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The role of economic agents' expectations in the formation of economic cycle: on the example of USA

Abstract. Introduction. The authors analyse the mechanism of the economic cycle formation under the influence of economic agents' expectations. It is emphasised that one of the main reasons for the termination of economic growth is generation and accumulation of systemic risk in the economy due to unreasonable expectations. *The purpose* of the research is to analyse the process of the economic cycle formation under the influence of economic agents' expectations in the USA in the period from 1947 to 2016. *Methods.* The authors of the article offer their own methodology to analyse dynamic processes by transforming primary data and applying the author method of total sliding expectations for time series analysis.

Results. Based on the analysis of data related to GDP of the USA, it has been concluded that the peaks of economic cycles in gross domestic product (GDP) values accurately reflect the peaks of time series of the total sliding expectations by GDP values. However, there were periods when the maximum of sliding expectations time series occurred without reaching the maximum gross domestic product.

An approach to economic entropy as synchronisation of expectations level coincidence with the actual course of events in the economic system is given. The entropy reaches its peak under the reversal of the economic system, when business profits are also maximised due to cheap resources and services. The phase of economic growth will last until certain economic agents accumulate a critical amount of divergence between the expectations and the actual capital efficiency. Once the level of economic entropy has dropped below the conventional critical limit, the crisis is inevitable because of overwhelming economic agents' erroneous actions.

Conclusions. The proposed conceptual approaches to explaining the economic cycle mechanism are based on the real economic mechanism and can therefore be applied to forecast it.

Keywords: Theory of Expectations; Economic Cycle; Gross Domestic Product (GDP); Economic Entropy; Total Sliding Expectation

JEL Classification: E32; E37; C12

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Анотація

У статті розглянуто актуальні проблеми дії механізму економічного циклу з урахуванням впливу фактору очікувань економічних агентів. Метою дослідження є аналіз процесу формування економічного циклу з огляду на вплив очікувань економічних агентів в США у 1947–2016 рр. На підставі аналізу даних про валовий внутрішній продукт США робиться висновок, що максимуми економічних циклів чітко збігаються з максимумами динамічних рядів сумарних ковзних очікувань. Запропоновані концептуальні підходи до пояснення механізму дії економічного циклу ґрунтуються на реальному економічному механізмі та можуть бути використані для його прогнозування.

Ключові слова: теорія очікувань; економічний цикл; валовий внутрішній продукт; економічна ентропія.

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Аннотация

В статье рассмотрены актуальные проблемы действия механизма экономического цикла с позиций влияния фактора ожиданий экономических агентов. Целью исследования является анализ процесса формирования экономического цикла под влиянием ожиданий экономических агентов в США в 1947–2016 г. На основании анализа данных по валовому внутреннему продукту США сделан вывод, что максимумы экономических циклов имеют четкое совпадение с максимумами динамических рядов суммарных скользящих ожиданий. Предложенные концептуальные подходы к объяснению механизма действия экономического цикла основываются на действии реального экономического механизма и могут быть использованы для его прогнозирования.

Ключевые слова: теория ожиданий; экономический цикл; валовой внутренний продукт; экономическая энтропия.

1. Introduction

In recent decades, problems of economic growth and economic cycle have been the focus of attention of economists. The achievements of the 1950s-1960s in Europe, of the 1960s-1970s in Japan, of the 1970s-1990s in South Korea were not stable and included periods of recession and stagnation. However, there have always been fast-growing economies. The patterns of economic success have been changing most rapidly in the past few decades. Some countries become leaders, while others continue their slow growth or even reduce GDP. According to A. Galor (Galor, 2005) [1], the average growth rate of income in the world accounted for approximately 0.05% during the period from 1000 to 1820. It was already 0.5% in 1820-1870, 1.1% in 1870-1950 and has been over 2% since 1950 [2]. The authors of the «World in 2050» report by PwC predict that the average annual world economic growth will be 3%, which will enable to double the global GDP by 2037 and triple it by 2050 [3].

2. Brief Literature Review

As history shows, economic growth is not permanent. It is anyway compounded by crises. In the early twentieth century, M. I. Tugan-Baranowski, a prominent economist, wrote: «The capitalist world is subject to its own special laws, the spontaneous force of which is revealed during crises; hence the crises are not understood. The modern man feels his helplessness before the action of forces created by him, but whose control he has lost» [4].

Theories which explain the cyclical nature of economic development are quite diverse, even within economic schools. In this paper, we do not aim to analyse different approaches and views on this issue. Let us just note that modern economists hardly have any doubts about the inevitability of the next economic cycle. According to Nobel laureate E. Phelps (Phelps, 2015), to consider the possibility of economic collapse to be a drawback is similar to calling a drawback the tendency to rapid changes in the mood - from mania to depression, which frequently occurs among creative people [5, 415]. The desire to predict the future has always been one of the most cherished human dreams. Moreover, predicting events is among human characteristics. Based on the accumulated data and experience, people are able to predict the future. In modern society, it is one of the most important aspects of life. Daily, we are surrounded by lots of various forecasts regarding the future, including the economic future. Accepting it or not, society creates expectations for the future, which are then accompanied by specific actions. The latter tends to minimise negative effects of the events that, as expected, may lead to losses.

However, it is questionable whether it is possible to predict future in terms of economic events. In the view of J. Keynes, it is impossible. He explains it by the lack of coordination in modern business projects. J. Keynes believed (Keynes, 1936), we do not know the future, although it would be better to know it [6].

A similar view, albeit from a different angle, is supported by Jesús Huerta de Soto (Huerta de Soto 2009) [7]. He believes that an unsolvable logical contradiction occurs when conducting a business analysis: the demand for entrepreneurial resources, based on the expected costs and benefits, involves the belief that some information can be received immediately today (about the possible future value of costs and benefits), and before this information is created by entrepreneurial efforts.

After all, the simple practice of human activity shows that in today's society people, including investors, have to constantly make decisions relying on the potential future income. Companies that intend to invest are to know the sequence of their future income from the invested capital. However, in this case the problem of uncertainty and risk evolves. The question is how economic agents form their future expectations. Modern economic theory formulates two approaches to this matter: the hypothesis of generally adaptive expectations and the hypothesis of rational expectations.

L. Koyck (Koyck, 1954) and P. Cagan (Cagan, 1956) are considered to be the founders of the theory of adaptive expectations [8-9]. The basis of this theory is a simple principle the essence of which is that people form their future expectations depending on the extent to which their expectations were wrong in the past as related to the present. In this case, a simple principle operates: the events of the past shape the future human economic expectations. For instance, if the inflation rate in the country by years is 3%, 4% and 5%, then we can expect a 6% inflation rate in the next period. At the same time, it can be different from the forecasted inflation rate due to urgent measures taken by the government or the central bank. It is unpredictable events that can significantly distort the importance of the previous events.

The founders of the theory of rational expectations are J. Muth (Muth, 1961) and H. Simon (Simon, 1958) [10-11]. They believe that people use more sophisticated methods while forming their expectations, especially when it comes to investing substantial capital. These economists claim that, while forming their expectations about the behaviour of economic variables, both companies and individuals use all the information available at their disposal, combining it with their own ideas.

The principles of the theory of rational expectations are widely spread when discussing the impact of expectations on the inflation rate. The impetus for this was the difference between the Keynesian theory and the actual results of governmental policy in the economy of the developed countries in early 1970s. The fact is that in 1958 A. Phillips (Phillips, 1958) [12] published his famous article highlighting the relationship between inflation and unemployment. This relationship is called the Phillips curve; it is included in all textbooks on macroeconomics today. One of its critics, Robert Lucas, a Nobel laureate, notes that this theory ignores the optimal behaviour of the economic agents, including formation of rational expectations [13]. As economic agents use obvious accessible information optimally (efficiently) when forming their expectations, R.-E. Lucas (Lucas, 1976) [13] claims that their predictions should be seen as rational. In fact, he meant that economic agents make the most precise future predictions and may foresee governmental actions in their plans.

Simultaneously, economists engaged in analysing the relationship between economics and psychology prove that, while making objective decisions regarding the received information, several factors caused by human psychological characteristics may occur. [14]. These include beliefs, social pressure and emotions. Only a limited number of people can overcome all the three obstacles. In our opinion, public pressure, or crowd psychology, has a particularly strong impact on making managerial decisions. These trends are most clearly demonstrated in the stock markets where the rapid growth in asset values often exceeds the cost-effective limits because of the psychological factors. Also, expectations have a significant impact on the formation of energy prices, in particular, oil. Ultimately, all these factors lead to formation of real efficacy at the level of specific enterprises [15].

On this occasion, I. M. Kirzner (Kirzner, 2001) [16] noted that if a person definitely knows what to expect, his or her plans can be fully explained based on the sound economic activity, optimal allocation of resources and their maximising. In other words, people's plans can be principally viewed as those that accumulate the total knowledge of all the current and future circumstances related to his or her situation and acting in the world of perfect knowledge. However, the researcher believes that it makes us to emphasise the importance of vigilance people demonstrate while treating new information [16].

3. Purpose

The objective of the research is to analyse the process of the economic cycle formation under the influence of economic agents' expectations in the USA in the period from 1947 to 2016.

4. Results

How may the expectation factor be taken into account to explain the reasons for the economic crisis or collapse? In order to answer this question, it is necessary to draw attention to the fact that, according to the theory of rational or adaptive expectations, economic agents will invest, expand their consumption only when they are confident in their future. In turn, confidence arises as a result of the factors that cause these expectations. These can be classified as positive in time economic statistics or decisive governmental action program. One way or another, people should receive positive signals, otherwise economic decisions will not be taken. On the other hand, one of the main reasons for the termination of economic growth and, therefore, the early phase of the economic crisis, is that during the recovery period systemic risk is automatically generated and accumulated, and false economic decisions are spread among the entrepreneurs. This is a psychological human trait of prolonging expectations for a longer period during the good times. This position is often wrong. In this case, economic agents' expectations match even more. It is possible to claim that the level of economic entropy decreases. This creates social pressure on all participants of economic relations. People start thinking that rising real estate prices, stock indexes and other assets will continue to grow further. Therefore, one should continue to invest, apply for loans or buy property. Back in the 1920s, A. Aftolion cited a stove as an analogue to this situation. He believed that, guided by a sense of cold and the thermometer value, the room may get overheated; it may take some time before the fuel flares and disperses heat in the room. «The thermometer and feeling cold» are quite misleading and can lead to a serious mistake because there is a long lag period between the first steps for getting more heat and the moment when finally more heat is received [17,158]. At this stage, entrepreneurs who are unable to make proper calculations and predictions about the effectiveness of their business are involved into the economic activity. These are the so-called «second wave» innovators. Their efficiency in terms of economic system is lower, and the risk level in their activity is higher.

All these events lead to the fact that some inconsistencies in the economic system create a rather precarious situation. One minor economic shock is enough to turn the whole system into the opposite direction - the economic crisis. To illustrate, in 2008 the bankruptcy of Lehman Brothers was quite a shock. This was a kind of «black swan» that appeared when no one expected. In 1927, A. Pigou (Pigou, 1927) [18] wrote about such impulses as factors pushing the start of new economic cycles.

Getting back to the economic concept of entropy, it should be noted that it was introduced by Clausius in 1865 [19]. According to the second law of thermodynamics, the level of entropy of any system must increase with time. It is characterised by the state of the system components. For example, if one adds milk to coffee, it will gradually distribute on the cup, increasing the overall entropy of the system. The probability that all the milk will be distributed by some clear principles, creating a circular or rectangular shape, virtually equals zero. If this happened, it could be assumed that the entropy of the system might decrease.

The economy is also a kind of system that consists of millions of different entities. The majority is represented by consumers, the minority - by investors and entrepreneurs. During the period of economic growth, the entropy of the system is gradually decreasing because all the expectations and actions of the system entities are predictable and identical. On the contrary, it is difficult to predict future events during the economic crisis. In fact, most investors minimise their investments, waiting for good news. Therefore, decisive actions are to be taken by any government in order to overcome the crisis.

Based on this concept, we believe that economic entropy can be regarded as the level of synchronisation of expectations matching the actual course of events in the economic

system. The entropy reaches its peak during the reversal of the economic system. Under these conditions, profits of business entities are also maximised due to cheap resources and services. The phase of economic growth starts. It will last until a certain economic segment (or segments) accumulate a critical amount of divergence between the expectations and the actual capital efficiency.

Once the level of economic entropy has dropped below the conventional critical limit, which is defined by the objective conditions, it means that the crisis is inevitable because of overwhelming economic agents' erroneous actions. At this time, various resources and investments are actively offered but cannot be demanded by the market for numerous reasons. Also, prices for a range of goods, primarily raw materials and real estate, start exceeding their real value.

The economic system has a relatively fixed margin for the erroneous decisions taken by its entities. However, if the number and the cost of errors exceed a certain limit, it pushes the system out of stability. These errors primarily occur when making investment decisions, both by businesses and consumers.

For the sake of testing our theoretical assumptions, a corresponding methodical approach has been developed. It is based on our method of calculating the total sliding expectations [20]. The essence of this method is as follows. The first stage is defining an interval of time series, according to which alignment should be performed. This trend line differs depending on the situation.

In the second stage, according to the obtained equation, the value is predicted one period ahead. The third stage is associated with a comparison between the predictive value (X') and the actual value (X) by finding the difference between them $\Delta X = X - X'$. The essence of this comparison is that if the trend has changed, the difference is quite substantial. Conversely, if the trend is preserved, the value ΔX cannot significantly vary from X . If the value of ΔX is negative, it means that the predictive value exceeded the factual, and therefore the real growth rate was lower than the expected one, based on the previous data. If the value is positive, the conclusion is opposite. In the fourth stage, the entire described process is shifted one period forward and repeated. As a result, the original time series is converted into a series showing the deviation between the actual and the forecasted data.

In the fifth stage, all values ΔX for the certain time periods are summed up (the period may be equal to 5-10 periods, or some other value). Subsequently, the resulting value can have either the «+» or the «-» symbol. If the value is positive, this indicates that the actual values prevailed over the expectations during the selected time period, and therefore the economic situation was slightly better than the expected one, based on the previous events. If the value is negative, the economic situation was worse than the expected one. It has been decided to name the resulting value «the total sliding expectation».

In terms of the level of expectations, these calculations are also important because the economy is difficult to predict in uncertain times. The total value of the sliding mode (ΔX) will significantly differ from 0, or from the average at least. It will give grounds to speak about the increasing risk and economic agents' uncertainty. Therefore, according to our concept, when the critical level is reached, mass panic in the relevant markets will start, as well as the removal and the transfer of assets into liquidity.

It has been decided to conduct the validation of the proposed conceptual approach to the explanation of the economic cycle on the basis of data related to GDP of the USA. This country has been chosen because it represents one of the world's largest economies and generates the current economic trends in the world. In addition, the National Bureau of Economic Research has considerable experience related to a formal definition of the beginning and the end of the economic crisis.

The website of the Bureau of Economic Analysis of the abovementioned country provides a great number of data

on GDP since 1929 [21]. However, GDP data sorted by quarters is available starting with the year 1947. As for the proposed method, this fact is important because a one-year period is not optimal when assessing the changes in expectations. The purpose is best achieved when quarterly or even monthly data are analysed. It has been decided to take quarterly data on changes in real gross domestic product (in USD as of 2009) for the period between 1947 and 2016. The width of the sliding window in determining sliding expectations equals ten periods (quarters), in order to eliminate the influence of random fluctuations. The sliding window, when summing the expectations, equals five periods. In this case, it is important to consider the current fluctuations, simultaneously eliminating the influence of random variation.

Furthermore, it has also been decided to compare the obtained results with the officially established minimum values of the economic cycle. The National Bureau of Economic Research publishes the latest values on its website [22]. For the chosen period, the maximum values of economic cycles occurred in the fourth quarter of 1948, the second quarter of 1953, the third quarter of 1957, the second quarter of 1960, the fourth quarter of 1969, the fourth quarter of 1973, the first quarter of 1980, the first quarter of 1981, the third quarter of 1990, the first quarter of 2001 and the fourth quarter of 2007.

Figure 1 shows the dynamics of real GDP growth rate of the USA changing in the period between 1947 and 2016 in terms of quarterly data. The vertical lines show the maximum values of economic cycles according to the National Bureau of Economic Research. This time series is characterised by fairly substantial variations and fluctuations, which makes data analysis far more complicated.

The results of processing data by applying the method of total sliding expectations are shown in Figure 2. The width of the sliding window in determining sliding expectations equals ten periods (quarters), in order to eliminate the influence of random fluctuations. The sliding window, when summing the expectations, equals to five periods. Such transformation of the initial data allows us to present the hidden patterns in the changes in GDP, specifically in the light of expectations.

It should be noted that almost every peak period of sliding expectations time series is preceded by the maximum value of the economic cycle. Nevertheless, there were periods when the maximum of sliding expectations time series occurred without reaching the maximum gross domestic product.

Let us summarise the results for the periods presented in Table 1. The difference between the actual and the maximum total sliding expectations values averaged 65 quarters. Although, it was the largest in the last cycle and equalled 22 quarters. We will not go deeper into explaining the reasons for such a discrepancy. This is a complex issue which requires

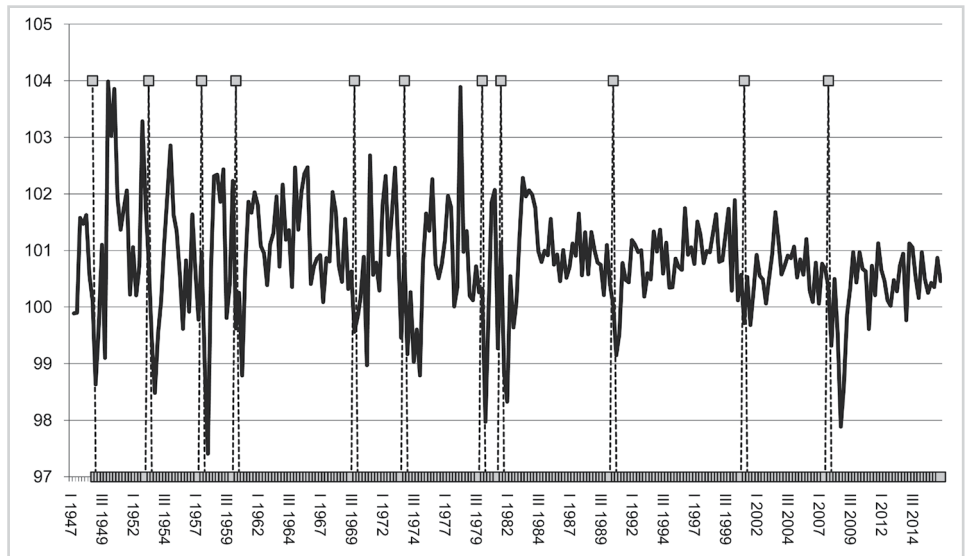


Fig. 1: The dynamics of the real US GDP changing rate in 1947-2016 (%)
Source: Calculated by the authors based on [21-22]

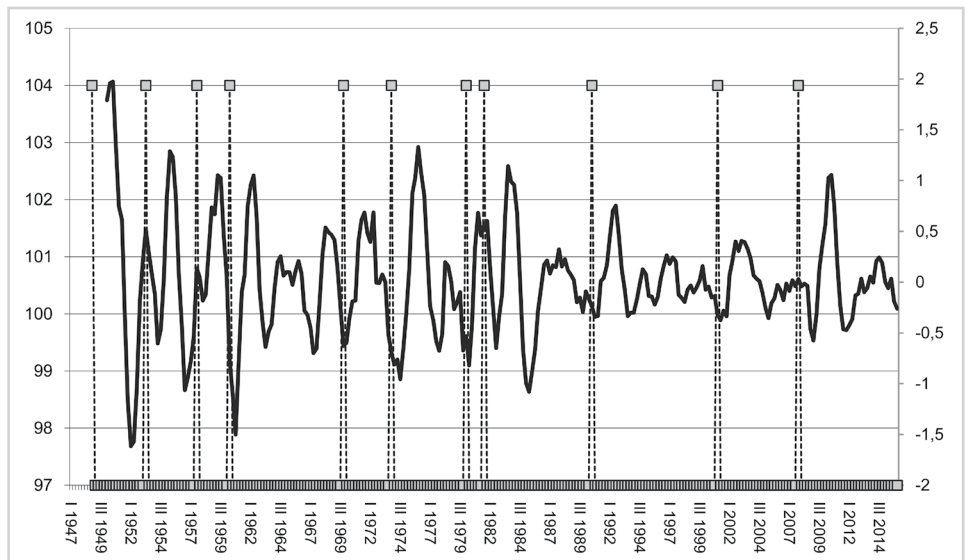


Fig. 2: The dynamics of the real GDP total sliding expectations in USA in the period between 1947 and 2016 (%)
Source: Calculated by the authors based on [21-22]

independent research. The main result is the establishment of the pattern.

Our aim is also to answer the question to what extent the total sliding expectations values correlate with the actual values of the economic cycle. In order to answer this question, the following calculations were carried out.

Tab. 1: Date of the maximum values of economic cycle and the maximum values of the sliding expectations time series relevant to GDP in the USA in the period between 1952 and 2016

Maximum values of the economic cycle	Maximum values of the sliding expectations time series
1953 - II	1952 - III
1957 - III	1955 - II
1960 - II	1959 - III
1969 - IV	1968 - III
1973 - IV	1972 - II
1980 - I	1978 - II
1981 - I	1981 - I
1990 - III	1987 - IV
2001 - I	1999 - IV
2009 - IV	2003 - II

Source: Calculated by the authors based on [21-22]

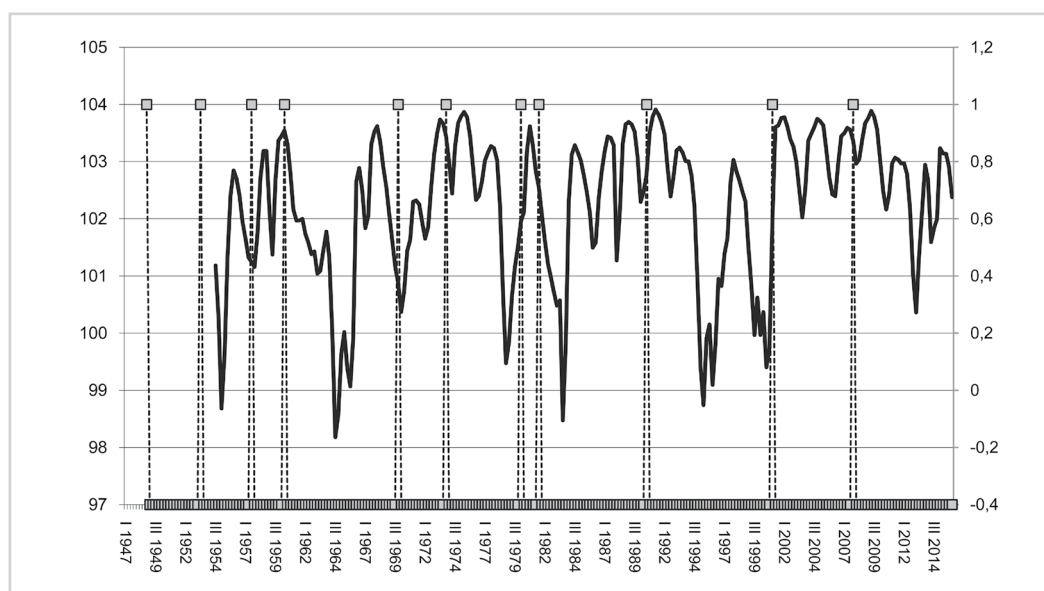


Fig. 3: Dynamics of correlation coefficients between the model and the real sliding expectations relevant to GDP in the USA in the period between 1947 and 2014 (%)
Source: Calculated by the authors based on [21-22]

In the first phase, the model values for the last time series value were determined according to the linear trend. Further, we applied the method of sliding window to calculate the subsequent data. The last stage was to determine the correlation coefficients between the model and the sliding expectations. The width of the sliding window was equal to ten periods (quarters).

The aim of this calculation was also to test the assumption that the peaks of economic cycles comply with the expectation maxima. This can be proved by the high values of correlation coefficients between the values of the model and actual sliding expectations. The resulting data are shown in

Figure 3. It can be inferred from the figure that the maximum values of the economic cycle coincide quite clearly with high values of the correlation coefficient. This confirms our assumption.

5. Conclusions

The conducted research allows us to claim that there is a fairly close relationship between the actual dynamics of the US gross domestic product and economic agents' expectations relative to possible changes in it. In addition, there is a coincidence of expectations with the economic cycle maxima. The results clearly encourage the possibility to increase the predictability of economic performance.

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