The Relationship between Inflation and Unemployment: A Theoretical Discussion about the Philips Curve

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Abstract

Inflation and unemployment are integral part of a market economy, with socioeconomic consequences for the population of the countries in which these processes occur. For most of the able-bodied population growing unemployment normally means catastrophe. Unemployment often brings terrible consequences, such as declining incomes and purchasing power, which in turn leads to an inability to raise their living standards. As for inflation, which many of us used to call "the enemy of society #1", its field of activity is increasing pricing of goods and services. For many emerging economies this phenomenon has the character of a disaster. The purpose of this article is to show the connection between inflation and unemployment, if this connection is significant, and which variables can define it. We will try to figure it out by analyzing different opinions of economists concerning the Philips curve, by constructing short-term and long-term Philips curves (basing on statistical data of The Russian Federation) by making some conclusions about the results at the end. We pay special attention in our research to the study of Phillips curve made by some economists of the last century.

**Keywords:** Philips curve, inflation, unemployment, Russia

1. Introduction

Inflation rate and unemployment rate are two of the key indicators of an economy. There are lots of scientists who still discuss the connection between them. But does this connection actually exist? How do they influence each other and is there any trade-off between these two indicators? To answer these questions, we need to analyze the works dedicated to the topic, give the definition to the concept of the "Phillips curve"; consider the evolution of the economic outlook for inflation and unemployment of outstanding economists of last century; analyze the statistics of inflation and unemployment in Russia with the help of graphs.

A great contribution to the study about the connection between unemployment and inflation was made by a Professor of the London school of Economics - Alban Phillips [10] (1914 – 1975) in 1958. Analyzing information with statistics for the period of more than a hundred years, he came to a conclusion that there is a certain level of unemployment (6-7%), in which the wage level is constant and its increment is zero. When unemployment falls below this natural level, we can see a more rapid increase in wages, and vice versa. The view of the Phillips curve is presented in Figure1 below.

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Figure 1 Phillips curve

The Phillips Curve
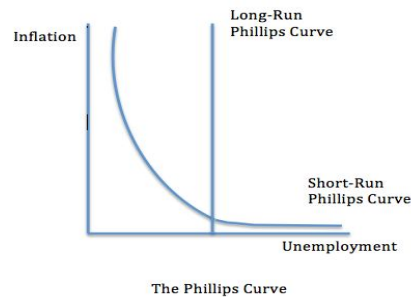
In the future, using a thesis of a strong correlation between wage growth and prices, this pattern was transformed into a relationship between unemployment and price levels – inflation [14]:

$$P_{t=}P_{t-1}[1-b(U_t - U^*),\hspace{4cm}(1.1)$$

Where U_t and U^* are the actual and natural levels of unemployment;

b is a coefficient showing the response of wage's changes to the situation on the labor market;
P_t and P_{t-1} are respectively the prices in the current and prior periods.

Phillips curve was reasonably well confirmed by empirical studies of statistical indicators of the leading countries in 1950 -1960s. During this time the economies of many countries achieved the full employment. However, during the adopting of the policy aimed at the further increasing of production and reducing unemployment, the rise in prices has accelerated, and the slowdown in inflation was accompanied by increases in unemployment.

There are different explanations of the existence of the inverse relationship between inflation and unemployment. Partly we can explain it with the role of flexibility of the labor market. Until there is a full employment in the economy, some segments of the labor market will remain unchanged unemployment, but situation on the other markets could lead to unsatisfied demand. This entire scenario could lead to the higher costs, growth in wages and so higher prices. The macroeconomic result of this process will be an accelerated inflation.

Another explanation of the Phillips curve is the obvious fact, that for producers and workers it is easier to increase prices and wages during periods of economic growth. High unemployment forces employees to accept lower wages, which breaks inflationary spiral "the salary - the prices". In the opposite situation, as we approach full employment, there is a growing demand for additional factors of production. The consequence of this situation can be as follow: growth in wages outstripping the growth in productivity. That can lead to untwisting the inflationary spiral "the salary - the prices" [8]. The result of these processes will be an accelerating of inflation. The essence of the Philips curve is visually represented through the analysis of the curves of aggregate supply and demand. The growth of aggregate demand in the economy creates new imbalances and psychologically increases the limited resources. Thus, we can see that with the growth of demand, inflation is increasing. The larger the increase in aggregate demand and the closer the economy to having full employment, the higher prices will be.

The theme of our paper was detailed in the following works: "Krivaja Fillpsa, ili eshhe o dostovernosti jekonometricheskih gipotez" made by Russian economist Shheglov A. [13], "An examination of U.S. Phillips curve nonlinearity and its relationship to the business cycle" by Derek Stimel [1] and "Choosing the Wrong Natural Rate: Accelerating Inflation or Decelerating Employment and Growth" by Hargreaves-Heap S.P. [5], etc. Also we were using such electronic resources as "Terra Economicus", "Economica" and others. The statistics that we used in this paper was taken from the "The Federal State Statistics Service of Russian federation" [15]. Based on the data of Russian Federation of unemployment and inflation between 1991 and 2015, we built short-term and long-term graphs. Russia is developing in the condition of emerging market, so the questions like "whether the patterns we described by the long-term Phillips curve are working in Russia?" or "is the natural rate of unemployment already existing here?" have important theoretical and practical significance. By analyzing them, we conclude that a clear inverse relationship between inflation and unemployment is valid only for some short-time intervals.

Analyzing the work of economists, we can notice that the existence of the Phillips curve for Russia basically was always rejected. This connection was confirmed only for several points, mainly for the short-term period. A study made by Gafarov [2], the intern of the laboratory (of the Moscow higher School of Economics) is searching the problems of inflation and economic growth, based on a complex mathematical processing of quarterly changes in unemployment rates and the Consumer Price Index for 1999-2009, showed that in the short-term periods, Phillips curve was still observed in some years of the last decade. The venerable scientists approved the study.

But still we can say that actually, there is no clear opinion about the Philips curve. Disputes about the relationship of inflation and unemployment continue up to nowadays. Scientists agree only with respect to a long-term Phillips curve, that it should be a vertical straight line. As for the short-term period, in this paper we consider three main areas – the Keynesian, Neoclassical and Monetarist's concept.

1) Traditional Keynesian interpretation of the Phillips curve

Some of traditional Keynesians (such as Lipsey [6], Samuelson and Solow [12]) have tried to give theoretical justification for described connection. They have built their beliefs based on the concept of static expectations. According to them, there is some alternative between inflation and unemployment, i.e. the Phillips curve is interpreted as a certain law, a certain dogma. If aggregate demand tends to increase, respectively, the same trend will have the demand for factors of production. And since the concept of static expectations provides all subjects are static in their expectations, the unemployment will decline and, ultimately, will be below the natural level of unemployment. In turn, inflation will increase. Thus, economists had gained a negative relationship between the rate of change of wages and unemployment:

$$\Delta W / W = f(U), f' < 0, \qquad\qquad\qquad (2.1)$$

Where $\Delta W / W$ is the rate of change of nominal wages; U is the unemployment rate.

The last step in the formulation of the usual way of the Phillips curve - changing the growth rates of wages at the inflation rate:

$$\pi = h(U), h' < 0, \qquad\qquad (2.2)$$

Where π is the inflation rate.

The Phillips curve played a dual function in the evolution of traditional Keynesianism. On the one hand, it filled some theoretical gaps in the construction of Keynesian thought, which, perhaps, paid too much attention on the emphasis on the interaction between markets of goods and money, paying too little attention to the labor market and its relation with the market of goods. On the other hand, the Phillips curve was a very convenient tool for people that were responsible for the macroeconomic policies. In fact, such a policy would turn into sliding on the Phillips curve, the slide that is showing us the compromise between inflation and unemployment: if people are dissatisfied with a high level of unemployment, it is possible to satisfy their requirements with expansionary policy. Then employment will increase, but at the cost of having such consequence as inflation. And if people protest over too rapid increase of prices for buying goods, the government can resort to restrictive policy, then the inflation rate would decrease, but unemployment will increase.

2) Interpretation of the Phillips curve by Monetarists and Neoclassicists

Monetarists (Friedman [4], Phelps [9]) upheld the concept of adaptive expectations according to which subjects adjust their expectations, taking into account the errors of previous periods. However, proponents of this concept believed that the entities do not have fully reliable information, therefore, will respond to changes with some delay. Monetarists believed that every single action that is a stimulating policy can lead to growth in wages and national income, but then subjects need to adapt to the new conditions, and they will start to revise the terms of sale factors. This will lead to an increase in the level of aggregate supply. As a final result we will get the initial value of employment, but with the higher inflation. So, as we said before, monetarists used the hypothesis of adaptive expectations. The expected inflation rate is a function of "past experience", i.e. past inflation:

$$P^e_t = P^e_{t-1} + \psi(P_{t-1} - P^e_{t-1}), \qquad (3.1) \text{ Where } \psi \text{ is the adaptation index}$$

Neoclassicists (headed by Lucas [7]) were criticizing the Monetarists' school approach, pointing to the incompatibility of the hypothesis of adaptive expectations with a fully rational behavior of economic subjects. Neoclassicism followed the concept of rational expectations. They believed that the subjects of economy are able to adequately analyze changes in economic performance, which must cause changes in the conditions of sale factors for expected inflation. Thus, changes in aggregate demand generate changes in aggregate supply and the level of output and employment will not change (if construct a graph, then the short term of Phillips curve will coincide with the long-term). Moreover, representatives of the neoclassical school believed that the simultaneous growth of wages and prices would lead to cost of production, as the economy will come to a situation where productivity growth will lag behind growth of wages. This can lead to slowdown of a business and to the decline in output growth and to the increasing of inflation. Economic subjects tend to use all the available information for decision-making (including the period of expectations' formation). As a rule, this implies that they know all the parameters of relevant economic functions. They can be mistaken in their expectations only in the situation of the random shocks. Algebraically this approach can be described as follows:

$$Q_{Dt} = \gamma - \eta P_t + U_t; \qquad\qquad (3.2)$$
$$Q_{St} = \mu + \tau P_t + V_t; \qquad\qquad (3.3)$$
$$P^e_t = P^e_t(\gamma, \eta, \mu, \tau); \qquad\qquad (3.4)$$
$$Q^e_{Dt} = Q^e_{St}; \qquad\qquad\qquad\qquad\qquad (3.5)$$
$$\gamma - \eta P^e_t = \mu + \tau P^e_t; \qquad\qquad (3.6)$$
$$P^e_t = (\gamma - \mu)/(\eta + \tau), \qquad\qquad (3.7)$$

Where, Q_{Dt} and Q_{St} are the volumes of demand and supply of a particular good in the current period of time;

γ, η, μ, τ are the parameters of demand and supply functions for particular good;
U_t and V_t are stochastic ("shock") variable in a function of supply and demand;
P^e_t is the price expectations of the current period.

In our situation, a similar shock could be an unexpected monetary policy. Neoclassicists believed that economic agents used to confuse the changes in the relative prices of the products with the changes of general prices. This situation is a great benefit for the Central Bank: following an unexpected policy, Bank is just not fulfilling the promises about maintaining a specified rate of growth of the money supply. In this case, the rate of increase of money supply and rising prices for the different types of products will be higher than expected by the private sector. Manufacturers of certain types of goods will perceive these changes as the rise in prices for their products, rather than as the general price level. As a result, in many sectors of economy we will see the increase of production and employment.

Both treatments led to a new point of view on the Phillips curve, which algebraically can be expressed as follows:

$$\pi = \pi^e + h(U - U^N) \qquad\qquad\qquad (3.8)$$

This view suggests the idea of shifting the short-term and vertical long-run Phillips curve. Shifts in short-term Phillips curve (in case of stimulating policy it is going up) occur when the economic subjects recognize their mistakes of expectations (no matter which kind of mistakes: adaptive expectations or imperfection of information). Eventually the economy returns to a long period, appearing on the vertical line of long period. The long-term Phillips curve, as a vertical line, represents a fundamental conclusion made by both neo classical and monetarist school: in the long run there is no trade-off between inflation and unemployment! Thus, the discretionary policy is not only ineffective, but harmful. The Government's policy in the face of the Central Bank should be regulated.

By the early 1980s, the interpretation of the Phillips curve made by neoclassical and monetarist school, started to be questioned by the various economists, primarily representatives of various Keynesian school, the criticism of this interpretation was carried out in different directions. Firstly, it has been questioned by the hypothesis of adaptive and rational expectations. It was alleged that the expectations is a complex process, so it is wrong to describe it by using the specified formula. Second, the combination of the hypothesis of rational expectations and the imperfection of the information is controversial.[11]

So, why do people manage to learn the parameters of the basic economic functions, but they are not able to get accurate information of the general price level?

In addition, the consumer price index is usually published at least once in a week (in Western countries), and a person is able to know it, even if his/her behavior is not "strongly" rational. Finally, econometric attempts to confirm the monetarist and neoclassical conclusions about the shape of the Phillips curve were not successful. The growth in employment and acceleration of inflation were correlating with each other.

3) Analysis of the level of unemployment and inflation on an example of the economic situation in Russia, 1999-2015

To give an understanding into why we took statistical data for the period from year 1999, let's turn to the historical aspect of Russia. Economic situation of the Russian Federation can be divided into two periods – 1992-1999 and from 1999 to present day. The Soviet Union collapsed in 1992 and the country was revived again. So, during the 90s, the economy experienced a deep recession, accompanied by a surge in inflation, lower investment, the growth of external debt, barter economy, the debt crisis, a decrease in income and many other negative phenomena. During the decade, some economic reforms were carried out, including the liberalization of prices and foreign trade, mass privatization. One of the results of the reforms was the transition of the economy from a planned one to a market economy. The economic policy that was pursued in 1995-1998 were generally unsuccessful. The government, using dubious methods to counter inflation, turned into a big violator of financial liabilities, and made a great contribution in support of a high level of distrust in the economy, which greatly impeded investment activity. The investigation of the macroeconomic policies of 1995-1998, in particular, led to the decline in production and a significant outflow of capital from the country.

From 1999 to 2007, the production index of manufacturing industries increased by 77%, including the production of machinery and equipment - by 91%, textile and clothing production - by 46%, production of food - by 64% [15]. By 2006, the Russian ruble became convertible on current and capital transactions. The volume of GDP in 2005 increased by 6.4%[15] compared with the previous year. The results of the Russian economy in 2007 showed accelerated growth in relation to the 2005-2006 years. In 2007, the rate of economic growth in Russia was the highest during those years. At the end of this year, Russia became one of the 7th largest economies in the world, ahead of Italy and France, and also joined the group of countries with high human development index.

Since 2012, the Common Economic Space of Russia, Belarus and Kazakhstan started to exist. In August 22 of the same year, Russia joined the World Trade Organization. During 2013, economic growth in Russia fell under the influence of structural problems and country faced decrease in investment activity. The stagnation of the economy in the first half of 2014 continued, and in December 2014, after the collapse of the Russian ruble against the US dollar and the EU euro, in the Russian Federation we can see the period of financial crisis. The authors of this paper propose to consider the period of the Russian economy starting from 1999, since that period seems to be the most interesting to consider in this context.

To understand whether the Phillips curve has a value in economy, we will analyze relevant statistical data about unemployment and inflation on the Russian example. First let's construct the empirical Phillips curve: the horizontal x-axis shows the value of unemployment as a percentage of the economically active population from 1999 to 2015 [15], the y-axis, respectively shows the value of inflation for the same period.

Table 1 Data on unemployment and inflation of Russian Federation for the period of 1999-2015

Years	Unemployed people(% of economically active population)	Inflation (%)
1999	13.0	36.6
2000	10.6	20.1
2001	8.9	18.8
2002	7.9	15.1
2003	8.2	12.0
2004	7.8	11.7
2005	7.1	10.9
2006	7.1	9.0
2007	6.0	11.9
2008	6.2	13.3
2009	8.3	8.8
2010	7.3	8.8
2011	6.5	6.1
2012	5.5	6.6
2013	5.5	6.5
2014	5.3	11.3
2015	5.8	11.2

Data used from: _www.gks.ru_ – Federal State Statistic Service of Russian Federation

Let's try to construct the Phillips curve using the statistical data of Russian Federation, and see if this curve is applicable for to the economic situation in Russia: the charts for short-term and long-term periods.

Graph 1 Long-term chart of inflation-unemployment curve
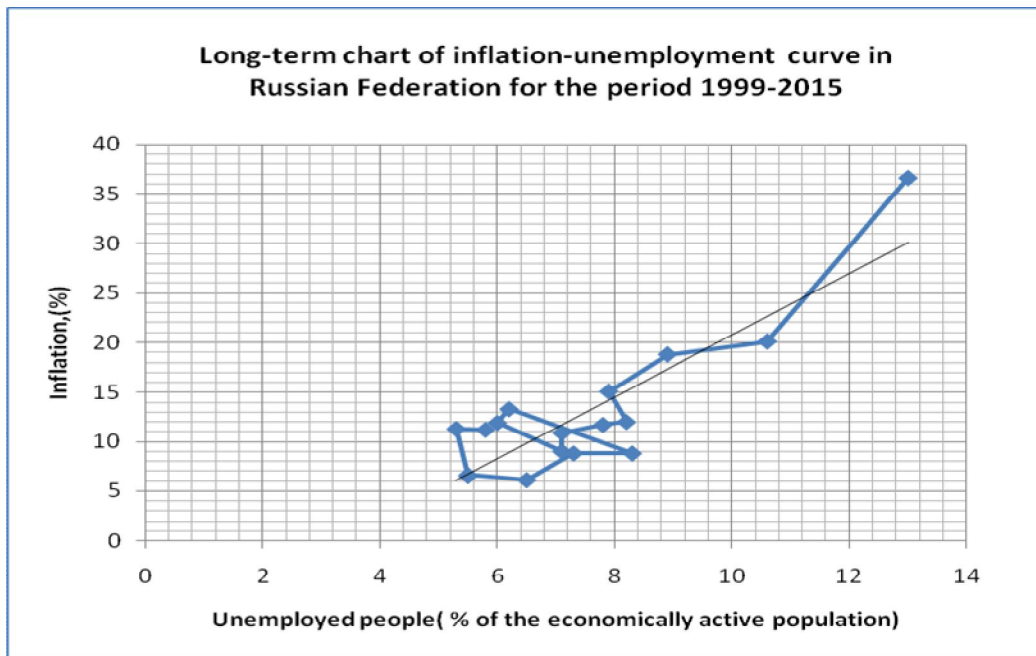
Made by author using Excel program and above data

Since 1993, Russia's economy is in a stage of stagflation, i.e. the decline in production is coupled with inflation and rising unemployment. The prices in October 2006 were increased compared to December 1993 by 4658 times, and the number of unemployed people was increased on 6040 thousand [15].

Looking at the graph 1, we are seeing a mismatch with the Phillips curve for the long term. The curve is not a vertical line. Moreover, we observe that the increase in inflation does not lead to a reduction in unemployment: the maximum point of inflation of 15,1% corresponds to the level of unemployment at the point of 7,9, as well as the decline in inflation does not lead to an increase in unemployment, mostly at this graph we can see that with the decline in inflation it is happening the decline in unemployment as well.

Table 2 Data of unemployment and inflation of Russian Federation monthly for the period of 2014

Month	Unemployed people(% of economically active population)	Inflation (%)
January	5.6	0.6
February	5.6	0.7
March	5.4	1.0
April	5.3	0.9
May	4.9	0.9
June	4.9	0.6
July	4.9	0.4
August	4.8	0.2
September	4.9	0.7
October	5.1	0.8
November	5.2	1.3
December	5.3	2.6

Data used from: www.gks.ru – Federal State Statistic Service of Russian Federation

Graph 2 Short-term chart of inflation-unemployment curve
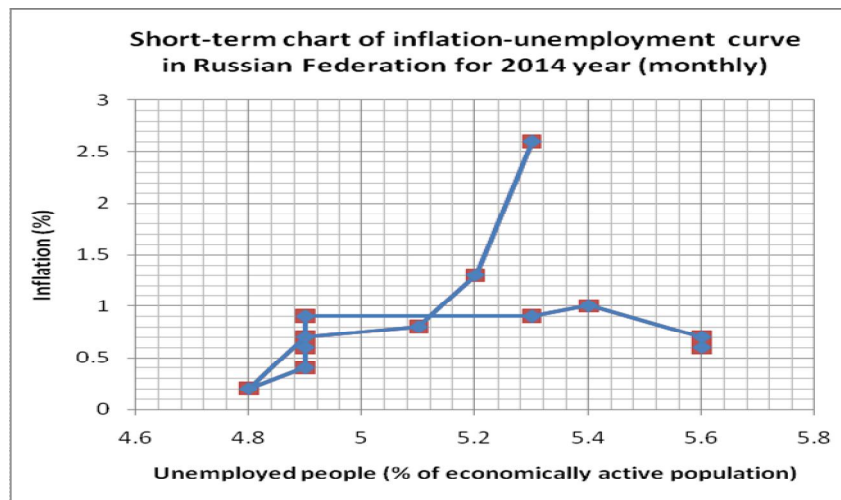
Made by author using Excel program and above data

As we can see, the maximum point of unemployment (5.6%) corresponds to inflation in the 0.6 and 0.7%, which in our example is the average number. The minimum point of the unemployment rate (4.8%) corresponds to the inflation rate of 0.2%. When considering the level of inflation, we can observe that the maximum level of inflation (2.6%) corresponds to the point of unemployment of 5.3%, and the minimum (0.2%) - 4.8% for Unemployment. Thus, it is easy to notice that on some points of the short-term graph, Phillips curve is suitable for the economic situation in Russia. For example, we see in January-March 2014 unemployment fell from 5.6% to 5.4%, while inflation increased from 0.6 to 1,%. However, from May to August, when the unemployment rate decreased slightly from 4, 9 to 4.8%, inflation also decreased from 0.91% to 0, 2%, so in this period, we can say that the Phillips curve is not applicable to the Russian economy.

Thus, we can conclude that in general the graph of the Phillips curve is not applicable to the economic situation of Russia: in the short-term and in the long-term (1999-2015 years). Unfortunately, the limited scope of this paper does not allow us to analyze the effect of the Phillips curve for a longer time interval, where building long-term Phillips curve would be possible. In our case, this behavior of the curve can be explained by the peculiarity of the economic situation in Russia chosen for the analysis period. For example, it may be caused by the policy of Russia on the international stage and difficulties in the economic situation of Russia in connection with the entered sanctions and the situation in Ukraine.

In addition, according to experts of Institute of system analysis ISA RAS[16], Russian inflation depends up to 48% due to unequal external trade and export of capital, up to 24% due to emissions of the ruble in ruble zone territory and loans to the other countries and only 23% is due to the state budget deficit and the emission of the Central Bank of Russia. At the beginning of 2000, degree of the monetary of Russian inflation and its relation to employment were rising, but were not dominant. All this testifies to the fact that unemployment and inflation in Russia has just a little connection with each other. Therefore, it seems very real to make an anti-crisis program, that combines the ways of reducing inflation and unemployment, and as for the theory of the Phillips curve, it was not applicable here none for a short and for a long periods.

4) Conclusion

The processes of inflation and unemployment are integral part of the market economy and are considered as the scourges of our time. During the recent years, unemployment has risen high enough, and the opportunity to find a job for the working population is still quite an acute problem. The rise of prices is continuing rigorously, as we can see it from increasing prices for goods and services (already in the current year). So, based on the study material, it's obvious that from the historical point of view the connection between inflation and unemployment does exist. Most of economists agree to the opinion that in the short-term, there is an inverse relationship between unemployment and inflation. As for the long-term, such a relationship is absent. Therefore, the government's efforts to stimulate aggregate demand to increase the volume of GDP at full employment only lead to an increase in inflation.

Phillips curve provides important insights for policymakers. It suggests that the ideal macroeconomic situation with stable prices, full employment, and stable growth is unattainable in certain short-term situations. If the government chooses the monetary or fiscal policy, in order to cope with specific short-term situation, sometimes it really has to decide whether to choose higher unemployment or higher inflation. In addition, analyzing the situation of the Russian Federation, it is possible to agree with Nobel laureates Milton Friedman and Edmund Phelps, who thought that the Phillips curve is a short-term effect. In Russia, as already stated, we have observed this effect for several years (and months from 2014).

To eliminate the occurrence of these phenomena is absolutely impossible, which proves that long-term economic practices of different countries. But there are certain methods of regulating the growth of inflation and unemployment, with the help of specially designed instruments of state regulation based on the legislative framework. So, our opinion is: a certain level of inflation and unemployment is necessary as it keeps the market in a balance. According to the above statistics, the author concludes that Phillips curve is not really applicable for the modern Russian situation. First it has to go through a stage of stabilization, which will take at least up to ten years, and only after that we can talk about achieving economic stability and full employment indicators

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