National Accounting Review

NAR, 4(2): 135–146.
DOI: 10.3934/NAR.2022008
Received: 01 April 2022
Revised: 30 May 2022
Accepted: 10 June 2022
Published: 14 June 2022

http://www.aimspress.com/journal/NAR

Research article

Structural rate of unemployment, hysteresis, human capital, and macroeconomic data

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Abstract: The relationship between the unemployment rate and the evolution of human capital is different depending on whether one subscribes to a neoclassical logic or to a hysteresis theory. This paper proposes that when the unemployment rate reaches a high level for some time, the persistence phenomenon, or hysteresis, weakens the attractive forces of the natural rate of unemployment. The unemployment rate can then reach a different equilibrium value. However, according to Blanchard and Summers, this equilibrium is unstable and fragile. In the second part of this paper, we propose an indicator to measure the intensity of the attraction forces of the natural rate of unemployment. The empirical values of this index show the weak attraction forces of the natural rate of unemployment in economies with high levels of long-term unemployment.

Keywords: natural rate of unemployment; hysteresis; fragile equilibrium; employment dynamics; attraction forces of the natural rate of unemployment

JEL Codes: E24, E32, J24

1. Introduction

This paper analyzes how the level of the unemployment rate affects the attraction toward its natural level, as well as the intensity of this convergence.

Three essential points are developed:

1. The paper proposes a theoretical analysis of the gap between the observed unemployment rate and the natural unemployment rate by integrating both the convergence and divergence factors of

the two rates. The concept of hysteresis plays an essential role in this analysis.

2. The paper proposes a new synthetic index of the net effect of convergence factors and divergence factors.

3. The paper applies this indicator to a sample of OECD countries to illustrate the marked differences in the functioning of their labor markets.

We present our theoretical analysis in the first part of the article. This analysis emphasizes the phenomena that can weaken the attractive forces exerted by the natural rate of unemployment. In the second part of the article, we calculate the convergence index reported above and apply it to a sample of OECD countries.

2. Methods and discussion: theoretical analysis

Why does the overall unemployment rate reach its natural value more easily in some economies than in others? We can explain the differences in the degree of attraction of the natural rate of unemployment by analyzing the ambivalent relationship between human capital and unemployment.

In an economy, the change in unemployment is a decreasing function of the rate of growth. The latter, in turn, is an increasing function of the accumulation of capital. However, physical capital and human capital tend to increase at the same rate in the long run, for two reasons. The first is that growth in developed economies is based largely on innovation, which cannot exist without the increased use of skilled labor. The second is that skilled labor and physical capital largely complement each other (Hamermesh, 1993). Unemployment therefore decreases even faster when the growth rate of human capital is high.

However, the growth rate of human capital has a complex relationship with the level of unemployment. Since the relationship between unemployment and human capital is ambivalent, two cases must be distinguished.

2.1. Human capital and unemployment rate

When unemployment is low and near its natural level, the human capital of workers tends to increase for several reasons. First, from a neoclassical perspective, more leisure time allows workers to have more learning time. Second, when the economy is close to its potential output, an increase in the unemployment rate indicates lower utilization of labor, and thus an increase in the marginal productivity of labor. In other words, more unemployment leads to increased productivity. Third, structural unemployment occurs due to employees whose integration into the labor market is poor, because, for instance, their training does not meet the needs of the economy. If natural unemployment is due to an excessively high minimum wage, unemployed workers are encouraged to increase their productivity by acquiring new skills or accepting a higher level of effort than before (Clemens, 2021). It is therefore reasonable to conclude that time spent in unemployment often corresponds to a period of growth in human capital. Fourth, when the economy is near its potential output, employees who change jobs have enough notice to do so without long periods of unemployment (Pissarides, 2010). This prevents any loss of workers' human capital to unemployment. Fifth, when the economy is close to full employment, part of the increase in unemployment often corresponds to a substitution of capital for unskilled labor. For example, new machines or robots perform tasks previously done by unskilled workers, but the new capital goods installed require the training of operators and the net creation of

maintenance jobs. Consequently, these changes in production techniques ultimately lead to increased human capital. Finally, in an economy with nearly full employment, most unemployed people seek jobs that require greater productivity and skills than their previous jobs. This may require a short period of unemployment.

On the other hand, when the unemployment rate exceeds a certain structural level, which could be called the critical unemployment rate, a persistence or even a hysteresis phenomenon occurs (Blanchard & Summers, 1986; Blanchard, 2018). Employees who lose their jobs are often sufficiently productive workers who get fired due to a decrease in overall activity. However, a long period of unemployment often corresponds to a loss of human capital, because it is inevitably accompanied by a loss of professional skills (Pissarides, 1992). For instance, when there is a recession in the United States, a growing part of the workforce subsequently becomes permanently unemployed (Glaeser, 2014). Each time learning by doing produces a rise in productivity, job losses cause the destruction of human capital. A layoff may thus have irreversible effects on the specific human capital of an employee, whose skills become obsolete. Moreover, the employability of jobless persons is lower if the duration of unemployment is long. These phenomena offer an empirical confirmation of the existence of pro-cyclical behavior in labor productivity (Okun, 1962; Burda et al., 2013).

Independently of the research on hysteresis driven by the work of Blanchard and Summers, the links between human capital and unemployment have been studied in the abundant literature on search and matching models (Pissarides, 1992, 2000). In the analysis by Pissarides, a negative shock on employment causes a loss of skills of unemployed workers, which leads to a drop in job offers during the following period. When the duration of unemployment increases, the job supply therefore decreases due to a *thin market externality* mechanism. Ortego-Marti (2017) later offered an analysis based on the impact of unemployment on productivity. His research resulted in a measurement of the consequences of unemployment on aggregate productivity differences in a sample of OECD countries. His analysis showed that the overall endogenous productivity of continental European countries is 7% lower than that of the United States due to differences in the functioning of the labor market. Doppelt (2019) studied the link between labor market dynamics and endogenous growth. He showed that the latter is slowed down by the depreciation of human capital caused by unemployment. In the same vein, Burdett et al. (2020) recently presented an equilibrium model of wage formation based on the fact that in the event of unemployment, an employee loses part of their skills. Ljungqvist and Sargent (1998) had also broken down human capital into two parts: one that depends on the activity that was carried out by the worker, and another that is specific to the individual. When an employee loses their job, there is therefore an instantaneous loss of human capital. It is this part of human capital that exerts a strong influence on long-term unemployment. This observation is confirmed by the work of Kospentaris (2021), according to which the effect of the loss of skills is significant among workers who have been unemployed for more than six months.

Thus, the relationship between the unemployment rate and the evolution of human capital differs depending on whether one subscribes to a neoclassical logic or to a hysteresis theory. In the first case, the dynamics of the unemployment rate are stable; in the second, a cumulative process occurs. These results can be highlighted by simple models linking the rate of change of total income and human capital to the unemployment rate. In what follows, two models of unemployment rate dynamics are displayed. The first model describes an economy near full employment, while the second model analyzes an economy with a high unemployment rate.

2.2. Unemployment rate dynamics in a near full employment economy

Our theoretical approach is not standard, because instead of relying on Diamond-Mortensen-Pissarides search models, it starts from the concept of hysteresis developed in the 1980s (Cross, 1988). This approach makes it possible to use a very simple model that analyzes the gap (and not the level) between the observed rate of unemployment and the natural rate without modeling unemployment.

Let us first examine the case of a near-full-employment economy. We use u to denote the unemployment rate and g to denote the rate of growth. One classical result of macroeconomics is that the variation in the unemployment rate is a decreasing function of the growth rate (Okun's law). We can thus write (a dot above a variable denotes the derivative with respect to time):

$$\dot{u}_t = a - bg_t; a > 0 \; and \; b > 0 \tag{1}$$

Moreover, the rate of growth is an increasing function of the rate of accumulation of physical capital. Assume for simplicity that the growth rate equals the rate of capital accumulation, as in the neoclassical growth model. Let us still suppose that the rate of growth of physical capital K is equal to the rate of growth of human capital H, since, as we have seen, K and H are complementary. This assumption is justified by the fact that if human capital grew faster than physical capital, physical capital productivity would increase, which would encourage entrepreneurs to invest more. The reverse reasoning would apply if human capital grew more slowly than physical capital. Therefore:

$$\frac{\dot{H}_t}{H_t} = g_t \tag{2}$$

When the economy is near full employment, human capital increases with the unemployment rate for the reasons stated above. An increase in human capital leads to a rise in labor productivity, which means an increase in job creation (Daly et al., 2012) and thus in the growth rate. Moreover, the probability of filling a job is higher when unemployment rises (Pissarides, 2000). We can then write:

$$\Gamma_t = Au_t^{\alpha}; with \; \Gamma_t = 1 + g_t, A > 0 \; and \; \alpha > 0 \tag{3}$$

The variation in the unemployment rate results from the combination of the Equations (1) to (3). We then obtain:

$$\dot{u}_t = c - \theta u_t^{\alpha}; with \; c = a - b \; and \; \theta = Ab \tag{4}$$

The natural rate of unemployment u^* (Friedman, 1968) is the stationary solution of this Equation:

$$u^* = \left(\frac{c}{\theta}\right)^{1/\alpha} \tag{5}$$

We can therefore express Equation (4) as:

$$\dot{u}_t = \theta[(u^*)^{\alpha} - u_t^{\alpha}] \tag{6}$$

At the steady equilibrium point u^*, the derivative of relationship (5) is equal to $-\alpha\theta(u^*)^{\alpha-1}$. It is negative, indicating the stability of the process.

This stability means that any difference in the unemployment rate from its natural value triggers attraction forces. The equilibrating mechanism is as follows. Let us take the instance of a negative growth shock in a full employment economy (i. e. $u_0 = u^*$). After the shock, the growth rate declines, inducing, in turn, a rise in the unemployment rate and in human capital. The surge in human capital

triggers an increase in the growth rate. The economy thus returns to its initial point. However, this equilibrating mechanism can sometimes be offset by a persistence, or hysteresis, effect in unemployment. We will now examine this phenomenon further.

2.3. Unemployment rate dynamics in an economy with hysteresis

When unemployment is high, wage earners become more reluctant to change jobs. They are also less likely to seek jobs better suited to their capabilities. Moreover, a long period of unemployment destroys part of the human capital of jobless workers.

In this case, the relationship between growth in human capital and the unemployment rate thus decreases, and we can suppose that:

$$\Gamma_t = Bu_t^{-\beta}; B > 0 \; and \; \beta > 0 \tag{7}$$

If we combine Equations (1), (2), and (7), we obtain:

$$\dot{u}_t = c - \tau u_t^{-\beta}; with \; \tau = Bb \tag{8}$$

The critical level of unemployment $\bar{u}$ is defined by the following Equation:

$$\bar{u} = \left(\frac{\tau}{c}\right)^{1/\beta} \tag{9}$$

We can therefore express Equation (10) as:

$$\dot{u}_t = \tau\left[(\bar{u})^{-\beta} - u_t^{-\beta}\right] \tag{10}$$

At the steady equilibrium point $\bar{u}$, the derivative of relationship (9) is equal to $\beta\tau(\bar{u})^{-\beta-1}$. It is positive, indicating the instability of the process. In this second model, there are no attraction forces to bring the unemployment rate back to its natural level. Moreover, note that this second model is consistent if the critical rate of unemployment is higher than the natural rate of unemployment, which implies:

$$c < \tau^{\frac{\alpha}{\alpha+\beta}}\theta^{\frac{\beta}{\alpha+\beta}} \tag{11}$$

We will suppose that this condition is verified.

The cumulative mechanism is as follows. We will suppose that the unemployment rate is initially equal to $\bar{u}$. After a negative growth shock, the unemployment rate increases. This induces the destruction of human capital and another drop in the growth rate. This process would naturally be reversed in the case of an initial positive growth shock.

2.4. Multiple equilibria

The above analysis suggests that there are two relationships at the origin of the dynamic behavior of the unemployment rate:

1. The link between the variation in the unemployment rate and the rate of growth of human capital.
2. The impact of the unemployment rate on the rate of change of human capital.

Due to the ambivalence of the second relationship, there may be two different values of the equilibrium unemployment rate.

The first equilibrium is stable and corresponds to the natural rate of unemployment. The second equilibrium is unstable due to persistence, or hysteresis, phenomena. This second equilibrium is fragile and history dependent. Blanchard and Summers (1988) have shown that such equilibria make unemployment extremely sensitive to initial conditions and to current and past shocks. But as this second equilibrium is fragile, it also moves. Therefore, it is not possible to provide a stable estimate of $\bar{u}$.

In this case, the global dynamics of the unemployment rate can be represented by Figure 1 below, which displays a synthesis of the dynamics highlighted in the previous analysis.

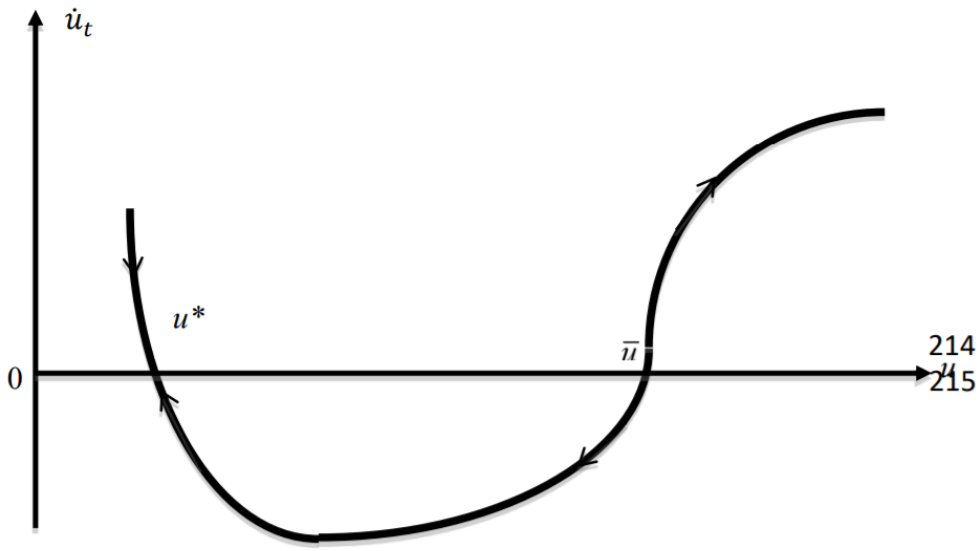

Figure 1. Stable and unstable equilibrium rates of unemployment.

Let us suppose that human capital growth may be expressed as follows:

$$\Gamma_t = \left(\frac{C}{u_t}\right)^{\gamma}; \gamma > 0, C > 0 \tag{12}$$

This relation implies that human capital rises when the unemployment rate drops below a critical level *C*, as in neoclassical theory. On the other hand, human capital diminishes when the unemployment rate crosses this threshold value, as in hysteresis theory.

On this basis, it can be shown that the evolution of the unemployment rate is indicated by the following Equation, where g^* is the potential rate of growth (see Appendix):

$$\dot{u}_t = c - \chi u_t^{-\gamma} \; with \; \chi = b(1 + g^*)(u^*)^{\gamma} \tag{13}$$

Hence, the unemployment rate increases if $u_t > \bar{u}$ with $\bar{u} = \left(\frac{\chi}{c}\right)^{1/\gamma}$.

The dynamics of Equation (13) are the same as those of Equation (10). The natural rate of unemployment is thus an attractor, whereas the critical rate is a repeller. The segment $[u^* \; \bar{u}]$ is comparable to Leijonhufvud's corridor (Leijonhufvud, 1973): inside this corridor, the system is stable, but if the economy creeps too far away from its equilibrium, there are no longer any feedback forces. Similarly, when the unemployment rate is higher than $\bar{u}$, the attraction forces of the unemployment rate disappear. In this case, because of the lack of feedback forces, more labor market flexibility could

be inefficient (Le Page, 2014). Thus, although market forces will clear the markets within the corridor, the type of institutional obstacles presented in the conventional Keynesian literature may make them ineffective at some point (Orlando et al., 2021).

From an empirical point of view, such a development seemed to characterize the eurozone from 2009 to 2013. In contrast, in the same time period in the United States, the unemployment rate never diverged by more than four percentage points from its natural level.

3. Results: empirical evidence

Empirically, it appears that the gap between the unemployment rate and the natural rate differs greatly from one economy to another. The literature does not offer a synthetic index of the difference between *u* and *u**. We propose here to use such an indicator, which we will apply to a sample of OECD countries. This index shows that the behavior of the unemployment rate is very different in countries in the Anglosphere and in other countries with large percentages of long-term unemployment.

3.1. Two dynamics of the unemployment rate

In Anglosphere countries, when the unemployment rate is high, it often returns to its natural level in a cyclical way, and then decreases further below that level before the next upturn. In contrast, in European economies with large percentages of long-term unemployment, the end of the drop in the unemployment rate can occur before it has returned to its natural level. Moreover, unemployment in Europe more rarely falls below its natural level. Therefore, we must find a synthetic indicator of attractive forces in the labor market.

3.2. A synthetic indicator of attractive forces in the labor market

This indicator should have a high value when the natural rate of unemployment is a powerful attractor. We therefore propose the following indicator I:

$$I = 1 - \frac{|\sum(u_t - u_t^*)|}{\sum|u_t - u_t^*|} \tag{14}$$

How can we justify the above formula? Indicator I is equal to 1 if the unemployment rate fluctuates symmetrically around its natural rate, because in this case, $\sum(u_t - u_t^*) \to 0$. Conversely, the value of the indicator is 0 if the unemployment rate is always above or below its natural level, as in this case: $|\sum(u_t - u_t^*)| = \sum|u_t - u_t^*|$. In addition, the numerator of the second term of this expression is low when periods of high unemployment compensate for periods of low unemployment, which implies the existence of large attraction forces. In such a case, the indicator value is high. Conversely, the numerator of the second term of the expression is high when periods of high unemployment do not compensate for periods of low unemployment, which implies the existence of weak attraction forces. In this case, the value of the indicator is low.

Table 1 shows the indicator we calculated for 24 OECD countries (United States, United Kingdom, Canada, Japan, Australia, New Zealand, Hungary, Denmark, Norway, Sweden, Switzerland, Turkey, and countries in the eurozone for which data on the natural rate of unemployment were available). The unemployment rates are from the OECD's quarterly statistics.

The natural rates are the values of the non-accelerating inflation rate of unemployment (NAIRU), derived from the OECD statistics. The quarter-to-quarter changes in the NAIRU are small (Watson, 2014; Blanchard 2016). Thus, we supposed that the NAIRU does not change over a year. The estimation period is 1983:1–2019:4. However, for some countries, the first statistics available are more recent: 1985 for Luxembourg and Norway, 1986 for Spain and New Zealand, 1988 for Finland, 1990 for Ireland, 1991 for Germany and the euro zone, 1998 for the Slovak Republic, 1999 for Slovenia, 2005 for Turkey, and 2010 for Switzerland.

Table 1. Index values of attraction forces in 24 OECD countries.

Index values								
United States	United Kingdom	Canada	Australia	New Zealand	Japan	Austria	Belgium	Denmark
0.52	0.94	0.62	0.42	0.78	0.49	0.14	0.67	0.96
Estonia	Finland	France	Germany	Hungary	Ireland	Italy	Luxemburg	Netherlands
0.98	0.90	0.06	0.46	0.54	0.87	0.25	0.68	0.74
Poland	Portugal	SlovakRep.	Slovenia	Spain	Sweden	Norway	Switzerl.	Turkey
0.5	0.37	0.30	0.39	0.50	0.74	0.45	0.15	0.65

The range of values of the index is important; it ranges from 0.1 to 0.98. We note the significant difference in convergence toward the natural value of the unemployment rate in the United Kingdom and in the eurozone. In the former case, the value of the convergence index is close to 1, while in the latter, it is only 0.33. This suggests that if the natural rate of unemployment is an attractor in the United Kingdom, this property is less evident in European countries.

The use of the index proposed in this paper makes it possible to judge whether a labor market flexibility policy should be implemented. This is what will happen when the value of the index is far from the value of 1. For instance, such a policy was used in France from 2017 onward.

One could assume that the indicator is a decreasing function of the degree of employment protection of the OECD. However, Figure 2 shows a very weak correlation between the values of the index of attraction forces and the OECD indicators of employment protection (OECD, 2014). These indicators, published by the OECD, are weighted sums of subindicators concerning the regulations for individual dismissals and additional provisions for collective dismissals. The value of the feedback forces of the natural rate of unemployment is then not particularly high when labor market flexibility is strong.

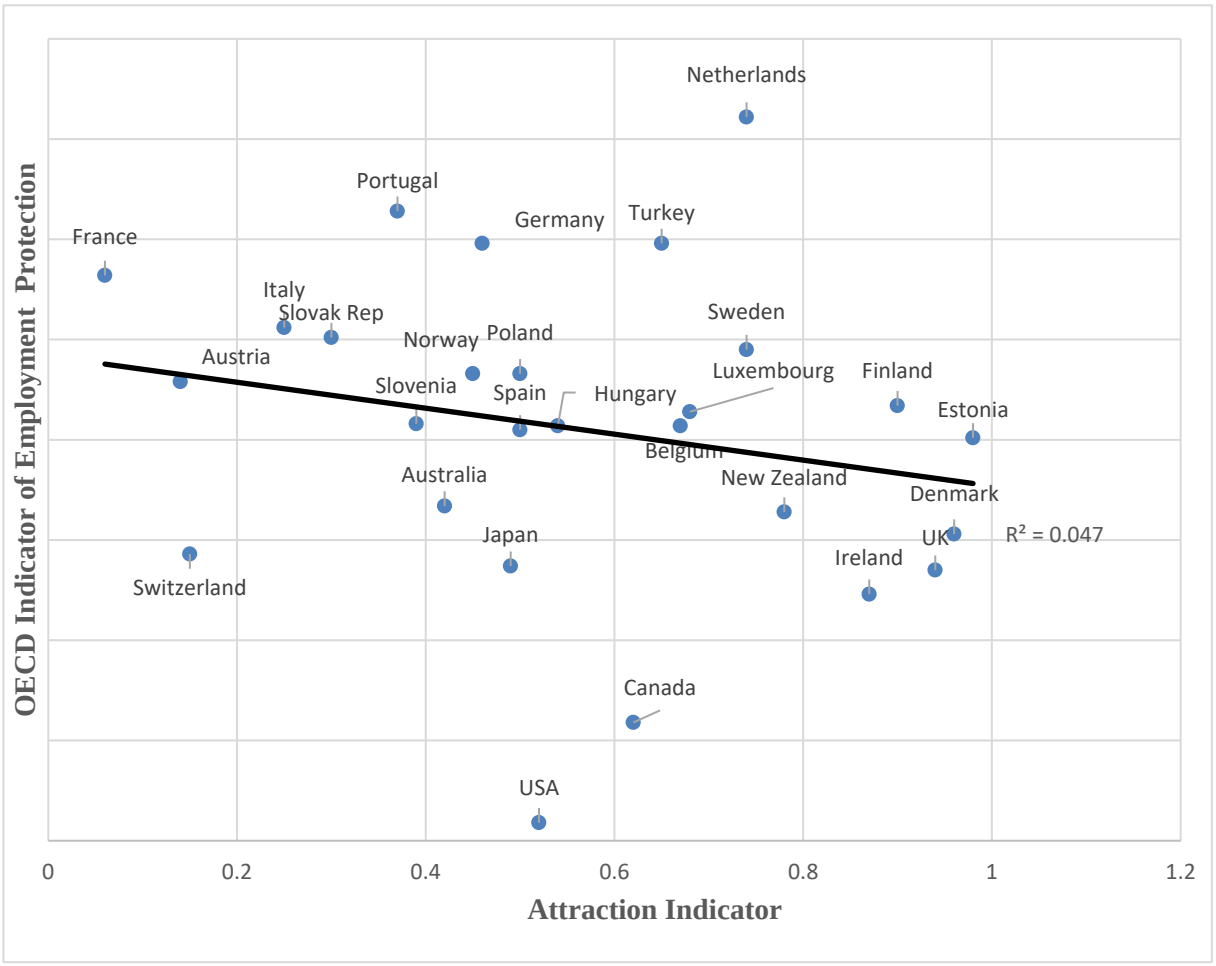

Figure 2. Attraction forces indicator and OECD indicator of employment protection.

However, there is a fairly clear negative correlation between the frequency of long-term unemployment and the feedback indicator of the natural rate of unemployment (see Figure 3; the percentage of long-term unemployment is from 2019). There is thus another reason besides labor market flexibility why the natural rate of unemployment attraction force is sometimes high and sometimes low: that is, the ambivalent nature of the relationship between human capital and the level of unemployment. Therefore, we proposed in the first part of this paper a theoretical study of this complex relationship between human capital and unemployment.

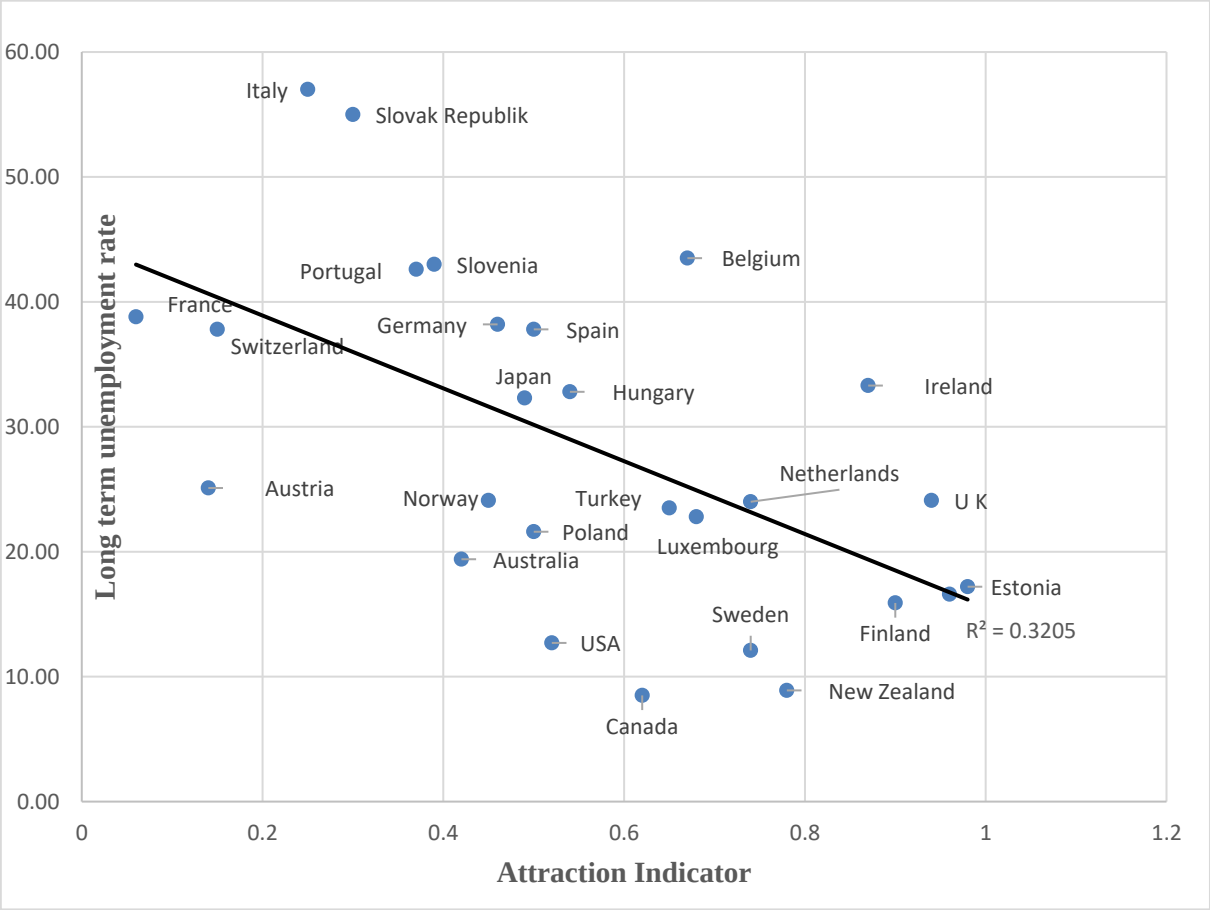

Figure 3. Attraction forces indicator and OECD frequency of long-term unemployment.

4. Conclusions

The preceding analysis leads to two main conclusions neglected by contemporary literature:

According to the model presented above, when long-term unemployment exceeds a certain threshold, the natural rate loses its attractive forces and may be replaced by an unstable equilibrium unemployment rate. In this case, it is therefore essential to implement an economic policy that allows the unemployment rate to reach the attraction area of the natural rate. This was done in most eurozone countries during the COVID-19 pandemic, preventing a violent macroeconomic shock from turning into a systemic crisis comparable to that of 1929.

Moreover, the use of a new index measuring the gap between the unemployment rate and its natural value has shown the magnitude of the differences in convergence toward the natural rate from one country to another.

Conflict of interest

The author declares no conflicts of interest in this paper.

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