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THE NAIRU AND THE NATURAL RATE OF UNEMPLOYMENT – A THEORETICAL VIEW

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ABSTRAKT

Příspěvek představuje teoretickou diskusi, jejímž cílem je na základě původních pramenů podat vysvětlení pojmů NAIRU a přirozené míry nezaměstnanosti a provést jejich srovnání. Oba pojmy hrají důležitou roli v hodnocení charakteru nezaměstnanosti a cyklické pozice ekonomiky. Příspěvek se proto soustřeďuje na vymezení obou pojmů v kontextu ekonomické rovnováhy. Druhým cílem příspěvku je vymezení obou pojmů s ohledem na otázku jejich empirického odhadu. Mají-li být použity relevantní ekonometrické metody pro odhad NAIRU nebo přirozené míry nezaměstnanosti, vědomí jejich teoretického zázemí je zcela nezbytné.

Klíčová slova: inflace, NAIRU, Phillipsova křivka, přirozená míra nezaměstnanosti, strukturální nezaměstnanost.

ABSTRACT

The paper presents a theoretical discussion with the aim to provide an exposition and comparison of the concepts of the NAIRU and the natural rate of unemployment based on the study of the original sources. Both concepts play an important role in assessing the nature of unemployment and cyclical position of the economy. Thus, the paper focuses on the concepts within the framework of economic equilibrium. The second target is to examine the concepts with respect to the problem of empirical estimation. If relevant econometric methods are to be used to estimate the NAIRU or the natural rate of unemployment, the knowledge of the theoretical background is necessary.

Keywords: inflation, NAIRU, natural rate of unemployment, Phillips curve, structural unemployment.

JEL Classification: E00, E24.

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The modern macroeconomic theory based on the intersection between the Neo-Classical version and the Keynesian economy views economy as a system that tends to fluctuate around its dynamic equilibrium. Economic equilibrium is the term that is relatively hard to be described in theoretical terms and rendered in empirical terms. One of the key images of macroeconomic equilibrium is potential output that can be defined as an output of the economy which fully exploits production factors while using a given technology. At the same time, this is a product for which the actual rate of inflation is equal to the expected rate of inflation or to put it in more general terms, where expectations of economic agents match reality. At any rate, potential output is attained by means of production factors: labour, land and capital available to a particular economy. This is precisely in the labour market that potential output is reflected in the natural rate of unemployment or from a certain perspective also in the NAIRU – non-accelerating inflation rate of unemployment.

This paper deals precisely with this possible image of macroeconomic equilibrium. Similarly as potential output, also the natural rate of unemployment and the NAIRU are terms that are relatively hard to be defined. This stems from the fact that in particular the NAIRU has not been initially defined as exactly as the natural rate of unemployment.

This paper is divided into three sections. The first section deals with the natural rate of unemployment in the context of the Phillips curve. While the NAIRU is not subject to any specific interpretation of the Phillips curve, the natural rate of unemployment is quite obviously related to the so-called expectations-augmented Phillips curve which, as a model, is attributed jointly to E.S. Phelps and M. Friedman who incorporated the inflationary expectation into the Phillips curve model. The first section starts with an analysis of studies by A.W. Phillips who described the relationship between wage inflation and the rate of unemployment. It continues by discussing modification taking the form of transformation of wage inflation to price inflation which was presented jointly by P.A. Samuelson and R.M. Solow and ends by the above mentioned augmenting of the model by the inflationary expectations. The Phillips curve model from the viewpoint of the rational expectations hypothesis is not presented in this paper since its contribution to the issue of the natural rate of unemployment itself is zero.

The second section of the paper presents the term NAIRU which is immediately confronted with the natural rate of unemployment. We took as the basis for our analysis the work by F. Modigliani and L. Papademos in which the idea, then under the name the NIRU, was introduced. The NAIRU concept was significantly and repeatedly worked out in detail and confronted with the natural rate of unemployment by J. Tobin to whose work subsequent reference is made in our paper.

In conclusion, the key findings from both sections are summarized and the paper focuses on implications of theoretical analysis for the empirical estimation of the NAIRU. The thing is that the different theoretical basis of both terms does not enable to use the same econometric methods for the estimation of the NAIRU and for the estimation of the natural rate of unemployment.

1 Phillips curve and the natural rate of unemployment

The natural rate of unemployment and the NAIRU can be understood as reflections of potential output in the labour market, i.e. the reflections of potential macroeconomic equilibrium. Consequently, the empirical expression of the NAIRU is useful for the assessment and prediction of the economy's cyclical development, as well as for the analysis of the labour market itself. The same holds for the term natural rate of unemployment. However, both the natural rate of unemployment and the NAIRU are very controversial terms. For this reason, their estimation, but also their interpretation itself is very ambiguous.

We can say that the history of these terms (not the issue as such) starts with the paper by A.W. Phillips (1958) who examined in his work the relationship between the dynamics of the development of nominal wages and the rate of unemployment in Great Britain in the period 1861-1957.

Phillips's paper was not the first systematic analysis of the relationship between the rate of inflation and the rate of unemployment. In 1926, I. Fisher published a study which examined the relationship between the price inflation (not the wage inflation as in the case of A.W. Phillips) and the rate of unemployment. This text has been published again in 1973 after its reappearance. However, it is true that the original edition went unnoticed and apparently, Phillips himself has not been inspired by this paper either. All key papers developing the issue of the Phillips curve, the natural rate of unemployment or the NAIRU further, build on the original Phillips paper.

A well-known negative relationship between the wage inflation rate and the rate of unemployment, as defined by Phillips, soon became part of the standard economic theory under the name the Phillips curve. The Phillips curve was an important building block within the system of the Keynesian macroeconomy where the link between real and nominal economy was missing[1]. Phillips himself has already defined the rate of unemployment for which nominal wages showed no tendency to rise or fall. This rate of unemployment has been defined in his work only on an empirical basis.

Soon, the original Phillips curve was transformed by P.A. Samuelson and R.M. Solow (1960) into the so-called price inflation Phillips curve. On condition that prices are set by mark-up to labour costs and if the development of the labour productivity is taken into

[1] Keynes in his key work The General Theory of Employment, Interest and Money (1963) basically assumed only a short period and economy in recession. Therefore, the price levels (including wage rates) were fixed and it was not necessary to take into account the relationships between the development of real output and prices. In this context, it is worthy of mention that from the viewpoint of the original Keynesian theory, economy, due to insufficient absorption, tends to attain equilibrium systematically below the level of the real output that would reflect full utilization of production factors. The terms, such as the NAIRU or the natural rate of unemployment in this context are devoid of any meaning, as regards the examination of the economy's cyclical nature.

account, the wage inflation can be relatively easily transformed to the price inflation. This curve, normally labelled as the modified Phillips curve, became the building block of economic policy in particular in the 60's of the last century. To put it briefly, it represented trade-off between the rate of inflation and the rate of unemployment.

In Samuelson's and Solow's work, we can see also clearly presented considerations about the shape of the Phillips curve and the rate of unemployment that represent neither inflationary (nor disinflationary) pressures. Samuelson and Solow compare empirical results for the USA with those that have been estimated for Great Britain. The estimate of this „equilibrium" rate of unemployment for Great Britain is lower than for the USA. At the same time, however, the whole modified Phillips curve was steeper for the U.S. economy than for Great Britain.

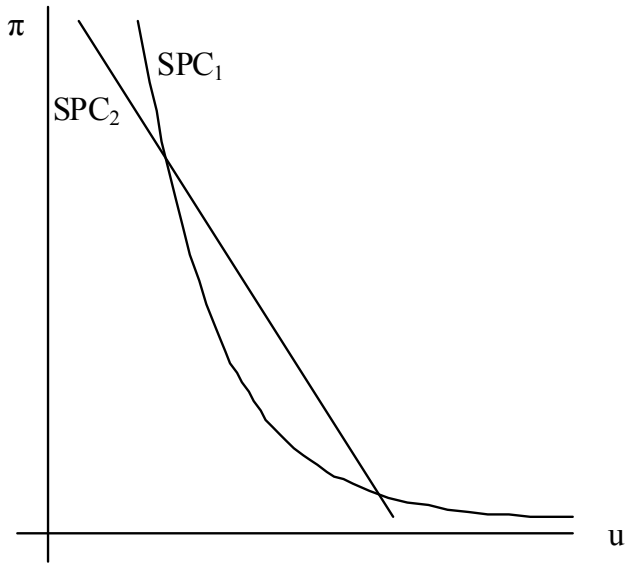
The specific behaviour of the Phillips curve plays a very important role, in terms of the rate of trade-off between inflation and unemployment. The shape of the Phillips curve was explained in particular by the downward rigidity in wage rates. The higher downward rigidity of wage rates in Great Britain resulted in the situation where reducing the rate of inflation by, say, a half percentage point, from a certain moment on had to be paid for by the rising rate of unemployment. The modified Phillips curve was a hyperbola. For the U.S. economy, it was rather linear in shape which indicated higher downward flexibility of wage rates. This issue is explained in Figure 1. The figure shows two modified Phillips curves: SPC_1 and SPC_2. The Phillips curve SPC_1 is nonlinear and the Phillips curve SPC_2 is linear. In the case of linear behaviour of the Phillips curve, it is obvious that the trade-off between the inflation and the rate of unemployment is a constant parameter in the whole assumed interval. On the other hand, the behaviour of the Phillips curve SPC_2 implies that by reducing the rate of inflation, gradually, the „price" in the form of the higher rate of unemployment is rising. From a certain, sufficiently low rate of inflation, any additional reduction in the rate of inflation can be attained with an unlimited rise in the rate of unemployment. This trivial finding is important in particular with respect to the later discussion pertaining to the relationship between the natural rate of unemployment and the NAIRU.

As far as the level of the non-inflationary rate of unemployment is concerned, Samuelson and Solow (1960, p.190) state the following:

„It is clear that the more fractionated and imperfect a labor market is, the higher the over-all excess supply of labor may have to bebefore the average wage rate becomes stable..."

„This suggests that any governmental policy which increases the mobility of labor (geographical or industrial) or improves the flow of information in the labor market will have anti-inflationary effects..."

Figure 1: Modified Phillips curve



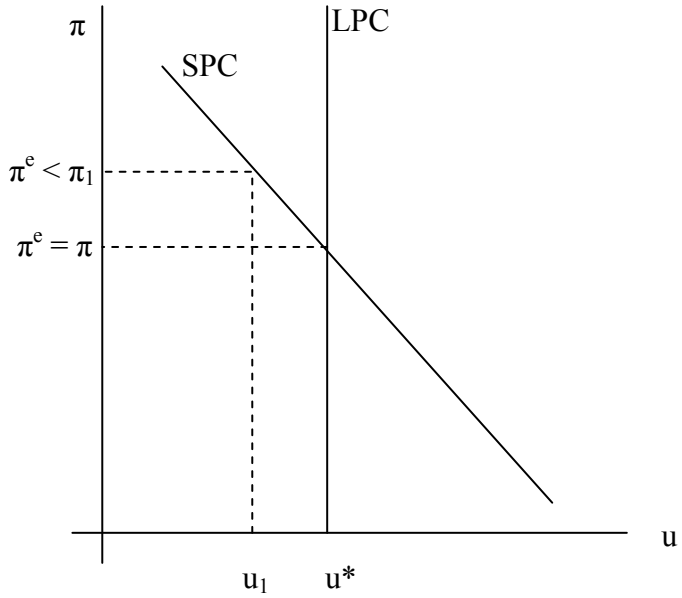
Although they do not directly specify in their paper links to individual types of unemployment and certainly do not define in theoretical terms this „non-inflationary" or „stable" rate of unemployment, the relationship between their discussion and later concepts in the form of the natural rate of unemployment and the NAIRU is obvious.

The development of the world's economy in the 70's of the last century was not very favourable for the modified Phillips curve. Oil shocks that were reflected in economies in the form of stagflation or slumpflation could not be theoretically explained in the context of the original Phillips curve. The Phillips curve model lacked something absolutely crucial for the modern economic theory – expectations.

M. Friedman (1968) and E.S. Phelps (1967) independently of each other augmented the Phillips curve model by the expected rate of inflation. Phelps's paper is much more analytical and much more exact, whereas Friedman in his rather popular paper stated and defined the term natural rate of unemployment and the mechanism through which the economy can in the short-term deviate from potential output. The fundamental problem of the original Phillips curve model was that it did not take into account the inflationary expectations of economic agents. From the viewpoint of the short-term period, the inflationary expectations can deviate from the actual rate of inflation which allows the deviation of actual real output from the potential output and therefore also the deviation of the actual rate of unemployment from its natural level. In the long-term, however, expectations always materialize and the economy is in equilibrium[2].

Figure 2: **Model of the augmented Phillips curve**

[2] It should be noted that modern Neoclassical economics that is based exclusively on the rational expectations and not on the adaptive ones used by M. Friedman and E.S. Phelps, is assuming, in this respect, only a vertical (long-run) Phillips curve and hence the economy that is in permanent equilibrium. Deviations can occur only if economic authorities (the Government, the central bank) make an unexpected intervention in the economy.



For clarity purposes, the augmented Phillips curve model is shown in Figure 2. Equilibrium is represented by the long-run Phillips curve (LPC), where the rate of unemployment is equal to the natural rate of unemployment and the inflationary expectations are met, i.e. are equal to the actual rate of inflation – $\pi^e = \pi$. On the other hand, disequilibrium is represented by a situation where the actual rate of unemployment is lower than the natural rate of unemployment and the economy experiences inflationary pressures since the actual rate of inflation is higher than the inflationary expectations (expected rate of inflation] - $\pi^e < \pi_1$. The adaptation of the inflationary expectations to the new, higher rate of inflation then results in the resumption of equilibrium, however, with the higher rate of inflation. Consequently, the natural rate of unemployment is virtually independent of inflation. However, it needs to be stressed that this is the case with this model that does not assume any other potential shape of the long-run Phillips curve than vertical.

The relationship between the movement of the rate of unemployment and real output of the economy was examined for the first time by A. Okun (1962). Specifically, this was the relationship between deviations of the rate of unemployment from the so-called full employment and deviations of actual real output from potential output. Potential output was defined in this context by Okun as the output of the economy which is produced under the conditions of full employment (the corresponding rate of unemployment was assumed at 4 %) and at the same time no inflationary pressures occur.

Friedman also clearly posits that the original wage Phillips curve was apparently valid, despite the fact that Phillips had not incorporated inflationary expectations in it. The reason was a relatively stable price level for the most part of the period for which Phillips examined the relationship[3]. However, the assumption of stable inflationary expectations could not be

[3] Phillips examined the relationship between the wage inflation and the rate of unemployment also in individual sections of the whole period 1861-1957 and it is possible to observe that although the relationship between the wage inflation and the rate of unemployment was always statistically significant, „the stable" rate of unemployment was not a constant. Consequently, the above statement does not mean that the expected rate of inflation was constant over the whole period but apparently was not too high and in particular was volatile as, for instance in the 70's of the last century.

applied to the 70's when the economies due to oil shocks but perhaps also due to ill-considered economic policies of previous years became significantly unstable.

Hence, the natural rate of unemployment is such rate of unemployment where the inflationary expectations are equal to the actual rate of inflation and the economy produces potential output. Phelps (1967, p.682) explains this issue as follows:

„Then the equilibrium unemployment rate – the rate at which the actual and expected price increases (or wage increases) are equal – is independent of the rate of inflation".

Friedman (1968, p.8) then defines the natural rate of unemployment as follows:

„"The natural rate of unemployment", in other words, is the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is embedded in them the actual structural characteristics of the labour and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labour availabilities, the costs of mobility, and so on."

Friedman (1968, p.9) adds to this issue:

„To avoid misunderstanding, let me emphasize that by using the term "natural" rate of unemployment, I do not mean to suggest that it is immutable and unchangeable. On the contrary, many of the market characteristics that determine its level are man-made and policy-made.."

From these quotations is clear that the determining factors of the natural rate of unemployment are similar to those that were used with respect to the stable rate of unemployment by Samuelson and Solow. However, it needs to be stressed that the very nature of this parameter is different. As Friedman himself noted, he considers the natural rate of unemployment to be „a product or output" of the Walrasian concept of general equilibrium. Hence, the basis of the natural rate of unemployment is quite obviously microeconomic and not macroeconomic. If the economy is in a situation where the rate of unemployment is at its natural level, we can say that it is really in equilibrium and all partial markets are also in equilibrium.

However at this point, there is a problem, how to interpret exactly the actual content of the natural rate of unemployment. Friedman's ideas were always based on the original Neoclassical economics that itself distinguished between voluntary unemployment and involuntary unemployment, while its criterion was the willingness of the economic agent to work for the equilibrium wage rate[4]. From this perspective, it is obvious that the natural rate of unemployment can be viewed as voluntary unemployment. Should we consider voluntary

[4] The Walrasian equilibrium is nothing else than the conditions of the general economic equilibrium from the perspective of the Neoclassical economics. All prices are assumed to be flexible and therefore partial markets are being permanently „cleared". Consequently, the situation of involuntary unemployment cannot occur.

unemployment as the sole component of the natural rate of unemployment, the question arises how to interpret positive output gap from the viewpoint of the labour market. It is obviously impossible for the voluntarily unemployed to work involuntarily. The explanation consists in the already suggested problem of money illusion which is the basis of the augmented Phillips curve. The deviation of the rate of growth of real output above the rate of growth of potential output is in principle caused by the fact that employees in consequence of adaptive formation of their inflationary expectations believe that the real wage rate is rising, whereas the companies correctly register its decline. For this reason, there is a temporary fall in the rate of voluntary unemployment which due to money illusion temporarily deviates from the natural rate of unemployment. When money illusion vanishes, employees become aware that the real wage rate has not changed (in contrast with illusory value perceived by them, it has declined) and the rate of voluntary unemployment rises to the initial level in the form of the natural rate of unemployment. Obviously, we can include among the factors that influence the level of voluntary unemployment all parameters of the social system of the given economy, since precisely these parameters affect decisions on choices between consumption (work) and leisure time. However, Friedman's definition does not fully support this definition.

It is obvious that at any rate Friedman was discussing something that he normally labels as friction unemployment[5], i.e. unemployment which is caused by normal fluctuation of the labour force. The reasons for this fluctuation can take e.g. a demographic form (school leavers/graduates entering the labour market) or stem from voluntary or involuntary leaving of the existing job. If an economic agent leaves his/her job involuntarily, then he must find a new job in a short (unspecified) time. The factors that affect friction unemployment include in particular the demographic structure and generally the level of the transaction costs that are associated with seeking a new job and the recruitment of new employees.

Whether Friedman included into the natural rate of unemployment also structural unemployment or not, is not clear. The current standard interpretation of structural unemployment and friction unemployment considers them to be the basic components of the natural rate of unemployment. However, it is not quite clear from Friedman's text whether he really meant by his term „the structural nature of the labour market" the current nature of structural unemployment or not. He himself stressed in particular the factors that affect the level of voluntary unemployment or the level of friction unemployment. The entire complexity of his approach stems from the fact that he has incorporated into the Walrasian equations elements that the Neoclassical economics itself does not use in a particular form he himself referred to, namely: the transaction costs, structural mismatch, etc.

At any rate, this definition of the stable rate of unemployment radically contradicted the Keynesian macroeconomics.[6] Firstly, it had the microeconomic basis which the Keynesian macroeconomics lacked at that time and which it, basically, rejected[7], secondly it suggested the economy's equilibrium associated with equilibrium in all segments of the labour market which was again in sharp contrast with the view of Keynesian-oriented economists.

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[5] It is worthy of mention that Keynes also considered precisely friction unemployment as the one that is compatible with the status of the so-called full employment.

[6] At that time, it was the so-called Neokeynesian approach.

[7] From today's perspective, this is no longer true. The new Keynesian economics, on the other hand, seeks explanation for price rigidity – its fundamental building block – at microeconomic level which is consistent with the nature of the relevant models.

2 The NAIRU and the natural rate of unemployment

The NAIRU (Non Accelerating Inflation Rate of Unemployment) was originally labelled by F. Modigliani and L. Papademos (1975) as the NIRU (Noninflationary Rate of

Unemployment). Their motivation is not quite clear and the difference between the NAIRU and the natural rate of unemployment became clear only later. Modigliani with Papademos (1975, p.142) define the NIRU as follows:

„...a level that we label the noninflationary rate of unemployment (NIRU). It is defined as a rate such that, as long as unemployment is above it, inflation can be expected to decline – except perhaps from an initially low rate. The existence of NIRU is implied by both the "vertical" and the "non-vertical" schools of the Phillips curve."

The difference between the definition of the NAIRU and the natural rate of unemployment is quite obvious. The NAIRU (NIRU) was not originally defined at all as a theoretical term, but rather as an empirical concept. All things considered, the article, in which this term was introduced for the first time, dealt with the recommendations for practical economic policy of the U.S. economy. The NAIRU even does not arise from the augmented Phillips curve model (Friedman, Phelps). Modigliani and Papademos further specify the term as follows (1975, p.145):

„For this purpose, all major view about the relation between inflation and unemployment imply the existence of a NIRU. The two extreme views carry this implication – the first that even in the long run, the Phillips curve has a negative slope throughout the entire range of the rates of unemployment; and the second that in the long run it can have no negative slope and must be vertical at some natural unemployment rate. The existence of a NIRU is also implied by intermediate positions such as our own, that the Phillips curve is relatively flat for high unemployment rates but approaches verticality (or may even be slightly backward sloping) for sufficiently low rates of unemployment."

Similarly, as Friedman has not considered the natural rate of unemployment to be a constant, the NAIRU is not an invariable parameter. Modigliani and Papademos summarize the issue as follows (175, p.157):

„In the years to come, this value (the NAIRU, author's note) will be affected by the composition of the labour force, and to some extent, by the development in the terms of trade."

Apparently, we can generalize that Modigliani and Papademos, similarly as Friedman, in connection with the NAIRU had the friction unemployment in mind. The links to the terms of trade can be understood in the purely empirical context as representing the supply shocks. For the purposes of the empirical modelling, the NAIRU is very often based on the so-called Gordon's triangle model (1997) which relates the current rate of inflation to the delayed values of the rate of inflation, thereby introducing into the model the issue of inflation inertia and the inflationary expectations, the difference between the actual rate of unemployment and the NAIRU reflecting the effect of the output gap and the aggregate demand on the rate of

inflation and finally the supply shocks reflecting the effect of the supply side of the economy on the rate of inflation.

The difference between the understanding and interpretation of the NAIRU and the natural rate of unemployment is also clearly defined in papers of J. Tobin who has analyzed the concept of the NAIRU on a more theoretical basis. Tobin (1997, p.8) asserts the following:

„The NAIRU does not assume a Walrasian equilibrium, in which markets, in particular labour markets, are being cleared by existing prices and wages. Instead, it assumes an economy in which at any time most markets are characterized by excess demand or excess supply at prevailing prices. ....

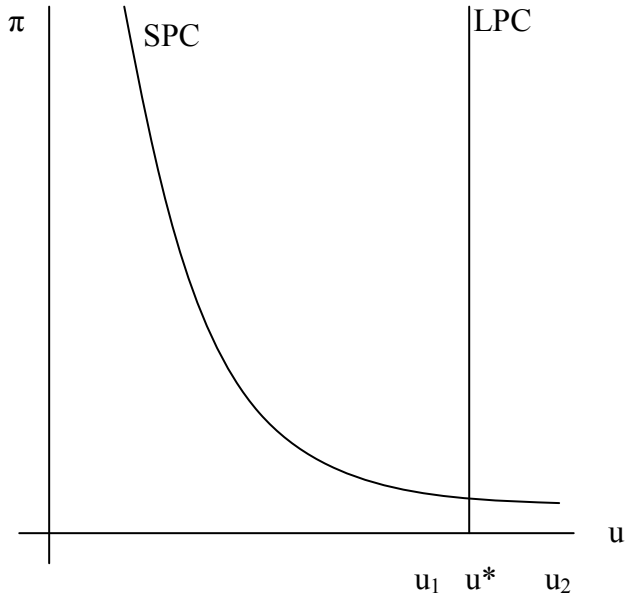
The NAIRU is the unemployment rate at which the inflation-increasing effects of the excess-demand markets just balances the inflation-decreasing impacts of the excess-supply markets. Unlike the natural rate, this is a balance among disequilibrium markets ....“

According to the standard approach, both the natural rate of unemployment and the NAIRU are considered to be the sum of the friction and the structural unemployment whose factors have been explained in the previous section. However, the NAIRU cannot be considered to be a virtually equilibrium concept, at least from the microeconomic viewpoint. The NAIRU is not subject to any specific interpretation of the Phillips curve, either. If we accept the augmented Phillips curve model, then we can treat the NAIRU in a way as a purely empirical counterpart of the natural rate of unemployment which would be very hard to be estimated empirically due to its theoretical basis. However, account needs to be taken of the fact that the informative value of the NAIRU has almost nothing in common with the natural rate of unemployment and that even in the augmented Phillips curve model these parameters can be unrelated.

Such situation is presented in Figure 3. The graph shows the rate of unemployment on the horizontal axis and the rate of inflation on the vertical axis. While the natural rate of unemployment u* is clearly defined by the long-run Phillips curve (LPC), the NAIRU would, by definition, fit in the interval between the rates of unemployment u_1 and u_2 where the rate of inflation indicated by the short-run Phillips curve (SPC) is basically stable. Please, note, that the NAIRU itself is not subject to any specific Phillips curve model. Or to put it more precisely, if we accept the augmented Phillips curve as the only „correct“ model of the Phillips curve, then the value of the NAIRU and the natural rate of unemployment would be the same. But their real meaning would never be the same.

Figure 3 also shows that potential discrepancy between the natural rate of unemployment and the NAIRU depends on the shape of the short-run Phillips curve. If it is rather hyperbolical, as in Figure 2, discrepancy can be expected. If it were linear and its slope were not negligible, then from the viewpoint of this model, these are empirically identical concepts.

Figure 3: **Augmented Phillips curve model**



On the basis of quotations of selected sources and associated milestones in the development of the economic theory, the terms natural rate of unemployment and the NAIRU have been defined. Both terms can be understood as equilibrium ones. However, while the NAIRU can be related exclusively to the macroeconomic conception of equilibrium, the natural rate of unemployment has a deeper microeconomic basis.

The natural rate of unemployment is quite clearly associated with the augmented Phillips curve model and theoretically it is defined by the rate of unemployment under which the inflationary expectations are met – i.e. the long-run Phillips curve. On the other hand, the NAIRU is not subject to any specific Phillips curve model. In simplified terms, we can assert that on condition that we accept the augmented Phillips curve model, the NAIRU can be considered to be identical to the natural rate of unemployment. However, in the case of the non-linear (hyperbolic) short-run Phillips curve, the NAIRU is defined rather by the rate of unemployment interval under which it holds that neither inflationary or disinflationary pressures are present in the markets.

Theoretical definition of the natural rate of unemployment and the NAIRU significantly affects methods that can be used for their empirical estimation. For the NAIRU, it is possible to use the approaches that are, on one hand, based on the formulation of the demand and supply side of the labour market, the so-called structural models and those that rely exclusively or mostly on the statistical methods on the other. These are models using the Kalman filter, VAR models, etc. It is completely wrong to use methods of modelling of

macroeconomic dynamics for estimations of the natural rate of unemployment, since these approaches cannot reflect the actual microeconomic nature of the examined phenomenon. However, as regards the natural rate of unemployment, exclusively structural models can be used which, nonetheless, do not model the aggregate labour market, but instead are based on partial labour markets. Consequently, to produce empirical estimates of the natural rate of unemployment is a much more difficult task than to do so with respect to the NAIRU.

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