart 2-18), which provides a possible measure of participation in the global value chain (WTO, 2016). Direct export refers to the export of SMEs active in the vehicle industry and in the market services sector, while indirect export refers to the export of SMEs belonging to other sectors, which are suppliers to the automotive industry or to market service provider enterprises.

The participation of Hungarian SMEs in global value chains is outstanding in market services. Less than 30 percent of the domestic value added in vehicle exports, which accounts for a substantial share of Hungarian exports, can be attributed to SMEs, while a large part of the domestic value added is provided by enterprises supplying from other industries. On the other hand, in market services 85 percent of the domestic value added is attributable to SMEs. In contrast to the vehicle industry, in the case of services a substantial share (more than 60 percent) of the domestic value added can be attributed to direct export.

Chart 2-18:
SME domestic value added in exports (2009)



Note: Direct exports of SMEs active in the motor vehicles industry and business services. Indirect exports are the exports of those SMEs, which are suppliers of motorvehicles or business services industries.
Source: MNB calculations based on WTO (2016), pp. 42-43.

On the whole, it can be stated that – similarly to large corporations – SMEs also have major room for international manoeuvre. The value of their exports falls behind that of large corporations, which follows from their size; however, precisely due to their smaller size and flexibility, they are quick to find a niche (OECD, 2008). Hence, they may become suppliers to larger corporations or seize other opportunities to enter international markets. In the case of market services, SMEs play an important role and this represents further growth opportunities for smaller enterprises in the future.

2.5 Exporting, technological and knowledge intensity

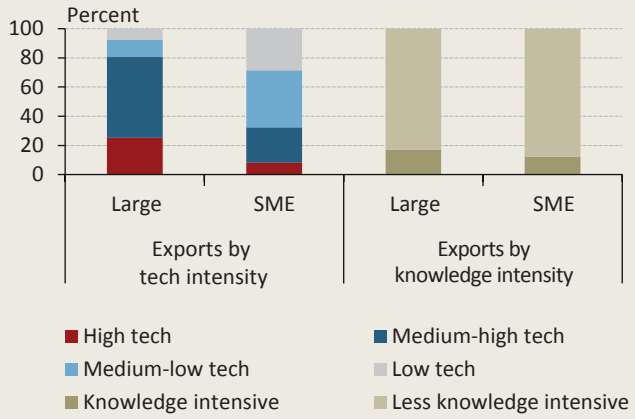
The data we have available to do not facilitate the analysis of the SMEs' exports by product or service type. However, the classification of enterprises by industries may provide a picture on the goods they produce. We follow the Eurostat classification by technological and knowledge intensity of economic activities and create four double-digit industry groups based on technological intensity and two based on knowledge intensity. Eurostat classified technological intensity based on the ratio of R&D expenditures to value added, while knowledge intensity is based on the ratio of those holding a university degree. However, this classification is only an approximation of the product portfolio produced by the enterprises, as, for example, the high technology products do not necessarily consist of high technology components only, and the same applies to the other product/service categories as well (OECD, 2009).

Compared to goods, products of higher technological intensity and services represent higher value added and hence represent better growth opportunities for SMEs.

Most of the goods exported by SMEs are less knowledge intensive and of medium-low technology. The distribution of exports in manufacturing and market services by knowledge and technological intensity is shown in Chart 2-19. **Almost three-quarters of SME's**

manufactured exports can be linked to enterprises of medium-level technology. The exports of enterprises of medium-low technology account for the highest share within manufactured exports. **Services exports are usually less knowledge intensive, i.e. roughly 90 percent of exports related to the market services sectors.** On the whole, SMEs' goods exports fall behind the goods exports of large corporations in terms of technological intensity. However, there is no major difference between large corporations and SMEs in terms of the composition of service sector exports based on knowledge intensity.

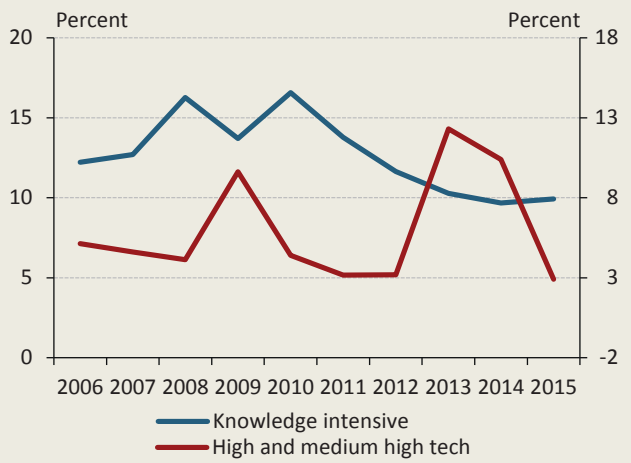
Chart 2-19:
Exports of large enterprises and SMEs by technology and knowledge intensity (2015)



Source: MNB calculations based on NTCA and HCSO data.

Compared to their total exports, the ratio of knowledge intensive exports is the highest on average in the case of micro enterprises; this is presumably attributable to a few enterprises producing services of high value added. However, from 2010 on, the ratio of knowledge intensive exports started to decline and in the last two years it stagnated at around 10 percent. The high and medium-high technology exports of micro enterprises was around 2 and 12 percent, respectively, and has fallen substantially since 2013.

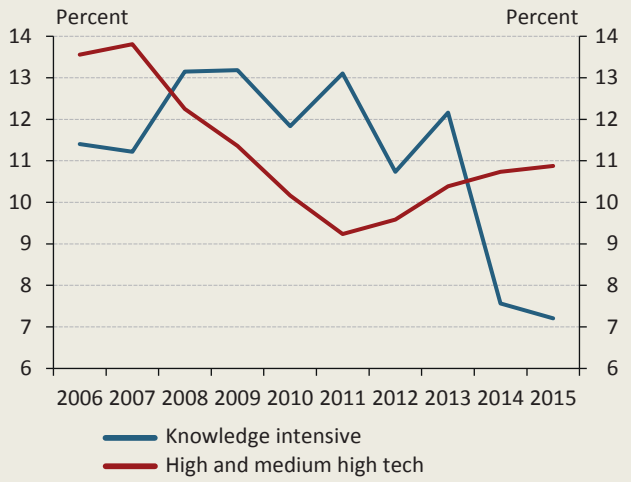
Chart 2-20:
The share of knowledge- and technology intensive exports in total exports for micro enterprises



Source: MNB calculations based on NTCA and HCSO data.

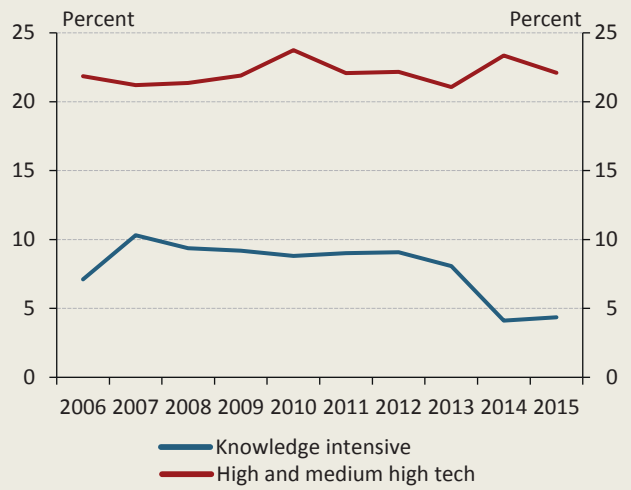
In the case of small enterprises, exports related to sectors of higher technological intensity have risen in recent years, while the exports of companies belonging to the knowledge-intensive service sectors fell (Chart 2-21).

Chart 2-21:
The share of knowledge- and technology intensive exports in total exports for small enterprises



Source: MNB calculations based on NTCA and HCSO data.

Chart 2-22:
The share of knowledge- and technology intensive exports in total exports for medium enterprises



Source: MNB calculations based on NTCA and HCSO data.

As we move upwards in the SME size categories, the ratio of technologically more intensive exports increases, with the highest ratio (between 20 and 25 percent) of exports related to higher technological sectors found at medium-sized enterprises. However, in recent years, the ratio of knowledge-intensive exports is the lowest in the case of medium-sized enterprises, according to the comparison with the other enterprise size categories (Chart 2-22).

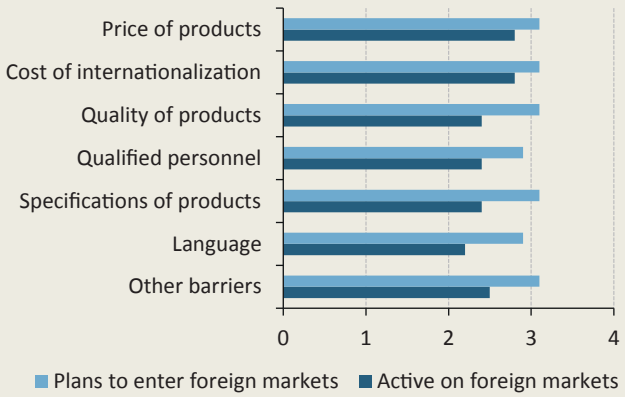
The exports of SMEs belonging to the technological or knowledge-intensive sectors account for a low ratio of total exports, and although this classification provides only a rough picture of the exported products and services, it can be stated that only a small part of these is characterised by high value added.

2.6 Why is it a challenge for SMEs to enter the export market?

As we have demonstrated, exports entail a number of advantages for SMEs: firms grow faster and become more productive once they start exporting. Despite this, only a small number of SMEs participate in external trade, which is mostly attributable to the fact that – compared to large corporations – they face more obstacles when entering external markets. This section reviews the export market challenges faced by SMEs.

The exploration of new markets and familiarisation with the regulations related to the products present high fixed costs for the enterprises and, depending on the volume of exported products, the transport and logistics expenses of the enterprise may rise. **Most of the factors hindering exports stem from the size of the enterprises and are related to the absence of human resources, financing and limited access to information (Cernat et al., 2014).** Compared to large corporations, it is more difficult for SMEs to employ a highly qualified labour force and they are short of resources for enterprise organisation and for the optimisation of work processes. In addition to the internal corporate obstacles, SMEs also face a number of external barriers.

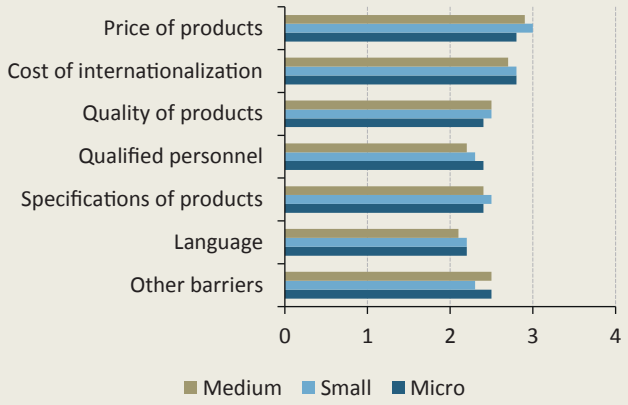
Chart 2-23:
Internal SME barriers in entering foreing markets



Note: The source of the data is a 2009 survey which targeted 9480 European SMEs. Firms were asked about the importance (1-not important, 5-very important) of certain barriers. The chart shows average scores for all firms.
Source: MNB calculations based on European Commission (2015), p. 59.

Chart 2-23 shows the difficulties in exporting originating from the internal, corporate characteristics and inefficiencies of SMEs operating in the EU for enterprises planning to enter the external markets and those already pursuing international trade. The price of the enterprise's products is a higher than medium hindering factor, which includes a number of cost, but it also reflects the efficiency of the absorption of inputs, which is clearly lower in the case of SMEs than at large corporations. The application of proper inputs, be it a skilled labour force or commodity and intermediate products, may already generate difficulties for exporting SMEs. Entering the international market may generate extra costs for firms in addition to domestic production costs, since their products must comply with regulations and standards, which may vary by destination. In order to produce proper products, enterprises must invest in new technology or modernise their production processes or develop their logistics system. The production of higher quality products may also be a requirement when entering external markets. In addition to the aforementioned factors, language barriers also pose difficulties in the case of exports or imports, and the costs of these are disproportionately higher in the case of SMEs than at the large corporations. Firms that are about to enter the marker attach higher significance to the barriers listed above than firms already active in the external markets. The internal obstacles are of roughly identical importance for SMEs by size category (Chart 2-24).

Chart 2-24:
Internal SME barriers in entering foreing markets by size class

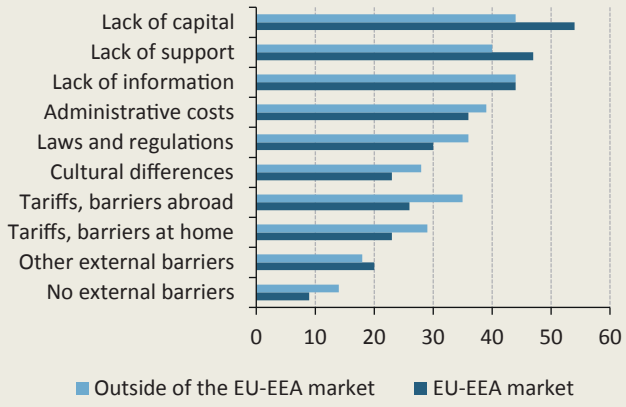


Note: The source of the data is a 2009 survey which targeted 9480 European SMEs. Firms were asked about the importance (1-not important, 5-very important) of certain barriers. The chart shows average scores for all firms.
Source: EMNB calculations based on European Commission (2015), p. 58.

In addition to obstacles arising from corporate characteristics, SMEs also face a number of external barriers when entering foreign markets. The frequency of these barriers is shown by Chart 25, depending on whether they trade with the EU or with countries outside the EU. The most frequent barriers in the case of enterprises producing for the EU market include the shortage of capital, absence of support, high cost of access to information and other administrative costs related to external markets. SMEs trading with more distant partner countries usually more often face trade barriers of a tariff and non-tariff nature, and for them different legislation and cultural differences represent larger challenges. It is only a very low ratio of the respondent SMEs, i.e. roughly 10 percent, for which external barriers generate no difficulties upon entering international markets.

The listed external trade barriers usually impact most of enterprises entering external markets. However, some barriers – such as legislation and other product-related regulations – pose disproportionately large difficulties for SMEs due to their size. Support for SMEs in these areas may encourage SMEs to enter export markets, reach new destinations and increase their export intensity.

Chart 2-25:
External SME barriers in entering foreing markets



Note: The source of the data is a 2009 survey which targeted 9480 European SMEs. The chart shows the percentage of those answering "yes".
Source: MNB calculations based on European Commission (2015), p. 60.

References:

Adlung, R. – Soprana, M. (2012) : SMEs in services trade: A GATS perspective, WTO Staff Working Paper, No. ERSD-2012-09.

Ariu, A. (2012): Services versus Goods Trade. Are They the Same? p. 237, National Bank of Belgium

Bernard, A. – Jensen, B. (1999): Exceptional exporter performance: cause, effect, or both? *Journal of International Economics* 47 (1999) pp. 1–25.

Bernard, A. B., Smeets, V. and Warzynski, F. (2016): Rethinking Deindustrialization, NBER Working Paper 22114, March 2016.

Bustos, P. (2011): Trade Liberalization, Exports and Technology Upgrading: Evidence on the Impact of MERCOSUR on Argentinean Firms", American Economic Review, 101 (1), 2011, 304–340.

Breinlich, H. – Criscuolo, C. (2011): International Trade in Services: A Portrait of Importers and Exporters, *Journal of International Economics*, Vol. 84, No. 2, pp. 188–206.

Castellani, D., Serti F. and C. Tomasi (2008): Firms in International Trade: Importers and Exporters Heterogeneity in the Italian Manufacturing Industry. LEM Paper Series 2008/04, Laboratory of Economics and Management (LEM), Sant' Anna School of Advanced Studies, Pisa, Italy.

Cernat, L., Norman-Lopez, A., Duch T-Figueras, A. (2014): SMEs are More Important Than You Think! Challenges and Opportunities for EU Exporting SMEs. EC Trade Chief Economist Note, Issue 3, September 2014.

Crozet, M. – Milet, E. (2015): Should Everybody Be in Services? The Effect of Servitization on Manufacturing Firm Performance, GSEM working paper series 15-10-2.

Di Giovanni, J., Levchenko, A. and Ranciere R. (2010): Power Laws in Firm Size and Openness to Trade: Measurement and Implications. IMF Working Paper WP/10/109.

De Loecker, J. (2007): Do Exports Generate Higher Productivity? Evidence from Slovenia, *Journal of International Economics*, 73, September, pp. 69–98.

European Commission (2015): Internationalisation of European SMEs. Final Report.

Eurostat (2011): Key figures on European business with a special feature on SMEs. Eurostat Pocketbooks. ISSN 1830-9720.

Kraay, A., Sologa I. and J. Tybout. 2002. Product Quality, Productive Efficiency and International Technology Diffusion: Evidence from Plant-level data. Policy Research Working Paper 2759, World Bank.

Levinsohn J. – Petrin, A. (2003): Estimating Production Functions Using Inputs to Control for Unobservables. *The Review of Economic Studies*, Vol. 70, No. 2 (April 2003), pp. 317–341.

Lodefalk, M. (2013): Servicification of Manufacturing--Evidence from Sweden. *International Journal of Economics and Business Research*, 6(1), pp. 87–113.

OECD (2008): Enhancing the Role of SMEs in Global Value Chains.

OECD (2009): OECD Science, Technology and Industry Scoreboard.

Pasadilla G. – Wirjo, A. (2014): Services and Manufacturing: Patterns and Linkages. APEC Policy Support Unit POLICY BRIEF No. 10, 31 July 2014.

Van Biesebroeck, J. (2005): Exporting Raises Productivity in sub-Saharan African Manufacturing Firms, *Journal of International Economics*, December, 67(2): pp. 373–391.

Verhogen E. (2008): "Trade, Quality Upgrading and Wage Inequality in the Mexican Manufacturing Sector." Quarterly Journal of Economics, vol. 123, no. 2, pp. 489–530, May 2008. (.bib) Appendix II, Erratum.

WTO (2016): World Trade Report. Levelling the trading field for SMEs.

3 Effects of Technological Change on the Labour Market

This chapter discusses the changes that the labour market has been undergoing since the 1980s. There is evidence from research that wage inequality has greatly increased in developed countries. In the 1980s, wage growth was determined by employees' educational attainment: the higher their skills were, the higher wage increment they could expect. That changed from the early 1990s, when wages not only increased significantly for high-skilled employees, but also for those with the lowest level of skills, who tend to provide personal services (such as drivers, cleaners, beauticians). The wage level middle-skilled employees, who are mostly skilled workers employed in factories, fell short of the earnings of other employees. An analysis of the presence of such employees shows that not only are their wages lower, their share within employment is also lower.

While a number of factors can be identified as underlying this phenomenon, such as globalisation and changing labour market institutions, this chapter discusses the effect that the spread of information and communication technologies (ICT) has on labour market polarisation. The development of computing had a major influence on the methods of communication and the development of robotics, as a result of which increasingly affordable industrial robots became more cost-efficient in carrying out the tasks of skilled workers. This caused labour demand for such workers to decrease. Conversely, the skills of high-skilled employees complement the new technology, which makes them more productive and increases demand for their work. This mechanism increased the wages of higher-skilled employees, despite the fact that in the meantime the expansion of higher education had also resulted in a significant increase in the supply of such employees. The wage increase in the lower segment of the wage distribution stems from the increased demand for the output of the service sector and thus for employees working in services, fuelled by the income growth of high-skilled workers. However, this employee segment does not only include low-skilled employees: this is where skilled workers who have been made redundant are also forced to look for jobs, which puts downward pressure on wages.

Occupational rearrangements can also be observed in the Hungarian labour market. Between 1994 and 2000, the share of low-skilled and middle-skilled employees increased, which can be explained by the fact that the appearance of large multinational corporations on the Hungarian market boosted demand for skilled workers. Conversely, wages increased linearly with educational attainment: the higher an employee's completed level of schooling, the higher wage increment they could expect. This trend changed at the beginning of the 21st century. As in many other countries, the labour market became polarised, i.e. both low and high-skilled employees saw their shares increase at the expense of middle-skilled employees. However, wages did not become polarised. Between 2000 and 2015, the wages of low-skilled employees rose at a faster rate than those of higher-skilled employees, for two possible reasons. One is the significant increase in the minimum wage during the period. The other is the expansion in higher education, which moderated the wages of high-skilled employees despite the rising demand for them.

This chapter discusses the changes that will be brought about by more rapid technological development in the years to come. Research findings suggest that the developments previously seen in production will be transferred to the services market. Robotisation will evolve to a level where robots will be capable of carrying out not only mechanical and repetitive tasks, but also more complex ones (see, for instance, the spread of driverless cars).

The spread of ICT is a fact, but the government may mitigate the negative developments evolving in the labour market. The most important task is effective support for SME innovation, along with the transformation and extension of the educational system. The largest possible number of people should learn and do so extensively, i.e. there should be growth in both the ratio of secondary school graduates and the number of participants in higher education, and in the number of participants in life-long learning. It is also important to improve the quality of education so that it equips employees with skills that make them flexible and thereby able to switch professions when needed.

"Labor will become less and less important. ... More and more workers will be replaced by machines. I do not see that new industries can employ everybody who wants a job."

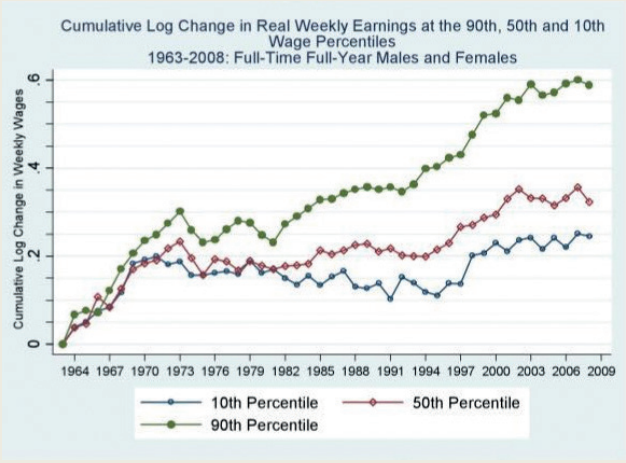
Wassily Leontief (1952), cited by Acemoglu and Restrepo (2017)

3.1 Changes in the labour market over the past 35 years

Although Leontief's observation did not materialise for another thirty years, the process finally started in the early 1980s, and the emergence of new information and communication technologies (ICT), which is still continuing today, has induced profound changes in all countries across the world. One of the most important changes took place in the labour market. This chapter discusses how the structure of the labour market has been influenced over the past 35 years by the robotisation of specific work processes, and the emergence of increasingly efficient technologies to collect information and facilitate communication.

In the labour markets of developed countries, changes took place on a large scale. As shown in this chapter, from the 1980s onwards there was a major increase both in the wage inequality between employees with different skill levels, and in the demand for specific occupations.

Chart 3-1
Changes in earnings in the US, 1963–2008

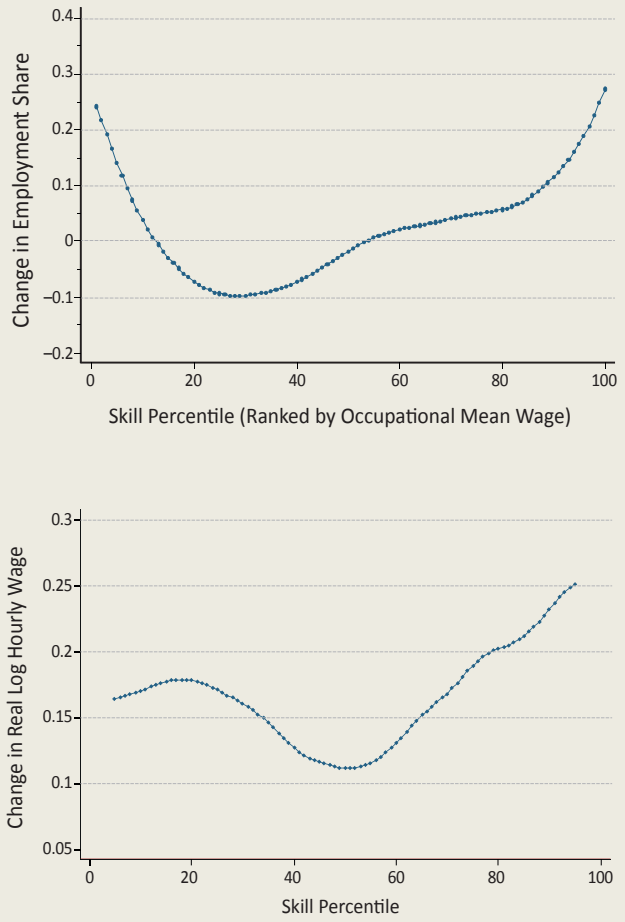


Source: Acemoglu and Autor (2011), Chart 7, panel A.

As shown in Chart 3-1, in recent decades the wages of high-earning employees in the US have grown at a much faster rate than those of middle or low-earning employees. There is a huge gap between the highest-skilled and the lowest-skilled employees: while the real earnings of an employee in the 90th percentile have increased by more than 60%, the real earnings of those at the 50th percentile grew only by 30%, and for those at the 10th percentile by even less, 25% (Acemoglu and Autor, 2011). In other words, the difference between very high and very low wages increased by some 35%. Although the chart shows wage growth rates from 1964, it is also apparent that the significant increase in inequality started in the late 1970s and early 1980s.

These labour market developments did not take place in the US alone. In their summary of the wage gap between high and low-earning employees in 16 developed countries, Katz and Autor (1999) find that inequalities have increased in most cases, although to a more limited extent than in the US. The authors conclude that while the underlying economic developments (discussed in detail below) are similar to those taking place in the US, labour market institutions are capable of mitigating the inequalities.

Chart 3-2:
Changes in employment shares and earnings in the US by occupational group, 1980–2005



Source: Autor and Dorn (2013).

The other major change took place at the level of occupations. Chart 3-2 shows the extent to which the share and wages of various occupations (at a depth of 3 digits within Standard Classification of Occupations) changed in the labour market between 1980 and 2005 depending on the percentile of the wage distribution at which each occupation was registered at the beginning of the period (Autor and Dorn, 2013). Obviously, the top segment of the distribution is comprised of occupations requiring a high level of educational attainment (e.g. engineers, attorneys). Middle-paying occupations are mostly filled by industrial skilled workers and by employees carrying out office work in positions that do not require a high level of educational attainment. By contrast, low-paying occupations tend to be service activities that do not require a high level of educational attainment (such as drivers, cleaners). The chart shows that occupations that require a high level of educational attainment (and are consequently high-paying) and occupations that require a low level of educational attainment both saw their shares increase in the labour market between 1980 and 2005, accompanied by a decrease in the share of occupations that qualified as middle-paying at the beginning of the period. The same change is also reflected in earnings: in the space of 25 years, high and low-paying occupations saw their wages rise at a much higher rate than middle-paying ones. Summarising the two charts, it can be argued that high-skilled employees gained a considerably greater wage advantage compared to middle and low-skilled employees, and that it was mostly middle-skilled employees that lost their jobs and saw their wages rise at the lowest rate. Again, the phenomenon at hand concerns the entire developed world: Goos et al. (2009) observe similar changes across 16 countries in continental Europe.

3.2 Explanations

Economic theory, therefore, needs to explain two interrelated phenomena. Data on developed countries show that wage inequalities have increased and that the increase is related to levels of educational attainment: the relative size and wages of both high and low-paying occupations have increased at a higher rate compared to middle-paying occupations.

Three explanations for this phenomenon are offered by economics: technological change, the emergence of globalisation, and changes in labour market institutions such as minimum wages and the influence of trade unions. In the following, a detailed discussion is offered of the effects of technological change, with a brief treatment of the other two phenomena.

3.2.1 TINBERGEN'S COMPETITION BETWEEN EDUCATION AND TECHNOLOGY

Wage changes are addressed in terms of employees' educational attainment on the basis of Tinbergen's (1974) model, which was first used to explain the changes taking place in the 1980s by Katz and Murphy (1992).[23] According to the model, the wage advantage of university graduates compared to the wage level of lower-skilled employees is determined by relative labour demand, i.e. the extent to which employers seek to employ high-skilled labour. **It can also be reasonably assumed that the two types of employees are complementary in production.** High-skilled and low-skilled employees are employed together both at the level of single firms (even a software development firm needs service staff) and at the level of the national economy (a high-skilled employee needs various products and services for work, which are provided by middle and low-skilled employees).

The wage premium will rise to the extent that technology is introduced to increase graduate employees' productivity (e.g. a computer will make a designer much more efficient than it would a machine operator).[24] It will do so because the new technology and higher-skilled employees are complementary in the production process, which will increase demand for skilled employees relative to demand for unskilled employees. However, there is an additional process at play in the development of the university wage premium, which is the change in the share of graduates. Where an economy is characterised by expansion of higher education (as was the case in developed countries and the whole of Europe), the supply of graduate employees will increase, which will in turn reduce their wages. Assuming that production processes remain unchanged, the steady increase in the supply of high-skilled employees should have caused the university wage premium to fall. As the very opposite has been happening, **it is likely that technological change has induced far more substantial changes in the labour market than what could have been counterbalanced by the expansion of higher education.**

23 An excellent summary of the model is provided by Acemoglu and Autor (2011).

24 Since individual productivity generally cannot be measured, the empirical studies testing the theory primarily focus on an analysis of changes in wages, and do not measure productivity, or do so only at the level of the firm.

3.2.2 ADJUSTMENT OF THE TINBERGEN MODEL25

The model discussed above is suitable for using simple labour demand and supply mechanisms to explain why wage inequality increased between graduate and lower-skilled employees. Yet, **it fails to explain the changes taking place in the labour market in the 1990s, i.e. that both high and low-skilled employee saw their wages rise, while middle-skilled employees saw both their employment rate and wages fall.** However, a few extensions to Tinbergen's theory will provide an explanation as to what causes polarisation in the labour market. The previous model's distinction between skilled and unskilled labour will be refined by subdividing unskilled labour into two groups, distinguished by the extent to which their occupations consist of routine tasks. In this context, a "routine task" will not be defined as one that is easy to carry out, but as one that can be broken down into steps that always need to be carried out in the same way, and are repeated over time. An automotive electronics technician will mount the same part on each car in production in the same way, and the work of a bank clerk or a retail teller is also subject to repetitive and well-defined rules. By contrast, a driver or a cleaner (and a number of other people working in the services sector) will encounter a different situation each time, although their work requires less expertise than that of a skilled factory worker or a young lawyer. **Low-skilled employees working in the services sector are generally found at the bottom of the wage distribution, with those in occupations comprising routine tasks in the middle, and graduate employees at the top.**

As robots can carry out repetitive routine tasks that are subject to rules, the share of occupations carrying out such tasks is decreasing as ICT is becoming increasingly cheap. Jobs requiring a high level of educational attainment will generally be made more efficient as a result of ICT and will complement it in production, because good communication and access to data will facilitate and increase the efficiency of the work of managers, engineers and analysts. **The work of low-skilled employees in services is impossible or at least very difficult to mechanise, because generally it requires complex communication skills** (e.g. in the case of a hairdresser or a beautician), as well as the recognition of complex, constantly changing patterns (e.g. a cleaner will clean rooms that are arranged differently each time). **Given that it is impossible, or at least difficult for the time being, for robots to apply these two skills** (Brynjolfsson and

25 This section relies on Autor and Dorn (2013).

McAfee, 2014)**, the introduction of ICT has had limited impact on the productivity of low-skilled employees working in services. That said, not even these employees are secure against indirect labour market effects.** Since employees carrying out routine tasks are increasingly losing their jobs and are not skilled enough for graduate occupations, they will also look for jobs in the lower segment of the labour market, and will therefore compete with employees who have already been providing services. However, **that effect is counterbalanced by increased demand for services, which is generated by high graduate wages and the fact that the prices of some products are falling (due to the possibility of producing them cheaper using ICT).**

On balance, there are two developments at work as a result of the spread of ICT. **In the labour market, robots are crowding out middle-skilled employees carrying out routine tasks** (who tend to work in manufacturing or in offices). **In turn, increased productivity is generating additional income, boosting demand for services and, consequently, for the employees who provide those services.** As the wages of skilled employees rise (due their skills complementing the new technology), the labour market is becoming polarised: demand increases for both high and low-skilled employees, which will in turn cause their wages to rise (the latter will occur when additional demand in the services market has a stronger effect than additional supply in the labour market for low-skilled occupations). **By contrast, the share of employees carrying out routine tasks in the middle of the wage distribution is decreasing in the labour market, and their wages also fail to rise substantially.**

Up to this point, we have been addressing the growth in inequality, but the question of what has happened to aggregate employment is obviously also very important. It may be assumed that since new technologies are replacing middle-skilled labour, the spread of ICT will lead to the loss of jobs, or even unemployment on a large scale (Pissarides, 2017). Accordingly, in economic literature analyses are being carried out increasingly frequently on the general effects of technological development on employment. **Even at the dawn of the industrial revolution, for many people technological developments represented the risk of losing their jobs;** take, for example, the Luddites, who in the early 19th century destroyed machines for fear of losing their jobs due to their increased use. Not only workers but also the best researchers in economics were concerned about the effects of machines. An apt example of that is the motto of this chapter, taken from 1973 Nobel laureate Wassily Leontief.

Research has produced evidence that robotisation and the spread of the internet have a causal effect on the labour market. Analysing the US, Acemoglu and Restrepo (2017) find that the spread of robots is reducing employee headcounts: **in a commuting zone, each additional industrial robot per thousand employees will reduce the employee headcount by some 0.3% and wages by 0.7%. For the most part, this effect hits non-graduate manufacturing employees the hardest, but interestingly it fails to improve the chances of other employees to find jobs.**

Other analyses measure far more moderate effects. Graetz and Michaels (2015) cannot demonstrate aggregate negative effects on labour across 17 developed countries in the European Union and in other regions. **On the other hand, the authors identified negative, but relatively modest effects on employees carrying out routine tasks.**

The composition and wages of labour can also be influenced by the spread of information technology, in addition to the spread of robots. Akerman et al. (2015) find that **the spread of broadband internet in Norway has reduced the opportunities of low-skilled employees in the labour market, while it has improved those of high-skilled employees.**

Finally, examining the relationship between productivity and employment in 19 developed countries, Autor and Solomons (2017) find that **in industries where productivity has increased (probably due to the use of computing), the employee headcount has indeed decreased, but that decrease was counterbalanced by rising employment in other countries (in the same country).** This is because increasing productivity in a given industry will increase wages, which will produce spillover effects on other industries through higher consumption. As a result, demand for labour will not fall in productive countries. **However, as we have also shown, the composition of labour is changing: the share of middle-skilled industrial jobs is falling, and is being replaced by services.** Productivity growth therefore indirectly contributes to polarisation in the labour market.

Arguably, then, the analyses available indicate that the spread of ICT is reducing the demand for employees carrying out routine tasks. On the other hand, it is unclear what its effect on aggregate employment is and whether the new technologies are indeed helping employees in occupations related to services (usually personal services) that cannot be standardised.

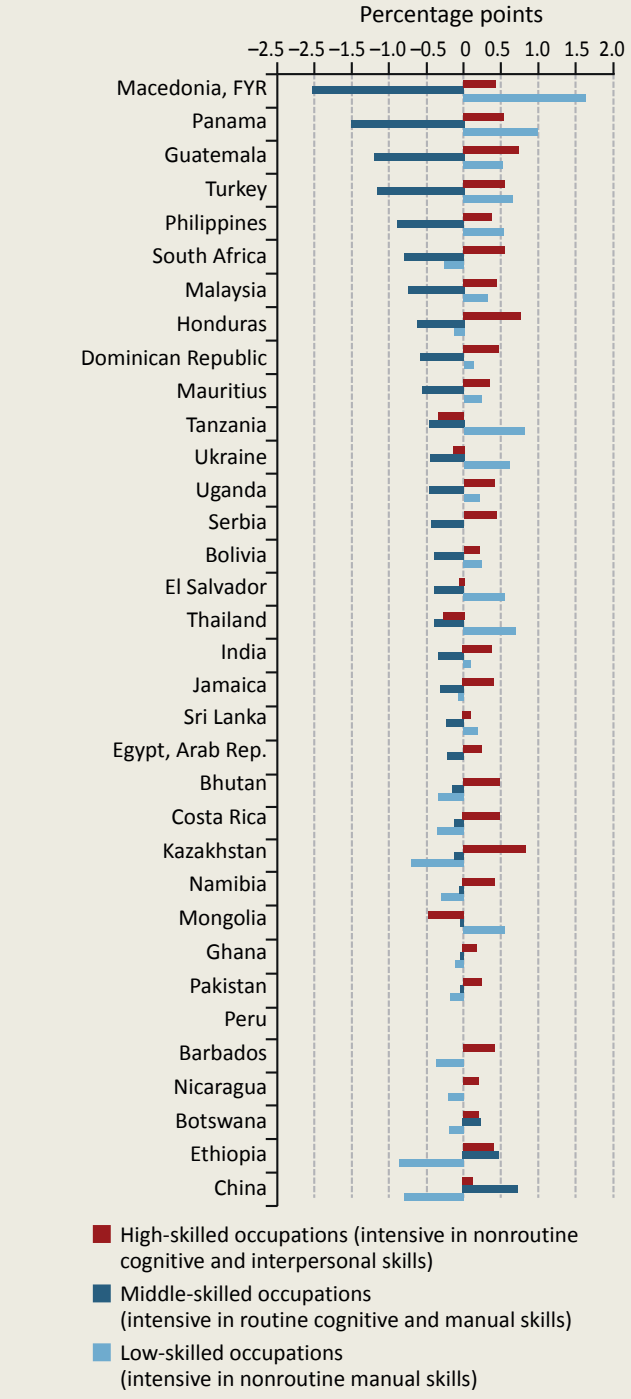
3.2.3 ALTERNATIVE EXPLANATIONS: GLOBALISATION AND LABOUR MARKET INSTITUTIONS

The above theories offer a coherent explanation as to why the labour market has become polarised, but is it certain that technological development is underlying that process? There is another development that has been taking place over the past 25 years and has the same effects on the labour market as ICT. That is the **rise in international trade**. **Since the products involved in trade have, until most recently, been predominantly produced by the manufacturing industry, in developed countries import competition is eroding internal demand for the typical employment patterns of such firms. The employees concerned are skilled workers and machine operators, which means that globalisation has been hitting the same professions as ICT.** Indeed, Autor et al. (2013) find that **in the US manufacturing employment has fallen to a greater extent in regions that were exposed to Chinese imports, and that the competition created by foreign trade is responsible for a quarter of the redundancies in manufacturing.**

Arguably, then, the **intensification of international competition is exerting similar effects on the labour market as those brought about by technological change.** However, looking beyond the direct effects of foreign trade, the question must also be asked as to what has caused international trade and multinational firms to relocate to certain developing countries on such a large scale. **In his extensive analysis, Baldwin (2016) argues that this development could not have taken place without advanced communication technologies. In other words, globalisation itself is being driven by technological change.**

The other piece of evidence on whether labour market changes are attributable to ICT may be obtained through an analysis of the labour markets of developing countries. If changes were to be driven by globalisation, changes should not be observable in these countries, because globalisation has in fact relocated industrial jobs to developing countries from countries with high wages and developed economies. Chart 3-3 shows the changes in employment shares between 1995 and 2012 for high, middle and low-skilled employees. **Apparently, labour market polarisation has also started in developing countries, reducing the share of middle-skilled labour that mostly carries out routine tasks; however, that development has not taken place everywhere.** For instance, in China, Ethiopia and in a few Latin American countries, this employee category has not seen its share drop over the past two decades (World Bank, 2016).[26] One reason for that could indeed be globalisation, the other being that since the substitution of people with machines depends on the relative prices of those two factors of production, employees are replaced by machines to a lesser extent in countries where labour is cheap.

Chart 3-3:
Annual average employment shares in developing countries



Source: World Bank (2016).

26 Since China has an extremely large share in manufacturing production, the reduction in routine labour in the rest of the countries could be due to the fact that most routine work has been relocated to China. Yet, the World Bank's study notes that also in that country, the increase in the share of routine labour is primarily attributable to the mechanisation of agriculture (World Bank, 2016).

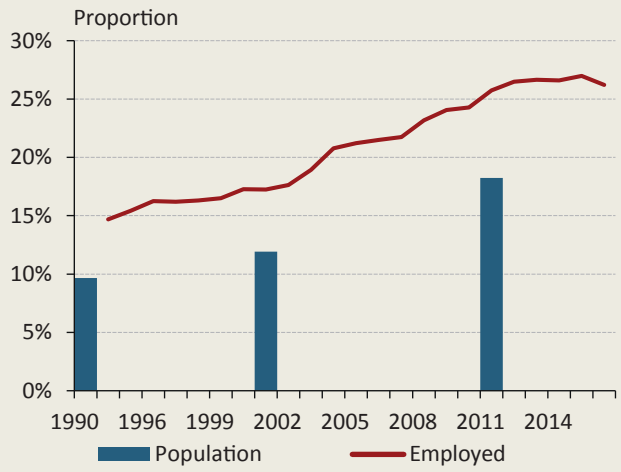
In addition to ICT and globalisation, changes in labour market institutions are believed to be the third cause of wage inequality. **Card and DiNardo (2002) argue that in the US, the fall in minimum wages in the 1980s and trade unions' loss of prominence go a long way in explaining the growth in wage inequality.** However, Autor et al. (2008) **demonstrate that labour market institutions fail to explain either the high growth rate of the highest wages** (which is obviously not influenced by the minimum wage) or polarisation in the labour market. The fact that polarisation has taken place in almost all developed countries and in the majority of developing countries, also suggests that labour market institutions are not underlying the phenomenon, because these vary by country.

There are thus several possible factors to explain major labour market changes, and all of them are likely to have influenced wage inequality and changes in the shares of the different types of occupation. In our reading, theoretical and empirical literature suggests the emergence if ICT as the key explanation.

3.3 Developments in Hungary

Moving on to the Hungarian labour market, let us now consider whether the changes taking place in many countries around the world can also be observed here. Our analysis disregards the public sector and only considers the wages of employees in firms, because the wages of employees in the public sector are not determined by labour market supply and demand.[27] Our analysis starts in 1994, so that its time span is sufficient for the observation of long-term changes in the labour market. An earlier starting date would not be a reasonable choice, because in that case the initial stage of our analysis would be too close the early 1990s, and thus the immediate shocks of economic transformation could influence the results. By 1994, that process had partly been completed, which allows us to assume that the following is an explanation of the effects of technology and not those of other changes.

Chart 3-4:
Expansion in Hungarian higher education



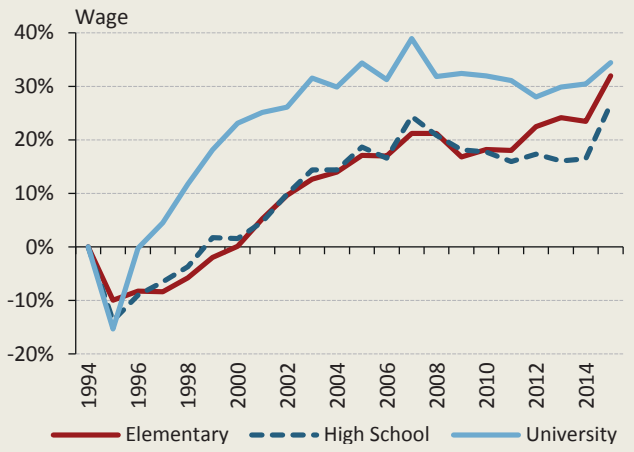
Note: Blue bars: share of graduates within the total population aged over 20; Red curve: share of graduates within the employed population;
Source: HCSO.

The expansion in higher education that took place in developed countries also reached Hungary in the 1990s. As shown in Chart 3-4, the ratio of graduates in the adult population was only 9.7% in 1990. Increasing steadily, the ratio reached 12% in ten years, and 18% by 2011. The rising ratio of college and university graduates is also reflected in their ratio within the employed population. The ratio of graduate employees grew from 14% in 1994 to 27% in 2015. If nothing had changed in the Hungarian labour market and production technologies, one would expect wages in occupations requiring high educational attainment to have fallen due to the steady increase in supply.

27 The analysis relies on the Wage Survey Database. Only firms with more than 20 employees are studied, because smaller firms are not available for the entire period of the analysis.

Chart 3-5 shows the annual growth rate of wages for three levels of educational attainment (below high school, high school, college and university). In the period under review, the wages of graduate employees grew at the fastest rate, but that difference was established by 2000, after which wages in the three categories grew at approximately the same rate. Another point of interest is that the earnings of low and middle-skilled employees grew at similar rates throughout the period, except for the last few years when the wages of employees without secondary school graduation grew at a much faster rate than those of secondary school graduates.

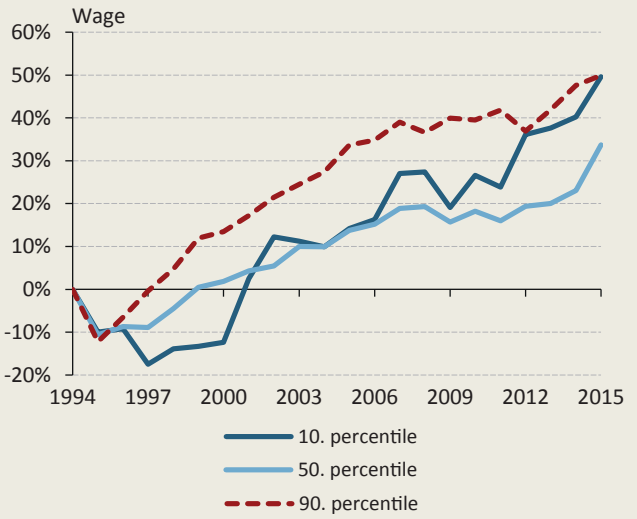
Chart 3-5:
Changes in earnings by educational attainment



Source: Calculations of the MNB based on the Wage Survey Database.

Why could it be that the wages of low earners grow at a similar rate, or in certain periods even faster, than those of secondary school graduates? To answer that question, wages are presented in a different breakdown. Chart 3-6 shows the evolution of the real wages of low, middle and high earners at the 10th, 50th and 90th percentiles relative to 1994. In terms of the whole period, the chart implies a polarised labour market: In the Hungarian private sectors, the wages of the highest and lowest earners grew at the same rate during the period under review, with the wages of middle earners falling significantly behind.

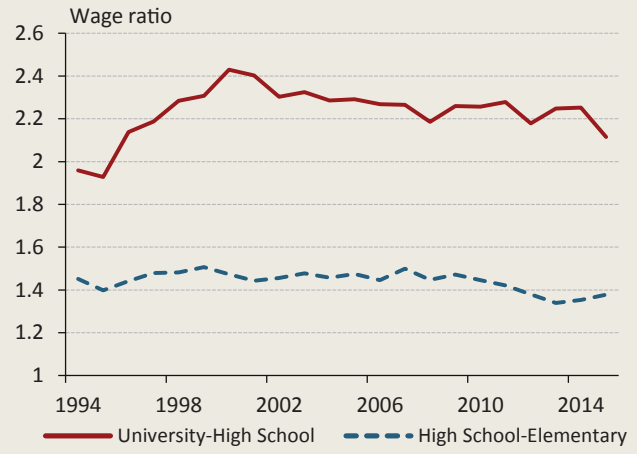
Chart 3-6:
Changes in wages at the 10th, 50th and 90th percentiles



Source: Calculations of the MNB based on the Wage Survey Database.

To provide a summary of developments in wage inequality, the differences between average wages are shown by educational attainment (Chart 3-7). One curve represents the difference between college graduates and secondary graduates, while the other curve presents the difference between secondary graduates and unskilled employees. The wage difference increased only for college graduates relative to secondary graduates, and only up to 2000. In the subsequent period the curve levels out, which means no change in the wage difference. The wages of low-skilled employees have increased slightly relative to those of secondary graduates since 2000, and that growth has accelerated in the past six years.

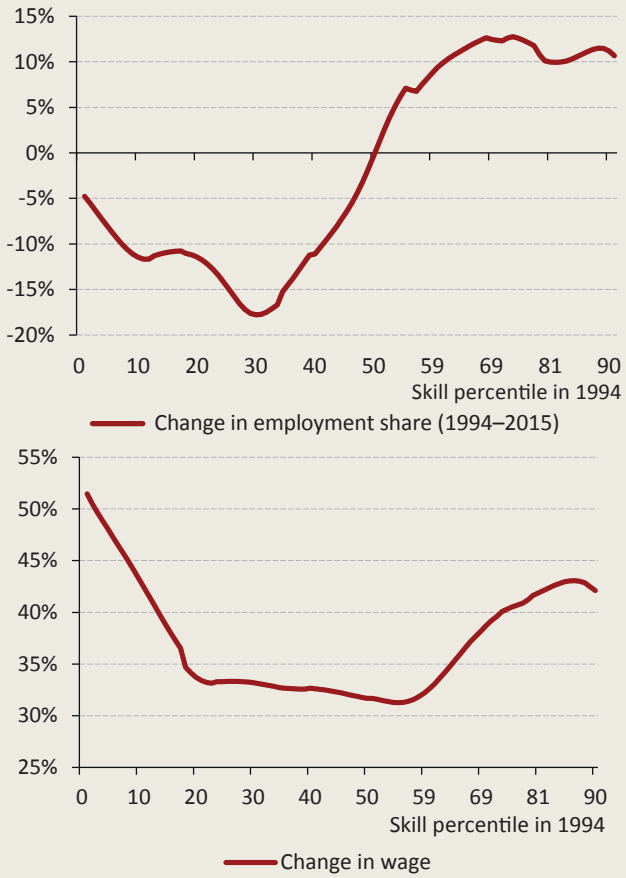
Chart 3-7:
Wage ratios by educational attainment



Source: Calculations of the MNB based on the Wage Survey Database.

So far, we have analysed changes in wages by employee category. Let us now consider how wages and employment shares changed in the labour market as a whole. For that purpose, the same charts have been produced as those presented for the US labour market at the beginning of the chapter: occupation categories were established[28] and ordered on the horizontal axis according to the median wage for 1994 (the higher the median wage was in an occupation in 1994, the further it is from the origin the chart). The vertical axis represents the share of employees in the given occupation (relative to all employees) and the increase in its median wage between 1994 and 2015.[29] Chart 3-8 shows that polarisation has also taken place in the Hungarian labour market. Both low and high-paying occupations are more prominent in the labour market in 2015 than 21 years earlier, and it was employees in those occupations who have seen their wages rise at the highest rate. The weight of the highest-paying occupations has increased to a far greater extent than that of occupations associated with low wages, while the opposite applies in terms of wage increases. Low-earning and (low-skilled) employees have seen their wages rise to a far greater extent compared to high-skilled employees. In turn, middle-skilled employees have fallen significantly behind, both in terms of their share and wage increase.

Chart 3-8:
Changes in earnings by occupation, 1994–2015



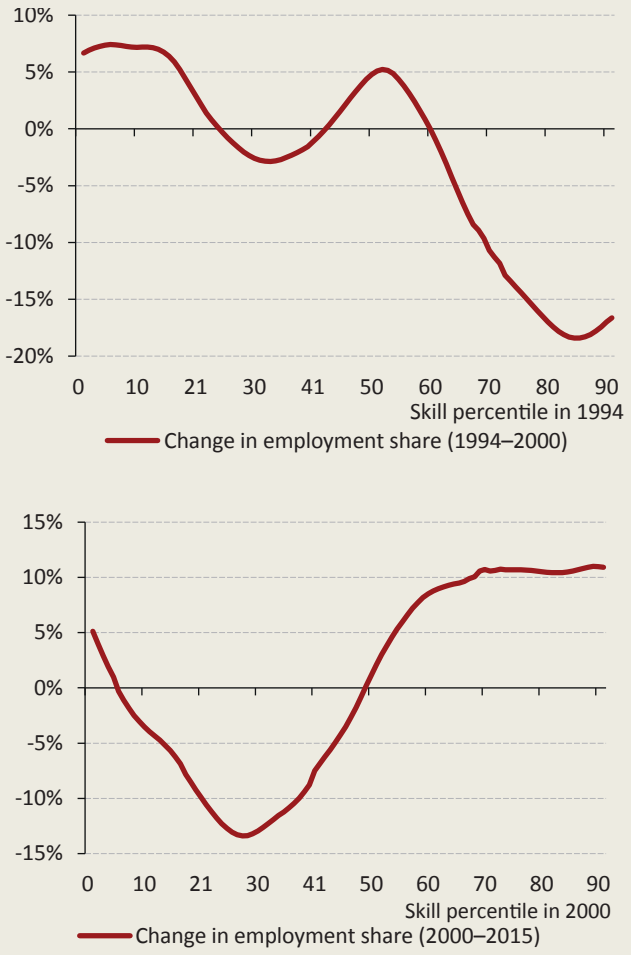
Note: The figure presents the change in the share of occupations in total employment (x100) and change in the occupation's median wage with respect to the percentile ranking of the occupation in the distribution of median wages in the first year of the period studied.
Source: Calculations of the MNB based on the Wage Survey Database.

The evolution of average wages (as presented above) implies a change in the behaviour of the Hungarian labour market around 2000. Between 1994 and 2000, wage inequality is shown to increase (with high-earning employees earning even more and low-earners increasingly falling behind), contrasted by a decrease in wage inequality over the next 15 years, with wages of low earners slightly converging. Let us break down the period under review into two stages and take a closer look at what happened in the labour market. The next two charts show the changes in employment shares and wage increments for 1994–2000 and 2000–2015. In 1994–2000, the strongest growth is observed in the share of low-skilled employees, and a strong increase is also seen around the 50th percentile. Wages become polarised to the extent that in the lowest-paying occupations wages rise at a slightly higher rate compared to the middle of the distribution; nevertheless, the most important phenomenon is that wages already increase linearly from the 20th percentile upwards relative to the initial wage.

28 Occupations are defined at a depth of 3 digits, on the basis of the Standard Classification of Occupations (FEOR). 105 standalone occupations are considered such as "heads of production units", "finance and accounting occupations", "occupations in the food industry", and "cleaners".

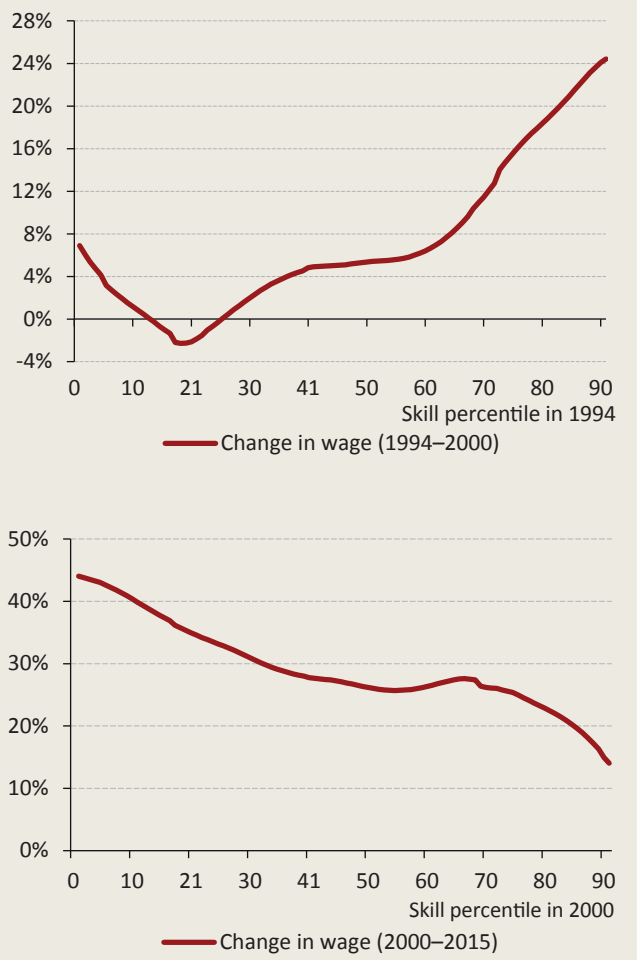
29 In more precise terms, the median of the wage logarithm is used, and the growth rate is derived as the difference of the logarithms. The chart was produced using locally weighted smoothed regression.

Chart 3-9: Changes in employment shares by occupation in 1994–2000 and 2000–2015



Source: Calculations of the MNB based on the Wage Survey Database.

Chart 3-10: Changes in earnings by occupation in 1994–2000 and 2000–2015



Source: Calculations of the MNB based on the Wage Survey Database.

In 2000, the behaviour of the labour market changes (Chart 3-10). The shares of both low and high-paying occupations increase at the expense of middle-paying ones. However, the behaviour of wages is completely different from that seen in the US, because their growth rate is inversely proportional to initial wages. The lower the initial wage of an occupation, the higher the wage increment.[30]

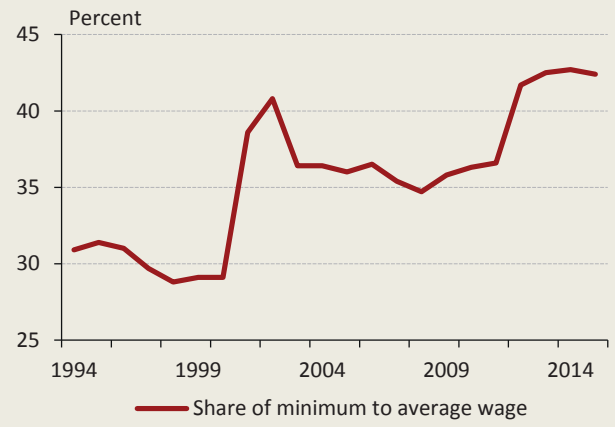
Two effects are likely to have reduced wage inequality in 2000–2015, despite the increased demand for high-skilled employees in the economy. Expansion in higher education took place at a very rapid rate. As shown earlier, between 1990 and 2011 the ratio of college and university graduates nearly doubled within the population aged over 20. In the first ten years of the market economy, the increasing number of new graduates were probably easily absorbed by additional demand; however, that trend changed around 2000 as high supply decelerated the rise in wages (this is also indicated by Tinbergen's model, which was introduced at the beginning of our paper).

The other change concerned the minimum wage, to which two major adjustments were made in the past 20 years (Chart 3-11), increasing the wages of the lowest earners relative to the average wage. The first major rise in the minimum wage occurred in 2001–2002, and the second in 2012. Wage growth, as presented in Charts 3-5 and 3-6, shows that the wages of the lowest

30 That view may be somewhat qualified by grey employment, where employees are officially paid the minimum wage, but in reality their earnings are higher. Since the minimum wage was low at the initial stage, the earnings of low-earning employees are likely to have grown less in the period relative to high-skilled and high-earning employees, who were not affected, even indirectly, by changes in the minimum wage.

earners increased significantly in these two periods. Without the major increases in the minimum wage, the earnings of low-skilled employees would be much lower today.[31]

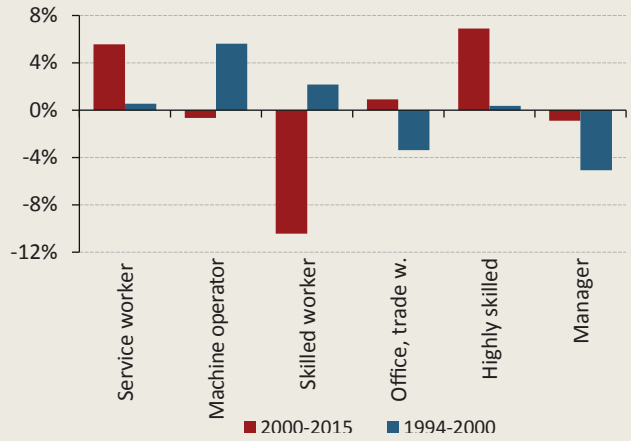
Chart 3-11:
Ratio of the minimum wage to the average wage



Source: HCSO.

Finally, let us consider how the shares of the large occupational groups changed in the labour market. Chart 3-12 shows the changes in employment shares in 1994–2000 (blue bars) and 2000–2015 (red bars) of employees in services, machine operators, skilled workers, office staff, high-skilled occupations and managers. In 1994–2000, the share of machine operators and skilled workers is shown to have increased considerably, contrasted by a decrease in the share of office staff and business managers.[32] This coincides with the appearance of large multinational companies in Hungary, the majority of which operate in manufacturing. Conversely, in 2000–2015 there was a major increase in the share of high-skilled and service occupations, whereas that of skilled workers and machine operators dropped.

Chart 3-12:
Changes in employment shares by major occupational groups in 1994–2000 and 2000–2015



Source: Calculations of the MNB based on the Wage Survey Database.

Arguably then, in 1994–2000 Hungary was more of a developing country in terms of labour market developments, where the share of factory workers grew considerably, despite which wages rose at the highest rate for graduate employees (probably due to a shortage in supply). This what changed in the next decade, when the labour market gradually evolved into a structure that is observed in developed countries, with labour market polarisation in terms of employment. However, wages have not become polarised. Considering the wage distribution as a whole, a decrease is seen in inequality: the lower a wage in 2000, the higher its growth rate over the next 15 years.

31 In most of the substantial body of research into the effects of the minimum wage on redundancies, zero or slight negative effects are found in terms of the employment of low-skilled workers (Card and Krueger, 1995; Neumark, 2014). In their analysis of the minimum wage increase of 2001–2002, Harasztosi and Lindner (2017) do not find any negative employment effects.

32 The group of business managers includes both management at large corporates and the managers of small businesses. As the two categories may respond differently to labour market shocks, it is not clear whether to expect the share of this group to increase or decrease in the future.

3.4 What does the future hold?

3.4.1 TECHNOLOGICAL CHANGES

It is difficult to say what the situation of employees will be like in the coming years and decades. Nevertheless, an attempt can be made here at outlining the labour market of the future based on current labour market trends and the technological changes which are foreseen.

The key development concerning the future will be acceleration in the speed of technological change. That development, which has in fact already started, is supported by a large body of direct and indirect evidence. The indirect evidence is that key technological changes over the past more than 200 years (steam engine, electricity) took place in a way that for roughly two decades after the fundamental inventions there was no substantial increase in productivity, for reasons that are not attributable to the technology concerned. On the one hand, radically new technologies are rather simple when they appear in the market, and need a number of additional innovations on a smaller scale in order to work (Perez, 2004). On the other hand, firms are resistant to radical changes. In order for innovation to make an actual impact on productivity, work processes must be reorganised so that the new technology can evolve to its full potential. This was also a drag on productivity at the initial stage of great innovations. At the dawn of the era of electric motors, for instance, the innovation consisted in merely replacing old steam engines with the new motors. However, in order for electric motors to make firms more productive, firms needed to be reorganised completely. While steam engines were used, all machines were linked to a single large axis driven by the steam engine of the firm. In the first decades of using electric motors, steam engines were replaced without reorganising the work processes. All of the machines remained crammed into a single room. Not only was this approach followed by old firms: new entrants simply copied the organisational structure of established businesses. The real boost in productivity came when managers realised the need to place machines according to the path followed by the product within the factory. This organisational reform led to a meaningful increase in productivity (Brynjolfsson and McAfee, 2014).

There is also direct evidence that ICT will increasingly spread in virtually all parts of life. Brynjolfsson and McAfee (2014) discuss the reasons for this in detail. They argue that technological change will be accelerated by innovation brought about by the development of computers, digital transformation, and people's extended social networks. As we know, according to Moore's law, computers double their computing capacity approximately every 18 months. Given the exponential behaviour captured by this empirical observation, computing capacity is considered to be growing at a constant rate. Equally important is the extraordinary proportions that the digital transformation has reached in recent years. Not only books and old databases have been converted into digital formats; for example, all of Google's search records and real time operating data of aircraft engines are also digital. A large proportion of humanity can access a vast amount of information on the internet, and use it independently or in collaboration with others to develop new products, production process and organisational arrangements. This can boost the number of innovations, which, combined with increasingly faster computers, would bring more and more aspects of life within the focus of robotisation.

While we also think that historical experience and recent technological changes all point to the probability that productivity will accelerate (which is why we will discuss the labour market effects of ICT penetrating all aspects of life), some researchers have a different vision of the future. Gordon (2016) argues that an ageing society, decelerating global trade, rising inequality, high debt levels and the decreasing efficiency of research and development all suggest that the high level of productivity seen in the 20th century cannot be repeated.

3.4.2 EFFECTS ON THE LABOUR MARKET

The effects of the technological explosion on the labour market are impossible to estimate. Until recently, robots could only replace humans for specific, repetitive routine task; however, that has changed in the past few years. The computing capacity of computers has increased to an extent that has enabled them to carry out, in whole or in part, work processes that do not qualify as routine tasks. Machines have (partly) become capable of driving cars or doing the company accounts, and Amazon, for

instance, already uses robots for warehousing.[33] As a consequence of that, all humans are gradually becoming defenceless against the effects of robotisation, increasingly surrendering their tasks to robots. There are several estimates concerning the future extent of that substitution. **According to World Bank calculations, in OECD countries 57% of jobs will be filled by robots instead of humans within twenty years** (World Bank, 2016). **Other authors** argue that an occupation comprises tasks that can be automated and tasks that cannot, and that employees will also be needed when automated tasks are carried out by robots. On those grounds, **they estimate that in OECD countries only 9% jobs will be lost to robots** (Arntz et al., 2016).

The effect of ICT will not be limited to the partial replacement of employees by robots. **Following the current stagnation, labour productivity is expected to increase**, which will entail a rise in wages. Indeed, as ICT becomes more affordable, the prices of many products and services produced using it will also decrease. Such effects will increase the purchasing power of people, especially of those lucky ones whose occupations cannot be automated or only to a limited extent. This will drive demand in the market for products and services, and the scale effect will in turn lead to the creation of new jobs, primarily in services (Autor and Solomons, 2017).

The acceleration of robotisation is also likely to impact the geographical distribution of production. As the ratio of capital to labour increases through the partial replacement of employees with ICT, employees' wages will become increasingly less relevant within the cost structure of a firm. **Demand for labour will shift towards high-skilled employees**, and even within that category expertise will gain increasing prominence. These two changes may **enable industry to return to developed countries, from which it has virtually disappeared in the past 30 years.** For instance, Adidas relocated its production to China twenty years ago, but opened its first production unit in Germany in 2017. However, this will not result in any future contribution to job creation in Germany, as the company will primarily use robots to manufacture shoes in the new factory (Forbes, 2016).

It is impossible to provide an accurate forecast of Hungary's future in the new economic world order. **The trends explained above suggest that a key factor in the country's success is likely to be its readiness to adopt new technologies. However, perhaps the most important factor will be the presence of a sufficient amount of high-skilled labour that is capable of operating the new technology.** Technology is changing at a rate that makes it difficult to predict what type of professionals will be needed going forward. It is general knowledge that will make employees flexible enough to switch occupations when necessary. That is why general education needs to be strengthened to prevent young employees from earning qualifications for a trade in which most of the work is going to be done by robots in a few years' time.

The cost of labour will become less dominant within total cost, and containing other costs at a low level may gain prominence. Such costs may include e.g. transportation costs or monitoring costs, which will decrease for firms located close to their parents (in the case of multinationals). **Its geographical position makes Hungary an attractive target where part of production can be relocated instead of Asian countries. As the country is a member of the European Union, its legal framework is known to investors.** Hungary is also located close to the headquarters of multinational corporations.

33 The robotisation of services is not only underway in developed countries. News portals reported that in September, three trucks travelled the length of the M1 motorway in Hungary, with only the first truck occupied by a driver and the rest following the lead through a wireless connection ("platooning"). This technology has already reached a level of operability that it could be tested live without stopping traffic—it is easy to imagine its impact on labour demand for drivers.

References

Acemoglu, D. – Autor, D. (2011): "Skills, Tasks and Technologies: Implications for Employment and Earnings". In: *Handbook of Labor Economics* (David Card and Orley Ashenfelter, eds.), North Holland: Elsevier.

Acemoglu, D. – Restrepo, P. (2016): "Robots and Jobs: Evidence from the U.S. Labor Markets". NBER Working Paper No. 23285.

Akerman, A. – Gaarder, I. – Mogstad, M. (2015): "The Skill Complementarity of Broadband Internet". *Quarterly Journal of Economics* 130(4), 1784–1824.

Arntz, M. – Gregory, T. – Zierahn, U. (2016): "The Risk of Automation for Jobs in OECD Countries". OECD Social, Employment and Migration Working Papers, No. 189.

Autor, D. – Dorn, D. – Hanson, G. (2013): "The China Syndrome: Local Labor Market Effects of Import Competition in the United States". *American Economic Review* 103(6): 2121–2168.

Autor, D. – Dorn, D. (2013): "The Growth of Low-Skill Service Jobs and the Polarization of the U.S. Labor Market". *American Economic Review* 103(5), 1553–1597.

Autor, D. – Katz, L. – Kearney, M. (2008): "Trends in U.S. Wage Inequality: Revising the Revisionists". *Review of Economics and Statistics* 90(2), 300–323.

Autor, D. – Salomons, A. (2017): "Does Productivity Growth Threaten Employment?" Paper presented at "ECB Forum on Central Banking, 2017".

Baldwin, R. (2016): *The Great Convergence: Information Technology and the New Globalization*. Cambridge, Massachusetts: Belknap University Press of Harvard University Press.

Brynjolvfsson, E. – McAfee, A. (2014): *The Second Machine Age. Work, Progress, and Prosperity in a Time of Brilliant Technologies*. United States: W.W. Norton & Company, Inc.

Card, D. – DiNardo, J. (2002): "Skill-Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles". *Journal of Labor Economics* 20(4), 733–783.

Card, D. – Krueger, A. (1995): *Myth and Measurement: The New Economics of the Minimum Wage*. Princeton, New Jersey: Princeton University Press.

Forbes (2016): "More Jobs Not Coming Back – Adidas and the Robot Shoe Making Factory". https://www.forbes.com/sites/timworstall/2016/05/30/more-jobs-not-coming-back-adidas-and-the-robot-shoe-making-factory/#3ac259684026. Last visited on 25 Sept 2017.

Gordon, R.J. (2016): *The Rise and Fall of American Growth: The U.S. Standard of Living since the Civil War*. New Jersey: Princeton University Press.

Graez, G. – Michaels, G. (2015): "Robots at Work". CEP Discussion Paper No. 1335.

Katz, L. – Autor, D. (1999): "Changes in the Wage Structure and Earnings Inequality". In: *Handbook of Labor Economics* (David Card and Orley Ashenfelter, eds.), North Holland: Elsevier.

Katz, L. – Murphy, K. (1992): "Changes in Relative Wages, 1963–1987: Supply and Demand Factors". *Quarterly Journal of Economics* 107(1), 35–78.

Neumark, D. (2014): "Employment Effects of Minimum Wages. When minimum wages are introduced or raised, are there fewer jobs? Evidence says yes". IZA World of Labor, May 2014.

Perez, C. (2004): "Technological Revolutions, Paradigm Shifts and Socio-Institutional Change". In: *Globalization, Economic Development and Inequality: An Alternative Perspective* (Eric Reinert, ed.), Northampton: Edward Elgar.

Pissarides, C.A. (2017): "Work in the age of robots". 6th Lindau Meeting on Economic Sciences. 22–27 August 2017. http://www.mediatheque.lindau-nobel.org/videos/37258/work-age-robots/laureate-pissarides. Downloaded: 20 Sept 2017.

Tinbergen, J. (1974): "Substitution of Graduate by Other Labor", *Kyklos* 27, 217–226.

World Bank (2016): *World Development Report: Digital Dividends*. Washington, DC: The World Bank.

4 Difficulties in GDP measurement in the age of information

The innovations and technological change seen in recent years serve as a foundation for the development of the global economy. Taken together, the rapid, continuous progress in information technology, the digitalisation of information and increased connectivity have fundamentally altered people's lives, both at work and in their free time. Robotisation, the increasing complexity of production processes and the advance of artificial intelligence are all developments which are changing and have changed the operation of companies and are transforming production chains. As a result of this, the number of robots used in industrial production has increased significantly and according to the projections, the current trend may continue to intensify in the future.

Despite these developments, productivity growth – i.e. real output per working hour – has declined substantially in the past decade, but in particular after the 2007–2008 crisis, and has remained very subdued since then, especially in the developed countries. In the case of the United States, the annual growth rate of productivity was around 3 percent between 1996 and 2003, mostly due to the significant development of the information and communication (ICT) sector. Despite the obvious continuation of the digital revolution, by the period 2004–2010 the growth rate declined to 2 percent, and at present (2010–2016) it is merely 0.5 percent. Thus, although digitalisation affects a wide range of the economies, it is not reflected in the productivity statistics. This phenomenon is also referred to as Solow paradox (Triplett, 1998). At present, there are essentially four explanations for the deceleration in productivity. Insufficient demand, deceleration triggered by supply factors, slower spread of innovations and their becoming commonplace, and GDP measurement problems. In this section, we attempt to analyse this latter problem and find an answer for the degree of GDP measurement problems. At the same time, we try to find a solution for the question whether the methodological difficulties alone are able to explain the deceleration in productivity, which has been observed globally.

The methodology used for the measurement of economic activity has been disputed by economists and statisticians for ages, particularly in the light of the dynamic digitalisation currently taking place and structural changes in the economy. Recently, an increasing number of papers have been published in relation to this topic and as a response to the deceleration in productivity, in which the authors discuss the potential reasons. Based on a review of the broad literature, the key explanations are as follows: erroneous measurement of qualitative changes, incorrect treatment of the increased role of services, ignoring free contents in the statistics, underestimating the role of the "sharing economy".

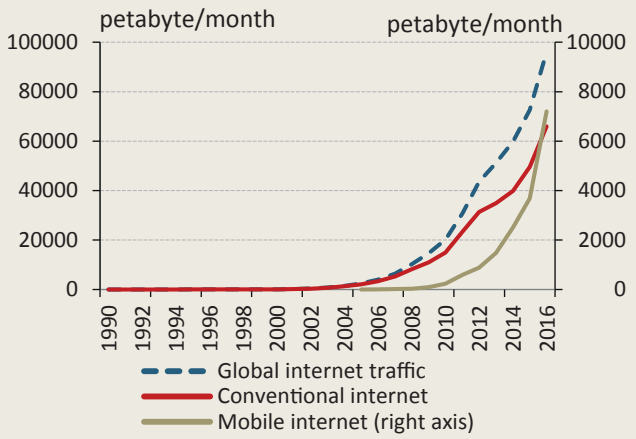
In this analysis, we examined whether the measurement problems alone are able to explain the deceleration in productivity, which has also observed in the Hungarian data. Based on our calculations, it can be clearly concluded that although these problems may contribute to the existing phenomenon to a small degree, in their own right they are insufficient to explain the problem. Based on our estimations, the consumption of free digital contents – which is essentially left out from the quantification of GDP – may have distorted the level of domestic output by a maximum of 2–3 percent in 2012 compared to 2004. The same values for the USA are substantially higher, according to the available estimations. The distortions affecting the ICT sector, which exist mostly in terms of prices, may raise the GDP level by 0.5–1.5 percent.

The colleagues of HCSO assisted in the completion and finalization of this chapter. We incorporated their useful comments into our analysis, for which we are thankful.

4.1 Introduction

The innovations and technological change seen in recent years serve as a foundation for the development of the global economy. Taken together, the rapid, continuous progress in information technology, the digitalisation of information and increased connectivity have fundamentally altered people's lives, both at work and in their free time. **In past decades, there has been substantial growth in total internet traffic**. While in 1992 the amount of daily traffic on the global internet was 100 gigabytes, by 2002 this figure had risen to 100 gigabytes/second. And by 2014 it exceeded the level of 16,000 gigabytes/second. This growth in online data traffic is a good representation of how digital contents are replacing traditional contents in modern economies. The reading of paper-based newspapers was replaced by browsing online news portals, and instead of buying CDs/DVDs people tend to stream the media contents provided by providers such as Youtube and Spotify. Other good examples of this development are the new forms of consumption and the several hundred thousand messages exchanged every minute in social media.

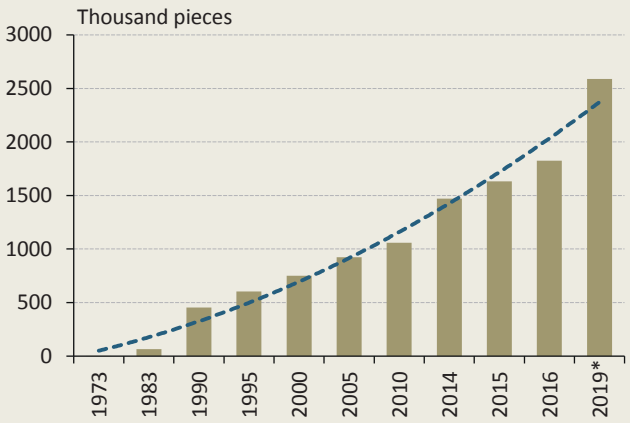
Chart 4-1:
Evolution of global internet traffic



Source: CISCO, University of Minnesota.

As a result of the significantly stronger competition triggered by economic growth in the emerging and developing countries in the past period, an unprecedented penetration of **automation and digitalisation** can be observed in modern economies, during the course of which the application of state-of-the-art technological accomplishments and procedures becomes everyday practice. **Robotisation, the increasing complexity of production processes and the advancement of artificial intelligence have changed and are changing the operation of companies and transforming production chains.** As a result of this, the number of robots applied in industrial production has already increased substantially and according to the projections, this trend may continue to intensify.

Chart 4-2:
The evolution of the number of industrial robots

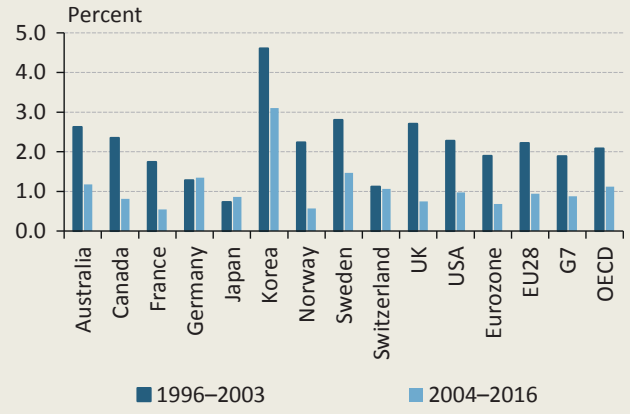


*Note: * forecast, polynomial trend.*
Source: IFR World Robotics Report 2016.

Productivity – i.e. real output per hour worked – is key for the standard of living, and is essentially shaped by the processes detailed above. For this reason, productivity is particularly important for long-term development. At present, an average US citizen needs to work merely 17 weeks to earn a similar annual real wage as a worker in 1915. Higher productivity – the increasingly efficient utilisation of capital and labour – facilitates the production of goods in higher volumes, but at the same time resources are also freed up, which may be used for the creation of additional products and services in the future, representing the foundations for economic development. The same processes took place in the decades that followed the industrial revolutions, as well as during the pre-crisis computerisation. **However, productivity growth has decelerated significantly in the past decade, particularly in the developed countries following the 2007–2008 crisis**. In the case of the United States, the annual growth

rate of productivity was around 3 percent between 1996 and 2003, mostly due to the significant development of the information and communication (ICT) sector. **Despite the obvious continuation of the digital revolution, by 2004-2010 the growth rate had declined to 2 percent, and at present (2010-2016) it is merely 0.5 percent.** However, these trends can be also observed in other developed countries around the world, as developed economies both in the Far East and Europe face similar problems (Chart 4-3). If this continues going forward, it may have considerable effects on the standard of living, because with a growth rate of 2 percent productivity doubles every 35 years, whereas with a growth rate of 0.5 percent this time span may increase to 140 years.

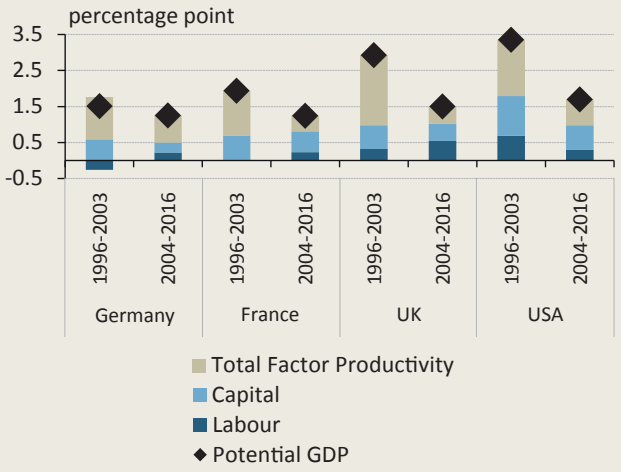
Chart 4-3:
GDP per working hours in developed countries



Source: OECD.

However, it is also worth examining **potential growth excluding cyclical factors, which is able to better describe the long-term growth of the economies.** Naturally, a substantial deceleration in productivity also significantly influences the potential growth of the economies, and at the same time it has a major impact on their development in the near future as well. As shown by Chart 4-4, potential growth has also decelerated sharply everywhere, except in Germany, which is essentially due to the lower investment, and the large-scale decline in the total factor productivity (TFP), an indicator capturing the efficient utilisation of labour and capital.

Chart 4-4:
Main factors contribution to potential growth in developed countries



Source: Ameco.

Moreover, the developments being examined have occurred and continue to occur in parallel with the start of the recovery of global economy and record low levels of long-term real interest rates. In addition, in recent years a revolution in digital technologies has been unfolding, which also complicates the understanding of the deceleration in productivity. The latter is also referred to as **Solow paradox** (1987), the essence of which is that "you can see the computer age everywhere but in the productivity statistics". Consequently, on the whole, in the light of continued robotisation and digitalisation, and the unfolding of the fourth industrial revolution, it is difficult to interpret the significant deceleration in productivity, the causes of which are the subject of economic analyses worldwide. The explanations can essentially be divided into four categories.

The first explanation **essentially** includes **supply factors**. Due to the stagnation/deceleration in the quality of education, the decreasing inflow of new labour into the labour market resulting from the aging society, and and the lower number of developments and innovations compared to the previous periods, there are also much lower incentives for enterprises to invest in new products and services. As a result, a lower demand and inflationary environment develops. In such situation, only measures designed to expand government demand can represent a solution, which however may lead to imbalance problems.

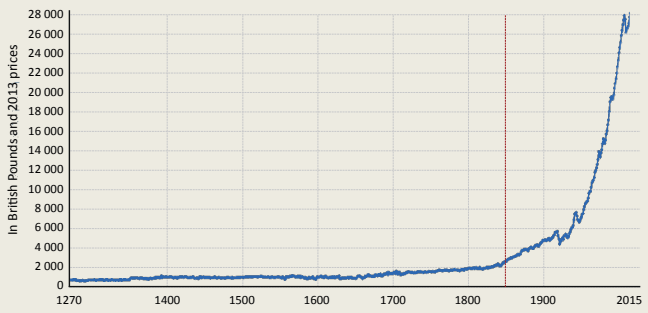
In addition, **demand factors** (secular stagnation[34]) may also exacerbate the deceleration in productivity.

34 Essentially, the notion can be tied to the thoughts of Alvin Hansen in 1938, which were supplemented with Larry Summers.

Nowadays, for the same corporate performance, substantially lower expenditure – investment – is sufficient, which can be also observed in the contribution of individual items to potential growth (Chart 4-4). In addition, the rising inequality observable within the societies, the unprecedentedly high debt levels, and the fiscal austerity triggered by the crisis, have all resulted in a slowdown in productivity.

However, it is possible that more time is necessary for the spread of innovations and for their use to become commonplace (Brynjolfsson and McAffe, 2016). That is to say, according to **the economists who reject the Solow productivity paradox**, innovations become widespread slowly, with delay, as it takes time for people to reorganise their life and work as a result of the innovations, and to become sufficiently self-confident and have adequate knowledge about the new products and services. **It took many years even for the accomplishments of the industrial revolutions to spread** (just think about the steam engine), even though those innovations were less complex than the products and services created during the digitalisation and robotisation. Moreover, the aforementioned processes started just 15 years ago, which is most probably not sufficient time to replace routine mechanisms with new ones. Furthermore, productivity expanded at an unimaginable rate between 1850 and 2004, which was unprecedented in history, and thus the question arises whether this growth rate can be repeated in the near future (Chart 4-5).

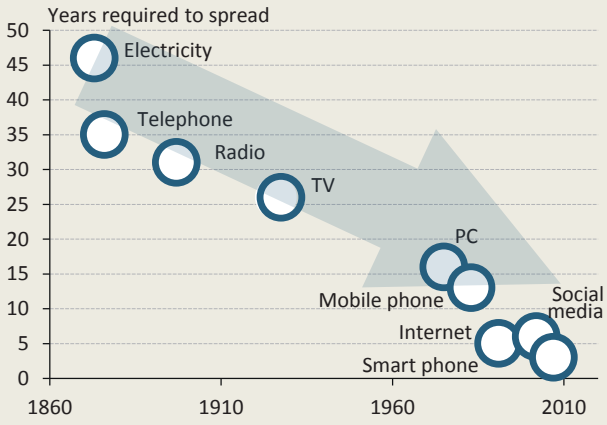
Chart 4-5:
Long-term productivity in the United Kingdom



Source: Broadberry, 2010; Bank of England.

Finally, **GDP measurement problems and distortions** also complicate the understanding of the phenomenon. Relying on the basic ideas of the Solow paradox (Triplett, 1998), several economists raised the issues related to the framework used for the measurement of the economy. The traditional methodology used for the measurement of the economy can hardly keep pace with the ongoing development and improvements. According to Will Page, CFO of Spotify, **the GDP measurement methodology has been essentially created for the measurement of tangible assets** – the first version of the National Accounts was developed in the 1930 and '40s, and obviously has been revised several times since then. The relevance of these assets in the age of digitalisation and modernisation has declined substantially ("square peg, round hole"). Thus, the statistical approach is evolving in parallel with the development of modern economies: from the statisticians' point of view, an optimisation is being performed for a constantly moving target (moreover, the adaptation of technical accomplishments has also accelerated substantially, Chart 4-6). As a result of this, **the internationally accepted rules become obsolete and imperfect from time to time, while they try to keep up with the continuously developing economies. All of this leads to the distortion of the GDP measurement, which may be a reason for the fact that – despite the digitalisation and modernisation – the pick-up in productivity is not currently reflected by the economic statistics.**

Chart 4-6:
The speed of the spread of consumer technologies



Note: Based on years to reach 25 percent market share in the USA.
Source: Singularity.com.

In this section, we try to analyse this latter problem and find an answer for the degree of GDP measurement problems. At the same time, we attempt to find a solution for the question whether the methodological difficulties alone are able to explain the globally observed deceleration in productivity.

4.2 Potential errors in the measurement of GDP in the age of information

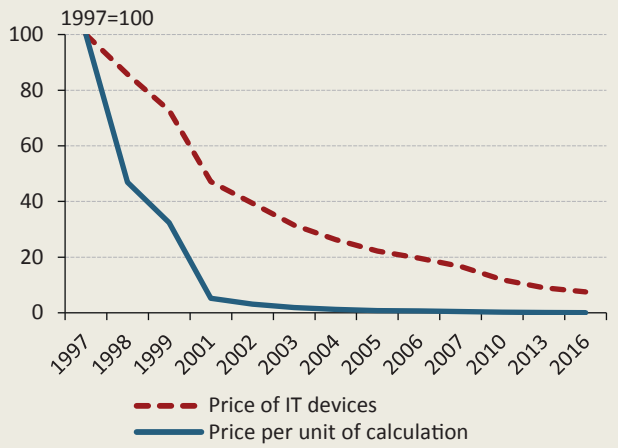
The methodology used to measure economic activity has long been disputed by economists and statisticians, particularly in light of the dynamic digitalisation taking place currently and the structural changes in the economy. **Recently, an increasing number of papers have been published in relation to this topic and as a response to the deceleration in productivity, in which the authors discuss the potential reasons.** Based on a review of the broad literature,[35] the key explanations are as follows:

- Measurement of qualitative changes
- Managing the increased role of services
- Management of free content
- Sharing economy

4.2.1 MEASUREMENT OF QUALITATIVE CHANGES

As a result of the innovation waves in recent decades, the quality of products has improved substantially. Nevertheless, incorrect treatment of qualitative changes in the case of GDP measurement led to substantial distortions: part of nominal output has been recognised, erroneously, purely as a price change. As an example, consider desktop computers, the prices of which, compared to other products and services, have only declined to a minor degree, while their performance has improved significantly and thus the quality of services supported by it have also increased. Thus, **it is not sufficient to observe the price of the computers on its own, as controls for qualitative changes also need to be carried out** (for example, the price per one unit of computing performance should also be quantified). Performing this test, it is clear that **the price per computing unit declined much more significantly during the 2000s (Chart 4-7).**

Chart 4-7:
The price per unit of calculation (MHz) of IT devices and the price of IT devices



Source: http://www.singularity.com/charts/page61.html, MNB calculation.

Economists have shown great concern about these problems for many years. **As early as 1996, the Boskin Commission noted that the qualitative changes and the measurement of new products lead to a 0.6 percentage point overestimation of the US price index, which at the same time resulted in a decline of a similar magnitude in the measurement of real output as well** (through the higher deflators). As a result of the currently ongoing and future innovations – mostly in relation to digitalisation – the importance of the qualitative improvement in products and services may rise further in the future, which could lead to increased distortion.

Recent research has tried to find the answer as to whether the described problem could have played a role in the statistically observable deceleration in productivity growth. Based on calculations by Goldman Sachs (2015), as a result of the methodology that erroneously treated qualitative change in the IT sector, the GDP of the USA and of the European Union was underestimated by 0.7 and 0.5 percentage point, respectively, during the past decade. Potential reasons included erroneous quantification of software and digital industry developments, and the treatment of the changed pricing behaviour in the semiconductor sector. Nevertheless, it appears that the magnitude of the distortions arising from the erroneous treatment of the qualitative changes on its own is not sufficient to explain the deceleration in global productivity (for more details, see Subsection 3).

35 Bean (2016); OECD (2014); OECD (2016); Stiglitz (2009).

There are many reasons why the erroneous treatment of qualitative changes can lead to measurement problems. On the one hand, **it is difficult to capture the variable characteristics of products and services** in the observation sample. For example, the life span of cars becomes longer or they are equipped with more functions (qualitative distortion), whereas the observed basket of goods can follow all of this only with a lag. **On the other hand, the addition of products to the consumer basket is performed only with a substantial delay**, and thus the price decrease from the initial high price level will not be observable (distortion caused by new products). **Thirdly, often the products affected by the largest qualitative change have extremely short life span**, which complicates the fungibility of these within the consumer basket (portable CD player, iPad). This problem is even more present in the case of digital services replacing the traditional services. Finally, **capturing qualitative differences based on non-physical attributes** (e.g. durability, security, ease of use) is also difficult.

4.2.2 POTENTIAL MANAGEMENT OF THE MEASUREMENT PROBLEMS RELATED TO QUALITATIVE CHANGES

Various methods to address the problem already exit and these may be able to reduce the degree of distortion. In detail, these are the following:

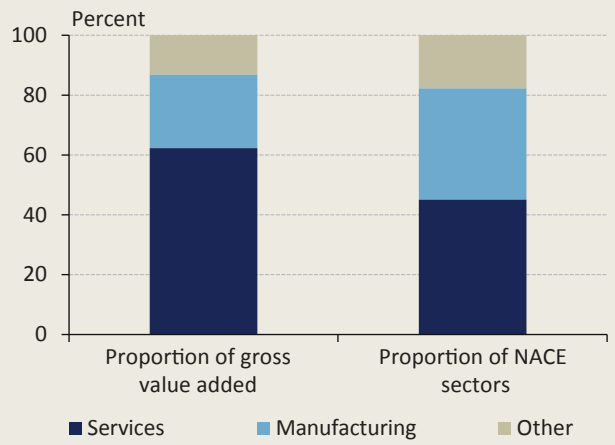
- **Direct quantitative analysis**: when the quantity of the product can be observed directly, the price of the new and old products can be compared after adjustment for the quantitative change. For example: the presentation of chocolate changes; in this case in proportion to the change in the quantity, the price should be also modified during the observation.
- **"Option costing"**: if there is a clearly observable difference in the attributes of two observed products, which can be quantified at market price, the product should be adjusted for the price of the surplus attribute. For example: If an older model TV still had no integrated DVD player and was meanwhile withdrawn from circulation, while the new model already has this feature, it is sufficient to adjust the formerly observed price only for the price of the DVD player.
- **Hedonic adjustment**: if the surplus attribute of the given product cannot be observed directly or is difficult to price it, there are econometric methods, which help estimate the impact of the new characteristics on the price.
- **Implicit methodology**: if no information is available on the impact of qualitative changes on price, the best approximation is to consider the average price change of similar products (imputing). Based on the alternative approach, if both the new and the old products are available in the market, the price difference between the two products may represent a kind of implication for the qualitative differences observable between them.

4.2.3 MANAGING THE INCREASED ROLE OF SERVICES

As mentioned in the introduction, in most cases economic statistics follows the changes that take place in the real economy with a lag. When the National Accounts were introduced, manufacturing accounted for the largest part of the economy. **Since then the role of services has risen substantially and at present two thirds of the value added generated in the Hungarian economy is produced by this sector, while the contribution of manufacturing has decreased sharply (Chart 4-8)**. The service sector includes an extremely wide range of activities. This includes "people-oriented" services (healthcare, education), the managing of finished and intermediate products (transportation, sales) and the advisory subsectors (financial and legal services). As a result of this, the observation of the sector's output and prices is much more complicated than in the case of manufactured goods, since in contrast to finished products, it is difficult to define the units of services (services are often tailored to individual preferences and thus it becomes extremely difficult to compare).

Despite their increased role within value added, the breakdown of services by subsector is less detailed than in the case of the manufacturing industries. Moreover, classification of an economic activity is also a complicated exercise, as the sector to which the statistics allocates it is essentially decided on the basis of the primary activity; however, **these days companies which manufacture finished products often also render services** (e.g. after-sales), which may also represent a larger source of income for the given company. Thus, all of these issues can give rise to serious distortions.

Chart 4-8:
Structrue of Hungarian economy



Source: HCSO, MNB calculation.

However, these challenges may further increase in the near future as a result of economic development**. New digital technologies, such as portable devices with constantly improving performance, may permit the performance of new types of services**, (e.g. fintech companies, streaming of entertainment industry services). Moreover, **technological innovations significantly raise the degree of service customisation**, which leads to an increase in the diversity of services and, at the same time, to a decrease in their comparability. All of these processes further complicate the daily work of statisticians. In parallel with technological progress, **trade in services is also picking up, and furthermore, commercial turnover tends to be increasingly dominated by specialised products through the internet.**

4.2.4 MANAGING THE CONSUMPTION OF DIGITAL PRODUCTS

Digital products are essentially products that are stored and/or transmitted, and/or used in electronic form. The measurement of their value is made particularly difficult by the following three attributes:

- **Electronic contents are usually non-competitive,** that is, the consumption of an actor, or its use for production or services does not preclude the consumption or use of another one. **Moreover, the value of digital contents increases further depending on the number of users ("network effect").**
- **Digital contents can be replicated under marginal costs**, and usually replicas do not differ from the original one at all.
- **They are not stationary and are mostly intangible**. Hence, they can be stored easily free of charge, and can be transported large distances as well.

The initial production of digital contents usually involves high costs, but as a result of the attributes listed above, they can be easily replicated without barriers to entry, and thus market mechanisms divert prices close to zero. Moreover, even if the company already on the market manages to create barriers to entry, it may be interested in keeping the price of its product low to have as many users as possible ("network effect"). Ultimately, in most cases **the most popular digital contents have no observable price**, except for the fixed costs of internet subscription, and thus during the measurement of GDP it is extremely difficult, and under the present methodology is not even possible, to determine the real value of such contents. As a result of this, major distortions develop, as popular and widespread products and services of significant value are left out from the GDP statistics.

The companies that provide digital contents rely on 3 main source of income:

- fees charged for their services
- sales of information collected on their users
- sales of online advertising space

In the latter case, however, based on the methodology of the National Accounts, digital contents are the intermediate products of the advertising sector. Thus, the advertising costs are added to the value added of the sector supplying the advertising space, and in parallel with this they are deducted from the value added of the advertising sector. As a result of all this, the value of digital contents financed from the sales of advertising space is added to the aggregated GDP only up to the degree of the additional increase in consumption generated by the advertisements.

By contrast, in the first case – direct fees – statisticians also face problems, as despite the fact that fees are charged for the services, the degree of consumption is unlimited, and **thus the volume of consumption remains unknown, as a result of which the calculation of the price per unit is also impossible**.

There are several estimates available for the significance of the problem, of which **according to Goolsbee (2006) in 2005 internet users spent 10 percent of their free time on the internet, while only 0.33 percent of their expense can be associated with internet servi-**

ces. Thus, in the case of internet users it resulted in a disproportionate increase in utility compared to their expenses.

4.2.5.5 Alternative approaches

The handling of digital contents in accordance with the present methodology inevitably leads to a large underestimation of digital activity. Nevertheless, measuring the value of digital contents is an extremely difficult task. There are several different methodological approaches to address the problem, of which the most important ones are listed below:

- measuring the advertising expenses associated with the digital contents;
- measuring the value of time spent;
- measuring the internet traffic.

Naturally, none of these methods provides a perfect resolution for the problem, but on the whole they are able to highlight the degree of the problem resulting from the shortcomings of the traditional methodology.

4.2.6 SHARING ECONOMY

The concept of the "sharing economy" utilises the feature of digital technologies, which permits them – using online markets and social media networks – to sell/hire/share tools and resources. It encompasses a broad range of economic activities: in addition to accommodation and transportation services, it also includes the renting of labour and household devices. The key characteristics of the concept is that modern economies shift from possession to rental. **Although the idea itself is not a modern thought, its present size and scope is much wider compared to previous periods, thanks to the rapid development of the internet and the evolution of commenting systems provided by social media network**.

The "sharing economy" essentially poses two main challenges for the statisticians. The first one is whether the current methodology properly handles, measures and classifies the transactions discussed above. The second, much more fundamental, question is the subject of measuring, since with the shift of the very thin dividing line between work and free time many activities (may) fall outside the concept of GDP.

4.2.7.7 Measurement difficulties

Traditionally, the measurement of GDP is based on corporate surveys. The principle behind this is that the companies produce useful values for the economy, while households consume all of those. However, as "non-surveyed" households are tending to take over the creation of value added from companies to an increasing degree, economic statistics are becoming increasingly distorted. All of this has an impact on the quality of GDP, prices and the labour market figures.

The accurate survey of prices presents large difficulties in practice in the case of the "sharing economy". **For example, in the case of accommodation services the rooms/flats offered under this concept are appealing, because they are cheaper and/or of better quality than those offered by hotels. However, since prices can be mostly approximated through those offered by hotels, the deflator of the accommodation services will be higher than the real value.** Thus, the unobserved lower price leads to lower nominal spending and through this to lower real GDP. **According to the calculations, in the case of the United Kingdom, the erroneous observation of prices leads to a 0.7 percent underestimation of the output of accommodation services.**[36]

36 Bean, 2016.

4.3 Estimates related to the measurement of the distortion level of GDP in Hungary

4.3.1 DEGREE OF MEASUREMENT PROBLEMS IN THE ICT SECTOR

In a wide range of technical literature, experts agree that the GDP measurement methodology results in distortion and is not able to capture economic activities with full accuracy. On the other hand, there is no consensus at all on the question as to whether these measurement errors alone are able to explain the global deceleration in productivity seen since the crisis**. In this section, we examine the degree of GDP distortion using Hungarian data, in an attempt to determine whether the aforementioned phenomenon alone can serve as an explanation for the deceleration in productivity**. However, for the analyses we use an indicator capturing the potential output of the Hungarian economy, which already filters out the fluctuations caused by economic cycles; consequently, it is better able to capture the long-term growth of a given national economy.

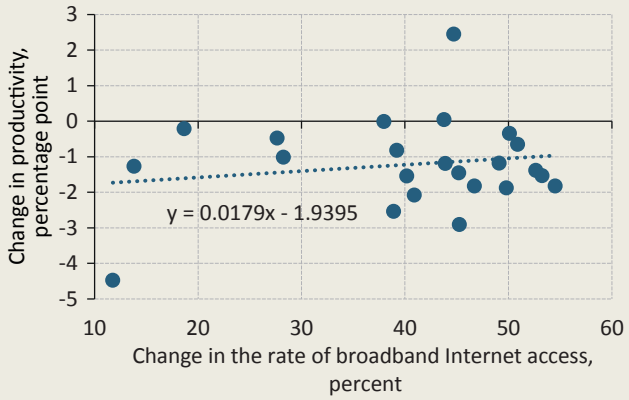
As a first step, we examine the degree of output lost from the deceleration in productivity.[37] Based on this, the 2016 annual potential output at 2005 prices was HUF 25,378 billion in Hungary; however, if we considered the output lost as a result of the deceleration in productivity, this figure would rise to HUF 32,000 billion. Based on this, the lost output may amount to roughly 6,800 billion. Thus, later on we try to find out **how realistic the assumption is that the deceleration in productivity observable in statistical terms despite the digital developments ongoing since 2006** (which we approximated by the growth rate of the GDP per capita, which eliminates the cyclical factors from the time series) **is merely the consequence of measurement errors.**

Before answering the question, we examine whether globally there is any relation between the role of the information and communication sector (hereinafter: ICT sector), which is most affected by innovation, in the given economy and the deceleration in productivity.

We **performed** the exercise from two aspects**: on the one hand, the change in the ratio of users with access to broadband internet represents the demand side, while we used the ratio of the ICT sector within gross value added as a supply factor.** On the vertical axis, we show the change in productivity growth between 1995-2004 and 2005-2017 Q1, while we used the OECD database as the data source.

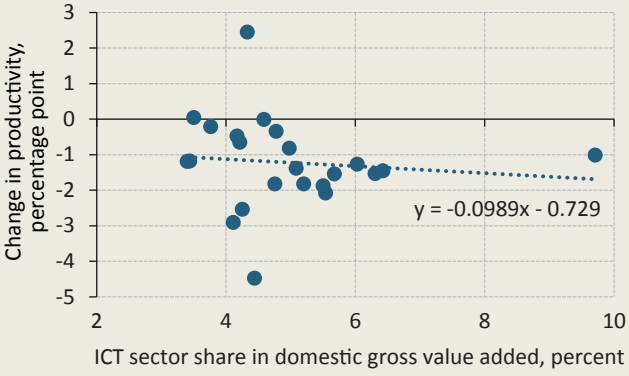
Both analyses show that in statistical terms there is no significant connection between the deceleration in productivity and the size of the ICT sector (Chart 4-9, 4-10). Among others, Syverson (2016) and Cardarelli – Lusinyan (2015), also obtained similar results using US data.

Chart 4-9:
Connection of productivity and internet



Source: OECD.

Chart 4-10:
Connection of productivity and ICT sector



Source: OECD.

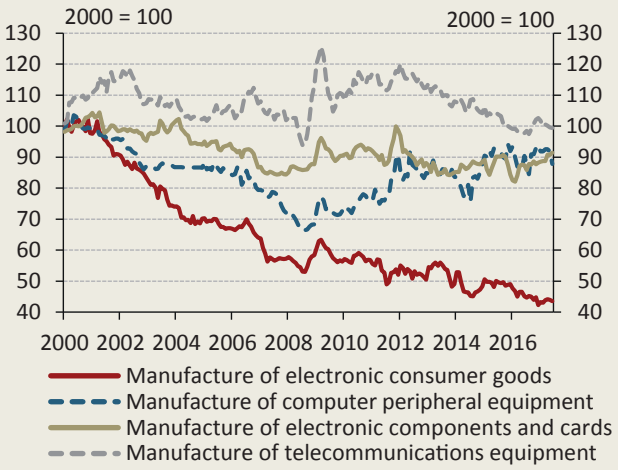
37 The deceleration in average quarterly productivity growth between 1995-2006 and 2007-2016 is 0.626 percent (=0.845%-0.219%), and thus the lost output in any t quarter since 2006 is $Y_c=Y_a*(1,00626)^q$, where Y_c is the lost output, Y_a is the currently observed output and q is the number of quarters elapsed between 2006 Q4 and date t. After all, as a result of the observed deceleration in productivity in 2016 the economic activity would have been higher by 28 percent (1.00626^{40} = 1.2834). However, it should be pointed out that this practice does not change the labour input.

The missing quarterly output of roughly HUF 1,700 billion can be examined in a different context as well. **The technical literature mentions the ICT sector the most often as the sector most affected by the GDP measurement error.** Thus it is worth examining the processes observable in the ICT sector since 2007 and comparing them with the output lost as a result of the deceleration in productivity.

The nominal value added of this sector was HUF 1,460 billion in 2016 (a dominant part of which came from the performance of IT and other information services, and the telecommunication subsector). However, when productivity started to decelerate – in 2007 – the performance of the ICT sector had not yet reached the value of 1,200 billion, which changes to HUF 1,107 billion when recalculated at 2005 prices. Hence, the sector showed real growth of almost HUF 300 billion in value added between 2016 and 2007. Had the distortions caused by the measurement problems (HUF 6,800 billion) mostly affected the sector under review, the output of the sector should have risen at a five times higher rate in the period of 2007-2016 compared to the actually observed value (HUF 1,460 billion /HUF 1,107 billion = 25 percent). This is such a large difference that **cannot be attributed purely to measurement problems.**[38]

In addition, it may also be that it is not the measurement of output that causes the distortions, but rather the deflator used for the calculation of the real value of the given sector. In the previous section, we already suggested that the erroneous treatment of qualitative changes is mostly reflected in the higher than "actual" prices of products and inputs. The chart below clearly illustrates that while the price of products used for the manufacturing of electronic consumer goods shows a substantial decrease, the price of other inputs essentially has not changed, despite the fact that a material quality improvement can be observed in this product range as well.

Chart 4-11:
The evolution of producer prices in the electronics sector



Source: HCSO.

Moving to prices in the ICT sector, we found that between 2007 and 2016 they fell by more than 5 percent. In order for the lost quarterly output of 1,700 billion to disappear in real terms, prices should have decreased by almost 100 percent. In the analysis mentioned previously (Syverson 2016), the same value for the USA is 67 percent, i.e. a major price decline would have been necessary there as well, for the distortion, observed in statistical terms, to disappear (Chart 4-11)[39].

On the whole, the hypothesis, according to which the productivity slowdown observed in the domestic figures since 2007 is solely attributable to measurement errors related to the production of the ICT sector, can be dismissed. In our view, it may contribute to it, but it cannot explain the missing output of HUF 6,800 billion even if the prices are adjusted.

Based on our own calculations, the distorted measurement of the ICT sector's information technology and other information services subsector[40] may influence the GDP level on the whole by a maximum of roughly 0.5-1.5 percent. Based on the data, the deflator of the ICT sector rose in the past period, albeit at a slower rate than in the case of the GDP price index. However, we believe that these processes are less consistent with the penetration of digitalisation and robotisation. In our view, **as a result of the major improvement in the performance of IT equipment, the price per one computing unit should gradually**

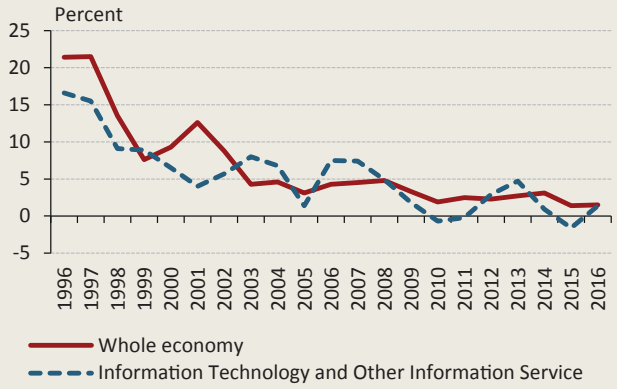
38 Similar examinations by Syverson (2016), performed on US figures returned the result in the case of the USA that the ICT sector should have grown six times faster than the 75 percent growth shown in the statistics (between 2004-2015).

39 During calculation, we used producer prices and not prices of services. The involvement of price index of services could make our conclusions more accurate.

40 In 2016, this subsector had a weight of 2.5 percent in GDP.

decrease. Based on Moore's law[41] **the sophistication of integrated circuits and through the computing capacity of computers doubles every 18 months.** Thus, assuming a roughly steady price level in aggregated terms, the prices per one computing capacity should be halved every 18–24 months (Chart 4-12)[42].

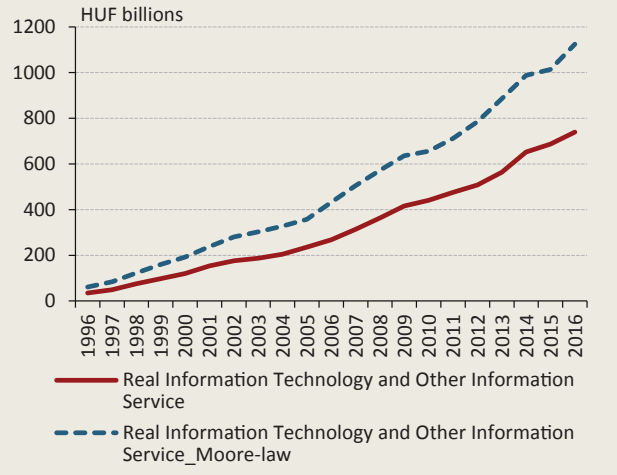
Chart 4-12:
Deflator of gross value added



Source: HCSO, MNB calculation.

Using this modified deflator, the real output of the sector under review reached higher levels. The difference appearing in the gross value added of the information technology and other information services subsector, published by the HCSO and calculated by us, may be maximum HUF 250-300 billion on an annual average (naturally, the applied deflator substantially influences the results), which may have even slightly increased in the past period. **Thus on the whole, in 2016 the ICT sector may distort the GDP level by maximum 0.5-1.5 percent (Chart 4-13).**

Chart 4-13:
Real output of the Information Technology and Other Information Service subsector with the usage of different deflators



Source: HCSO, MNB-calculation.

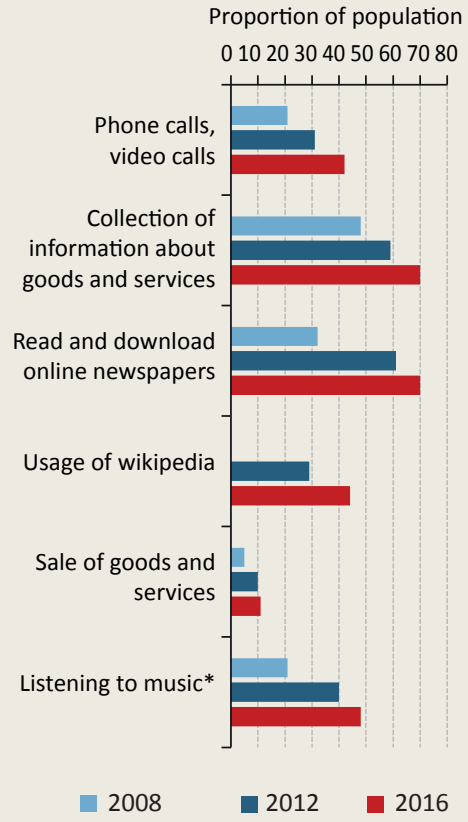
41 Moore (1965).

42 The price elasticity of demand is also decisive for the evolution of the consumer prices of the examined product group.

4.3.2 DEGREE OF MEASUREMENT PROBLEMS RELATED TO FREE CONTENTS

The trend that the consumption of free contents has substantially increased after the crisis can be observed in Hungary as well (Chart 4-14). This may cause major distortions even based on the factors discussed in Section 3, and thus we make an attempt to estimate the degree of the problem. For the calculations we used the European Union Statistics on Income and Living Conditions (EU-SILC) and the Timeuse statistics published by HCSO, as well as the data published by Eurostat in respect of the purpose of internet use by the public.

Chart 4-14:
Purpose of internet usage



*Note: * estimated value.*
Source: Eurostat.

As a first step, we examined the question of the Timeuse statistics most relevant for us, comparing the 2010 survey with the 2000 survey. Based on the latest questionnaire, we found that the ratio of those who do not use internet at all as a main activity has decreased (from 99.6 percent to 84 percent) (shopping, job search, reading of books and periodicals, collection of information, listening to music, watching movies, administration, travel organisation, real time conversation). **In parallel with this, the number of minutes per person used for internet browsing on an average day also**

increased. Based on the surveys performed on the entire population, on an average day in 2000 we spent on average 1 minute as prime activity with internet browsing, whereas this value had risen to almost 15 minutes by 2010. When examining the distributions within the sample, we find that although there is still a negative skew – that is, a large part of the population hardly uses or does not use the internet at all – the degree is much smaller than in 2000. **Moreover, the number of those individuals who use the internet for at least 30 minutes per day rose substantially. In addition, it should be also noted that among households the maximum time used for the consumption of digital contents almost doubled, rising from 495 minutes to 700 minutes (Table 4-1).**

Table 4-1
Time spent on internet in 2000 and 2010

	1999–2000	2009–2010
Rate of Internet Users *	0.8%	16%
Average Internet Time (Minutes)	1	15
Maximum time spent by a person on the Internet (minutes)	495	700

*Note:*who spent at least 1 minute on the internet.*
Source: HCSO.

The Hungarian economy of 2000s went through an enormous transformation by 2010, hence the questions in the Timeuse statistics from that period are less detailed in term of the digital contents compared to the latest survey. As a result of this, the 2010 Timeuse statistics include a much more varied range of activities and examines not only the time spent on the internet in aggregate, but it is also possible to analyse the various types of activities much more closely. **For the purpose of our analysis the most important activity types include: Film and music download, upload; Read news and newspapers; Book reading; Real time conversation on the internet (Table 4-2).**

Table 4-2
Digital time spent on daily consumption in 2010

	Rate of users	Average Time (Minutes)	Maximum time spent (minutes)
Film and music download, upload	10.4%	9.4	660
Read news and newspapers	1.9%	1.3	305
Book reading	0.1%	0.05	100
Real-time conversations on the internet	4.2%	3.8	450

Source: HCSO.

Thereafter, we examined **the changes in the expense categories that best cover the digital contents in the European Union Statistics on Income and Living Conditions (EU-SILC)**. Since the Timeuse is surveyed every 10 years, in the case of EU-SILC we used the statistics that are the closest in time (2004 and 2012). **In our view, the most relevant groups from the EU-SILC statistics for the purpose of digital contents may include newspapers, books, sound recording and player equipment (the potential best proxy of listening to music) and the telephone and telecommunication services. We found that with the exception of books, expenses in all other groups have decreased.** We believe that the largest distortion may exist in the case of telephone and other telecommunication services, and the purchase of newspapers and books. In the first case internet-based communication services represent increasing substitutability, while in the latter case, the freely accessible new webportals and the digitally downloadable e-books may give rise to distortions. In addition, there may be also a significant measurement problem in the case of listening to music, although this product group already had a relatively lower expense weight in the previous period as well.

Table 4-3
Consumption expenditure of the groups most affected by digitization at 2004 prices

Expenditure (HUF billion)	2004	2012	Difference
Newspaper	39.58	27.59	–11.98
Book	19.61	23.95	4.34
Sound recording and playback equipment	3.21	1.23	–1.98
Telephone and other communications services	340.58	339.95	–0.64

Source: HCSO.

When comparing the two statistics, we find that although the households' actual consumption expenditure indeed declines, the time spent on the use of the respective products and services increases substantially (Table 4-3)[43]. Based on these – although subject to using assumptions that are able to influence the outcomes – it is possible to estimate the distortion.

Based on the Timeuse figures, the daily internet use per person increased substantially between 2000 and 2010. Although for the accurate estimation of the distortion it would be essential to have the statistics from 2000 (which are available in 2010 and present internet usage in more detail), the estimate may also be performed under various assumptions. **It is easiest to assume that the time spent on the individual sub-groups changed to the same proportion as the total time spent on internet browsing** (from 1 minute to 15 minutes, i.e. an almost 15-fold growth). Based on this assumption, in 2000 the time spent on downloading movies and music, on books, on reading news and on internet-based conversation may have been 0.6, 0, 0.1 and 0.3 minutes, respectively. Naturally, had we judged the degree of distortion purely based on the time and expenditure spent on the consumption of digital contents, we would overly simplify the issue, as there are a number of items within the sub-groups the consumption of which had become practically free by 2010, while there may also be cases when the service quality has improved substantially. Let us just examine telephone expenditures. It is obvious that in the early 2000s SMS services had a substantial weight, which is a marginal item nowadays. In parallel with this, in the case of telephone subscriptions, a decade ago it was not possible to subscribe to mobile internet, while at present the testing of the 5G networks is under way (composition effect).

43 During calculation, we used the EU-SILC database, which do not fully comply with the national accounts.

Based on the analyses performed on US data (Brynjolfsson, 2012), in the case of newspapers, books and music, one- or two-thirds of the internet usage takes place on sites providing free services, while in the case of internet-based telephone conversations this ratio may be lower (one-fifth or one-seventh, based on estimates).

Table 4-4
The degree of possible distortion in the various expenditure items

Expenditure (HUF billion)	2012	Based on time-consuming	Difference
Newspaper	27.59	~100	~72.41
Book	23.95	~85	~61.05
Sound recording and playback equipment	1.23	~5	~3.77
Telephone and other communications services	339.95	~680–1020	~680.05
Total	**432.3**	**~1249.58**	**~817.28**

Source: HCSO, MNB calculation.

Based on these, we believe that the appearance and spread of free digital contents and the treatment of these in the present methodology may distort Hungarian GDP by a maximum of about HUF 800 billion, equalling to 2–3 percent of GDP (Table 4-4).

Based on the estimates performed on US data, this value is higher; according to the methodology of Brynjolfsson (2012) – which considers the time spent – purely as a result of internet penetration (in the case of television it quantified almost twice as high data) the growth rate of the US economy would have been higher by 0.3 percentage points on an annual average in the last 10 years. Nakamura's (2017) results also measured higher distortion in the case of the USA. The essence of the methodology is that it treats free contents as a kind of barter transaction, in the course of which households are the active "producers" of the audience rating service, in lieu of which they receive "consumer entertainment". Based on the results – which even the authors admit to be slightly underestimated – the real GDP growth rate of the United States between 1995 and 2014 could have been higher by 0.08 percentage point annually on average as a result of the measurement distortion related to the free digital contents[44].

44 The utility resulting from the use of free digital products is a consumer surplus which, according to the OECD's recommendation, should be quantified in satellite accounts. Utility-based calculations do not comply with the national billing framework.

References:

Hansen, A.H. (1939): Economic progress and declining population growth, The American Economic Review, March 1939.

Gollsbee, A. – Klenow, P.J. (2006): Valuing consumer products by the time spent using them: An application to the internet, American Economic Review Papers and Proceedings, 96 (2).

Bryne et al. (2016): Does the United States have a productivity slowdown or a measurement problem?, Federal Reserve Bank of San Francisco Working Paper Series, April 2016.

Syverson, C. (2016): Challenges to mismeasurement explanations for the US productivity slowdown, June 2016.

Byrne, D. – Sichel, D. (2017): The productivity slowdown is even more puzzling than you think, 22 August 2017.

Brynjolfsson E. – Oh, J.H. (2012): The attention economy: Measuring the value of free digital services on the internet, October 2012.

Brynjolfsson, E. – McAffe, A. (2016): The second machine age. W. W. Norton, New York.

Goldman Sachs (2015): Doing the sums on productivity paradox v2.0, US Economics Analyst, 24 July 2015.

Goldman Sachs (2016): Productivity paradox v2.0 revisited, US Economics Analyst, 2 September 2016.

Moore, G.E. (1965): Moore's law to roll on, Electronics Magazine 19 April 1965.

Triplett, J.E. (1998): The Solow productivity paradox: What do computers do to productivity?, Brookings Institution, 7 May 1998.

HCSO (2002): Time budget statistics 1999–2000, 2002.

HCSO (2012): Time budget statistics 2009–2010, 2012.

Summers, L. (2016): A Model of Secular Stagnation. What It Is and What to Do About It, Foreign Affairs, 15 February 2016.

Nakamura, L. – Samuels, J. – Soloveichik, R. (2017): Measuring the "free" digital economy within the GDP and productivity accounts, October 2017.

OECD (2014): Measuring the digital economy: A new perspective, OECD Publishing.

OECD (2016): Measuring GDP in a digitalised economy, OECD Statistics Working Papers 2016/17.

Stiglitz, J.E., et al. (2009): Report by the Commission on the measurement of economic performance and social progress.

Bean, C. (2016): Independent review of UK economic statistics, March 2016.

Gordon, R.J. (2012): Is US economic growth over? Faltering innovation confronts the six headwinds, NBER Working Paper, August 2012.

Gordon, R.J. (2006): "The Boskin Commission Report: A Retrospective One Decade Later," International Productivity Monitor, Centre for the Study of Living Standards, vol. 12, pp. 7-22, Spring

5 Economic growth and structural transformation

Rearrangement of the weights of large sectors within GDP is a well-documented phenomenon in the evolution of the economy. The weight of the agricultural sector has typically declined, the proportion of industry appeared as an inverted U-shaped curve, and the services sector showed steady growth. In the case of agriculture, both demand and supply effects contributed to the decline in the weight of this sector. Rapid expansion in productivity was observed in the sector, and the income elasticity of agricultural products (i.e. the proportion spent on agricultural products from one unit of additional income) was also low. Considering the weight of industry, the fall in prices caused by the expansion in productivity initially entailed an increase in sales revenue and thus a rise in the weight of the sector. However, as demand reacted less and less to the decline in prices, the economic weight of the sector started to decrease, and even the high income elasticity of industrial products could not offset this. In the case of services, productivity expansion was also relatively subdued, while the income elasticity of demand is also high, i.e. the weight of this sector increased. Looking ahead, we can formulate two important messages. Firstly, sectors in which prices are very high at the moment but decline quickly have great potential (e.g. electric vehicles). Secondly, the demand for goods which does not grow proportionately to the increase in income will represent a declining weight in production and employment.

It is primarily the widespread penetration of the general purpose technology (GPT) typical of the given era that is responsible for the expansion in productivity. The appearance of GPTs is accompanied by two phenomena: Firstly, upon the introduction of a new technology, the expansion in productivity is typically slower. Secondly, with new combinations coming into existence, previous solutions and skills are crowded out and become redundant, and a process that destroys the previous structures, that is creative destruction, occurs in the innovation developments of market economies. Undoubtedly, the GPT of the current period is information and communication technology. The most important technologies of the near future are fundamentally related to electromobility, the storage of electric energy, means of communication and environmental protection. In addition, significant potential can be identified in the automation of working processes that represent higher knowledge in the case of the Internet of things, cloud computing, robotics and self-driving cars as well. According to certain analyses, wide application of artificial intelligence will change the economy and our everyday life to an extent that already means a new technological era.

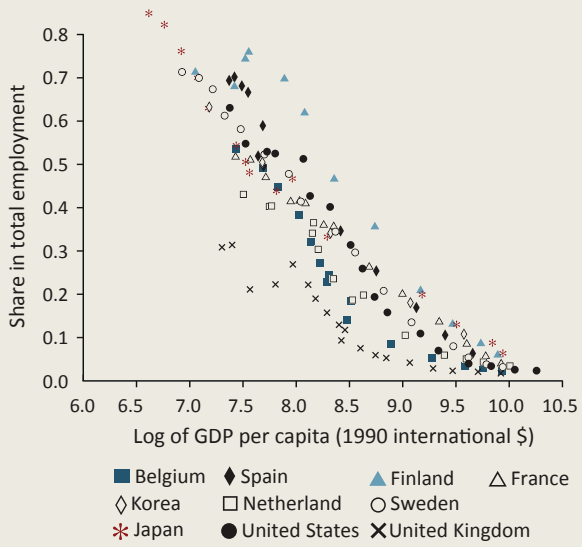
The European Commission designated six Key Enabling Technologies, the support of which will allow Europe to become one of the global leaders in innovation and to preserve this position. These six technologies are: advanced materials, nanotechnology, micro and nanoelectronics, industrial biotechnology, photonics and advanced manufacturing technologies. Common features of the key technologies are their high R&D intensity, they operate with rapid innovation cycles, they are capital intensive and require highly qualified labour. Hungary specialises in the production and export of technologies, but even compared to the V3 region it lags behind in patenting a number of key technologies. According to Grinin et al. (2017), the next 30–50 years will mostly be characterised by the economic cycle determined by the MANBRIC (medical, additive, nano-, bio-, robotics, IT and cognitive) technologies, and this field may become the general purpose technology of the global economy. The projection was formulated on the basis of the dynamics of patent statistics observed in past decades and the expected innovation requirement of medical technology improvements necessary for the health care of the ageing society. The main fields of innovation of the future were primarily corroborated by data for Far Eastern countries, where, in their opinion, the next technological change will start from

The increase in productivity shows significant rearrangement across economic branches and sectors. Therefore, it is worth examining which sectors may be the winners and losers of development in the next decade. It is an important issue, however, how the significance and success of a sector are measured. Classical analyses typically focus on the weight of individual economic sectors within GDP or employment. The restructuring of large sectors, i.e. structural change, is a well documented phenomenon in the evolution of the economy (Kuznets, 1966; and recently Herrendorf et al., 2013). **Nevertheless, the weight of individual sectors does not necessarily provide sufficient information on its role in the growth of an economy, as there are lower-weight sectors that produce technologies that have an impact on all sectors. A technology like this is called a general purpose technology (GPT).** One such general purpose technology is electricity, which appeared at the beginning of the 20th century, and info-communication technologies, which appeared starting from the 1980s. The use of general purpose technologies covers production and everyday life: they change production processes and the way households organise their lives. GPTs launch waves of innovation, resulting in the rise and fall of sectors (creative destruction). This section presents what role the change in demand and supply plays in the major restructuring. The two most important questions are which sectors will be the winners of the current info-communication revolution and what are the short-term and long-term technological trends which the structural changes in the economy will follow, according to the current expectations.

5.1 Major sectoral changes taking place with economic growth

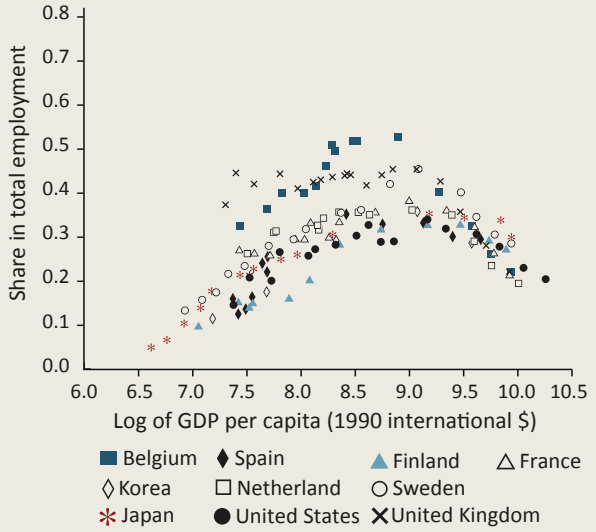
On the growth paths of economies, significant rearrangement of economic sectors is observed, which extends to changes in the structures of production and employment across sectors. Using 19th and 20th century data of 11 developed countries (EU KLEMS), Herrendorf et al. (2013b) examined how sectoral employment and added value proportions changed. **In the initial stage of development, agriculture is the determinant**: this sector has the highest proportion in employment and value added. **Later, however, the share of agriculture declines considerably** (Chart 5-1). **By contrast, in the case of the industrial sector the weight of the sector is an inverted U-shape, i.e. until a certain point of development the share within GDP and employment increases, and then starts to decline. The economic weight of services, however, grows steadily.** Moreover, an accelerating growth path can be detected at the point where industry has reached the peak of its share in added value and employment within the time interval under review.

Chart 5-1:
The relationship between the share of agriculture in total employment and economic productivity



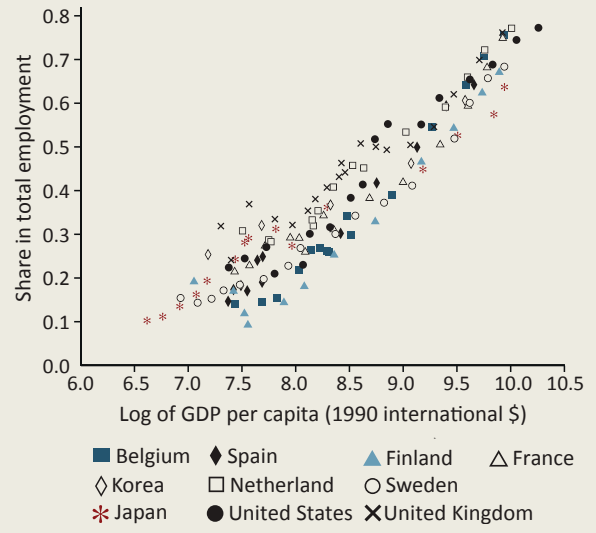
Source: Herrendorf et al. (2013).

Chart 5-2:
The relationship between the share of industry in total employment and economic productivity



Source: Herrendorf et al. (2013).

Chart 5-3:
The relationship between the share of services in total employment and economic productivity



Source: Herrendorf et al. (2013).

(demand effect) (Gabardo – Pereima – Einloft, 2017).[45] An increase in productivity reduces the marginal cost of the company or sector. If the company operates in a competing market or the mark-up percentage is constant, an increase in the productivity of the company or the sector reduces its prices as well. One important question in this case is how demand reacts to the decline in prices. If demand reacts to the decline in prices in a flexible manner, i.e. a one percent decrease in prices entails a more than one percent increase in demand, the sales revenue of the sector grows. However, if demand increases by less than one percent as a result of a one percent decline in prices, the sales revenue of the sector falls, and thus its weight also decreases. Contrary to the general model framework of growth theories, **non-homothetic[46] preferences** need to be used in order to understand the demand side developments. In this case, **the relative demand for inferior consumer goods declines** on a growth path, while the demand for superior goods rises.

According to microeconomic theory, the supply curve of a corporation is represented by the section of the marginal cost curve which is above the shutdown point (Kopányi, 1992). If we would like to state the supply curve of a whole sector in the price–quantity co-ordinate quarter, the individual corporate supply curves must be summed up horizontally. A sectoral supply curve of this kind is depicted in Chart 5-4, and marked as MC1. **As a result of technological progress and capital deepening, corporate marginal costs (i.e. the cost of producing one additional product) decline**, i.e. the MC2 function will be the new marginal cost curve representing the higher technology and productivity. The reaction of the given sector's sales revenue to this depends on the demand curve. In the more flexible section of the demand curve (i.e. above the point marked with the star) a one percent change in prices entails a more than one percent growth in demand, i.e. the sales revenue increases.

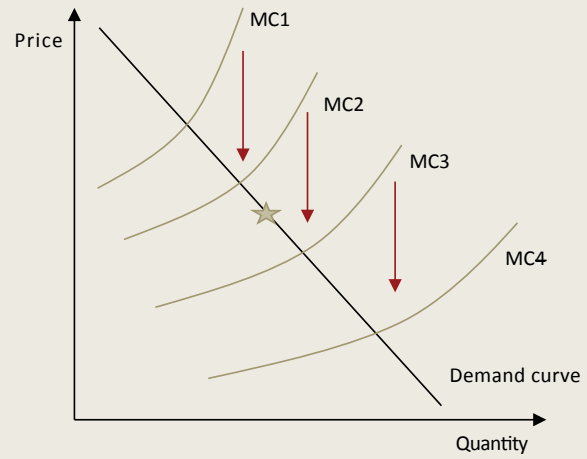
5.1.1 POSSIBLE CAUSES OF MAJOR SECTORAL CHANGES

The main sectoral restructuring is basically driven by two factors: firstly, there may be significant differences in terms of individual sectors' productivity growth (supply effect), **and secondly, income elasticities of individual products and services are also different**

45 Of the determinants of structural transformation, the variety of products and sectors (evolutionist approach, see: Montobbio, 2002; Saviotti and Pyka, 2004; Ciarli et al., 2010) as well as the role of the correlation between the sectoral composition of trade and income elasticity across sectors (see: Araujo and Lima, 2007; Araujo, 2013) are also emphasised.

46 We may speak of homothetic preferences if the consumer basket does not change as a result of an increase in income.

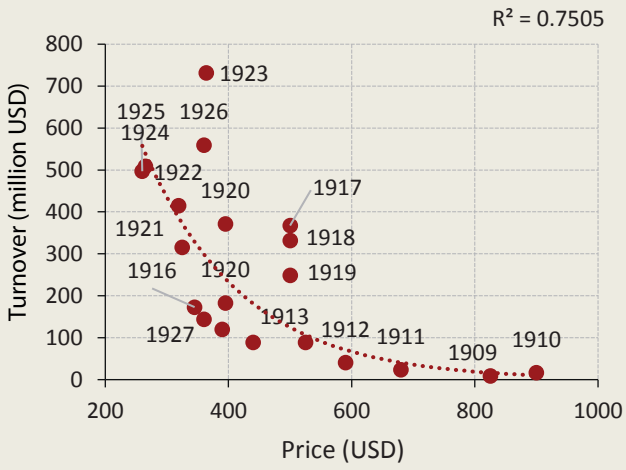
Chart 5-4:
Shift of the marginal cost curve due to productivity growth



Source: MNB.

A good example for these developments is car manufacturing. At the turn of the 19th and 20th century, cars were non-series products or were manufactured in small series; therefore, only the richest could afford to buy a car. At the time of its introduction in 1908, the Model T Ford cost USD 825. However, as a result of the mass production made famous by Ford, prices dropped significantly (to USD 260 by 1925). Remaining with the example of the Model T, the demand for the car increased steadily due to the decline in prices, and the initial production run of 10,000 cars increased to 2,000,000 vehicles by 1923. As a result of these developments, the sales revenue from the Model T rose considerably, i.e. a negative correlation between price and sales revenue was observed (Chart 5-5).

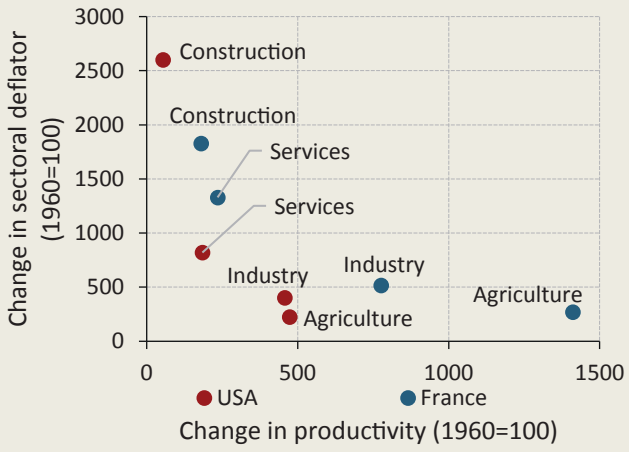
Chart 5-5:
Evolution of the Ford Model T price and revenue



Source: Wikipedia, MNB.

By contrast, in the inflexible section of the demand curve a one percent decline in prices entails a less than one percent decrease in demand (the MC3 curve shifts downwards to MC4). Then, the increase in production reduces the sales revenue of the sector.[47] Of course, the extent to which companies reflect the lower marginal cost in the prices is an important question. The decline in the marginal cost curve is also well reflected in the prices of the sector if competition is strong in the given sector, while import replaceability might be significant, entry barriers are low or the mark-up is constant over time. An examination of the data from the USA and France reveals that in the past more than 50 years the correlation between productivity and the sectors' price index was negative (Chart 5-6).

Chart 5-6:
The relation between the labour productivity and sectoral deflator for USA and France (1960–2016)



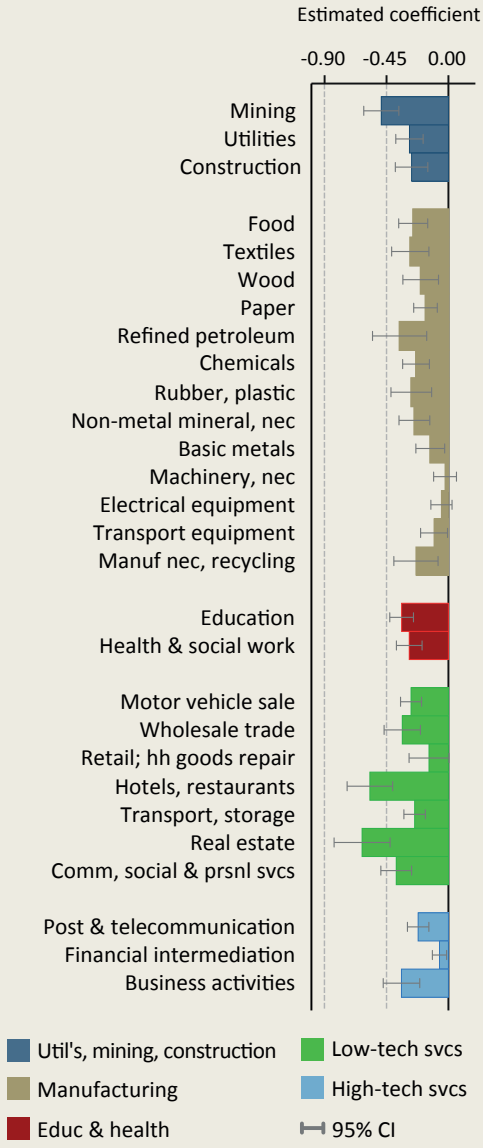
Source: AMECO, MNB calculations.

Autor and Salomons (2017) examined the impact of productivity expansion on employment in the sector. **According to their findings, in the same industry, an increase in productivity results in a decline in employment in all industries under review** (Chart 5-7).[48]

47 In general, employee ratios and shares within GDP show similar trends.

48 Nevertheless, aggregate employment typically did not decline, as sectors characterised by increases in productivity raised aggregate demand, entailing growth in employment in the other sectors.

Chart 5-7:
Sectoral direct, indirect and net employment effects in 19 developed countries, 1970–2007



Source: MNB based on Autor-Salomons (2017).

Nevertheless, the supply side does not provide a sufficient explanation regarding changes occurring in individual economies. **As income increases, the demand for individual products and services does not grow at the same rate as income does.** As shown in Table 5-1, there are significant differences in the income elasticities of individual products and services in the countries under review. **In the case of an increase in their income, households typically spend a greater proportion on clothing, furniture, health care and recreation.** Demand for these products and services is likely to increase on the growth path of the economy. The ratio of spending on food is likely to decline, while significant dispersion is observed in the case of communication.

The findings of empirical studies were different in terms of which explanatory factors have a greater impact in the sectoral transformation during the examination of the various economies. Analysing data for the United States for the period 1947–2010, Herrendorf et al. (2015) point out that **the share appearing in added value and thus in employment changes as a result of relative price effects and not as a result of the various income elasticities**. Swiecki's (2016) combined model (in which both demand and supply factors play a role) examined structural transformation using the data for 1970–2005 from 45 countries with different levels of development. In his opinion, **non-homothetic preferences have very important explanatory power at lower levels of development, but at higher levels the structural change is primarily attributable to the difference in technological development**.

Table 5-1:
Income elasticity of demand for particular non-durables

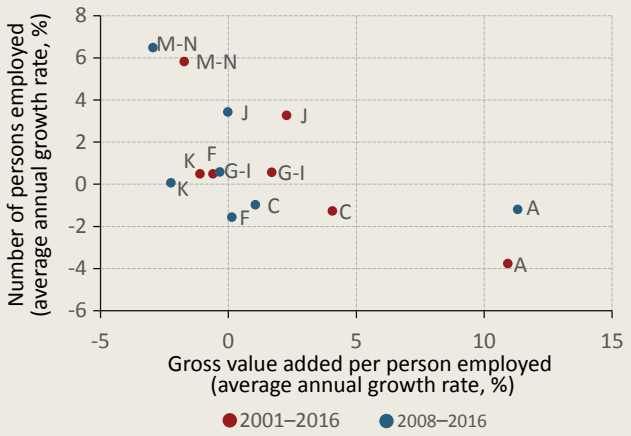
	Food	Clothing	Furniture	Health	Communication	Recreation	Other
Austria	0.5	1.4	1.5	1.4	1.1	1.3	0.9
France	0.7	1.2	1.4	1.3	0.6	1.3	1.2
Italy	0.6	1.3	1.7	1.2	0.5	1.4	1.3
Slovak Republic	0.7	1.6	1.9	0.9	0.8	1.3	1.0
Spain	0.7	1.1	1.3	1.1	0.7	1.4	0.9
United Kingdom	0.6	1.2	1.3	1.0	0.5	1.1	1.0
Average	0.6	1.3	1.5	1.2	0.7	1.3	1.1

Note: On the basis of 2004–2006 household-level surveys.
Source: Salotti et al. (2015).

On the whole, **in the case of agriculture, both demand and supply effects contributed to the decline in the weight of the sector**. Rapid productivity growth was observed in the sector, and the income elasticity of agricultural products was also low. **Considering the weight of industry, the fall in prices caused by the expansion in productivity initially entailed an increase in sales revenue and thus a rise in the weight of the sector. However, as demand reacted to the decline in prices less and less, the economic weight of the sector started to decrease, and even the still high income elasticity of industrial products could not offset this. In the case of services, productivity expansion was also relatively subdued, while the income elasticity of demand is also high, i.e. the weight of this sector increased.**

Recent years' employment and productivity statistics reveal that the largest productivity expansion in Hungary occurred in agriculture (average annual growth exceeding 10 percent in the 2000s), while the least favourable developments in terms of employment also happened here. Similarly to the G7 countries, manufacturing can also be characterised by positive productivity, but negative employment growth, while the services sector is typically much more effective in terms of the increase in employment than productivity. The sectors of professional, scientific, technical and administrative activities in particular had a significant impact on employment in the period under review, coupled with a decline in productivity, while in the case of the information and communication sector the major expansion in employment was also supported by the increase in productivity within the sector (Chart 5-8). **Based on the above, the ICT sector is still in the elastic phase of demand, i.e. the decline in the prices of products results in higher sales revenue and expanding employment.**

Chart 5-8:
Average annual change in productivity and employment in selected industries in Hungary, 2001–2016



Note: A-Agriculture, forestry and fishing, C-Manufacturing, F-Construction, G-I-Wholesale and retail trade, transport, accommodation and food service activities, J-Information and communication, K-Financial and insurance activities, M-N-Professional, scientific and technical activities; administrative and support service activities. Value added used for calculating productivity is expressed in euros at constant 2010 prices. The number of employed persons are calculated according to the domestic concept.
Source: Eurostat.

Looking ahead, we can formulate two important messages. Firstly, **sectors in which prices are very high at the moment, but decline fast have great potential** (this is also presented in the time series of the special topic for electromobility in the Growth Report). **Price declines due to productivity will entail increases in incomes and employment for quite a few decades in these industries that are in the making.** However, the market will become saturated after some time, and declining prices will result in lower and lower growth in volume, and thus the sector will enter a more mature phase. At that point, the reduction in costs will not be enough to maintain the level of sales revenue. At this time, goods for which demand does not grow proportionately to the increase in income will represent a declining weight in production and employment. As a result, marketing and the positioning of products become key issues.

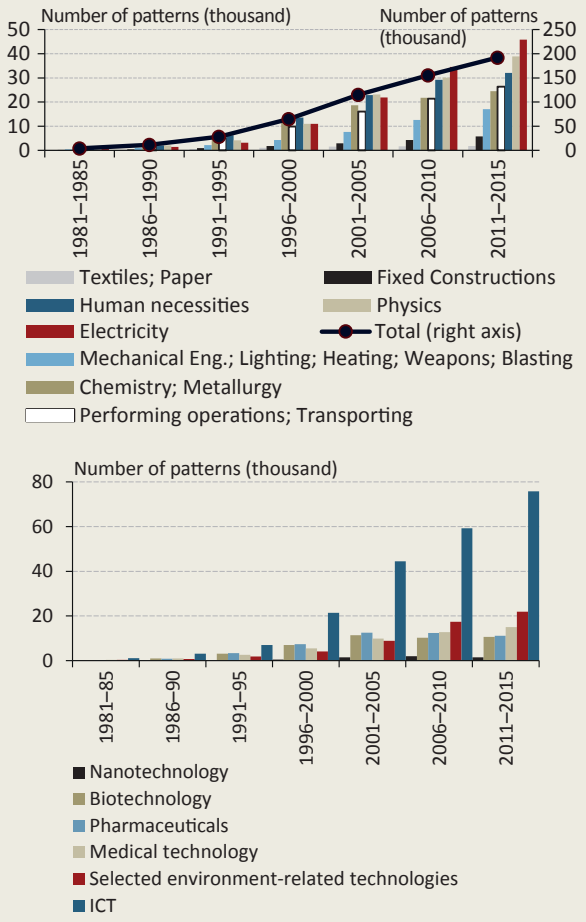
5.2 The importance of general purpose technologies in economic development

One important question is to what extent the weight of a sector within GDP or employment reflects the role of the given sector in economic growth or development. **It is primarily the widespread penetration of the general purpose technology of the given technological era that is responsible for productivity growth** and its impact covering several sectors. Steam power at the time of the first industrial revolution or electricity as of the end of the 19th century were general purpose technologies of this kind. According to Jovanovic – Rousseau (2005), the main features of general purpose technology are as follows:

1. **penetration**, i.e. the technology has to reach the majority of industries and the majority of households;
2. **development**, i.e. the technology has to produce better and better results, i.e. the costs of users have to decline steadily;
3. **extension of innovation**, i.e. the technology has to contribute to the development and application of new products and processes.

Examining the data, Jovanovic – Rousseau (2005) come to the conclusion that as a result of the development that took place in the past period, the **ICT sector meets the criteria of general purpose technology**. In terms of its penetration, the ratio of companies with access to the Internet reached 97 percent within the European Union in 2016.[49] Within the EU, the lowest ratio was recorded in Romania, although penetration reached 84 percent there as well. The remarkable decline in the prices of ICT devices was discussed in detail in Section 4 of the report. The innovation wave, in turn, is well illustrated by the drastic rise in the number of patents (Chart 5-9). It is also clearly visible that the spread of ICT technologies starting from the 1990s entailed increases in the number of patents in a wide range of sectors.

Chart 5-9:
The total number of patents submitted by inventors by sector (upper panel) and technology (lower panel), 1981–2015



Note: Data points show the averages of the given time intervals. PCT statistics on the basis of the inventor's country.
Source: OECD.

The appearance of general purpose technologies is accompanied by two phenomena: Firstly, upon the introduction of a new technology, expansion in productivity is typically lower. This may be explained by the fact that new technologies are not user-friendly in the beginning. Secondly, the reorganisation of economic processes or any additional investment in physical or human capital takes time (Brynjolfsson et al., 2017). This is a kind of response to the productivity paradox raised by Solow (1987), i.e. the impact of the information and communication era on productivity growth will be perceived in a delayed manner. In addition, **market turbulence is strengthening**, as far as firms' entering and leaving the market, mergers and acquisitions as well as changes in stock exchange pricing are

49 Non-financial corporation with at least 10 employees.

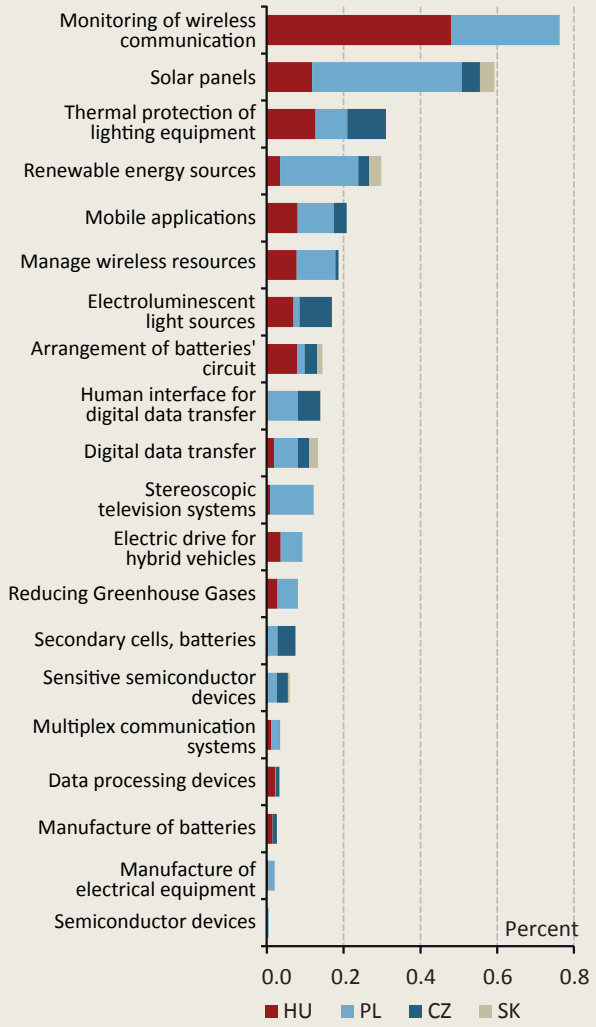
concerned. **A concomitant aspect of technical innovations is that the capital that uses outdated processes loses its value.** This results in losses for the owners and users of the expiring technology and profits for entrepreneurs investing in new processes (Bródy, 2010). According to Schumpeter (1942), with new combinations coming into being, previous solutions and skills are crowded out and become redundant, and he called the changes that take place in the innovation developments of market economies and demolish previous structures creative destruction (see: ILO, 2008; Bródy, 2010).

5.2.1 WHAT TO EXPECT IN THE SHORT TERM?

Accordingly, ICT as a general purpose technology raises sectors that can become the most important growth factor of the era in the given period. **Based on the collection of the OECD, today's most important technologies are fundamentally related to electromobility, the storage of electric energy, means of communication and environmental protection (Chart 5-10).** Similar conclusions are drawn by McKinsey (2013) as well. For the next 10 years, experts assume that the **mobile internet** will have the greatest economic impact. In addition, significant potential can be identified **in the automation of working processes that represent higher knowledge in the case of the Internet of things, cloud computing, robotics and self-driving cars as well**. Energy storage plays a major role in the McKinsey analysis as well, moreover 3D printing and a more intensive use of genetics also appear.

According to Brynjolfsson et al. (2017), the spread of artificial intelligence (AI) will usher in a new technological era. Let us take self-driving vehicles as an example. In 2016, 3.5 million people worked as drivers in the USA. Let us suppose that this number drops to 1.5 million in the next 10 years because of self-driving vehicles. In this case, productivity would increase by 1.7 percent at the aggregate level in the United States, corresponding to an annual 0.17 percent expansion of productivity. However, the technology would have second-round effects as well, as expected of a GPT: the vehicles collect data, which they share with other vehicles, and they harmonise and optimise routes in order to avoid traffic jams, which will reduce accidents and insurance costs. The image recognition software used in self-driving vehicles could be applied in medical or industrial diagnostics, saving further input costs for companies and increasing productivity. But self-driving vehicles may improve productivity through other channels as well. At present, cars are parked 95 percent of the time, and their owners only use them in the remaining 5 percent. If the utilisation of 'smart cars' improved during the passive time of the owner(s) because other people were also allowed to use them, significant productivity improvement could be achieved again in road traffic.

Chart 5-10:
Top technologies share in patent for the V4 countries (2010–2012)



Source: OECD.

The adoption of legislation related to technological development could become an important issue already in the short run. Returning to the automotive industry: in many cases, the spread of self-driving vehicles will raise personal liability issues that are unknown at the moment (who is responsible if a self-driving vehicle causes an accident?). In addition, the general purpose technology will increase the demand for data in a wide range of sectors, which raises the question of drawing the line between personal data and business data. For example, it will be possible to retrieve a great deal of information from the traffic data of vehicles and convert it into profit for the operator of the technology, but location data are considered personal information, so this issue needs to be treated legally as well. It may become an important issue to develop a

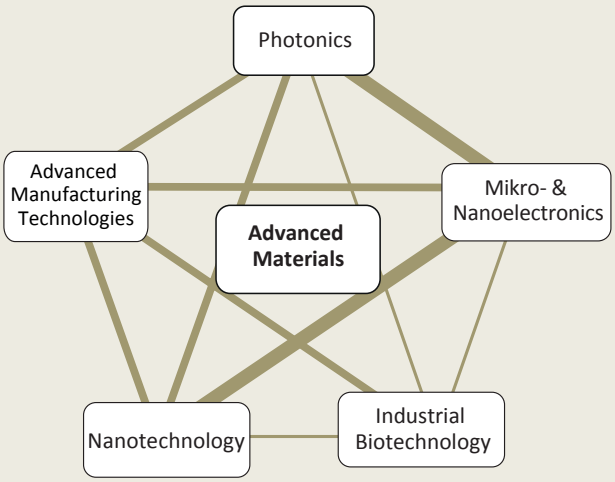
regulatory environment for the technological progress that serves the social welfare. With the penetration of new technologies it may happen in traffic, for example, that the number of those who exceed the speed limit increases, which may add to accident statistics (modern community-based navigation systems are able to spot police radars). Of course, in some cases it is difficult to prove a causal relationship, but issues like this or similar ones that are on the boundary of various areas of science will continuously interest decision-makers.

5.2.2 LONG-TERM PROSPECTS

A well-designed policy may also contribute significantly to overcoming technological challenges. The European Commission designated six **Key Enabling Technologies**, and by supporting them – in view of the natural relations encoded in them – the EU may be able to keep Europe among the global leaders in terms of innovation. These six technologies are: **advanced materials, nanotechnology, micro and nanoelectronics, industrial biotechnology, photonics and advanced manufacturing technologies**.[50] The idea behind designating these technologies is that **they created devices such as smart phones, lithium batteries, nano medical devices and smart textiles, which have been crucial so far**. Another important aspect in this selection is that **multiplicative processes** also should be created with the support of these technologies. Due to the raw material needed for production, **advanced materials technology** is in the common profile of the six Key Enabling Technologies (Chart 5-11). As a result of materials technology improvements, **cost-effective substitute solutions may be found** for industry, **which can mostly be used in the fields of space industry, transport, construction and health care**. Moreover, the relevant final products reduce the raw material demand of economies, which is critical in the case of Europe, and Hungary in particular, because of its dependence on raw materials. Stemming from their nature, **common features of the technologies are that they involve high R&D intensity, operate with rapid innovation cycles, are capital intensive and require highly qualified labour**.

As a result of technological competition and the global shift in the centre of gravity, state support for the creation and spread of technologies has become extremely important. While EU countries have (for the time being) a high proportion of world patents for a number of key technological products, manufacturing is rarely done in Europe.

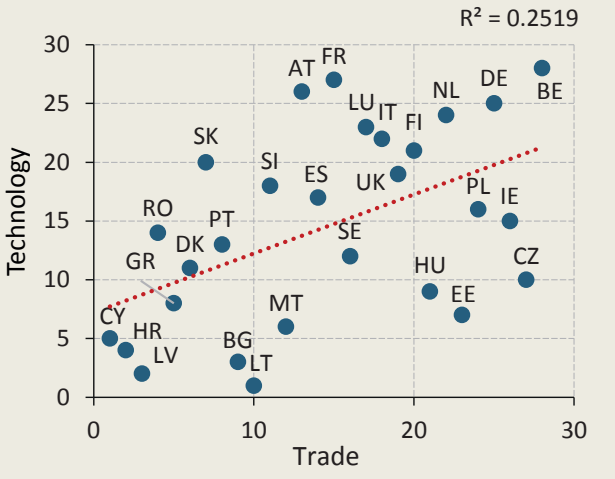
Chart 5-11:
Key Enabling Technologies and their natural interrelations



Note: The thickness of the lines shows the strength of the relationship.
Source: MNB based on European Commission (2014), pp 24.

Hungary specialises in the production and export of technologies, but even compared to the V3 region it lags behind in adopting a number of key technologies.[51] Moreover, **Hungary lags behind most in the field of advanced material technologies, which are particularly important among the Key Enabling Technologies** (Chart 5-12)**.**

Chart 5-12:
Relative positions in patenting and trading advanced materials (inverse ranking, 2011)



Note: The highest point is attributed to the best performer.
Source: MNB based on European Commission (2017).

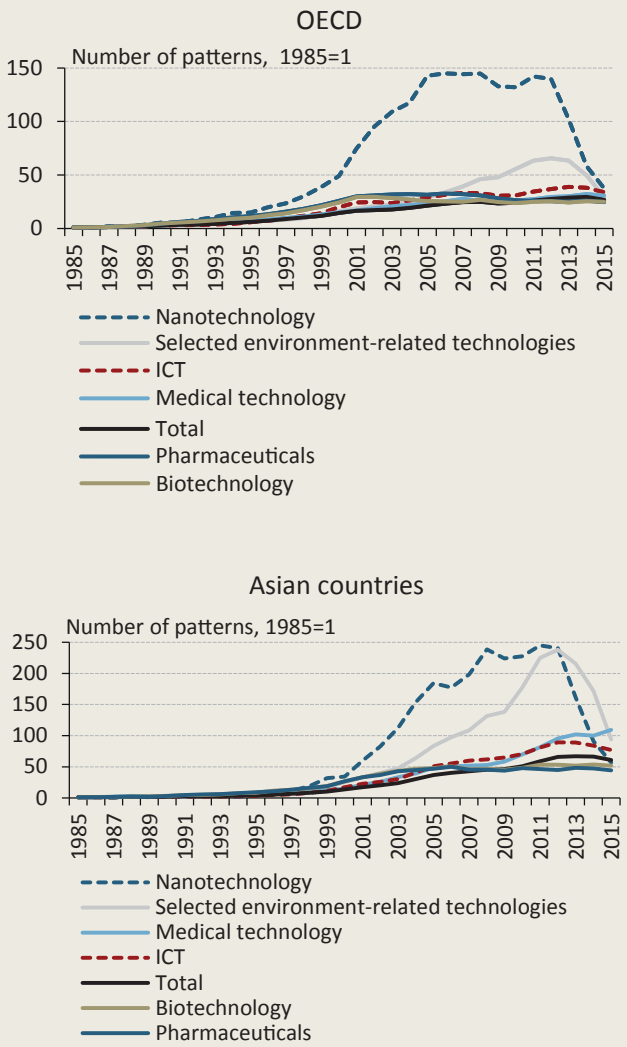
According to Grinin et al. (2017), the next 30–50 years will mostly be characterised by the **economic cycle determined by the MANBRIC (medical, additive, nano-, bio-, robotics, IT and cognitive) technologies**; this field may become the general purpose technology

50 For a more detailed description of the technologies, see European Commission (2014), pp. 21–22.

51 The data are for 2011.

of the global economy. The projection was formulated on the basis of the dynamics of patent statistics observed in the past decades and the expected innovation requirement of medical technology improvements necessary for the health care of the ageing society. **The main fields of innovation of the future were primarily corroborated by data of Far Eastern countries, where, in their opinion, the next technological change will start from** (Grinin et al., 2017). Based on the past thirty years' patent statistics, the dynamics of innovations in nanotechnology and environmental protection as well as medical technology were even higher than that of information and communication technologies in the OECD countries and in the more developed countries of Asia (Chart 5-13).

Chart 5-13:
Increase in the number of patents in seed technological fields in the OECD countries and in selected Asian economies, 1985=1



Note: PCT (Patent Cooperation Treaty) statistics on the basis of the inventor's country.
Source: OECD.

References:

Araujo, R. A. (2013): Cumulative causation in a structural economic dynamic approach to economic growth and uneven development. Structural Change and Economic Dynamics 24, pp. 130–140. http://www.sciencedirect.com/science/article/pii/S0954349X1200063X.

Araujo, R. A.– Lima, G. T. (2007): A structural economic dynamics approach to balance-of-payments-constrained growth. Cambridge Journal of Economics 31, pp. 755–774.

Autor, D. – Salomons, A. (2017): Does Productivity Growth Threaten Employment? ECB Forum on Central Banking. 26-28 June 2017. Sintra, Portugal. https://www.ecbforum.eu/uploads/originals/2017/speakers/papers/D_Autor_A_Salomons_Does_productivity_growth_threaten_employment_Final_Draft_20170619.pdf

Basu, S. – Fernald, J.F. (2006): Information and Communications Technology as a General-Purpose Technology: Evidence from U.S Industry Data. Federal Reserve Bank of San Francisco. Working Paper 2006-29. http://www.frbsf.org/publications/economics/papers/2006/wp06-29k.pdf

Bessen, J.E. (2017): Automation and Jobs. When Technology Boosts Employment. Boston University School of Law, Law and Economics Research Paper No. 17–09. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2935003

Bródy, A. (2010): Fejlődés vagy növekedés? (Development or Growth?) Közgazdasági Szemle, Vol. LVII, Dec. 2010, pp. 1072-1086.

Brynjolfsson, E. – Rock, D. – Syverson, C. (2017): Artificial intelligence and the modern productivity paradox: A clash of expectations and statistics. NBER Working Paper Series, 24001.

Ciarli, T. – Lorentz, A. – Savona, M.M.V. (2010): The effect of consumption and production structure on growth and distribution: a micro to macromodel. Metroeconomica 61, pp. 180–218.

European Commission (2014): Horizon 2020: Key Enabling Technologies (KETs), Booster for European Leadership in the Manufacturing Sector. http://www.europarl.europa.eu/RegData/etudes/STUD/2014/536282/IPOL_STU(2014)536282_EN.pdf

European Commission (2017): KETs Observatory Composite Indicator Database. https://ec.europa.eu/growth/tools-databases/kets-tools/kets-composite-indicator

Fuhrer, J.C. – Little, J.S. (1996): Technology and growth: An overview. New England Economic Review, November-December, pp. 3-25. https://www.researchgate.net/publication/5027074_Technology_and_growth_An_overview

Gabardo, F.A. – Pereima, J.B. – Einloft, P. (2017): The incorporation of structural change into growth theory: A historical appraisal. EconomiA, in publication. https://doi.org/10.1016/j.econ.2017.05.003

Grinin, L.E. – Grinin, A.I. – Korotayev, A. (2017): Forthcoming Kondratieff wave, Cybernetic Revolution, and global aging. Technological Forecasting & Social Change. 115. pp. 52–68.

Herrendorf, B. – Herrington, C. – Valentinyi, Á. (2015): Sectoral Technology and Structural Transformation. American Economic Journal: Macroeconomics, 7(4), pp. 104-33. https://www.aeaweb.org/articles?id=10.1257/mac.20130041

Herrendorf, B. – Rogerson, R. – Valentinyi, Á. (2013): Growth and Structural Transformation. NBER Working Paper Series, Working Paper 18996. http://www.nber.org/papers/w18996

ILO (2008): Skills for improved productivity, employment growth and development. Report V. Fifth item on the agenda. International Labour Conference, 97th Session, Geneva. http://ilo.org/wcmsp5/groups/public/@ed_norm/@relconf/documents/meetingdocument/wcms_092054.pdf

Jovanovic, J. – Rousseau, P.L. (2005): General Purpose Technologies. In: Handbook of Economic Growth, Volume 1B. eds.: Aghion, P. – Durlauf, S.N. – Elsevier, B.V. – Jorgenson, D.W. – Stiroh, K.J. (1999): Information Technology and Growth. American Economic Review, Vol. 89., No. 2, May 1999.

Kopányi, M. (1992): Mikroökonómia, Műszaki Könyvkiadó-Aula Kiadó, Budapest, ISBN 963 10 9850 8.

McKinsey (2013): Disruptive technologies: Advances what will transform life, business and the global economy. https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/disruptive-technologies

Montobbio, F. (2002): An evolutionary model of industrial growth and structural change. Structural Change and Economic Dynamics, vol. 13., issue 4., pp. 387–414.

PricewaterhouseCoopers EU Services EESV (2016): Final report: Skills for Key Enabling Technologies in Europe. http://ec.europa.eu/growth/content/final-report-skills-key-enabling-technologies-europe-0_en

Salotti, S. – Montinari, L. – Amores, A.F. – Rueda-Cantuche, J.M. (2015): Total expenditure elasticity of non-durable consumption of European Households. European Commission, JRC Technical Reports.

Saviotti, P.P. – Pyka, A. (2004): Economic development, qualitative change and employment creation. Structural Change and Economic Dynamics, pp. 265–287.

Schumpeter, J.A. (1926): A gazdasági fejlődés elmélete (Theory of Economic Growth). Közgazdasági és Jogi Könyvkiadó, 1980.

Schumpeter, J.A. (1939): Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist Process. London: McGraw-Hill.

Schumpeter, J. A. (1942): Capitalism, Socialism & Democracy. Taylor & Francis e-Library, 2003.

Solow, R. M. (1987): „We'd better watch out." New York Times Book Review, July 12, p 36.

Święcki, T. (2017): Determinants of structural change. Review of Economic Dynamics, Volume 24, pp. 95–131. https://doi.org/10.1016/j.red.2017.01.007

Tinbergen, J. (1974): Substitution of Graduate by Other Labor. *Kyklos* 27, 217–226 pp.

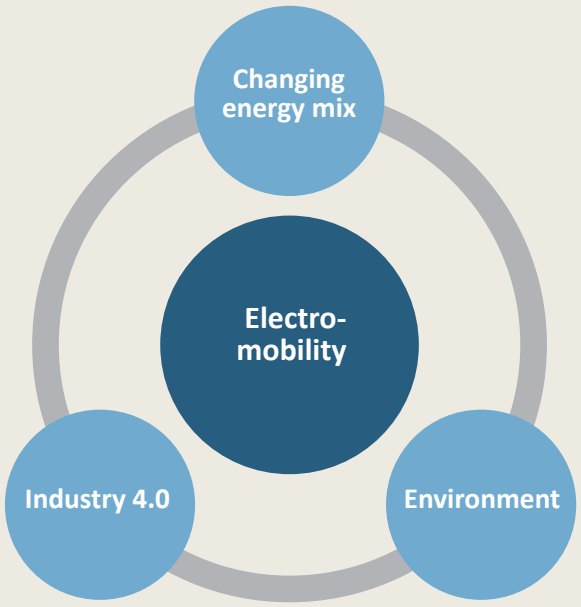
6 Spread of electromobility and expected impact thereof on the Hungarian economy

Of the key megatrends, the spread of electromobility is supported by environmental protection, the changing energy mix, as well as by Industry 4.0. The automotive industry is approaching a turning point, where e-mobility and digitalisation may be defining factors. At present, the market of electric vehicles lags behind that of traditional vehicles, but in parallel with the decline in production and investment costs, this market may grow dynamically in the coming decades. The evolution of production is also reshaping the geographic configuration of commodity supply; demand for lithium and cobalt – which are relatively scarce in volume with highly concentrated extraction in geographic terms – may increase significantly. This turning point in the automotive industry is particularly important for Hungary, considering the high economic weight of the sector, even in a regional comparison. The strategy of the car manufacturers, which is relevant for Hungary, focuses on electric drive. However, as a result of the fewer components, supplier networks may shorten, which may complicate entering the changing production chains. Developed education and infrastructure, as well as an increase in the importance of creative industries and services, are key for the shift towards production of higher value added.

6.1 Where does electromobility fit into the new megatrends

In recent years, the topic of electromobility has increasingly come to the forefront of corporate strategies and economic policy discussions. In terms of **the key megatrends** which determine the global economic system and the ecosystems of individual economies, **environmental protection, the changing energy mix and the evolution of production as part of Industry 4.0** may support the spread of electromobility (Chart 6-1).

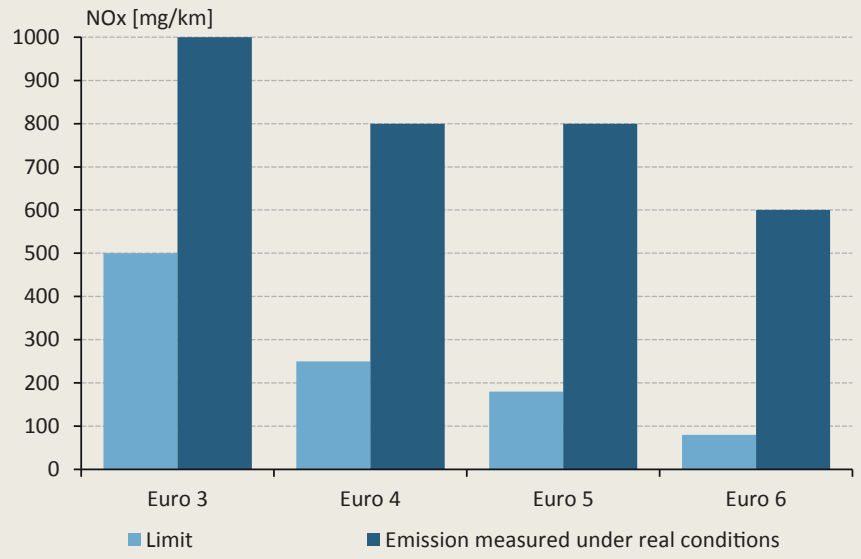
Chart 6-1:
Connectivity of electromobility to new megatrends



Source: MNB.

Recently, various **environmental protection considerations** have gained increasing importance, and hence the policymakers have made strong efforts to reduce the emissions of new vehicles and restrict diesel engines in the future in larger cities. The Volkswagen scandal, which erupted in September 2015, **highlighted** the fact that – in the view of the general public as well – **in the case of diesel vehicles there is an increasing difference** between consumption and emissions **in actual use** and consumption and emissions measured in laboratories (Chart 6-2). Through the increasing popularity of e-mobility, environmental protection is also gaining more significance, and thus the industry may shift more and more away from traditional vehicle manufacturing to alternative drive.

Chart 6-2:
Real nitrogen oxide emissions of diesel vehicles compared to the relevant limits

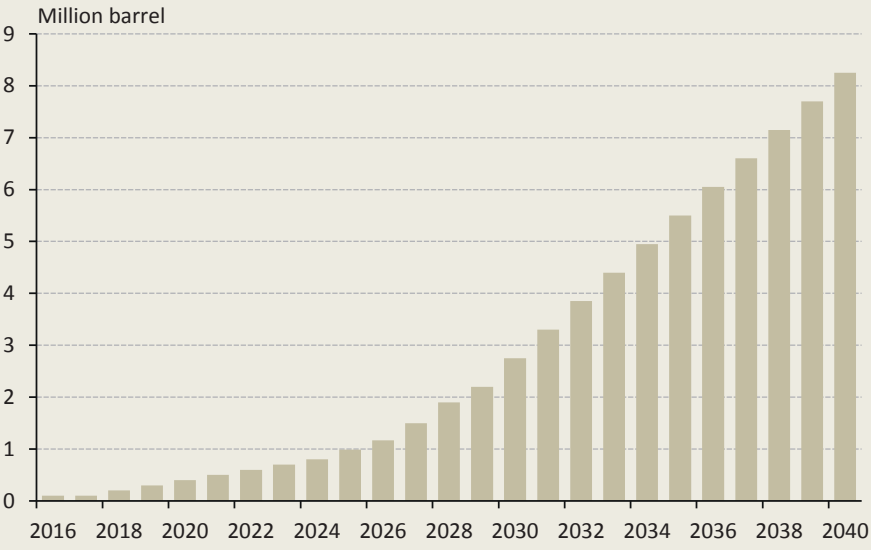


Source: Franco et al. (2014): Real-world exhaust emissions from modern diesel cars. ICCT.

As a result of the **changing energy mix**, fossil fuels may lose from their importance in the years ahead, and thus the increased energy demand generated by the spread of electric drive may also be covered from renewable resources. As a result of e-mobility, **dependence on oil may be reduced**, and thus the impact of crude oil on inflation may also be more moderate. According to the IMF (2017), due to the spread of electric vehicles, by 2040 the oil price – calculated at the current exchange rate – may drop to USD 15 as a result of declining demand.

Due to the spread of e-mobility, daily global oil demand may shrink **in 2040 by roughly 6-8 million barrels** (Chart 6-3), which is nearly 25 percent of the present oil extraction of the United States or OPEC.

Chart 6-3:
Decline in oil demand due to the spread of electric vehicles



Source: MNB based on Bloomberg's New Energy Finance.

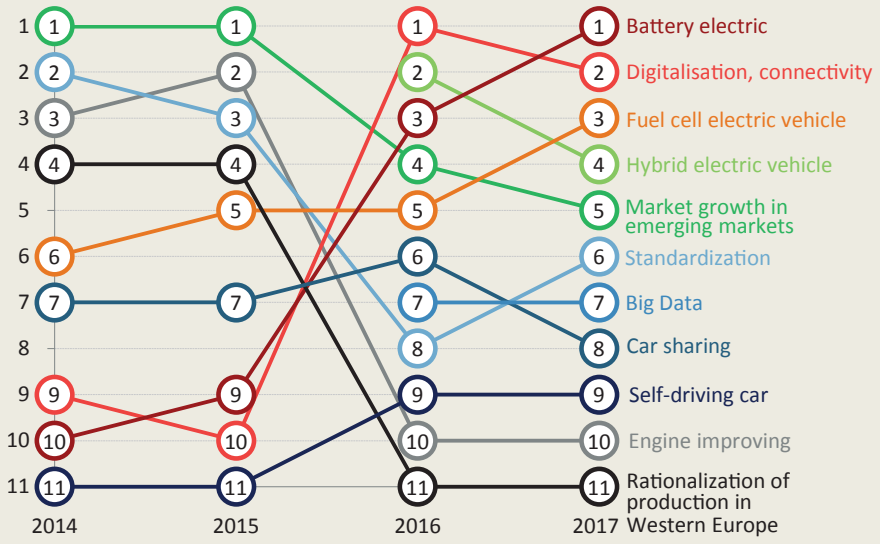
In addition to environmental protection and the changing energy mix, the **contribution of** emerging economies – particularly China – **to global industrial production rose, and thus the European countries and the large car manufacturers are facing new challenges.** The **purpose** of the new German economic strategy elaborated with a view to preserving competitiveness and the cornerstone thereof, i.e. **Industry 4.0, is to prepare the German industry for the evolution of production processes** by applying technological achievements and processes more strongly.

With a view to preserving their competitiveness, **the actors of the automotive industry may** – within the framework of Industry 4.0 – **focus on technological progress and stimulating innovation**, thereby also **contributing to the shift towards the production of higher value added.**

The innovations and procedures of the fourth industrial revolution facilitate the acceleration of production processes, the increase in capacity utilisation and the optimisation of technical, human and natural resources. In addition to **automation and robotisation**, the topics of **big data**, **digitalisation** and **data protection** are also coming to the forefront, with **connectivity** and improvement in service quality gaining increasing importance, and new business models are being introduced. **The evolution of production processes may pave the way for the penetration of e-mobility**.

The automotive industry is approaching a turning point, which is also confirmed by the **major change in the opinion** of the most important **global actors** in the industry **which took place just in a few years (KPMG, 2017)**. In 2014-2015, the industry leaders considered, along with **market expansion**, the development of standards and engines, to be among the most important trends, while based on this year's survey, **electric drive, digitalisation and connectivity are the most important, defining industry trends** (Chart 6-4).

Chart 6-4:
Most important trends based on the perception of industry leaders



Source: KPMG (2017).

In addition to the more advanced production procedures and business models, the **adaptation of new technologies for consumers** is also essential for the spread of electromobility. The penetration of new technologies has continuously accelerated in the past decades. While the spread of telephone or radio among consumers took almost 30-35 years at the end of the 19th century, **use of the internet, social media and smart phones has penetrated in just 5 years**.

6.2 Changes in the market of electric vehicles

6.2.1 ELECTRIC VEHICLES

In order to reduce emissions at the fleet level (all vehicles sold by the vehicle manufacturer), **hybrid power technology is the most popular in the short run**, but **due to the technological limits, it will not meet the environmental requirements in the longer term**. For manufacturers that wish to preserve their competitive advantage and market share in the long run, it is essential to **use as broad a selection of drive technologies as possible** in their vehicle fleets.

At present, in terms of alternative drive technology the large automotive companies can **select between two options:** electric drive or hydrogen drive. Electrically powered motors emit substantially **less pollution into the environment** and **are also cheaper to maintain**; due to the lower number of moving components **service costs are also lower**. On the other hand, at present the **expensive technology** is a disadvantage, and with one recharging **these vehicles are able to cover substantially shorter distance; moreover, weather conditions also influence their performance** (Table 6-1).

Table 6-1:
Advantages and disadvantages compared to conventional drives

	Electric drive	Hybrid drive
Advantage	Unlimited fuel source Can be charged at home Cheaper fuel Environmental friendly	Environmental friendly The by-product is water
Disadvantage	Slow charge Lack of filling network Short driving range Expensive technology	Fuel must be stored at high pressure Limited availability Lack of filling stations

Source: MNB.

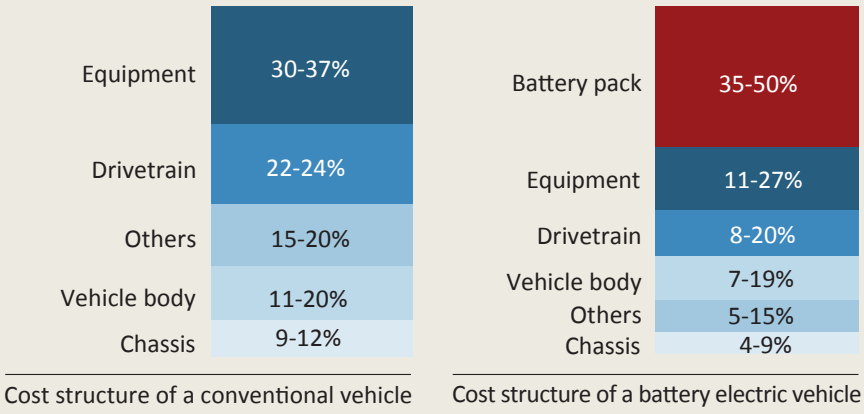
Electric cars obtain the necessary energy through different physical and drive processes. While in the case of electric cars the propellant is partly electric energy, traditional cars are fuelled by petrol or diesel. There are three types of electric vehicles: ones powered purely by electricity, hybrid ones equipped with an electric battery and an internal combustion engine, and the hydrogen gas or reactor cell powered vehicles.

At present, the Asian-based manufacturers Toyota, Hyundai and Honda are developing hydrogen-powered technology, whereas **the strategy of BMW, Volkswagen, Tesla and BYD – all companies more relevant for Hungary – focus on electric cars**. Purely electric cars are vehicles with an integrated high-capacity battery, which stores the absorbed electricity and is driven exclusively by an electric motor. In terms of components, the key differences include the charging system delivering the energy to the battery, the battery storing the energy necessary for the drive system, as well as the electronics controlling and electric motor and the electric motor itself.

6.2.2 MARKET OF ELECTRIC CARS

At present, the market size for electric vehicles lags behind that of traditional vehicles, and the production costs, as well as the one-off investment costs necessary for operation, are also higher. At present, the technological backlog of car manufacturers is primarily significant in the field of battery technology. At present, the battery takes up much more space and is much heavier **than an internal combustion engine**, and consequently it is also relatively **more expensive, and hence it is a significant item in the price structure of the car** (Chart 6-5)**.**

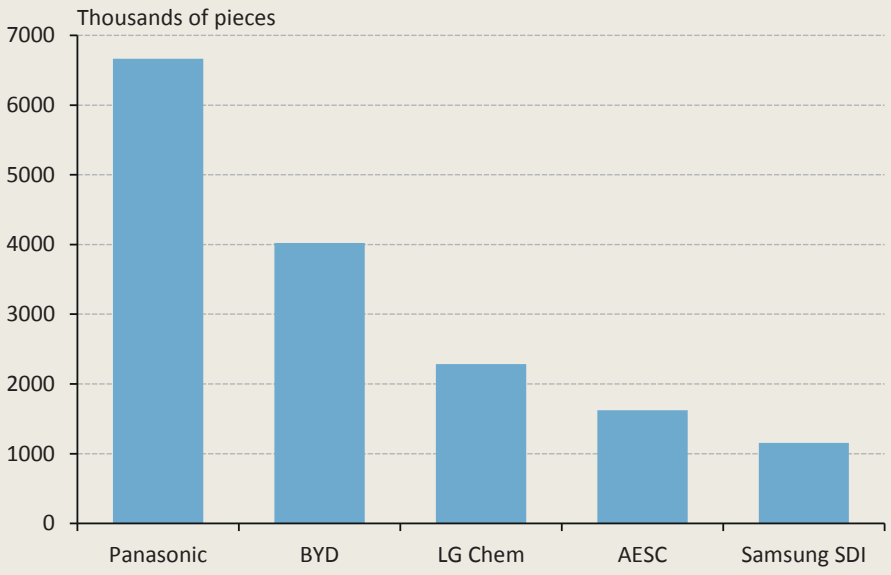
Chart 6-5:
The cost structure of conventional and electric cars



Source: Kochhan et al. (2014): An Overview of Costs for Vehicle Components, Fuels and Greenhouse Gas Emissions.

Large vehicle manufacturers typically procure batteries from suppliers, thereby further strengthening the position of battery manufacturers in the production chain. **There is a strong Asian dominance among battery manufacturers**, as the world's leading battery manufacturers are almost all from the Far East (Chart 6-6), **thus these companies may shortly obtain major competitive advantage both in Europe and America**.

Chart 6-6:
Total production of the largest battery factories in 2016

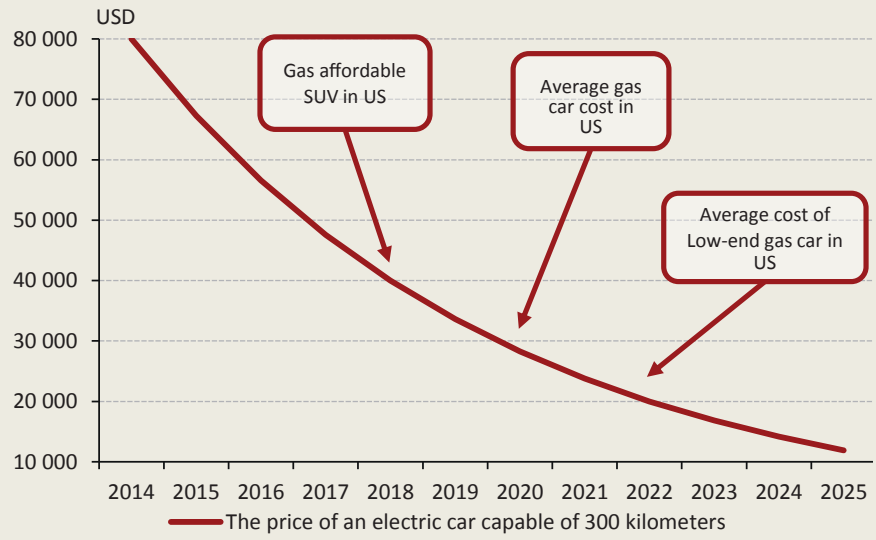


Source: InsideEVs.

Based on the capacities sold, at present the largest market participant is Panasonic, which supplies batteries to Tesla, Volkswagen and Ford. The second largest supplier – which also has Hungarian interests – is BYD, the only large actor in the market of electric cars which produces its own batteries. LG Chem is the supplier with the third largest market share, working as a partner with Renault, Chevrolet and Ford. The fourth company, AESC, is the supplier of one the world's leading electric car manufacturers, Nissan. The fifth participant on the list is Samsung SDI, which is the supplier for the BMW brand and also has interests in Hungary.

However, according to industry estimates, **the price of electric cars may fall substantially in the future.** This **may be supported by changing regulations**, as part of which the use of diesel cars will be restricted, while the purchased cars will benefit from various tax and other allowances. There is a high probability that by 2025 the price of an electric car will be more favourable than that of cars with the same parameters, equipped with internal combustion engine (Chart 6-7).

Chart 6-7:
Expected developments in the price of electric vehicles



Note: 4 miles/kWh, 50 kWh batteries, 16 percentage yearly improvement in battery.
Source: Based on Seba (2014): Clean disruption of energy and transportation.

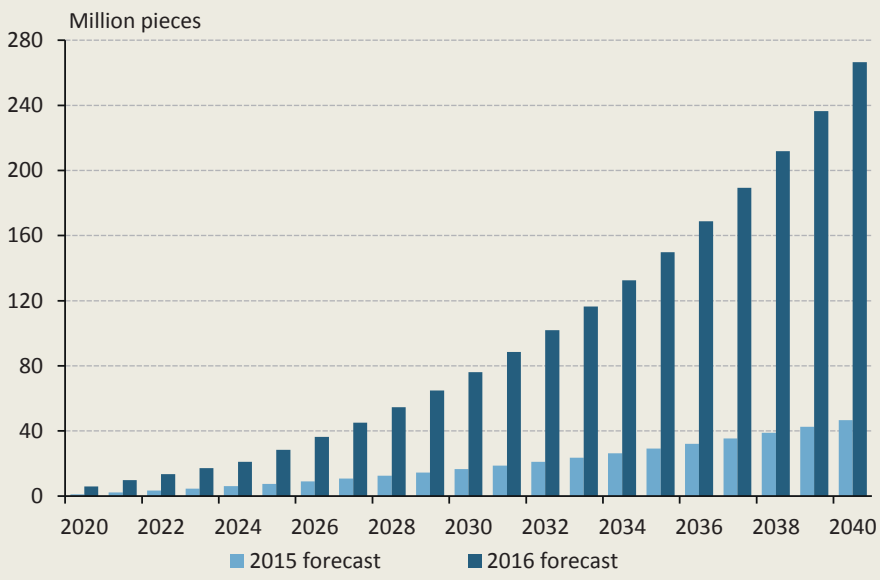
Due to the declining prices, the market for electric vehicles may expand strongly in the coming decades. Last year, the number of cars driven purely by electricity reached 1.2 million. **The dynamic growth in the Chinese market, taking the lead from the United States**, played a key role in this.

The expected penetration rate of electric vehicles varies on a broad scale among the various forecasting institutions. According to the various scenarios prepared by IEA, the International Energy Agency, supported by a large number of countries, by 2040 the share of electric vehicles will be between 10 and 30 percent. OPEC and BP expect somewhat slower penetration than this (6-22 percent), while the authors of Barclays, Bloomberg and particularly the IMF anticipate a much faster rate (36-93 percent).

At present, economists at several companies are reviewing their forecasts related to electric vehicles and revising them substantially upwards, in line with the sharp decline in battery costs. By 2030, the International Energy Agency expects 58 million electric vehicles instead of the previous forecast of 23 million. ExxonMobil modified its forecast for 2040 from 65 million to 100 million, while according to British Petrol, the fleet will reach 100 million by 2035, which represents 40 percent growth relative to its projection from last year.

According to Bloomberg (2017), the largest adjustment in the forecast (about 500 percent) was recently performed by OPEC (Chart 6-8). Last year, the Organisation of the Petroleum Exporting Countries expected that 46 million vehicles driven purely by electricity would be on the roads by 2040. In this year's projection, the Organisation projects 266 million e-vehicles. This means that in 23 years the share of electric vehicles in the total global market may be as high as 12 percent, whereas a year ago OPEC only expected 2 percent for 2040.

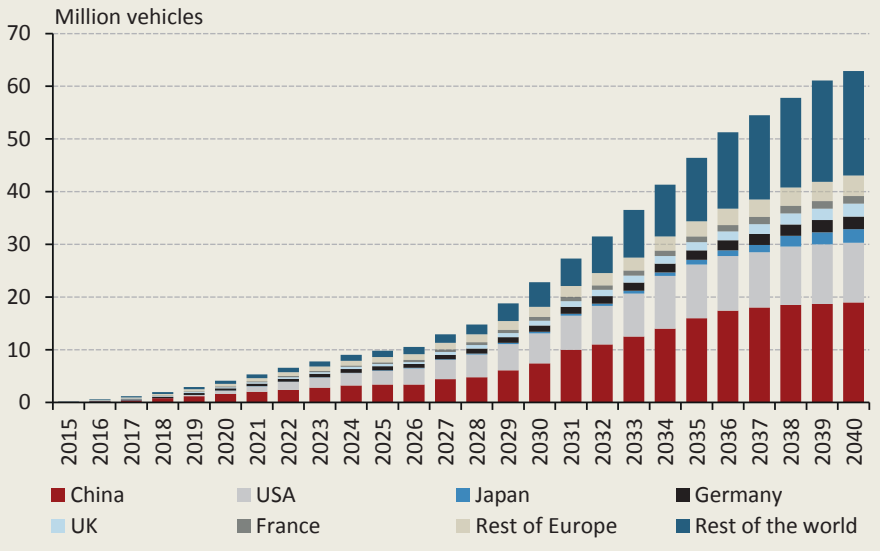
Chart 6-8:
Expected spread of electric vehicles (OPEC)



Source: MNB based on Bloomberg New Energy Finance.

In its forecast, Bloomberg (2017) anticipates dynamic growth in the future. **By 2040, there may be an almost fiftyfold increase in the e-vehicle market, primarily due to growth in the Chinese and US markets** (Chart 6-9). Economists expect that in 2040 electric vehicles will account for 54 percent of all new cars sold. **According to their expectations, in 2038 more electric cars than vehicles with internal combustion engines will be sold.**

Chart 6-9:
Expected developments in the global sales of electric vehicles



Source: MNB based on Bloomberg New Energy Finance.

According to the forecasts, in the coming decades, the emerging regions – particularly **China and India** – may play a major role in global growth, while growth in GDP per capita in these regions may also be accompanied by a rise in the number of cars. On the other hand, it is not plausible to assume that the newly generated demand in these countries would be satisfied by already obsolete, internal combustion vehicles; it is much more likely that **Asian consumers with average income will choose electric cars, which will be competitive in terms of price by then.** This assumption is further supported by the significant **air pollution** of the highly populated, large metropolises

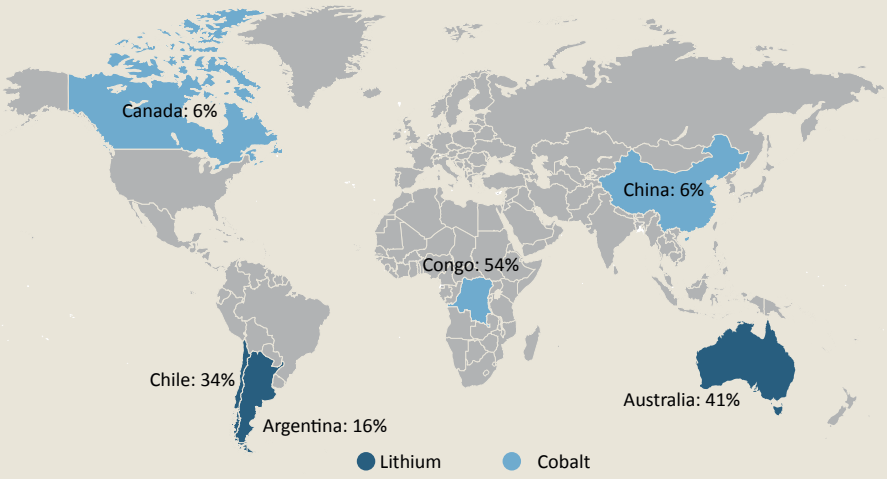
of the countries in the Far East, where one solution to the problem may be the support for the penetration of electric cars, even with state subsidies, if necessary.

The electric motor is expected to transform not only passenger transport, but goods transport as well. In 2017 Q4, Tesla will introduce its new, purely electric-drive truck, and one of its competitors, **Cummins**, engaged in the manufacturing of trucks and lorries, already **presented its electric truck**, named Aeos, meant for city transportation, to the general public **this August.**

The significant difference between the various forecasts suggests that the **penetration rate of e-vehicles is uncertain.** Progress in the battery technology, the development of new prototypes and political commitment may represent upside risks.

In parallel with the growth in the market of electric cars, demand for commodities may also rise. The evolution of production may **transform the geographic configuration of commodity supply**. Of the metals necessary for the battery manufacturing, **manganese, nickel, cobalt and lithium are of key importance.** Looking ahead, **lithium and cobalt may soon become bottlenecks**, as their volume is relatively small and their extraction is extremely concentrated. **More than 90 percent of** the global **lithium production comes from three economies** (Australia, Chile, Argentina), while **in the case of cobalt Congo accounts for more than half of global production** (Chart 6-10).

Chart 6-10:
The main countries with cobalt and lithium reserves



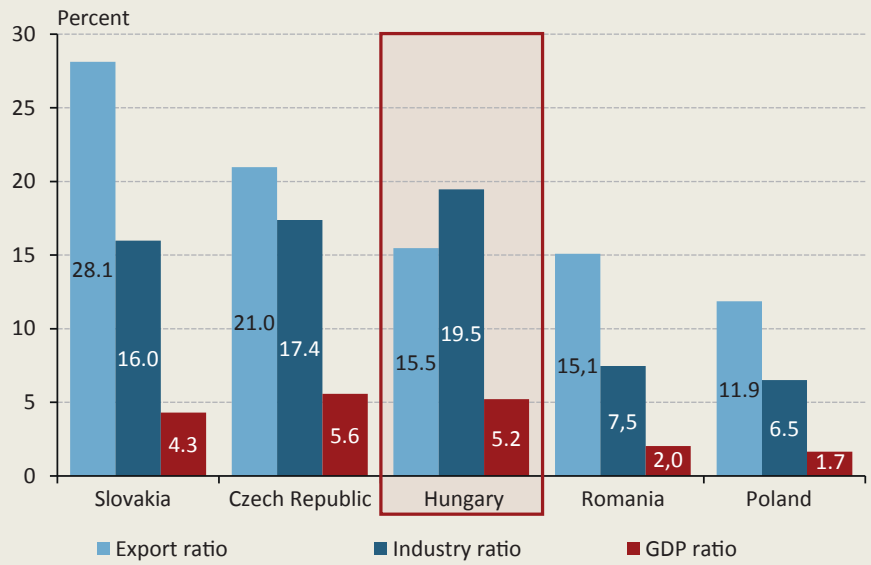
Source: MNB based on United States Geological Survey.

6.3 Features of the Hungarian automotive industry and potential impacts of sectoral transformation

6.3.1 ECONOMIC IMPORTANCE OF THE HUNGARIAN AUTOMOTIVE INDUSTRY

The electric vehicle revolution bears the utmost importance for Hungary. The economic weight of the Hungarian automotive industry is high even in a regional comparison. The **weight** of the subsector **within manufacturing is the highest in Hungary among the countries of the region, while its weight in terms of contribution to GDP is the second largest after the Czech Republic** (Chart 6-11).

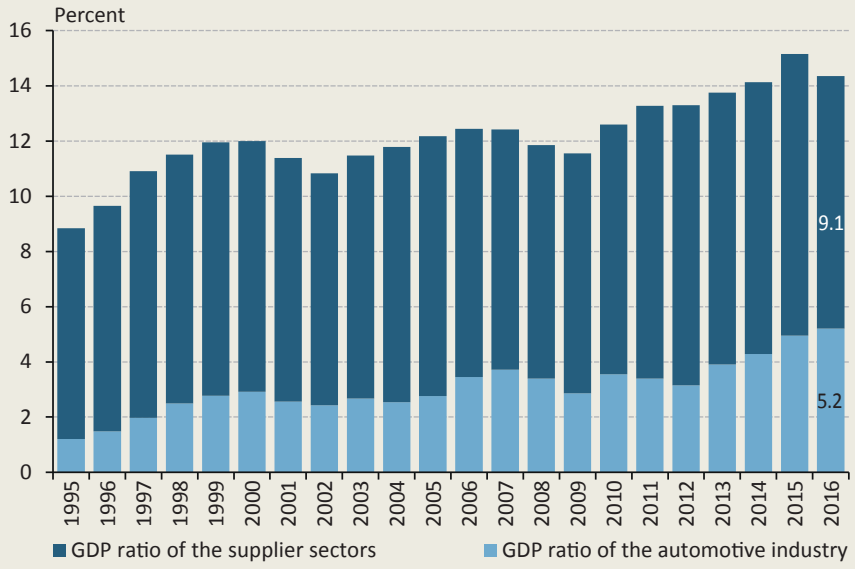
Chart 6-11:
Importance of the automotive industry in the region, 2016



Note: Based on figures of Romania for 2015, in the case of Poland for 2014.
Source: Eurostat.

The weight of automotive industry has been continuously rising in past years, in line with the major capacity expansions in the post-crisis years (Audi, Mercedes, GM, BYD). In line with the developments at the large car plants, the supplier network has also expanded, and the weight of the respective subsectors in recent years may have been around 10 percent of GDP (Chart 6-12). **The dynamic growth in the automotive industry has left its mark on employment as well**. Vehicle manufacturing, which had only 85,000 employees in 2008, already employed almost 156,000 people in 2016.

Chart 6-12:
Evolution of the GDP ratio of vehicle industry and supplier sectors in Hungary



Source: Eurostat.

The Hungarian engine and car manufacturing plants, as well as the supplier network, are strongly integrated in the manufacturing of internal combustion engines and vehicles. As a result of the expected changes in the automotive industry, fierce competition may develop in the future for the manufacturing of electric vehicles and the major components thereof, among the European and regional competitors. **Four large automotive companies are present in Hungary**: **Audi** is engaged in the manufacturing of both vehicles and engines, **Mercedes** and **Suzuki** produce vehicles, while **Opel** manufactures engines in its factory in Szentgotthárd. The main manufacturers in Hungary employ almost 20,000 people.

6.3.2 TRANSFORMATION OF THE SECTOR AND ITS IMPACT ON THE HUNGARIAN AUTOMOTIVE INDUSTRY AND SUPPLIERS

In the European market, traditional manufacturers still have competitive advantage; however, Tesla and the entry of other new participants of this sector may modify the balance of power. With the strengthening of competition, at this year's Frankfurt Motor Show, the traditional actors in the automotive sector, outbidding each other, sought to strengthen their positions with increasingly ambitious announcements (Table 6-2).

Table 6-2:
Announcements of the major European manufacturers during the Frankfurt Motor Show

	Medium-term objectives
BMW	In 2025, 15-25 percent of the total sales were made by electric cars
Daimler	50 fully or partly electric models by 2022
Renault-Nissan	Electric vehicles will account for 20 percent of European sales in 2020
Volkswagen	80 new electric cars by 2030
Ford	Introducing 13 hybrid and electric models by 2020

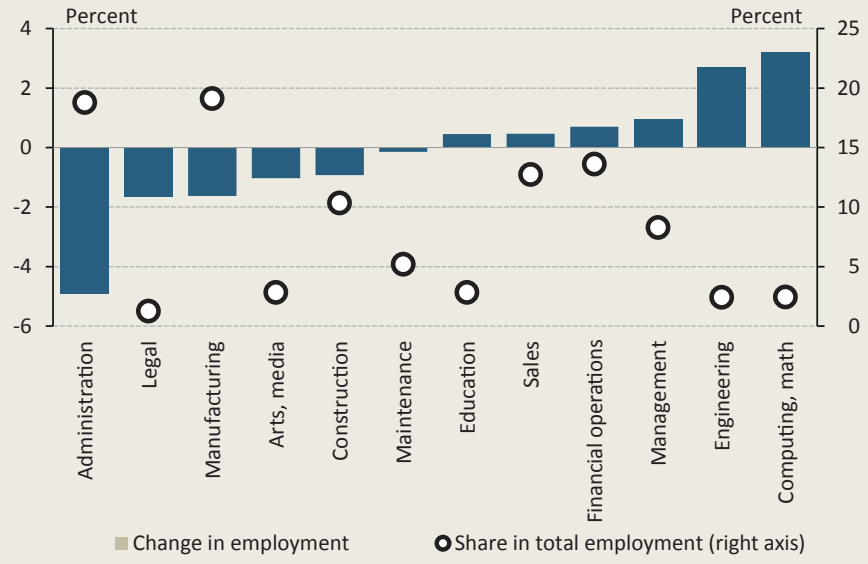
Source: The Times.

As a result of the new technology, the more than 100 year old business model of vehicle manufacturing may change, since the manufacturing of electric cars is much more simple and takes shorter time, as it **requires merely 7,000 components, instead of the 30,000-35,000 parts used for traditional cars.** As a result of the lower number of components, supplier chains may shorten, and hence **entry for new actors may become more diffi-**

cult. According to current industry estimates, the changeover to manufacturing electric drivetrains alone would require 40 percent less labour force compared to the manufacture of the present drivetrains.

As a result of the transformation of production, **in order to preserve their competitive advantage, suppliers may shift towards the sales of products and services of higher value added** (big data, data protection, developed software, smart factory). As a result of the technological transition, assembly jobs in factories will be thrust into the background, while the importance of engineering, IT and management jobs may increase (Chart 6-13).

Chart 6-13:
Employment outlook by job types in 2015–2020



Source: WEF (2016).

As a result of this, the leading manufacturers are spending larger and larger amounts on research and development as well (Table 6-3).

Table 6-3:
Expected annual e-mobility R&D expenditure of the automotive factories by 2020

Brand	Annual expenditure
Audi	1.4 billion USD
Volkswagen	1.5 billion USD
Daimler	2.5 billion USD

Source: Based on press information.

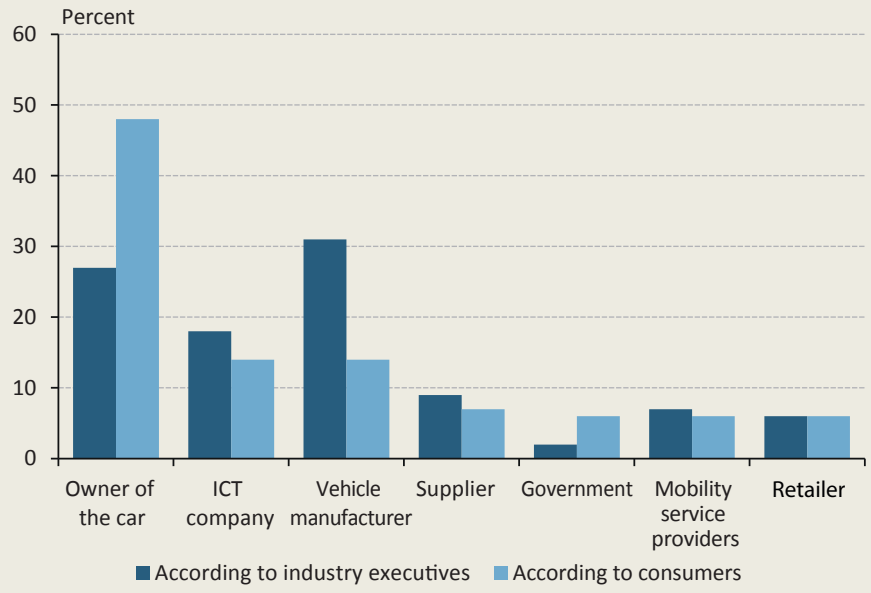
The purpose of the increasing efforts is, on the one hand, to preserve the leading role in the manufacturing of alternative drive, and on the other hand, for the traditional automotive companies to retain their competitive advantage against new entrants in terms of technology as well. The competition is growing stronger: for instance the German post office started to produce electric vehicles for the purpose of fulfilling its own tasks, and recently Dyson, a company manufacturing vacuum cleaner and hand dryers, announced that it would introduce its own e-vehicle within a few years.

In the case of electric vehicles, manufacturers have two options to **satisfy the increasingly complex demands** (real time GPS, customised services, data protection). They either **have their own programmers develop software**, competing with the participants of another sector with competitive advantage (Google, Apple), or they procure and install the applications and equipment in their vehicles in cooperation with these companies.

As a result of the electronic achievements, cars are able to store data in increasing volumes, and relying on those they may improve travel comfort or optimise the functioning of the car in the future. **Thus, the collection, storage and security of data may appear as new sources of income.** At present, there is no agreement between the leaders of the sector as to where to draw the line between the data necessary for the functioning of the car and the user data.

The Global Automotive Executive Survey conducted in 2017 wanted to find out **who should possess the consumer data** collected by the vehicle (Chart 6-14). No clear consensus was reached by the industry leaders and the consumers, which **highlights the challenges of digitalisation in the automotive industry.** In contrast to traditional vehicles, in the future the owner of the vehicle, the manufacturer and the IT service provider may all compete for possession of the data.

Chart 6-14:
Who has to be the owner according to industry executives and consumers



Source: MNB based on Global Automotive Executive Survey 2017.

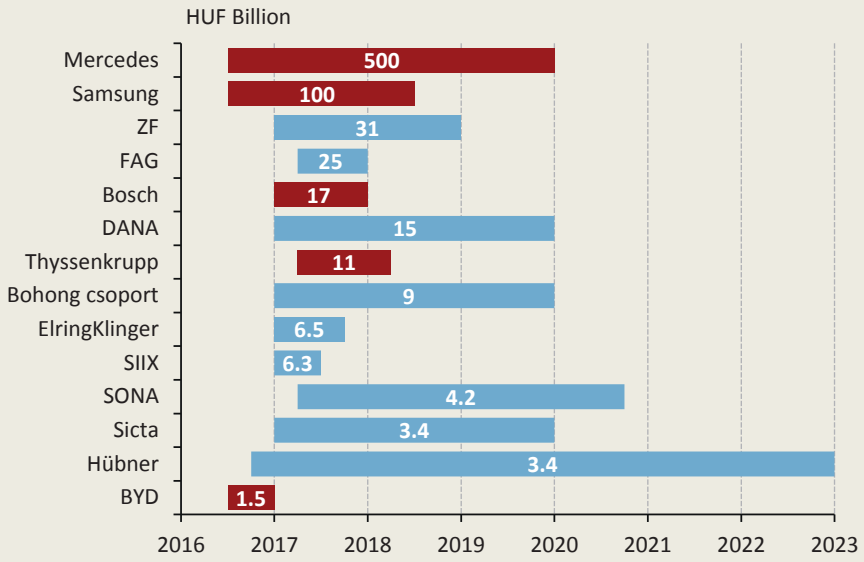
Together with the spread of electric vehicles and the digital revolution, financing may also undergo a transformation, as manufacturers realised that they need to increase their participation in the technologies of the future. The current analysis by Oliver Wyman (2017) examined the participation strategies of 12 brands, including BMW, Daimler, Volkswagen and Audi. In 2016, **venture capital investments** rose by 150 percent at an annual level, **70 percent of which was accounted for by mobility services, alternative-drive vehicles, and network connected and autonomous vehicles**.

The factories in Hungary are also involved in the transformation of the sector and the penetration of e-mobility. The member of Audi's Board of Directors in charge of manufacturing and logistics, announced in Ingolstadt that **in the future the electric engines of the electric cars will be also produced in Hungary** and according to the chairman of Audi Hungaria Motor Kft's management board, the **conditions for manufacturing of electric cars are available in the Győr plant.**

The Mercedes factory will implement investments of almost HUF 500 billion until 2020 in Hungary, as part of which, it will also build a new assembly hall. According to the plans, production in this plant may commence at the end of decade, by **manufacturing** front and rear wheel drive cars, as well as **alternative drive models. Opel currently has no plans in Hungary related to the manufacturing of electric cars**, but General Motors, the parent company, has long-term plans with regard to alternative drive technologies. **Suzuki also does not anticipate a portfolio change**; based on the information available to date, it will not produce purely electricity driven cars even in the case of new models.

The spread of the manufacturing and use of electric vehicles also creates an opportunity for **the transformation and expansion of the supplier chain**. **The changeover of the Hungarian automotive sector and the adoption of new technologies has already commenced**. The developments that concern the Hungarian automotive industry, announced in recent years, typically support the introduction of new technologies and the **shift toward the production of higher value added** (Chart 6-15).

Chart 6-15:
Announced investments related to the automotive industry



Note: Investments in red are linked to electromobility. In case of Hübner's investment, the timing is not known.
Source: MNB based on press information.

In addition to the drive train, the battery is a key component, and thus increasingly important R&D activities and capacity expansion investments are linked with this component. In Hungary, **Samsung is investing almost HUF 100 billion in a new battery factory** in Göd, **which would substantially increase the Hungarian industry's capacities related to e-mobility.** According to the plans, the Samsung factory will deliver domestic batteries for, among others, BMW's electric models. The Chinese **BYD**, outstanding in the manufacturing of electric buses, is developing its first European electric bus factory in Komárom, although for the time being the plant will only perform assembly.

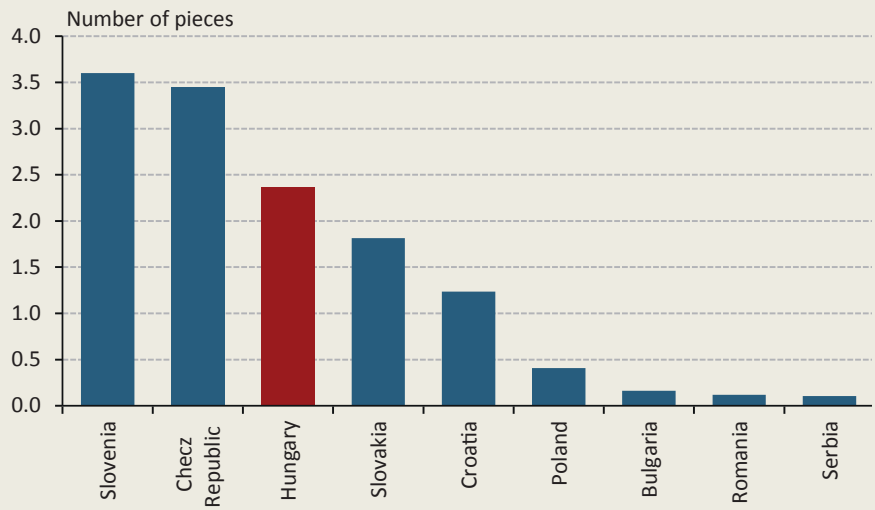
For the adaptation of the new technologies and business models it is essential for Hungary to have a solid grounding in the areas of infrastructure, training and education. The provision of energy and network necessary for the spread of e-mobility is key for the development of the **proper physical infrastructure**, while the improvement in the **digital infrastructure and data protection** can facilitate the fast adoption of the technologies of the future.

Increasingly complex and sophisticated activities are appearing in the Hungarian vehicle manufacturing sector, such as **electromobility and software technology.** In the first case there are already two large German companies (ThyssenKrupp, Bosch), which regard Hungary as their R&D centre. **ThyssenKrupp regards Hungary as its primary cooperating partner and location in the changeover to digital industry** and it will control the activity aimed at the development of the steering equipment of self-driving vehicles from its Budapest-based global research and development centre.

In the area of self-driving cars, **an automotive test track, also suitable for the testing of autonomous cars – unique in Europe – will be built in Zalaegerszeg.** The test track under construction will create, directly and indirectly, roughly 350 new engineer jobs, the primary purpose of which is to attract automotive industry interests to Hungary.

At present, Hungary has no information on the potential future manufacturing of charging stations, but **the government supports local governments' charging station installations, which is currently implemented with imported equipment**. In parallel with this, through their joint consortium, the NEXT-E project, Mol Group, E.ON Group and Nissan's Hungarian subsidiary, are developing a universal electric flash charging network with a density of 150 km at the MOL fuel stations located along the European transit routes, as a result of which Hungary will become traversable by purely electric vehicles. **The number of public charging stations in Hungary lags behind that of the developed countries, but among the countries of the region Hungary is among the leaders** (Chart 6-16).

Chart 6-16:
The number of public filling stations per thousand square kilometers

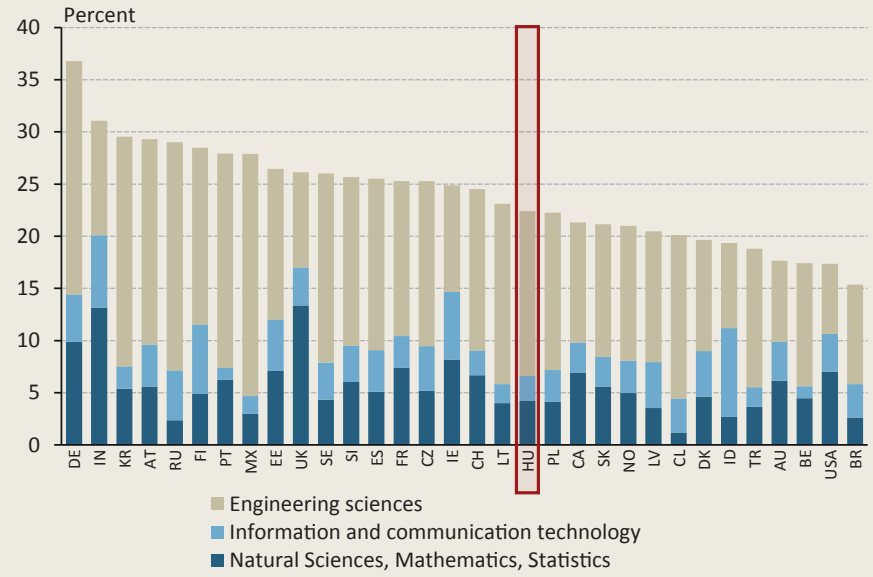


Source: Open Charge Map, MNB calculations.

As regards the charging stations in Hungary, it is an important information that **Hungary is also included in Tesla's international charging station network.** According to the plans, by the end of 2017 the first Tesla Supercharger will be up and running in Győr, followed by a new charging station in Nagykanizsa, to be built in 2018. In parallel with this, Tesla is expected to announce officially already this year in which European country it will deploy its newest giga factory, the investment value of which may exceed EUR 5 billion and create ten thousand jobs. **Hungary is also competing as a potential location for the Gigafactory**.

In addition to the suitable physical and digital infrastructure, the **adjustment of the training and education system** as well as of the Hungarian **labour market** to the changing production culture, also bears utmost importance. In the case of Hungary, **there is a lag in higher education** in **natural sciences** (Chart 6-17). The new jobs created in parallel with the penetration of electromobility demand superior **information technology and ICT skills.**

Chart 6-17:
Science graduates in proportion to graduates in higher education, 2015



Source: OECD.

6.3.3 SUMMARY

The increasing spread of electromobility is closely linked to the **new megatrends** determining the global economy, and thus to the topics of **environmental protection, changing energy mix and Industry 4.0**. The actors of the traditional automotive industry **are facing new challenges** as a result of the evolving production processes and easier market penetration. Recognising this, the traditional car manufacturers are making very strong efforts in the area of R&D, as well as venture capital investments. In order for Hungary to preserve its market share, it is essential to actively participate in new technologies and production processes, and to implement the achievements of the fourth industrial revolution.

For the time being, the manufacturing and penetration of electric vehicles falls substantially behind vehicles equipped with internal combustion engines; however, based on industry estimates, in the coming decades **e-vehicles may gain ground increasingly quickly and unit costs may decrease significantly**.

The e-vehicle revolution **may have a special impact on Hungary**, as **the weight of the subsector is substantial even by regional standards**. The automotive industry, which accounts for more than 5 percent of Hungarian GDP, **is accompanied by a significant supplier network**, and thus proper integration with the changing industry bears utmost importance for Hungary. The **factories operating in Hungary are also affected by the transformation and the penetration of e-mobility**: the investments by Audi, Mercedes and several suppliers already permit the adoption of new technologies. **The transformation of the sector provides Hungary with the opportunity to advance in the global value chain and move toward the production of higher value added**. Developed education and infrastructure, as well as an increase in the importance of creative industries and services, are key for the shift towards production of higher value added.

References:

Bloomberg (2017): The electric car revolution is accelerating. https://www.bloomberg.com/news/articles/2017-07-06/the-electric-car-revolution-is-accelerating

Bloomberg (2017): OPEC sees a future with fewer cars. https://www.bloomberg.com/view/articles/2017-11-10/opec-sees-a-future-with-fewer-cars

Bloomberg (2017): Executive Summary. https://data.bloomberglp.com/bnef/sites/14/2017/07/BNEF_EVO_2017_ExecutiveSummary.pdf

Franco, V. – Sanchez, F. P. – German, J. – Mock, P. (2014): Real-world exhaust emissions from modern diesel cars. http://www.theicct.org/sites/default/files/publications/ICCT_PEMS-study_diesel-cars_20141010.pdf

International Energy Agency (2017): Global EV Outlook 2017. https://www.iea.org/publications/freepublications/publication/GlobalEVOutlook2017.pdf

IMF (2017): Riding the Energy Transition: Oil Beyond 2040, no. 17/120.

Sogeti (2014): The Fourth Industrial Revolution. Things to Tighten the Link Between IT and OT. http://www.fr.sogeti.com/globalassets/global/downloads/reports/vint-research-3-the-fourth-industrial-revolution

Kochan, R. et. al. (2014): An Overview of Costs for Vehicle Components, Fuels and Green-house Gas Emissions. https://www.researchgate.net/publication/260339436_An_Overview_of_Costs_for_Vehicle_Components_Fuels_and_Greenhouse_Gas_Emissions

KPMG (2017): Global Automotive Executive Survey

Oliver Wyman (2017): Patenting the future of mobility. http://www.oliverwyman.com/content/dam/oliver-wyman/v2/publications/2017/jun/Art3-Patenting-the-future.pdf

Seba, T. (2014): Clean disruption of energy and transportation

USGS (2017): Commodity Statistics and Information: https://minerals.usgs.gov/minerals/pubs/commodity/

World Economic Forum (2016b): The Future of Jobs. Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution. http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf

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Count István Széchenyi

(21 September 1791 – 8 April 1860)

Politician, writer, economist, minister for transport in the Batthyány government whom Lajos Kossuth referred to as 'the greatest Hungarian'. His father, Count Ferenc Széchényi established the Hungarian National Museum and Library; his mother, Julianna Festetich was the daughter of Count György Festetich, the founder of Georgikon, an institution for the teaching of agricultural sciences.

With his ideas – whose message remains relevant even today – and his activities both as a writer and a politician, István Széchenyi laid the foundation for modern Hungary. He is one of the most eminent and significant figures in Hungarian politics whose name is associated with reforms in the Hungarian economy, transportation and sports. He is also known as the founder and eponym of numerous public benefit institutions, a traveller all across Europe and an explorer of England as well as the champion of economic and political development at the time. István Széchenyi recognised that Hungary needed reforms in order to rise, and considered paving the way for a Hungary set on the path of industrialisation and embourgeoisement to be his calling in life.

Published in 1830, his Credit outlined the embourgeoisement of Hungary and summarised its economic and social programme. Count Széchenyi intended this writing to make the nobility aware of the importance of the country's desperate need for a social and economic transformation. Another work of his, Stádium [Stage of Development] (1833) listed the cornerstones of his reform programme in 12 points, including the voluntary and compulsory liberation of serfs; the abrogation of avicitas (inalienable status of noble property); the right of possession for the peasantry; and the freedom of industry and commerce. This work of Széchenyi already conveyed the idea of equality before the law and the general and proportionate sharing of taxation.

After the revolution in 1848 István Széchenyi joined the Batthyány government and as minister embarked vigorously on implementing his transportation programme.

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