



# METHODOLOGY FOR MEASURING COMPETITIVENESS



2019

*'To see what everybody else has seen and to think what nobody else has thought.'*

*Albert Szent-Györgyi*



# **METHODOLOGY FOR MEASURING COMPETITIVENESS**

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# Contents

<b>Executive summary</b>	<b>5</b>
<b>I Milestones in the MNB's work on competitiveness</b>	<b>7</b>
<b>II Structure of the MNB's Competitiveness measurement system</b>	<b>9</b>
<b>III Competitiveness mirror – Measuring the implementation of the 330 points</b>	<b>11</b>
III.1 Quantifying implementation status	11
III.2 Detailed description of implementation	15
<b>IV Competitiveness Report – Objective measurement of Hungary's competitiveness position</b>	<b>16</b>
<b>References</b>	<b>20</b>



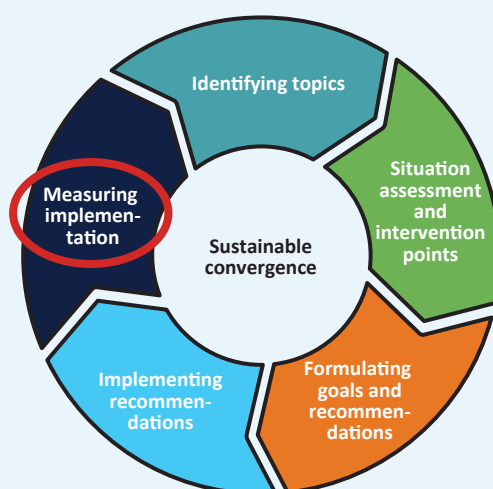
# Executive summary

Since 2013, the Magyar Nemzeti Bank (MNB) has been carrying out its tasks – in accordance with its legal mandate – with a broader perspective than previously and incorporating the development of competitiveness into its analytical framework. In addition to its primary mandate to achieve and maintain price stability and to ensure financial stability, the Magyar Nemzeti Bank is required by law to use the instruments at its disposal to support the economic policy of the Government. In recent years, the Hungarian economy has successfully followed a path of convergence; however, adhering to this path over the long run requires an annual growth surplus of at least 2 percentage points compared to developed countries. A turnaround in competitiveness is required in order to achieve such an increase in the potential growth rate of the economy.

In recent years, the MNB has analysed Hungary's competitiveness in several publications and has put forward recommendations for its improvement. The MNB started to address Hungary's competitiveness in greater depth in 2016. As a first step, the book *Competitiveness and Growth* provided an overview – including an economic and theoretical background – of successful international examples of convergence and a comprehensive analysis of the factors shaping the performance of Hungary's economy over the long term. This was followed by the first *Competitiveness Report*, which evaluated Hungary's competitiveness on the basis of more than 100 indicators and compared Hungary's competitiveness to the Member States of the European Union and the Visegrád region. As a vision for the next 12 years, the 2018 *Growth Report* set a path for the Hungarian economy upon which it could approach Austria's level of development by 2030. The *Competitiveness Programme in 330 points* published in 2019 and the 180 points published in the previous year specified the measures to be implemented for Hungary to achieve a turnaround in competitiveness.

The Magyar Nemzeti Bank remains committed to improving and measuring Hungary's competitiveness, and is therefore reinforcing its system for the analysis and measurement of competitiveness. In order to improve competitiveness, it must first be measured properly, and in Hungary this task is being performed most comprehensively by the MNB. We analyse the evolution of competitiveness from two aspects: the continuous monitoring of structural measures concerning competitiveness on the one hand, and the objective measurement of the factors shaping competitiveness on the other. Both types of analysis have already appeared in the MNB's practice, but will take on even greater prominence going forward. This publication provides a summary of the methodological elements of future analyses in that regard (Figure 1).

**Figure 1**  
**Steps required for the achievement of sustainable convergence**



Source: MNB.

**The MNB's system for monitoring competitiveness will assess the progress towards a turnaround in competitiveness with two annual publications.** The *Competitiveness Mirror* will monitor the degree and pace of implementing the recommendations made by the MNB to improve competitiveness. The *Competitiveness Report* will serve to assess the impact that the implementation of the recommendations has on Hungary's competitiveness. Both publications will be published once annually.

**The *Competitiveness Mirror* will be released in the autumn of each year and assess the extent to which the 330 competitiveness recommendations of the MNB have been realised.** The publication will monitor the recommendations made in the 12 areas addressed as part of the *Competitiveness Programme* and present the measures taken in those areas. In addition to describing the measures, it will also quantify the degree to which the 330 recommendations have in fact been realised in each of the areas and on aggregate as well.

**The *Competitiveness Report* will be released each spring and will present key competitiveness indicators in an objective manner.** This publication was first released in 2017 and assessed over 100 structurally important indicators. In contrast to some international competitiveness rankings, the aim of the *Competitiveness Report* is to – as far as possible – solely use objective indicators, to present Hungary's competitiveness status in a European comparison. In particular, the *Competitiveness Report* seeks to describe the areas, competitiveness factors and indicators where Hungary has improved in recent years, as well as those where it still lags behind its peers across the region and the EU.

**The MNB's system for monitoring competitiveness will also be unique by international standards.** As far as we are aware, currently no other central bank, country or international competitiveness ranking has a system for assessing competitiveness that is comparable to the system described here in terms of its comprehensiveness and diversity, the objectivity of the indicators used, and the level of detail of the analyses incorporated.

**The MNB considers it important to provide information on Hungary's competitiveness position not only to experts, but also to the interested public.** Accomplishing a turnaround in competitiveness requires an active contribution and a new approach from both the Government and all participants in the economy. For that reason, we consider it particularly important that the MNB's messages and recommendations on competitiveness reach the widest possible audience through a variety of means of communication.

# I Milestones in the MNB's work on competitiveness

In the MNB's approach, a national economy is competitive if it utilises its available resources optimally to attain the highest possible level of welfare, which is at the same time sustainable. However, just as there is no single and universal recipe for successful economic convergence, there is no general consensus on a precise definition for competitiveness. In some countries, improved competitiveness implies faster growth of the real economy, while in others its more prominent results are the preservation of economic leadership and improvements in core factors such as quality of life, environmental protection and sustainability. There is however consensus on the necessary and beneficial character of some core factors. The competitive functioning of an economy certainly requires solid foundations such as a stable macroeconomy and financial sector, efficient governance, favourable demographic trends, a strong domestic corporate sector, a flexible labour market, and high quality education and health care systems. Building on these foundations, a well-functioning and predictable business environment can be established and incentives can be provided for investments and innovation, which – through the appreciation of qualified labour – may lead to increased productivity and sustained economic convergence.

**Figure 2**  
Milestones in the competitiveness work of the MNB

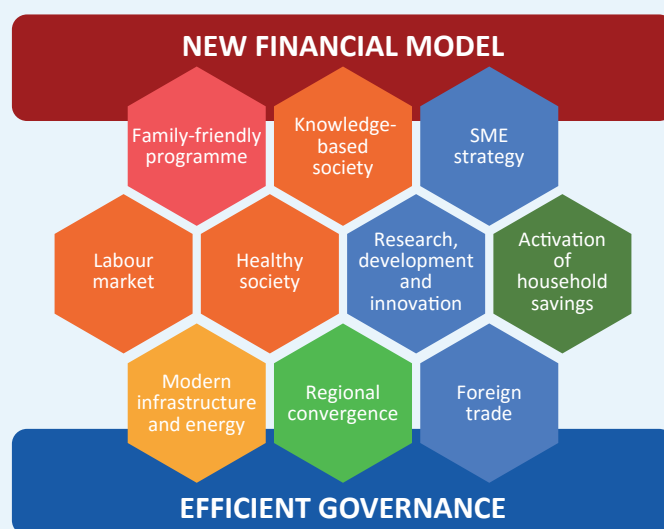


Source: MNB.

At the Government's request, the MNB started to analyse Hungary's competitiveness in a deeper and more comprehensive way in 2016 (Figure 2). The book *Competitiveness and Growth* was published that year, providing an overview of the theory of economic convergence through the history and characteristics of countries with successful convergence efforts. Drawing on international experience, the publication made a total of 50 recommendations in 7 areas with a view to the sustainable development of the Hungarian economy. This was followed by the release of the *Banking System Competitiveness Index* in 2017, which assessed the situation of the Hungarian banking sector by enhancing the methodology of international competitiveness rankings. That same year, the first *Competitiveness Report* was published, which sought to present the fullest possible picture of Hungary's competitiveness status based on more than 100 mostly objective indicators in 11 areas. The publication also monitored the implementation of the recommendations made in the monograph *Competitiveness and Growth*.

According to the MNB's analysis, accomplishing a turnaround in competitiveness in Hungary is a prerequisite for sustainable convergence. In several publications, the MNB has put forward recommendations concerning the measures that need to be implemented to substantially improve Hungary's competitiveness. The monograph *Competitiveness and Growth* referred to in the foregoing included 50 such recommendations. In the summer of 2018, the MNB then submitted to the National Competitiveness Council its new working paper featuring 180 recommendations. The details of the convergence model presented in the working paper were set out in the Growth Report released in the autumn of the same year. In the next step of the work on competitiveness, the *Competitiveness Programme* of 330 points was released in February 2019, which made recommendations in 12 areas drawing on the results of previous publications (Figure 3).

**Figure 3**  
Key areas of the MNB Competitiveness Programme



Source: MNB Competitiveness Programme in 330 points.

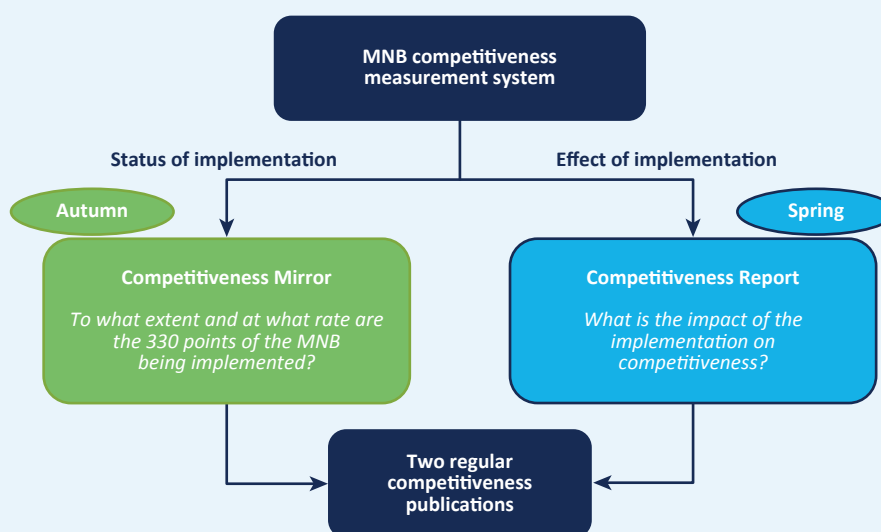
The recommendations in the MNB *Competitiveness Programme* primarily address the framework and main directions of competitiveness reforms, whereas the specific rules are established and scheduled outside the scope of the MNB, by the Government and the departments concerned. Having proposed these 330 points, the MNB can contribute to the turnaround in competitiveness by continuously monitoring the implementation of reforms and by providing comprehensive, objective analyses of the competitiveness position. It should be noted that the competitiveness reforms required for successful convergence have multiplier effects that go beyond the reforms themselves, triggering a range of positive developments throughout the national economy with multiple levels of feedback. For that reason, the sooner the recommendations are implemented, the sooner their positive impact will be felt on economic development. At the same time, the available fiscal space must always be kept in mind to ensure that the financial balance of the national economy is continuously maintained.

## II Structure of the MNB's Competitiveness measurement system

The MNB will continue its analysis of Hungary's competitiveness in a renewed and enhanced form compared to the previous practice. Following several stages of situation assessment and the formulation of recommendations based on the outcome of that work, the next step is to monitor the progress made in specific areas of competitiveness. This is because accomplishing a successful turnaround in competitiveness requires the continuous monitoring of areas that are relevant to competitiveness and of the implementation of the recommendations which were made.

The MNB's system for monitoring competitiveness will be comprised of two annual publications (Figure 4). Within the measurement system, one publication will assess the extent and rate of implementing the recommendations put forward by the MNB for improved competitiveness (*Competitiveness Mirror*), and the other will assess the impact of the implementation of the recommendations on Hungary's competitiveness status (*Competitiveness Report*). Both publications will be released once annually (Figure 5).

**Figure 4**  
Components of the MNB competitiveness measurement system



Source: MNB.

To be released in the autumn of each year, the *Competitiveness Mirror* will assess the extent to which the 330 competitiveness recommendations made by the MNB have been implemented. The publication will monitor the recommendations made in the 12 key areas of the *Competitiveness Programme* and present the measures taken in those areas. In addition to describing the measures, it will also quantify the degree to which the 330 points of the programme have in fact been implemented in each of the key areas and on aggregate.

The *Competitiveness Report* will continue to present key competitiveness indicators in an objective manner. The publication was first released in 2017 and assessed over 100 structurally important indicators. In contrast to some international competitiveness rankings, the aim of the *Competitiveness Report* has been to – as far as possible – solely use objective indicators, to present Hungary's competitiveness status in a European comparison.

**Figure 5**  
Expected publications of the MNB competitiveness measurement system



Source: MNB.

**The MNB's system for monitoring competitiveness will also be unique by international standards.** As far as we are aware, currently no other central bank, country or international competitiveness ranking has a system for assessing competitiveness that is comparable to the system described here in terms of its comprehensiveness and diversity, the objectivity of the indicators used, and the level of detail of the analyses incorporated. A number of countries across the European Union publish competitiveness reports on the status of their economies. However, the monitoring systems of most countries (except for e.g. Ireland and Portugal) focus primarily on macroeconomic indicators, and none is particularly geared to formulating specific directions and recommendations for competitiveness. Some international organisations (such as the European Commission, the OECD and the IMF) carry out situation assessments and formulate recommendations on the functioning of specific countries, and in certain cases they also monitor the implementation of those recommendations. That said, the recommendations of international organisations tend to feature a considerably lower number of elements, and cover fewer areas of the economy and society compared to what is addressed in the Magyar Nemzeti Bank's publications.



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# III Competitiveness mirror – Measuring the implementation of the 330 points

The MNB's new regular publication, the *Competitiveness Mirror* aims to support the implementation of the recommendations included in the *Competitiveness Programme in 330 Points*, through the accurate and quantitative monitoring of implementation. The system for monitoring the implementation of the recommendations will also make use of analytical and descriptive methods for its assessment of the accomplishment of the turnaround in competitiveness according to the MNB's Competitiveness Programme. The chapter on the details will provide a descriptive summary of the measures related to each recommendation, based on which progress on implementation will be quantified in the analytical chapter. Progress will be evaluated in a dual approach, because in addition to a summary of the results, a strong emphasis will also be placed on the tasks that remain to be done. The publication will be released annually.

## III.1 QUANTIFYING IMPLEMENTATION STATUS

As part of quantitative analysis, the status of the competitiveness turnaround is assessed according to the importance of each recommendation and the respective degree of implementation. The analysis primarily seeks to determine the implementation status for each recommendation. The degree of progress is established using a 4-point scale ('not started', 'started', 'mostly implemented', and 'fully implemented'). In terms of what is to be considered as implementation, the recommendations in the 330 points fall into one of two groups. One part of the recommendations require the approval of a specific measure, the introduction of new regulations, or adjustments to those in place. By contrast, recommendations in the other group set directions for development, the objectives of which can be accomplished through the implementation of programmes involving a series of coordinated actions. Obviously, a recommendation of the former type may be considered as implemented when the competent institution has approved the regulatory adjustments, and one of the latter type when the programme has started. In assessing the degree of implementation, another aspect to be taken into account is whether the approved regulation or initiated programme is fully aligned with the recommendation made in the 330 points. A recommendation may be considered as partly implemented when the measure taken is similar in direction, but still different or smaller in volume, whereas a point may be considered as fully implemented when the same end has been achieved by a different method without any considerable or harmful side-effects. Taking these considerations into account, the categories indicating the degree of implementation are applied with reference to the following criteria:

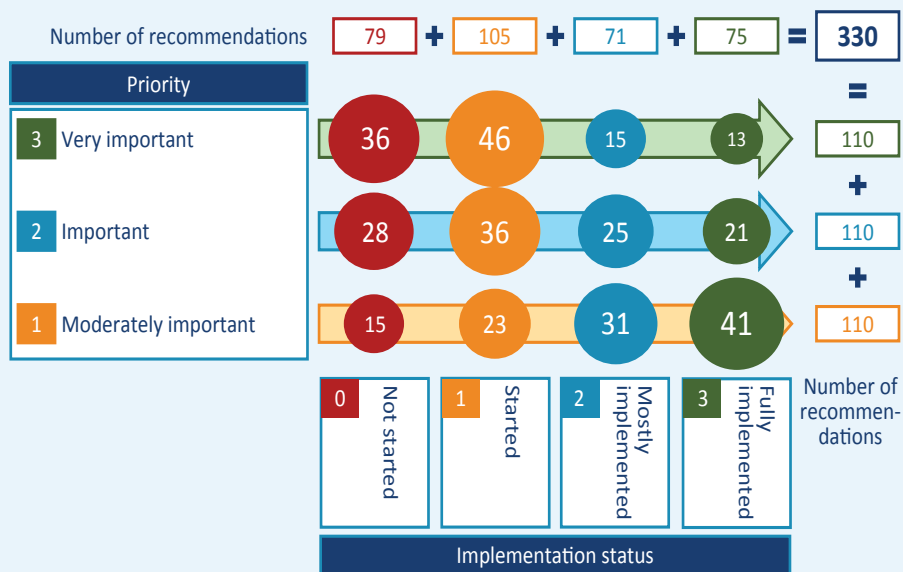
- A recommendation is **'fully implemented'** when the corresponding regulatory adjustments (including amendments) have taken place, or respectively, for recommendations of a more general nature, when the programme seeking to accomplish the objective is effectively underway. A recommendation may also be considered as fully implemented when the same end has been met by different but equally effective and efficient means.
- The **'mostly implemented'** category comprises programmes which have been organised and are set to be launched, as well as measures about to be approved. Additionally, it may also comprise approved measures or initiated programmes that do not fully cover the corresponding recommendations included in the 330 points or are more limited in scope. In such cases, implementation of the initial recommendation requires changes to the programme or measure, or the adoption of a new measure.
- A recommendation may be considered as **'started'** when a specific plan or strategy has been adopted for the implementation of a measure proposed as part of the 330 points. The 'started' category also comprises recommendations that involve an approved measure or initiated programme, the essential elements of which have not been implemented.
- The **'not started'** category comprises recommendations in respect of which no measure has been approved or no specific notification has been made, or no programme involving the recommendation has been initiated.

Every recommendation will be assessed by the MNB's experts in terms of the contribution of implementation to competitiveness improvement. The 330 points have been elaborated in the spirit that all of its parts should substantially promote the improvement of Hungary's competitiveness. Nevertheless, not all of the recommendations may be considered to be equally important; some of them are key elements. The greatest importance is attached to recommendations that make the largest contribution to competitiveness, have the strongest multiplier effect, and are prerequisites for additional actions. According to the degree of contribution to improve competitiveness, three categories ('moderately important', 'important' and 'very important') have been established. In all of the 12 key areas, the recommendations are classified into these groups in equal proportions, i.e. each of the three categories are comprised of 110 recommendations.

Figure 6 illustrates how the 330 points can be classified according to degree of priority and implementation status.

**Figure 6**

**Example analysis – Implementation status of the competitiveness recommendations by priority**

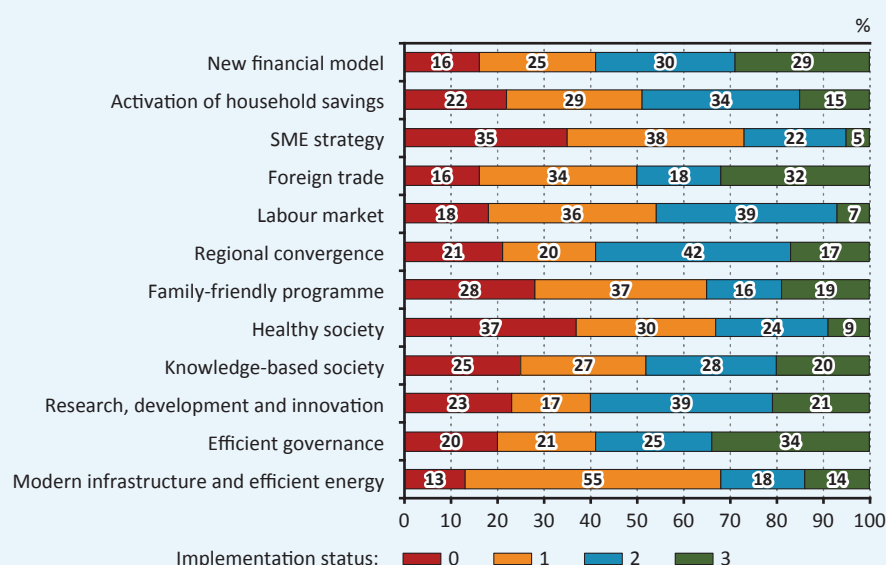


Note: The size of each circle corresponds to the number of recommendations. The figure is for illustrative purposes only, i.e. the numbers shown here do not reflect the MNB's current assessment, which will be presented for the first time in the Competitiveness Mirror to be released in the autumn.

Source: MNB.

The implementation of recommendations should also be examined by key areas. In its *Competitiveness Programme*, the MNB made recommendations for the improvement of competitiveness in 12 areas (Figure 3) and accomplishing the turnaround in competitiveness requires implementation of the interventions proposed in each of the 12 areas specified. The analysis of the recommendations by chapter will show where the most progress has been made, as well as the areas where stronger support for progress is needed going forward. The breakdown by areas of recommendation is shown in Figure 7 (the data are illustrative).

**Figure 7**  
Example analysis – Implementation status of competitiveness recommendations by key areas



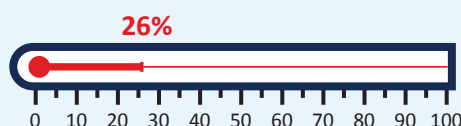
Note: The figure is for illustrative purposes only, i.e. the numbers shown here do not reflect the MNB's current assessment, which will be presented for the first time in the Competitiveness Mirror to be released in the autumn.

Source: MNB.

The most important feature of the *Competitiveness Mirror* is the analysis of the implementation of the recommendations over time, because that is how the degree of progress compared to the previous period can be identified. The *Competitiveness Mirror* will be released annually in the autumn of each year, which will allow it to report on the progress made over twelve months. Naturally, comparability requires a constant methodology and its consistent adaptation. Progress can be measured in the aggregate and also separately for each area.

The methodology is suitable for presenting the degree to which the recommendations have been implemented, concentrated into a single figure both by area and on aggregate. Recommendations are scored 0–3 according to the status of their implementation, where 0 stands for 'not started' and 3 for 'fully implemented'. The score obtained is then weighted by the priority of the recommendation concerned (this is a number between 1 and 3, where 3 stands for recommendations rated 'very important'). The resulting implementation scores are aggregated for each key area, as well as for all recommendations collectively. The aggregate implementation status is a percentage that shows the level of implementation, weighted by priority, compared to the full implementation of the recommendations. The indicator may be assessed in respect of the complete set of recommendations (Figure 8) and in respect of specific key areas, while it also provides a means to present the degree of progress over time (Figure 9).

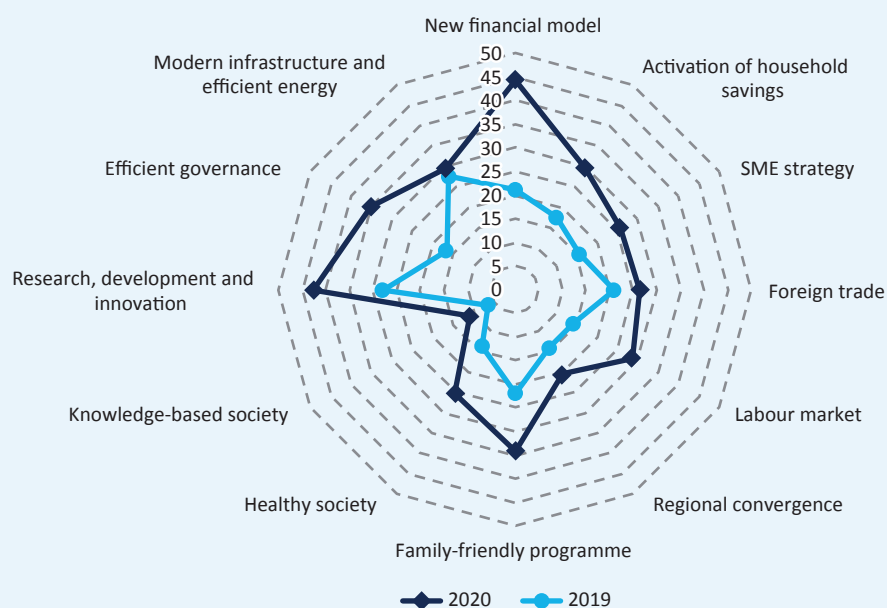
**Figure 8**  
Example analysis – Aggregate implementation status of competitiveness recommendations



Note: The figure is for illustrative purposes only, i.e. the number shown here does not reflect the MNB's current assessment, which will be presented for the first time in the Competitiveness Mirror to be released in the autumn.

Source: MNB.

**Figure 9**  
**Sample analysis – Aggregate implementation status of competitiveness recommendations by key areas**  
 (%)



*Note: The scale ranges from 0 to 100 per cent. The figure is for illustrative purposes only, i.e. the numbers shown here do not reflect the MNB's current assessment, which will be presented for the first time in the Competitiveness Mirror to be released in the autumn.*

*Source: MNB.*

## III.2 DETAILED DESCRIPTION OF IMPLEMENTATION

Implementation of the recommendations will be described in detail in the second part of the *Competitiveness Mirror*. Approved or planned measures and programmes related to each recommendation will be explained in detail (Table 1). Essentially, this descriptive summary will follow the principles of the recommendation monitoring system that was also used in the first *Competitiveness Report*, released in 2017. To that end, the activities of all entities and ministries concerned, the MNB, banks and other economic agents will need to be monitored closely. The description of the measures will provide the basis for the classification used in quantifying the implementation status. Accordingly, the assessments will include the details of the measure or programme linked to the 330 points, whether the contents of the measure or programme are identical or different from the recommendation made in the 330 points, and the status of implementation. In addition to the table containing a detailed description of the measures, the chapter will also include a summary table providing an overview of the implementation status of all recommendations.

**Table 1**

**Detailed description of the implementation of the MNB's competitiveness recommendations**

#	Recommendation	Priority
66.	Reduce the investment limit from HUF 500 million to HUF 100 million for the development tax benefit available to SMEs	3

**Implemented measure:** In 2018, the volume of investments implemented in Hungary amounted to an unprecedented HUF 8,500 billion. Seeking to provide further incentives for investments, the Government wishes to gradually reduce the threshold of HUF 500 million for the tax benefit on development for small and medium-sized enterprises, in 3 successive steps: to HUF 300 million for small enterprises and HUF 400 million for medium-sized enterprises from 2020, to HUF 100 million for small enterprises and HUF 200 million for medium-sized enterprises from 2021, and to HUF 50 million for small enterprises and HUF 100 million for medium-sized enterprises from 2022. The tax cut affects approximately 7,000 enterprises.

79.	Establish the János Neumann Fund to support firms' ICT developments	2
124.	Increase the capacity for active same-day care	1

**Implemented measure:** As announced by the Government, 18 health care institutions are to set up same-day surgery centres as an independent organisational unit in a total of 20 locations by 2020. The project will be implemented from HUF 8 billion worth of EU funds, half of which will be allocated to the development of infrastructure, with the remaining amount for the procurement of 12,000 items of medical equipment and instruments.

Legend	Fully implemented	Mostly implemented	Started	Not started
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Note: Illustration.

Source: MNB.

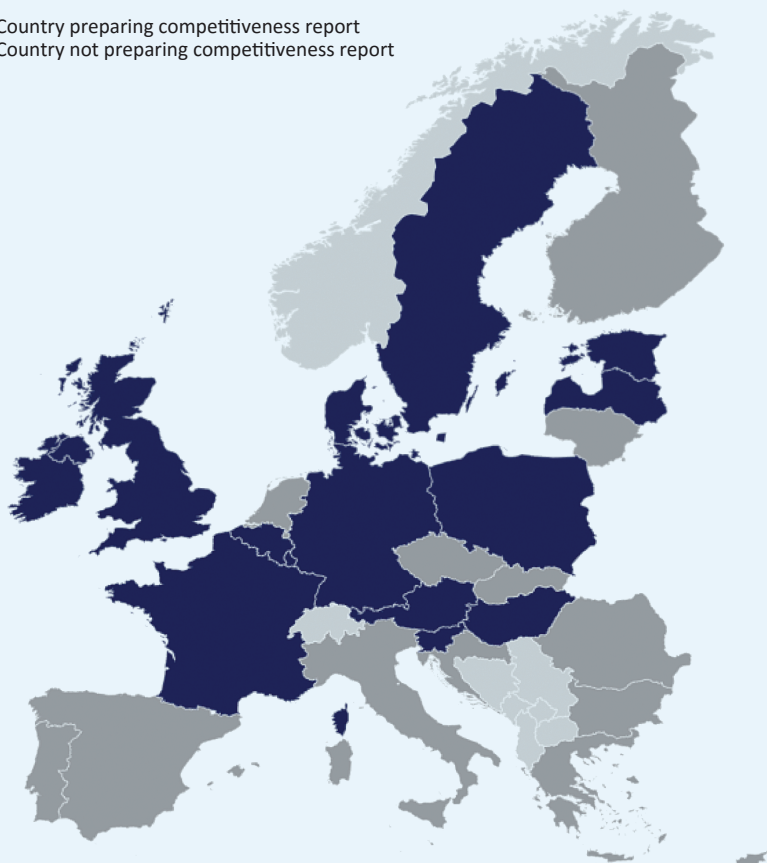
## IV Competitiveness Report – Objective measurement of Hungary’s competitiveness position

Released for the first time in 2017, the *Competitiveness Report* aims to provide a comprehensive, objective picture of Hungary’s competitiveness. The publication also addressed in detail aspects which are given less focus in the MNB’s standard macroeconomic analyses despite their prominence in terms of economic development, particularly in the longer term. Essentially structural in nature, these areas and factors exert an influence on economic agents’ decisions concerning consumption, savings and investments, on the growth potential of the economy, on the financial balance, and consequently on the returns expected, price levels and inflation.

One-half of the EU Member States prepare competitiveness reports on the position of their economies (Figure 10). However, comprehensive, more in-depth reports are only published by some countries (e.g. Ireland, Latvia and Luxembourg), while the monitoring systems of other countries focus primarily on macroeconomic indicators. National competitiveness reports mostly focus on objective indicators, and their analyses rely mainly on an assessment of those indicators over time and comparisons with benchmark countries. National reports are not particularly geared to formulating specific directions and recommendations for competitiveness.

**Figure 10**  
EU Member States preparing competitiveness reports

■ Country preparing competitiveness report  
■ Country not preparing competitiveness report



Source: MNB.

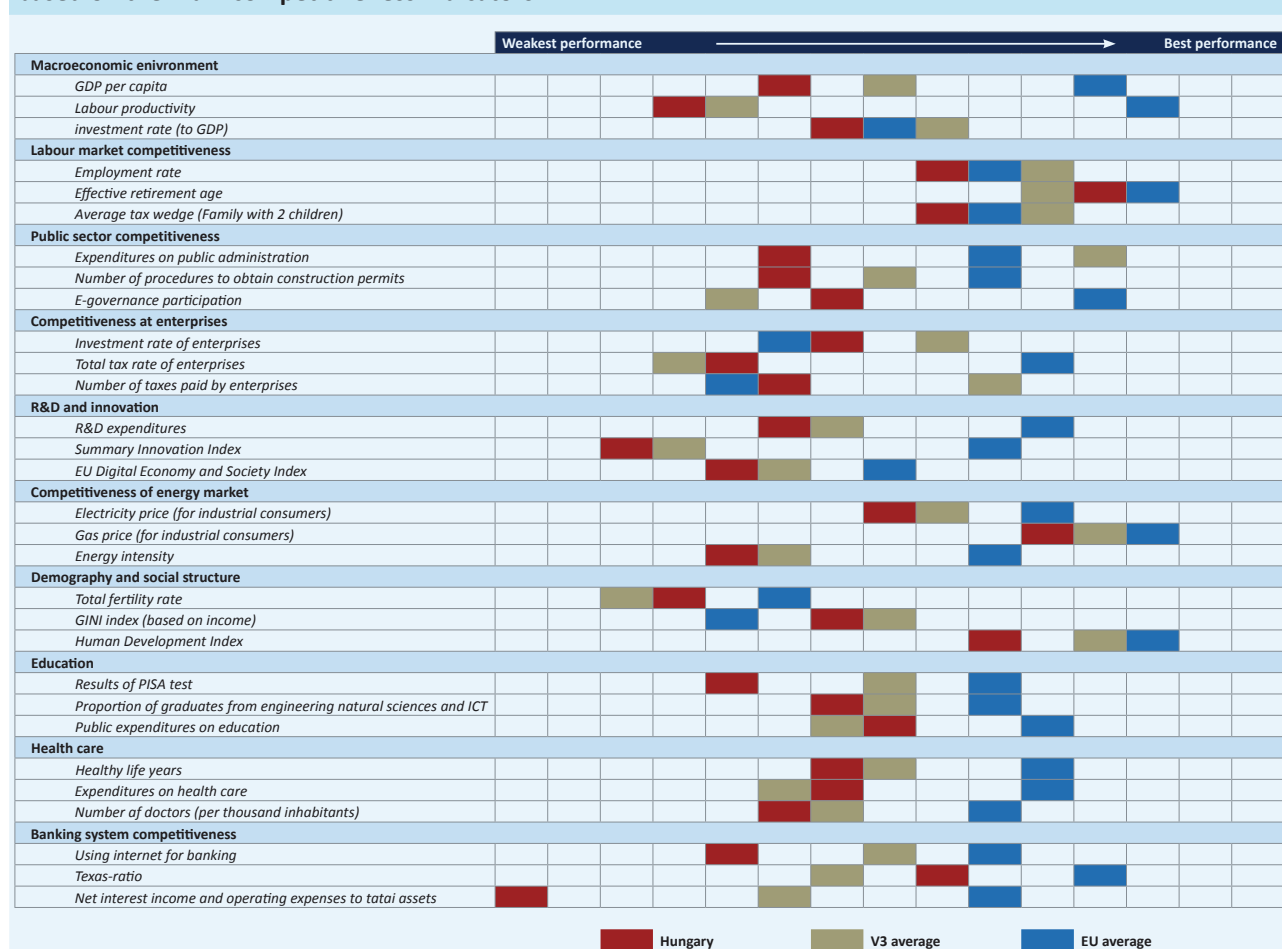
The *Competitiveness Report* seeks to eliminate the shortcomings of other reports on competitiveness. International competitiveness rankings (such as the IMD, the WEF ranking and the World Bank's Doing Business publication) tend to cover individual countries only briefly, and without any narrative assessment for the most part, while their results may also be distorted by survey methodologies (Table 2). In addition to the quantitative values of individual indicators, the *Competitiveness Report* includes analyses on key competitiveness factors both based on time series and in an international comparison. To prevent the loss of information involved, the areas and their indicators are not condensed into a composite indicator. Nevertheless, for better transparency the stylised results of the key indicators in each area of competitiveness are represented in a figure (Figure 11).

**Table 2**  
**Methodology summary of international competitiveness rankings**

	World Economic Forum – GCI	IMD – WCR	World Economic Forum – IDI	World Bank – Doing Business	Economic Complexity Index
Number of indicators	114	341	12	45	–
Number of objective indicators	30	226	12	45	–
Number of countries	138	63	109	190	131
Comprehensive	✓	✓	✗	✗	✗
Global	✓	✗	✓	✓	✓
Objective	✗	✓	✓	✓	✓

Source: MNB.

**Figure 11**  
**Stylised competitiveness position of Hungary compared to the average of V3 and European Union countries based on the main competitiveness indicators**



Source: MNB Competitiveness Report 2017.

**Rather than comparing a wide range of countries, the analysis focuses on Hungary, using the averages of the Visegrád countries, Austria and the European Union as benchmarks.** International competitiveness reports generally seek to achieve the widest geographical coverage, which, however, often compromises data quality or comparability. By contrast, national analyses tend to be restricted to the circumstances and prospects of the country concerned, or even to those of specific sectors within the country. The MNB's *Competitiveness Report* is also different in that regard from the competitiveness publications of international organisations or individual countries. For selection purposes, the MNB deliberately limited the number of countries analysed to the level of the European Union, ensuring both data quality and that relevant peers are included in the analyses. While the analyses essentially focus on Member States of the European Union, in certain cases, primarily due to data availability, other country groups (such as OECD countries) are also subject to scrutiny. In the 2017 *Competitiveness Report*, Austria was not yet given a prominent role in comparison. However, given that approximation to Austrian economic performance has been set as the target for sustainable convergence, Austria's results will also be included among the benchmarks.

**Compared to international competitiveness reports and rankings, our analysis is also different in terms of the range of objective data and evaluation of the results.** For the sake of a wide geographical coverage, international rankings frequently rely on data which are not objective, but are based on surveys, which in some cases are carried out on small populations and are thus not representative. However, surveys primarily reflect subjective impressions and sentiment, which are liable to paint a distorted picture about the actual circumstances, particularly in international comparisons. In our view, an accurate and valid assessment of the situation is an essential precondition for a turnaround in competitiveness. Consequently, the MNB's analyses of competitiveness mainly rely on objective indicators.

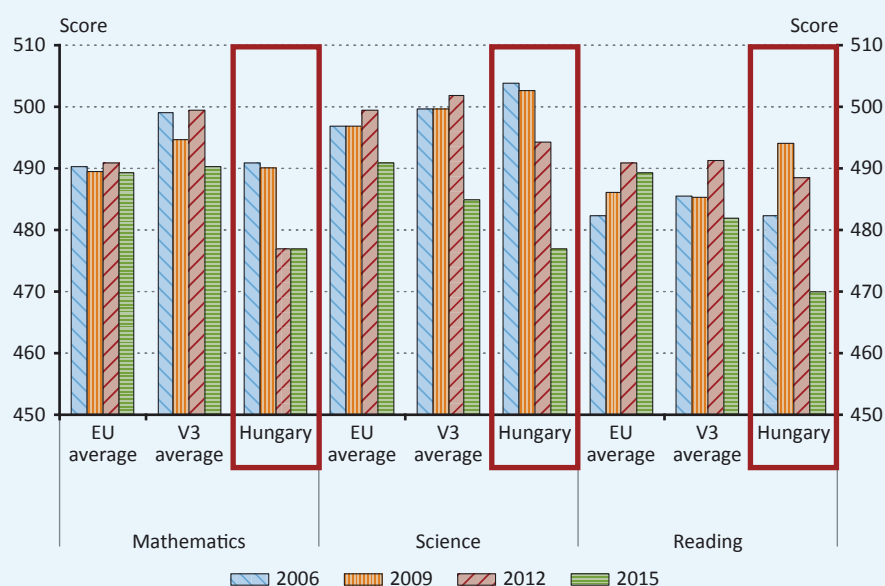
**In particular, the *Competitiveness Report* seeks to specify the areas where progress has been made compared to the initial situation as described in the *Competitiveness Programme*.** Changes, i.e. the changes in the factors of Hungary's competitiveness compared to their previous status, are at least as important as an assessment of Hungary's position compared to its international competitors. The MNB considers it crucial to present the achievements, while also objectively pointing to deficiencies and areas where further improvement is needed.

**The *Competitiveness Report* also relies on time series to present developments in Hungary's competitiveness position, accompanied by an analysis of the underlying causes of the developments in the indicators.** One shortcoming in global rankings is the general absence of a narrative analysis of the results, and that indicator values are not compared to their past developments. By contrast, the MNB's report seeks to present Hungary's competitiveness status in a way that offers users ease of access and use. Figure 12 shows a sample analysis, which relies on both time series and a comparison with benchmark country data to present Hungary's results, providing a summary of key methodology aspects, and a brief interpretation of the results.

**The *Competitiveness Report* aims to provide information on Hungary's competitiveness position not only to experts but also to the broader public.** Accomplishing the turnaround in competitiveness requires an active contribution and a new approach from both the Government and all participants in the economy. For that reason, we consider it particularly important that the MNB's messages and recommendations on competitiveness reach the broadest possible audience through a variety of means of communication.



**Figure 12**  
Example analysis – Results of PISA tests



Source: MNB Competitiveness Report 2017.

Organised by the OECD every 3 years, the PISA survey is carried out to assess the competences of 15-year-olds in 3 areas of literacy (mathematics, science and reading). In the latest survey, carried out in 2015, Hungary's results deteriorated in the areas of science and reading, while in the case of mathematics the downward trend observed in earlier years stopped. According to the 2015 survey, the shortfall in the results of Hungarian students compared to the regional and EU averages appear to have increased, which is partly explained by the significant increase in the percentage of students failing to reach the threshold level. The deterioration in Hungarian results is nuanced by the fact that the most recent survey showed poorer results in all three areas of literacy both across the EU and the region. The decline is particularly striking in the area of science, as the average scores declined across the EU with the exception of three countries.

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# Albert Szent-Györgyi

(Budapest, 16 September 1893 – Woods Hole, Massachusetts, 22 October 1986)

Albert Szent-Györgyi, Nobel Prize winner Hungarian physician, biochemist.

Between 1904 and 1911 he attended the Presbyterian Secondary Grammar School in Lónyay Street, then continued his studies at the Medical Faculty of the Budapest University. He participated in World War I as a medical officer on the Eastern Front. Risking his life, he helped to rescue the wounded, for which he received the Silver Medal for Valour. After World War I he continued his studies in Bratislava, Prague, Berlin, Leiden and Groningen in the fields of biology, physiology, pharmacology, bacteriology and then physics and chemistry.

During his studies, he identified a new material in the adrenal of animals; later he succeeded in extracting the same material from cabbage and orange. The material with the molecular formula  $C_6H_8O_6$  was named hexuron acid. In 1927 he defended his doctoral thesis written about discovering the hexuron acid at Cambridge University, and became a doctor of chemical sciences.

On 1 October 1928 he was appointed to professor of Szeged University, where he started his research and teaching activities as a professor of the medical chemical institute in 1931. As of 1931, he dealt with the research of vitamin C, whose exact composition was still unknown. However, Szent-Györgyi proved that the hexuron acid found in the adrenal and vitamin C is the same material. Following that, he succeeded in producing significant quantity of vitamin C from green pepper. His further researches covered, inter alia, biological oxidation, the examination of certain parts of the citrate cycle, which was not completely known at that time, and the exploration of the protein chemical background of mechanical muscular movement.

In 1937 he received the Nobel Prize in Physiology or Medicine for his research related to vitamin C, 'for his discoveries in connection with the biological combustion processes, with special reference to vitamin C and the catalysis of fumaric acid'. He offered the medal he received with the Nobel Prize to those who suffered from the Finnish war that broke out at that time. Later this medal was bought by Wilhelm Hilbert, a company director in Helsinki, who, in 1940, presented it to the Hungarian National Museum, where it is still preserved. In 1938 he became a member of the Hungarian Academy of Sciences.

In 1947 he left the country, and settled in Woods Hole, near Boston, where first he was the director of the Marine Biological Laboratory, then a professor of Dartmouth College. He devoted the last two decades of his life to cancer research. His important observation was the realisation of the role of free radicals in the development of cancer and the realisation of the radical catching role of vitamins (such as vitamin C). In 1972 he founded the National Cancer Research Foundation. In the 1960s he started to deal with politics as well. He wrote numerous articles in which he criticised the nuclear arms race, and in 1970 he also protested against the Vietnam War. In 1978 he was a member of the delegation that brought the crown jewels back to Hungary.

Albert Szent-Györgyi remained mentally and physically fit in his old age as well. He died in his home due to renal insufficiency on 22 October 1986. He was buried in the garden of his house on the shore of the Atlantic Ocean.

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