IS THE EUROPEAN GROWTH POTENTIAL SUSTAINABLE?[1]

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Abstract

We suppose that the dramatic decline in the European output is more than a cyclical diversion from the potential (or sustainable in economic terms) output. We performed a medium term quantitative analysis combining data based on the production function and growth accounting approach. Our results show that the erosion of the European growth potential has been a longer latent process. It began well before the outbreak of the latest economic crisis. Simulations suggest that the recovery in the rate of potential growth can only be partial in the medium term and further erosion of the European growth potential can be expected in the longer term.

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1. Introduction

There is no universally agreed definition on what sustainability means. There are many different views on it. The idea of sustainability stems from the concept of sustainable development first conceptualised at the World's first Earth Summit in Rio in 1992. The original definition of sustainable development is considered to be that of used in the Bruntland Report (1992): "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs". As for economic growth, we can apply the definition of the World Bank (2017): "sustainable development recognizes that growth must be both inclusive and environmentally sound to reduce poverty and build shared prosperity for today's population and to continue to meet the needs of future generations. It must be efficient with resources and carefully planned to deliver immediate and long-term benefits for people, planet, and prosperity".

Two main categories of literature on sustainability can be identified. When they focus on developing countries, sustainable development mainly focuses on growth what is sustainable on a longer term. I case of developed economies however, the literature usually concentrates on environmental/ecological sustainability. Our study gives a special picture on sustainable

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development. We examine how sustainable are the growth models of the EU member states in order to examine whether they are able to deliver immediate and long-term benefits for people, planet, and prosperity.

In Europe, the pain caused by the latest crisis has been particularly acute and has raised several questions as regards the sustainability of the European growth model (see e.g.: Anders – Djankov, 2017 or Garcia et al, 2016). We suppose that the dramatic loss of the European output is more than a cyclical diversion from its potential output. There were clear signs of the European growth potential moderating for a long time. The previously latent elements began 'to come to the surface' from the mid-1990s. At the same time, the financial and economic crisis that began in 2008 has had significant impacts on the European growth potential too. The impacts of the crisis on the potential output are also reviewed in our paper. These tendencies are examined in detail through a quantitative analysis. In order to test our hypothesis we perform a medium term quantitative analysis combining data based on the production function and growth accounting approach.

2. Methodology of the potential growth analysis

Potential growth is a cumulative measure showing the sustainable and non-inflationary growth generating capacity of the economy. (Okun (1962), Mishkin (2007)) Growth rate of the potential output reflects the steady-state economic dynamics (growth potential). Unlike the actual growth rate it does not contain cyclical factors[2].

The difference of the actual and the potential growth is the output gap, a fundamental measure of business cycles. Instruments of the economic policy strongly depend on the development of the output gap. However, it is very difficult to estimate the value of the output gap. Potential growth cannot be directly observed, while data on actual output could be updated from time to time.

The literature about growth is mainly dominated by articles discussing actual growth trends. These trends reflect the business (and other kind of) cycles and they provide important information. However, actual growth cannot permanently differ from potential growth. Potential output reflects the structurally sustainable output level of an economy, while growth potential reflects its sustainable dynamics.

The European growth model and the performance of its sub-models can be analysed also on the basis of potential growth. Potential growth can be analysed on the one hand based on the past development path. There is an advantage in the ex post analysis, namely that the degree of the actual output is known. At the same time, potential growth can be measured through future projections too. Methodological difficulties may occur in both cases.

Calculation (or estimation) of potential growth creates an opportunity to separate structural development from cyclical development. There are different approaches. Potential output can be estimated by trend outputs resulting from moving averages of GDP time series and different filtering approaches. The most commonly used application is the Hodrick-Prescott (HP) filter. It is a simple and transparent method. Data with the highest frequency are utilized through the

[2] For details see e.g.: Denis et al. (2006), Hobza- McMorrow- Mourre (Eds.) (2009), Basu - Fernald (2009), Steindel (2009) and D'Auria et al (2010) Borio et al (2013), Havik et al (2014).

application of the filter[3]. However, there are significant problems too. The method of HP filters does not have its roots in economic theories. Its features depend on the specific value of the smoothing parameters[4].

On the other hand, as all centered filters, they are loaded with endpoint distortions, i.e. real time trend output estimates should be based on extrapolations of GDP, possibly with subsequent revisions. Finally, similarly to other methods applied for filtering GDP series, it cannot utilize information adequately to separate cyclical and structural changes.

An alternative to simple data filtering is based on the supply side model of the economy. Potential output is calculated in this case on the basis of a production function, which is the result of the combination of contributions of production factors and technological level. Compared with simple growth accounting, the production function based approach of potential output is consistent with the balanced utilization of the available resources (i.e.: oversupply or excess demand can be excluded).However, although there are clear benefits relative to the HP filter, this approach has its limits too. Its credibility depends on both the accessibility and the quality of data on the contribution of production factors.

Economic sustainability is a basic definitive feature of potential output. Inflation rate may be low and constant, while the output follows a financially unsustainable growth path. Information on financial cycles (loan and asset prices) may give additional details on the cyclical component of the output. (Borio et al (2013) argue that they can explain a large part of the cyclical movements.) Borio et al's main objective is to measure the *financially neutral* output gap, which can show us when the output unusually exceeds its potential level, independent of the level of the inflation. These financially neutral measures may improve the estimations based on HP filters and production functions.

We follow the growth accounting and production function approach in order to calculate potential growth. This approach focuses mainly on the supply-side of the economy, on the quantity and quality of labour, accumulation of capital and on the total factor productivity as a driver of the output. The objective of this paper is to identify the impacts of these drivers and to decompose the growth rate of output based on their impacts. In the production function approach potential growth can be calculated on the basis of the development of labour and capital inputs and of the total factor productivity. In order to apply the method, equilibrium rates of unemployment are required too. These are provided by the NAIRU or NAWRU approaches[5].

Under the framework of the production function approach, the determining factors of the neoclassical growth model are taken into account. Recent growth (and development) theories emphasize also the importance of further, mainly quality factors (innovation, geographical location, institutional system, macroeconomic policy etc.).[6] The latter factors are important also in the ex post analyses. The uncertainty involved in the ex ante analyses is, however, extremely high. In the production function approach these factors have an impact through the development of the

[3] We get the filtered series (τ_i) from the original GDP series (y_t) with the help of the following algorithm:

$$\min_{\tau_t} \sum_{t=1}^{T} (y_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1} \left[(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1}) \right]^2$$

[4] The smoothing parameter generally equals 100 in case of yearly GDP data. This is the standard value applied by the European Commission in trend output estimates.

[5] NAWRU: Non-Accelerating Wage Rate of Unemployment.

[6] See e.g. the overall analysis of Jones and Romer (2011).

total factor productivity. (The important qualitative factors of the economic system are taken into account in an implicit way.) At the same time, it is difficult to quantify some of the factors mentioned. That is why the ex ante analyses need to be carried out very cautiously. After all these considerations, the production function approach can be applied in researches on growth and development.

The production function and growth accounting approach has recently received increasing attention in the literature. As regards to their long term application, studies, e.g. on ageing in the European Union, are considered significant contributions to the literature (e.g.: EC, 2011, 2012; Carone et al., 2006). As an example of the short term approach and the mid-term extension of the growth accounting analysis we can mention the database of the EU EPC Output Gap Working Group (OGWG). (For their methodology see Denis et al., 2006 and D'Auria et al., 2010, Havik et al (2014)) Of course, this model has its own limitations as well. Due to significant simplifications of the real world there may be distortions in the calculated data. However, the method can help to identify the most important trends, the direction and pace of change. The methodology of the production function approach is described in the Appendix.

3. Impact of the crisis on the potential growth

The latest financial and economic crisis ("Great Recession") might have a significant impact on potential growth. (The impacts on the long-term potential growth are particularly difficult to reveal.)

In the short run the significant decrease in the level of potential output is the result of the decrease in the productive capital stock (increasing capital depreciation), and the negative impact on the labour supply and structural unemployment. The decisive question is: what is the impact of the crisis on the long-term potential output growth. If potential growth intensifies after the crisis, then the loss caused by the decrease in the output level might be compensated for after a while. As the crisis may force out structural change, the economy might get on a higher, sustainable growth path. (As for these processes, developments in Sweden and Finland following the crisis at the beginning of the 1990s might serve as good examples.)

In order to understand profoundly the impacts of the crisis on the potential output and its growth, the individual growth factors need to be analysed in detail. Under the framework of the production function approach the recession might have an impact on growth through three different channels: capital accumulation, labor input and total factor productivity. Labour supply can be divided into the participation rate; the average hours worked and the working age population; and the structural unemployment rate. (The latter is NAWRU - *Non-Accelerating Wage Rate of Unemployment.) Total factor productivity (TFP) shows the effectiveness of the use of production factors. (As the latter is actually unobservable it is often calculated as the residue.)*

For the time being, economic recession may have different impacts on these factors of potential growth. Depending on the mechanism of the growth process, the relation between downturn and potential growth may be both negative and positive.

Financial crises in general have deep impacts on the long-term output growth. (See Furceri and Mourougane, 2009.) According to Cerra and Saxena's analysis (2008) recession was not followed by rapid recovery in these cases, moreover, neither was the loss of trend output fully recovered. The loss of the GDP level was generally not offset by higher growth after the crisis.

Recessions following a financial market crisis are deeper than 'ordinary' recessions. Those are generally associated with a significant decrease in housing prices and construction output. (For

more details see: Reinhard and Rogoff, 2009; Claessens et al., 2008.) Consumption decreases significantly during recessions. It reflects also the loss of assets (e.g. decrease in housing prices).

Economic recessions (not only the financial crises) have had diverse effects on the long-term potential growth in the European countries in the last few decades. Potential growth has increased in about half of the countries during the decade following the crisis.

The dynamics of capital accumulation has decelerated in most European economies in the short- and medium term. (For details see e.g.: Haugh et al., 2009; Hobza et al., 2009.) In the long run the contribution of capital accumulation to the potential growth has basically not changed in most EU Member States. Dynamism of capital intensity slowed down in a smaller group of the examined countries (Finland, Sweden and Ireland). Although the recession affected their capital accumulation in the short run, the structural factors played a decisive role in the long run. The growth model of these economies changed significantly in the 1990s: due to the change in the economic structure, capital accumulation declined and the contribution of the TFP to the potential growth increased.

Haugh et al. (2009) argue that the output loss resulting from a bank crisis is 2-3 times higher than the loss originating from other kinds of downturns, and also the output needs more time to reach its potential level. The current crisis is a very robust one as regards the level of both the output and the investment. It can only be compared to the great world economic crisis of 1930's.

In terms of the demand components, the main factor in the downturn was the collapse of the fixed capital formation. The development of household consumption, the fixed capital formation and the net exports contributed to the recession as well. It is not clear, however, what mechanism can result in the increase in investment or private consumption. The deleveraging has continued in the household and the corporate sectors (financial and non-financial sectors) also during the deepening of the recession.

The likelihood of lasting effects on potential growth is much higher in the case of the latest crisis than in any previous recession. The length of the crisis, its global nature and the change in the risk related behaviour might explain that. It has had an adverse effect on investments - on intangible investments in particular (namely R&D) – which has a severe impact on the TFP growth and the potential output. On the one hand the NAIRU might increase due to the hysteresis effect (as shown by Blanchard et al., 1989 and 2000), resulting in a further drop in the potential output level and a slowing down in potential growth in the short and medium term. Many discouraged workers left the labour market and in this way decreased the labour supply.

Structural adjustment and the reallocation of resources are of decisive importance. The latent erosion of potential growth (hidden by relatively favourable actual growth rates) in the years preceding the crisis and transitionally very low capital costs in the period of the great moderation resulted in the exceptionally high level of the investment rate in the EU member states. However, this accumulation was not based on a high level of a marginal product of capital resulting from an improving total factor productivity. Investment boom was mainly restricted to non-traded goods and services (mainly real estate). Overheating of the economy was accompanied by an asset bubble and, with the outbreak of the crisis, recession and adjustment became unavoidable. External imbalances, significant current account deficits and increasing vulnerability characterized the member states with the most at stake. The unavoidable adjustment requires reallocation of resources from the non-tradables to the tradables sector. Productivity in the export-oriented sectors is higher, so increasing their share will improve efficiency too. A fast reallocation of resources may reduce the loss in the growth potential. Integration into global value chains may enhance the

structural change. Reallocation disturbances, however, may worsen the utilization of resources and increase the rate of unemployment.

The changing attitude to risk prevents R&D and innovation financing. It holds back reallocation of resources to potentially more dynamic activities, weakening the growth of total factor productivity in the longer term.

Although the double-dip recession has been a great challenge for the European economy, the output shows a slightly increasing trend since Spring 2013 in most of the member states (the exceptions are the countries with the highest level of sovereign debt)[7]. Nevertheless, the long lasting recession has had significant and permanent impact on the main factors of the production function. Negative structural developments can be expected on the potential growth path. Among the risks we can mention is the echo phenomenon. Recession generally results in investment scarcity and strong depreciation of capital stock. There is a positive echo in the phase of the boom. Renewal of the capital is fast due to the investment boom, there are technological breakthroughs and the dynamism of the total factor productivity can possibly increase. This kind of process characterized Sweden and Finland after the recession of the 1990s.

The latest crisis results in a loss of potential output for the European Union. At the same time, parallel reductions in the medium and longer term dynamics of the potential output (supposing unchanged policies) seems to be unavoidable mainly due to the significantly weakening dynamics of total factor productivity.

As the declining level of employment and of the dynamics of productivity are not cyclical developments since the latest crisis, long term (secular) stagnation remains a significant risk. (See e.g.: Teulings és Baldwin (2014), Roeger (2014), Eichengreen (2015)) The low level of capital accumulation has especially string impact on the development of the potential growth. Recession in the Euro zone however has a double feature: financial crisis was followed by sovereign debt crisis. This second phase of the crisis strengthens the need for a supranational financial stability mechanism and weakened fragmentation forces.

4 Development of potential growth and its factors (Quantitative analysis[8])

As credible, longer term time series are not available as for the EU28, we examined the development of potential growth in the EU15 (member states of the EU before 2004) and in the United States in our growth accounting analysis. Countries of the EU15 were grouped into three groups. The six founding countries (DE, FR, IT, B, NL, L) of the European Economic Community (EEC) belong to the group of Founding 6 (F6). Economies of these countries have developed under the European integration framework for more than 50 years. These countries represent the continental European model. The "New" member states (N6) are the (relatively) more developed countries that joined the European Communities or the European Union in 1973 or in 1995: UK and IE representing the Anglo-Saxon model and DK, FI and SE following the Scandinavian model and finally AT.[9] The group of the Mediterranean countries (M3) countries comprises Greece (EL),

[7] Since 2011, not only problems of the bank sector, but also the problems related to sovereign debt have been increasingly accentuated in the processes of the European crisis. This is an important feature of the deep financial crisis. (See: Reinhart és Rogoff, 2011; Claessens et al., 2011; Mody and Sandri, 2012).

[8] Analyses are based on the OGWG database as of 2016 Autumn.

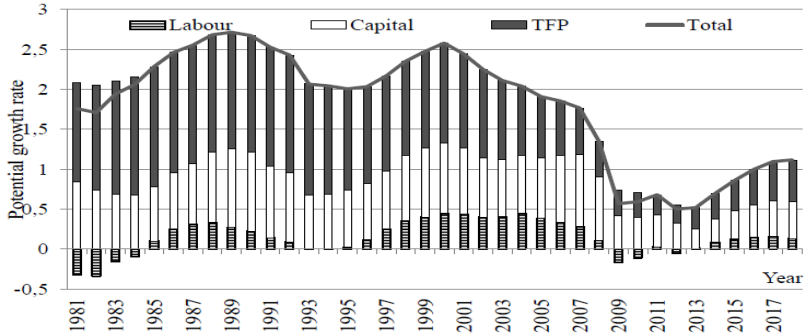
[9] In the meantime the EU was enlarged by 10 new member states in 2004, by 2 in 2007 and by another one in 2013. These countries are considered to be the new member states nowadays. However, new member states refer to the above mentioned countries in this chapter.

which joined the Community in 1981 and the countries that have been member states since 1986 (ES and PT). Members of this latter group follow the so called Mediterranean (economic development) model.

Based on the above analysis we can summarize the main characteristics of the growth models of the examined country groups.

The potential growth rate of the EU15 has kept on decreasing since 1989 (see Figure 1). This decrease can be explained by the development of the labour productivity. (Labour's contribution was positive between 1995-2008.) The growth rate of labour productivity has continuously decreased since 1993. As capital's contribution to the potential growth did not decrease significantly until 2009 (its rate was between 0.7-0.9% per year), the unfavourable development of the total factor productivity became a structural factor as regards the decreasing labour productivity. (The growth rate of total factor productivity dropped by a third during three decades.)

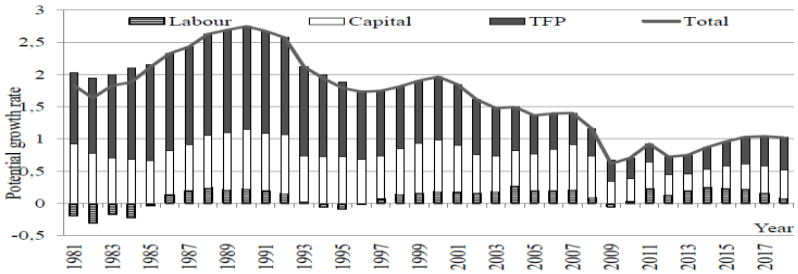
Figure 1. Development of potential growth and its factors in the EU15



Source: Authors' own calculation

The growth model of the F6 countries shares the same characteristics. As regards the F6, labour's contribution to the potential growth was moderate but positive over almost all the examined period. Capital's contribution was between 0.6-0.9% per year until 2009. The most important explaining factor of this dynamism (or more precisely of this decrease) was the permanent and strong decline of the TFP (see Figure 2). Therefore, we can conclude that the rate of potential growth dropped to 1.4% per year (from the rate of 2.8% in 1990) even before the crisis, and it will be around 1% in the examined period in the F6 countries.

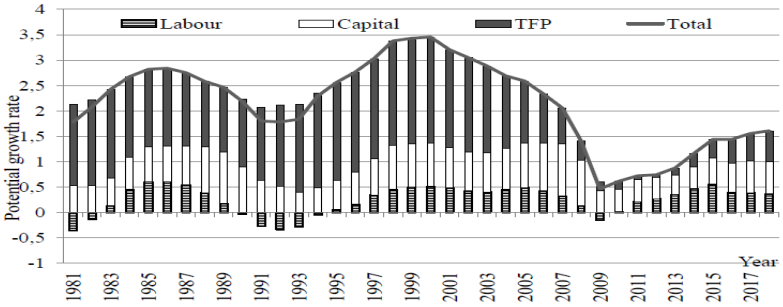
Figure 2. Development of potential growth and its factors in the F6 countries



Source: Authors' own calculation

The main trends in the N6 differ from the previously reviewed situation of the F6 in several aspects. Countries of the N6 experienced the highest rate of potential growth in 1999-2000 (3.5% per year!). The decrease in this rate began only after that period (see Figure 3), arriving at 2.1% in 2007 and 0.5% at the bottom of the crisis (in 2009). However, from 2010 we can see the signs of recovery and the rate of potential growth could reach 1.6% by 2017-2018. (Exceeding the average rate of the EU15 by almost 50%.) Labour contributed to the rate of potential growth with 0.3-0.6% per year between 1984 -1989 and 1996-2007. At the same time, the increasing labour productivity (2-3 % per year) was the decisive factor in the development of the potential growth, just as in the case of the F6. As the capital's effect was 0.7-1.0% in the periods of 1985-1991 and 1997-2008, development of the TFP was the dominant factor in their case too. TFP's contribution exceeded significantly even that of the United States until 2006. However, the growth rate of the TFP has showed an accelerating decreasing trend since 2000. This was partly compensated for by the effect of the transitionally increasing capital accumulation and by the increasing contribution of labour (as a result of the labour market reforms). Labour's contribution became negative again at the time of the crisis. Capital's and TFP's contributions moderated significantly too. The dynamism of the labour productivity improved again at the time of the recovery: simulations suggest that both capital deepening's and TFP's contribution will reach 0.6% by 2017-2018.

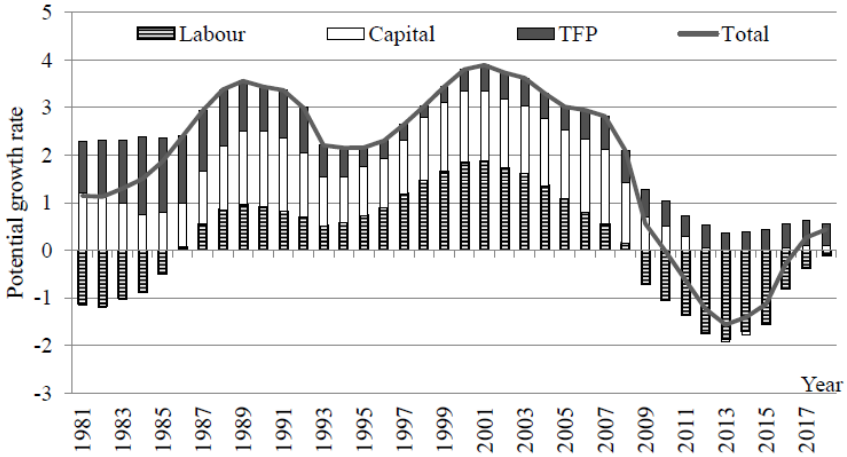
Figure 3. Development of potential growth and its factors in the N6 countries



Source: Authors' own calculation

Following the accession, the rate of potential growth steadily increased for more than two decades in the countries of the M3 (see Figure 4). Labour's contribution became positive and significant (with structural unemployment decreasing simultaneously): its rate was 0.9-1.9% in the periods of 1988-1990 and 1997-2007. Capital's contribution was 1.1-1.5% between 1987-1992 and 1997-2008. Although TFP was above 1% until 1992, it began to decline after that period. The latest crisis has resulted in a structural break in the development of potential growth of the M3. After a significant decrease, the rate of potential growth is expected to become and remain negative between 2010 and 2017 and staying below the average of the EU15 until the end of the examined period. Labour's contribution has been negative since 2009. The crisis, and particularly the sovereign debt crisis, that hit the examined countries especially hard, has resulted in significantly increasing capital costs and narrower capital accumulation possibilities. Therefore, capital will not contribute to the growth of the potential output after 2011. (What is more, its contribution will be negative between 2013 and 2015.) TFP's contribution in the same period will be around 0.4-0.5% per year. Therefore, we can argue, it will be this group of the M3 that will experience the most unfavourable labour productivity trend.

Figure 4. Development of potential growth and its factors in the M3 countries

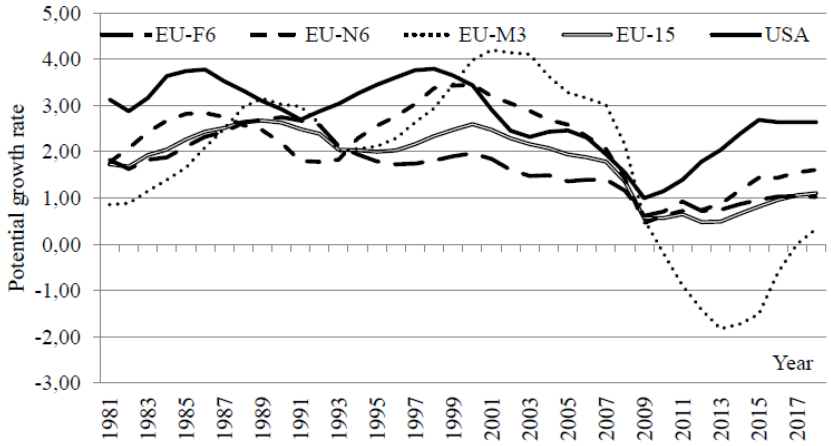


Source: Authors' own calculation

Structural unemployment (NAWRU) in the EU15 slightly increased until the mid-1990s and then decreased until the current crisis. Structural unemployment has been the highest in the M3 countries throughout the examined period. (Its ratio exceeded 10% - except for 2003-2005.) NAWRU has decreased significantly since the mid '90s in the M3. It began to rise along with the emergence of the latestcrisis, reached a record level in 2010 and continues to rise. Projections suggest that structural unemployment will continue to rise between 2013-2018 due to the recovery and mainly to the sovereign debt crisis, however the average of the M3 may increase above 25% (!) from 2015.

The potential growth rate of the United States exceeded the EU15's average in almost all single years throughout the examined period (see Figure 5). The potential growth showed a relatively strong dynamism until the beginning of 2000: its rate fell below 3% only in certain years. As regards growth, permanent and significant positive contributions of labour were amongst the most important factors. At the same time, there was a significant (about 50%) increase between 1980 and the end of the 1990's regarding the TFP's contribution. Capital's contribution has increased from the middle of the 1990's. The rate of potential growth has moderated since 2000, and it stood at 50% of the former level before the crisis. Any positive effect of labour has more or less faded away and the dynamism of the TFP has also started to decline. The potential growth rate declined dramatically between 2008 and 2011. (Labour's effect became negative and in parallel to the moderating TFP, capital accumulation's contribution significantly decreased.) Recovery characterizes the 2012-2018 period. Labour becomes positive again and contribution of all of the three factors (labour, TFP and capital) increases. Simulation suggests that the rate of potential growth can reach its pre-crisis level by 2014 in the United States.

Figure 5. Development of potential growth in the examined country groups



Source: Authors' own calculation

We can argue that the growth model of the USA involved a higher level of growth dynamics in the examined three and a half decades. Average growth potential of the EU15 lags behind that of the USA. We could not identify a catch up potential for the EU15 in the examined period. The same comment applies for the F6 countries. As regards their potential growth rate, the M3 countries managed to cut back somewhat on the large differences in certain periods (from 1988 to 1992 and between 2000 and 2009), but their fall-back relative to the better performing country groups seems to be unstoppable since the outbreak of the crisis. Development of potential growth in the N6 countries however, is similar to that of the USA. (The growth of potential output between 2000 and 2008 was even faster in the N6 countries than in the USA.) Labour productivity, and particularly the dynamics of the total factor productivity, is the decisive factors in accounting for the growth performance of the N6. The growth rate of these factors exceeded the US levels up to 2006.

However, the USA had more robust structural characteristics (more favourable total factor productivity above all)[10] even before the outbreak of the crisis. Forecasted demographic and TFP trends and investment and productivity dynamics are more favourable than the forecasted trends for the EU15 and for the member states of the euro zone. (See Figure 6.) Therefore, it is not surprising that the dynamics of the pre-crisis growth potential can recover more or less in the United States, while it can reach only the half of the pre-crisis level in the examined European countries.

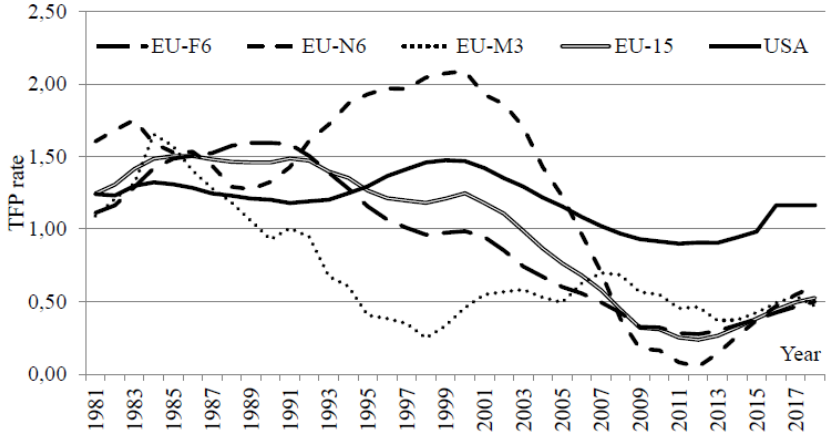
Table 1. Development of potential growth and its factors in the examined country groups (% of potential GDP, annual average in the examined period)

[10] The TFP gap, that has developed between the USA and the EU15 since the mid 1990s can mainly be attributed to the differences in the intensity of the competitive environment, differences in innovation mechanisms and industrial structure, and to the different ratio of ICT and ICT dependent sectors. Revealing impact mechanisms of these factors requires further research.

	EU15					A6					U6					M3				
	1988-1993	1994-2000	2001-2008	2009-2013	2014-2017	1988-1993	1994-2000	2001-2008	2009-2013	2014-2017	1988-1993	1994-2000	2001-2008	2009-2013	2014-2017	1988-1993	1994-2000	2001-2008	2009-2013	2014-2017
PF Potential Growth	3	2,23	1,97	0,56	0,86	2,6	1,8	1,5	0,7	0,9	2,1	3,0	2,6	0,8	1,4	3,1	2,8	3,2	-0,6	-0,4
Total Labour (Hours) Contribution	0	0,49	0,62	0,00	0,09	0,5	0,4	0,5	0,2	0,2	0,1	0,5	0,6	0,2	0,3	0,9	1,2	1,4	-1,4	-0,9
Capital Accumula-tion Contribution	1	0,77	0,79	0,36	0,37	0,9	0,7	0,6	0,3	0,4	0,7	0,7	0,9	0,4	0,6	1,4	1,2	1,4	0,3	0,0
TFP Contribution	1	1,25	0,83	0,33	0,47	1,5	1,1	0,7	0,3	0,4	1,5	2,0	1,3	0,4	0,6	1,2	0,5	0,6	0,4	0,4
Labour productivity	2	2,02	1,62	0,69	0,84	2,4	1,8	1,3	0,6	0,8	2,2	2,7	2,2	0,8	1,2	2,6	1,7	2,0	0,7	0,4
NAWRU (% of Labour Force)	8	8,57	7,75	8,97	10,18	8,0	8,7	8,3	8,0	8,1	7,5	6,7	5,5	6,9	7,9	14,0	12,7	10,5	18,1	25,1
Investment Ratio (% of Potential Output)	19	18,98	20,16	17,69	17,90	19,6	19,0	19,5	17,9	18,1	17,5	17,3	18,5	16,3	17,5	23,4	23,2	27,5	19,6	17,6

Source: authors' own calculations

Figure 6. Contribution of TFP to potential output growth



Source: Authors' own calculation

5. Conclusions

The main conclusions are summarized as follows:
1. The rate of potential growth in the EU15 has continuously and gradually decreased since 1990. At the same time, the latest financial and economic crisis has resulted in a significant decline in the dynamism of the potential output and the simulations suggest that it can reach only half of the pre-crisis level in the medium term. It is the development of labour productivity that can explain

the decreasing dynamism of potential output. Declining TFP growth rate is a decisive and structural factor of this development.

2. Significant differences are revealed among the different country groups of the EU15. Potential growth rate of the founding (F6) countries has declined continuously (mainly due to the development of the TFP). The dynamism of potential output increased until 2000 in the "new member" states (N6 countries), and then it began to gradually decline. The chance of a possible recovery is the greatest in this country group in the medium term. TFP is the dominant factor in their performance. The Mediterranean (M3) countries followed a transition path until the outbreak of the current crisis. High structural unemployment was successfully reduced and it became the decisive factor of potential growth. From 2009 onwards very serious growth crises have developed in these countries resulting in an extraordinary high level of the NAWRU and a low level of investment and TFP.

3. It is important to compare the European and the US growth model. In the long run the potential growth rate shows a declining trend both in the USA and the EU15 countries. The TFP growth rate is much higher in the USA from the middle of the 1990's onwards than in the EU15. This higher dynamic is expected to last also in the medium term.

4. Due the globalization and competitiveness problems of the European Union's economy - the current average annual rate of potential growth in the European Union of 2.2% is only a 50% restoration as regards the pre-crisis potential growth rate. Recovery differs from country to country. The decisive structural element here is the decreasing dynamics of total factor productivity. At the same time, potential growth prospects of the EU12 are more unfavourable than that of the EU15, convergence may stop and even divergence may become apparent. All of these stress the need for macroeconomic policies and structural reforms that enhance potential growth.

5. The risk of shock repetition is high. The expected changes project a further erosion of the European growth potential. That is: due to the crisis and its potential longer term impacts, development of the potential growth might even be more unfavourable than indicated in previous points. The trajectory of a permanent shock poses the threat of the complete collapse of the European growth and catch-up model.

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Appendix

The production function approach focuses on the supply potential of the economy. In the framework of the production function approach potential GDP is the result of the combination of factor inputs and technological level (total factor productivity, TFP). While measuring potential output the cyclical factor is removed in the case of labour and capital as well. (For details see D'Auria, 2010.)

The Cobb-Douglas production function simplifies the analysis. Potential GDP can be calculated as follows: (1) $Y = (U_L LE_L)^{\alpha}(U_K KE_K)^{1-\alpha} = L^{\alpha}K^{1-\alpha} * TFP$

Where U_L, U_K is degree of excess capacity; E_L, E_K is efficiency level of the production factors

$$(2)\ TFP = (E_L^{\alpha}E_K^{1-\alpha})(U_L^{\alpha}U_K^{1-\alpha})$$

TFP summarizes the degree of utilization of production factors and their technological level. Factor inputs are measured in physical units. (Through hours worked for labour input and a comprehensive measure including spending on infrastructure and equipment for capital.)

The most important assumptions entering the specification of the production function are: constant returns to scale and factor price elasticity, which equals 1. The main advantage of these assumptions is simplicity. These assumptions are largely consistent with empirical evidence at the macro level. The assumption of unit elasticity is consistent with the relative constancy of nominal factor shares. The labour and capital elasticity are represented by α and (1- α). Under the assumption of constant returns to scale and perfect competition, these elasticities can be estimated from the wage share.[11]

While moving from actual to potential output the potential factor use (labour and capital input) and the trend level (normal level) of efficiency of factor inputs need to be defined.

Capital's contribution to the potential output is given by the full utilization of available capital in the economy. As capital stock is the indicator of full capacity, it is unnecessary to smooth time series when applying the production function approach. Series without smoothing tend to be more stable both for the EU and the USA. (For details see D'Auria et al., 2010.) Investment shows significant fluctuation over the years. Capital's contributions however, are relatively stable. (Net investment is only a small portion of capital stock in all of the years.)

It is more difficult to calculate the contribution of labour. Estimation of labour input has several steps. The starting point is the maximum possible level, the development of the working age population. The level of trend labour can be determined from participation rates by applying HP filters. The next step is the calculation of the trend unemployment in consistency with the NAWRU. Finally, we can calculate the potential labour supply (number of trend work hours) multiplying trend employment with average work hours. This approach generates relatively stable potential employment series. At the same time, yearly development of the series may strongly relate to long term demographic and labour market developments, to the actual population of working age, to trend participation rate and to the development of the structural unemployment.

[11] Based on the mean wage share for the EU15 over the period 1960-2003 α=0.63 and (1- α)=0.37. The OGWG calculated with 0.65 and 0.35 as factor elasticity.

As regards the production function approach potential output refers to the level of output which can be produced with a "normal" level of efficiency of factor input. This trend level efficiency level is measured by using a bivariate Kalman filter model which is based on the link between the TFP cycle and the degree of capacity utilization in the economy. (For details see Planas – Roeger – Rossi, 2010.) Normalizing the full utilization of factor inputs, the potential output can be described as follows: (3) $Y^P = (L^P E_L^T)^\alpha (KE_K^T)^{1-\alpha}$

In the model described briefly the exogenous variables are as follows: population of working age (POPW), smoothed participation rate (PARTS), investment ratio (expressed as percentage of potential GDP, IYPOT) structural unemployment (Non-Accelerating Wage Rate of Unemployment - NAWRU), Kalman filtered Solow Residual and trend average hours worked (HOURST). The endogenous variables are the potential employment (LP), investment (I), capital stock (K) and the potential output. (YPOT).

Potential employment for a given time period is determined as follows:

$$LP_t=(POPW_t*PARTS_t*(1-NAWRU_t)*HOURST_t$$

Development of investment and capital stock are determined by the following equation: $I_t=IYPOT_t*YPOT_t$ and $K_t=I_t+(1-dep_t)K_{t-1}$, where dep_t is depreciation rate of year *t*.

Based on all these the equation of the potential output can be described as follows:

$$(4)\ YPOT=LP\ 0.65\ K\ 0.35\ SRK$$

We can determine the output gap with the following equation:

$$YGAP = (Y/YPOT - 1)$$

The output estimates derived from production functions show the present output capacity of the economy. Those enable a mid-term extension: they indicate the likely development, if past trends were to persist.[12] Projections for 2014-2018 in the OGWG database can be considered technical extrapolations instead of forecasts.

[12] In the mid-term extension the trend TFP, the NAWRU (Non-Accelerating Wage Rate of Unemployment), the population of working age, participation rate changes, average hours worked, and the investment to potential GDP ratio are determined.