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Growth–Employment Relationship and Leijonhufvud’s Corridor

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***Abstract:** Since 2008, the euro area unemployment rate has increased constantly, while this economy’s GDP was the same at the end of 2012 as it was in 2008. The recent trend of aggregate economic activity in this area illustrates the risk that an economy leaves its stability corridor, in which it usually progresses in a cyclical way, to enter an area of turbulence. In this area, the automatic stabilizers have weak feedback forces. To examine this kind of situation in a theoretical framework, this paper presents a model that relies both on Leijonhufvud’s corridor and on Harrod’s instability principle. This model allows a threshold to be defined beyond which the economy runs the risk of entering a cumulative process of simultaneous declines in growth and employment. However, the existence of such a process requires unemployment to have a sufficiently direct effect on the growth in aggregate demand, as seems to be the case nowadays.*

***JEL Classification:** B22, E12, E24*

***Key words:** growth–employment relationship, economic dynamics, instability principle, corridor*

¹ I am grateful for helpful comments and suggestions from an anonymous reviewer.

I. INTRODUCTION

To understand the upheavals of the world economy since 2008, we need to distinguish crisis from recession. Nowadays, the interpretation of crisis seems to require the use of new analytical tools. Actually, such tools have existed for a long time: the writings of R. Harrod and A. Leijonhufvud offer concepts that seem to be essential today, but these concepts are often overlooked by macroeconomic theory. However, the macroeconomic events in the main developed countries during the 2007–2009 period and in the euro area for the past several years belong much more to crisis economics than to a business cycle. It follows that the interdependence between growth and unemployment could now be of a different nature than is usually the case. It is from this perspective that this research was conceived.

The term ‘crisis’ is used in the economics literature in two ways. According to the first meaning, it is one of the phases of the cycle (Haberler, 1937, 1963), but the expression ‘crisis’ may also designate a major failure of a market system. In this article, this second meaning is used.

The main theme of this research is the following. In a crisis, the decline in growth and rise in unemployment mutually strengthen each other, while in a recession, the existence of automatic stabilizers limits the decline in employment and the impact of unemployment on aggregate demand. A fundamental aspect of employment dynamics during a crisis is indeed that the nature of the relationship between the unemployment rate and the growth rate changes. The reason for such a change of nature is that the economy is then developing outside its usual stability corridor. In other words, to distinguish crises (which are exceptional phenomena) from recessions (which are recurring changes), it is important to remember that a sharp decline in activity initiates a process of a potential cumulative nature only when the rise in unemployment in a context of total uncertainty is itself a direct brake on the growth effect.

However, such a process exists only if the decline in growth exceeds a certain threshold. We present a very simple model in which the economy has two equilibrium rates of growth: one is stable and the other is unstable. Moreover, the second equilibrium rate of growth is lower. When the effective rate of growth falls to the lowest equilibrium rate, the economy leaves its stability corridor and a self-reinforcing downward spiral begins. Thus, this article does not study the causes of the crisis in the eurozone (differences in competitiveness between countries and the excessive indebtedness of certain states) but one of its powerful propagation mechanisms.

The low macroeconomic activity seen in the euro area for several years seems to illustrate fairly well that this is empirically a ‘crisis’ situation. The GDP of this economy at the end of 2012 was approximately the same as it was in 2008. The trend of the unemployment rate is an important indicator of the seriousness of a macroeconomic disequilibrium. The euro area’s harmonized unemployment rate increased by two percentage points in 2009 and reached a record level in 2011 at 10.2%. Moreover, after the ‘recovery’ of 2010, this unemployment rate did not fall. These facts are indicators of the exceptional nature of recent events. We then discuss the question of the choice of analytical instrument for studying the growth–unemployment relationship in both contexts in which it has come to be referred. There is little doubt that the concept of a corridor proposed by Leijonhufvud (1973) forty years ago and Harrod’s instability principle (1973) shed interesting light on the links between growth and unemployment. We illustrate the use of these concepts with a simple macroeconomic model, which allow us to confirm that there are two possibilities for the trend of the coupled rate of unemployment–rate of growth: global stability that corresponds to the business cycle and a saddle-point equilibrium that should be associated with situations of crisis and depression.

During a crisis, macroeconomic activity and employment deviate from the relative stability range in which economies usually grow cyclically. Therefore, economists have to use

heterodox analytical tools to interpret recent events in the double dimension of growth and unemployment.

Roy Harrod's theory has a fundamental characteristic that distinguishes it from the dominant macroeconomic analysis: the system he describes has no feedback forces. In this analysis, the price system is not the main adjustment mechanism to macroeconomic disequilibria. Thus, Harrod (1973) writes in Chapter 3 (p. 42) of his book *Economic Dynamics*:

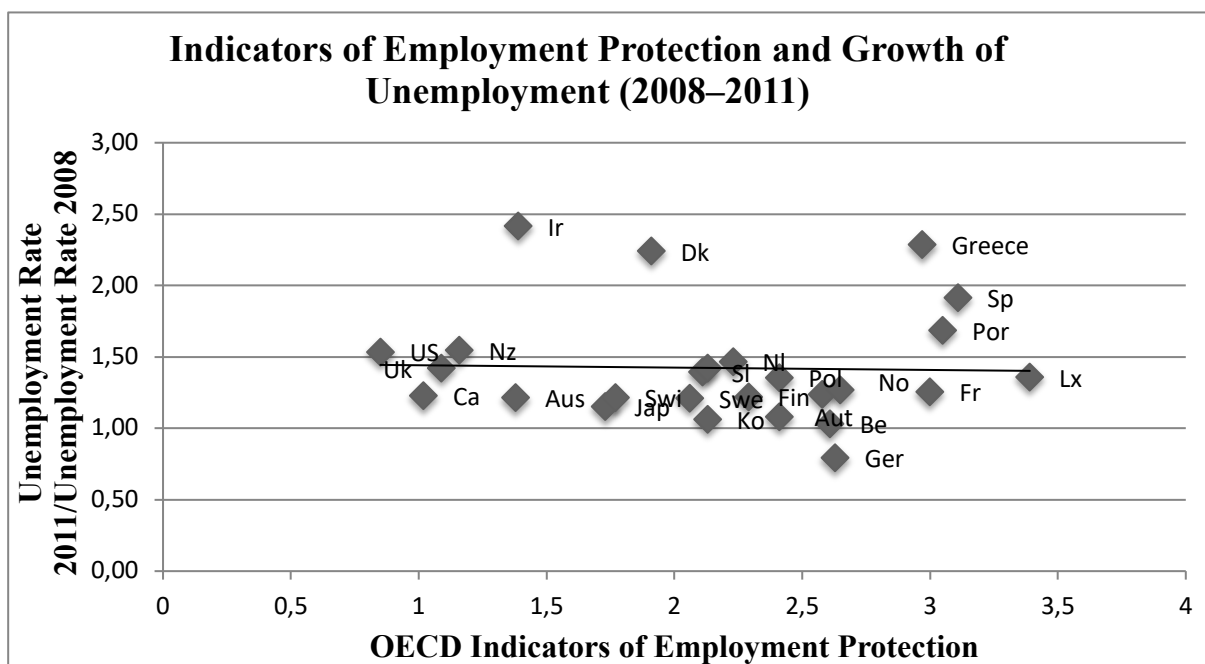
Neoclassical economists have (...) sought to show that, if there is a deviation from equilibrium growth, there must be some price mechanism that restores the equilibrium. This is by analogy with the processes in the field of micro-statics, by which, if there is over-production or under-production of a particular commodity, the consequent fall or rise in its price restores its production to its equilibrium level. In fact the processes involved in growth are entirely different from those of micro-statics.

Today, Leijonhufvud seems to share Harrod's opinion when he writes (2008, p. 5):

More than seventy years ago, Keynes already knew that a high degree of downward price flexibility in a recession could entirely wreck the financial system and make the situation infinitely worse.

This potential deficiency of the price mechanism seems to be verified particularly during a crisis. Thus, after the collapse of Lehman Brothers, the fall in aggregate demand necessitated expansionary monetary and fiscal policies. By contrast, countries with a high level of flexibility in their labor markets were no better protected than others. Figure 1 shows that there is complete independence between the OECD's indicators of employment protection (OECD, 2010) and the growth in unemployment between 2008 and 2011. In these years, countries with great flexibility in their labor markets were no more protected from a strong rise in unemployment.

Figure 1



2. CRISIS DYNAMICS

In standard economic theory, markets are stable. The working of these markets is a central theme of contemporary economic analysis, whereas the interpretation of a crisis requires an explanation for why and *under which circumstances* they failed (Skidelsky, 2009). However, Keynesian economics seem well suited to such a study because they are based on a radically opposite conception of the functioning of market economies considered to be potentially unstable (Minsky, 1986, 2008). It is this Keynesian perspective that underpins this research, as the European crisis that we face demonstrates the difficulty of the single price system in balancing the disequilibria that affect our economies. At the macroeconomic level, it is the growth in production and employment that constitutes the main mechanism of adjustment, with the risk of the occurrence of a cumulative downward movement in a context of growing uncertainty that hampers investment (Krugman, 2009, 2012).

We have seen in the introduction that the analysis proposed here simultaneously uses Leijonhufvud's concept of a 'corridor' (1973) and Harrod's 'instability principle' (1973). It is known that the first principle sets a lower threshold beyond which the traditional automatic stabilizers no longer stabilize demand.

Leijonhufvud defined the notion of a corridor as follows: 'The system is likely to behave differently for large than for moderate displacements from the "full coordination" time-path. Within some range from the path (referred to as "the corridor" for brevity), the system's homeostatic mechanisms work well, and deviation-counteracting tendencies increase in strength. Outside that range these tendencies become weaker as the system becomes increasingly subject to "effective demand failures"' (pp. 109–110). Thus, according to this author, no feedback forces exist beyond a threshold of weak aggregate demand.

Similarly, the instability principle to which Harrod (1973) devoted an entire chapter of his

book *Economic Dynamics* focuses on the absence of feedback forces in the economy when it is diverted from its path of growth *by a sufficiently significant event* such that the expectations of firms are suddenly changed. From a methodological point of view, these authors occupy opposing situations. Whereas Leijonhufvud provides a relatively static analysis based on research on the microeconomic foundations of macroeconomic theory, Harrod, from the beginning, displays a macroeconomic analysis by adding a dynamic framework. However, the two analyses converge to one essential point: the existence of thresholds at the start of the mechanisms that are at work. Harrod, in his book, refuted the interpretation of his theory based on the existence of a ‘knife edge.’ He insisted instead on the fact that the economic system submitted to an unstable process only when it suffered a disruption of significant magnitude (1973, p. 33). In addition, neither of these two authors believed that the price system, without the help of economic policy, has (in the short and medium term) a rebalancing capability such as that usually found in neoclassical theory. The recent developments in the euro area seem to confirm this inefficiency.

3. A SIMPLE ANALYSIS OF THE GROWTH–UNEMPLOYMENT RELATIONSHIP

The main hypothesis of our model is the existence of a reciprocal relationship: the unemployment rate is reliant on the pace of growth that is itself a function of the unemployment rate. However, as we have seen, the influence of growth on the rate of unemployment is usually more sensible than the reverse influence. This asymmetry allows the analytical distinguishing of recessions from crises and depressions. During a recession, the impact of the degradation of employment on the trend of aggregate demand is mitigated by the elements that constitute the stability corridor, but this dampening process vanishes during

a crisis.

We build the model in three stages:

1) We begin by writing a relationship whose form is akin to ‘Okun’s law,’ although in the model of the paper this relationship is not linear. The unemployment rate u in our countries is subject to a significant degree of persistence (Cross, 1988; Ball, 2009). Therefore, the rate reached over the previous period has a strong impact on the current unemployment rate. In addition, the unemployment rate is sensitive to growth (Okun’s law). Finally, the employment–growth relationship is subject to unceasing macroeconomic shocks, be they real or financial. Therefore:

$$u_t = \varphi(u_{t-1}, g_{t-1}) + \varepsilon_t \text{ with } 1 > \varphi'_u > 0 \text{ and } \varphi'_g < 0 \quad (1)$$

where g is the growth rate and ε a random macroeconomic shock.

The first derivative φ'_u is a measure of the persistence of the unemployment rate. This derivative is such that $0 < \varphi'_u < 1$. The second derivative φ'_g is the coefficient of a non-linear Okun’s law.

It is plausible that relationship (1) is convex in the (u, g) plane. Indeed, for low values of growth, or even negative values, the unemployment rate is very high, whereas strong rates of growth begin in bottlenecks in the labor market that prevent the unemployment rate from becoming very low.

2) Consider now the opposite influence of the unemployment rate on the growth rate (Bean and Pissarides, 1993). The rate of unemployment negatively affects the growth rate g according to its impact on purchasing power. This influence on growth is no doubt modest when the slowdown is restrained. However, when the decline in activity is pronounced, it enhances both uncertainty and long-term unemployment, while the degradation of the labor market increases the proportion of the population that spends all its income. In this case, the rise in unemployment is a direct factor of the decrease in aggregate demand and therefore of

growth. Moreover, the observed rate of growth is positively linked to the previous rate of growth because a high rate of growth stimulates investment and the latter refiles activity. Indeed, it is net investment that increases production capacity that will later help achieve growth. On the other hand, a fundamental aspect of the direct impact of unemployment on growth is that it is especially strong in situations in which a high degree of uncertainty, as well as a contraction in wages, dampens the incentive to invest. Therefore, let us assume that the impact of u on g can be represented by a function such that:

$$g_t = \psi(u_{t-1}, g_{t-1}) + \eta_t \text{ with } \psi'_u < 0 \text{ and } 0 < \psi'_g < 1 \quad (2)$$

In this expression, η is a macroeconomic shock. The first derivative expresses the impact of unemployment on the rate of growth. In a recession, this impact is weak because the economy is in a corridor with buffers and shock absorbers, such as dissaving, unemployment compensations, fiscal stimuli and so forth. However, during a crisis or a depression, unemployment directly slows the rate of growth according to the vanishing of these shock absorbers. Nowadays, with financial liberalization, household debt has risen substantially as a percentage of income. In usual macroeconomic situations, this causes a drop in the propensity to save and sustains aggregate demand (Zezza, 2008). However, when unemployment increases, more and more consumers become victims of credit restrictions. Thus, the direct impact of unemployment on growth is especially strong in situations of high uncertainty and of credit crunch, as in recent years.

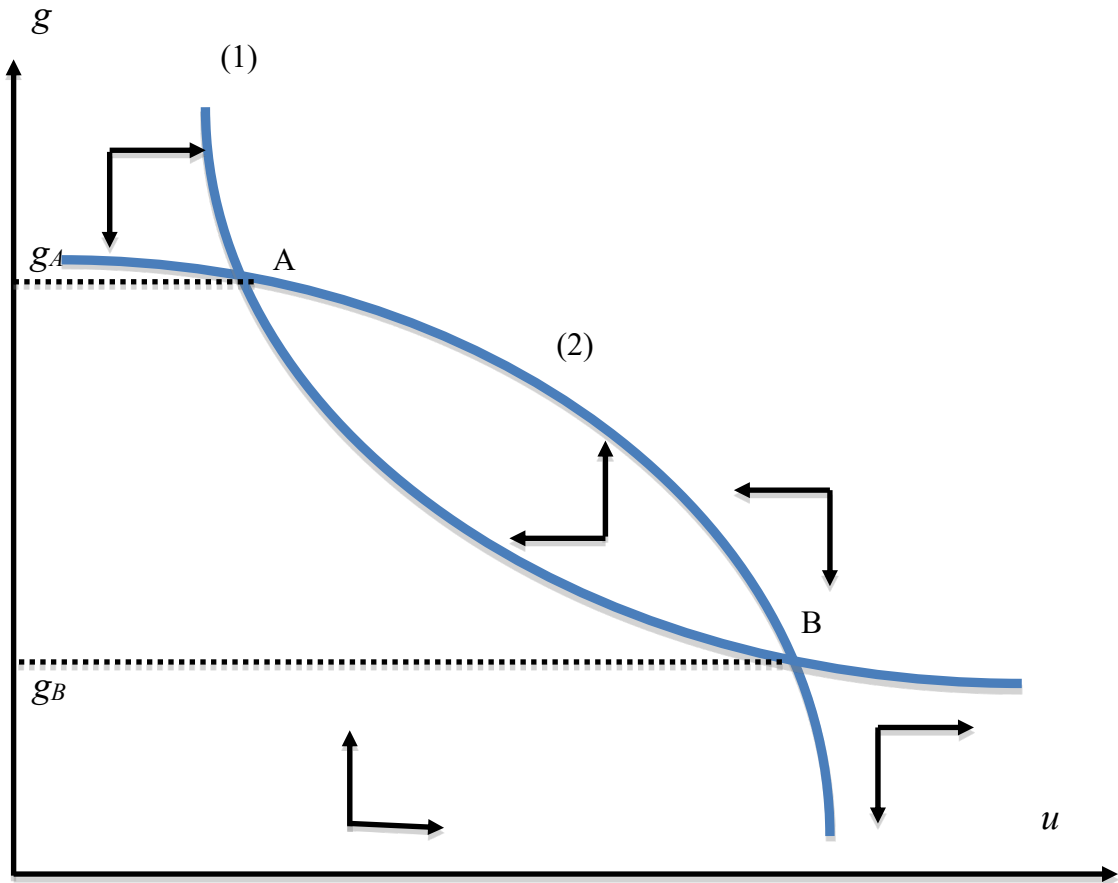
The second derivative of the function ψ is positive, since in Harrodian theory, an increase in the rate of growth tends to be cumulative. If, for instance, the actual growth rate increases as a result of a fall in the savings rate, the divergence between this rate and the warranted rate will widen and the economy will expand at a higher pace because savers will expand their purchases (Harrod, 1939; Hoover, 2012). Similarly, a rise in aggregate investment will cause a higher increase in aggregate demand (the multiplier effect), which will in turn stimulate

profitability and subsequent growth (Hahn and Matthews, 1964). This is the essence of Harrod's instability principle.

A realistic assumption is that relationship (2) is concave in the (u, g) plane. High levels of unemployment indeed imply that an increasing proportion of the population is constrained by liquidity and that it spends all its very low income. Growth is then restricted by insufficient aggregate demand and fades quickly as unemployment rises. On the other hand, low unemployment rates match situations close to full employment in which growth becomes independent of the unemployment rate. The slope of relationship (2) tends towards zero for low levels of unemployment.

3) System (1)–(2) has dynamic equilibria corresponding to the simultaneous conditions $\Delta g = 0$ and $\Delta u = 0$. Under the foregoing assumptions, two dynamic equilibria exist (points A and B in Figure 2) as in Joan Robinson's model of accumulation (1962). The first dynamic equilibrium (point A) is related to a low rate of unemployment. The other (point B) is characterized by low growth and high unemployment. Moreover, as we show below by using first the phase diagram, the dynamic properties of the two points are very different.

Figure 2
The Two Dynamic Equilibria



Indeed, the phase diagram shows point A's stability and point B's instability. The reasons for these properties of each dynamic equilibrium point are as follows. Let us begin with the stable one (point A). If the growth rate is weakening while it was initially equal to its equilibrium value g_A , the rate of unemployment becomes higher than at A (Okun's law). However, thanks to the automatic stabilizers of the 'corridor,' this new unemployment rate brings about (through relationship (2)) a higher rate of growth that is itself a factor of falling unemployment. Gradually, the economy thus comes back towards point A. If, symmetrically, the economy suffers a shock increasing the rate of growth from A, unemployment decreases but reaches a level that gives rise to a lower growth rate, the source of the increase in unemployment. The economy gradually returns to point A.

Moreover, we see that a positive growth shock from point B onwards determines the path of decline in the unemployment rate and triggers a rise in the growth rate until the economy reaches dynamic equilibrium A. On the other hand, a negative growth shock from point B causes an increase in the unemployment rate that creates a new decline in the rate of growth because the automatic stabilizers are too weak. A cumulative process expands constantly away from its initial dynamic equilibrium.

This model allows cyclical dynamics to be distinguished from those of the crisis. The area between point A and point B belongs to the dynamics of the business cycle with a limited span (usually two or three percentage points in the real world) in the variations in the unemployment rate (Zipperer and Skott, 2011). On the other hand, the area to the right of point B corresponds to crisis cases (which are unusual events). The area to the left of A empirically corresponds to situations of full employment or overemployment.

We see in Figure 2 that the respective slopes of the two relationships are essential to the dynamics of system (1)–(2). The economic reason for why point A is stable is as follows. In 'normal' times, when the rate of growth slows, unemployment increases, but this trend

impinges sparsely on aggregate demand. We can consider that around dynamic equilibrium A, ψ'_u is very low. Thus, at point A, the dynamics of the system are dominated by Okun's law, which is stable because the inertia coefficient ϕ'_u is positive and less than 1.²

From a technical point of view, point A is a stable dynamic equilibrium since (as shown by the phase diagram) at this point, the slope of relationship (1) (Okun's law) is greater in absolute value (and lower in algebraic value) than the slope of relationship (2). The (negative) slope of relationship (1) is equal to $\frac{1 - \phi'_u}{\phi'_g}$ because in this relationship, $\frac{\Delta u}{\Delta g} = \phi'_g + \phi'_u \frac{\Delta u}{\Delta g}$.

The (negative) slope of relationship (2) is equal to $\frac{\psi'_u}{1 - \psi'_g}$ since in this relationship,

$\frac{\Delta g}{\Delta u} = \psi'_u + \psi'_g \frac{\Delta g}{\Delta u}$. Point A thus satisfies (in algebraic values) the condition

$\frac{1 - \phi'_u}{\phi'_g} < \frac{\psi'_u}{1 - \psi'_g}$. Moreover, when $\psi'_u \approx 0$, this inequality (considering the negative value of

ϕ'_g) is always true.

In the general case, $\psi'_u \neq 0$ and the condition $\frac{1 - \phi'_u}{\phi'_g} < \frac{\psi'_u}{1 - \psi'_g}$ can be written (because

$\phi'_g < 0$): $1 - (\phi'_u + \psi'_g) + \phi'_u \psi'_g - \phi'_g \psi'_u > 0$. We show in the appendix that this condition is precisely a local stability condition of system (1)–(2) at point A.

On the other hand, dynamic equilibrium B is a saddle point, since the slope of relationship (1) at this point is lower in absolute value (and greater in algebraic value) than the slope of

² However, even when $\psi'_u \approx 0$, the dynamics are much more complex in this case than would be the case if the model included only Okun's law because in this last case, a decline Δg in the rate of growth implies a total

$$\text{variation } \Delta u, \text{ such that: } \Delta u = \left[1 + \phi'_u + (\phi'_u)^2 + \dots \right] \phi'_g \Delta g = \left[\frac{\phi'_g}{1 - \phi'_u} \right] \Delta g.$$

Such a variation corresponds to a non-cyclical convergence towards a new equilibrium.

relationship (2). In algebraic value, point B thus satisfies the condition $\frac{1 - \varphi'_u}{\varphi'_g} > \frac{\psi'_u}{1 - \psi'_g}$, or

considering the negative value of φ'_g : $1 - (\varphi'_u + \psi'_g) + \varphi'_u \psi'_g - \varphi'_g \psi'_u < 0$. We show in the appendix that this is the condition that characterizes a saddle point.

The main results of the previous analysis are thus as follows. When the equilibrium rate of growth is sufficiently high, the economy is in a ‘corridor’ and the impact of the rate of unemployment is low, so that ψ'_u is equal to zero. This is a case of business cycle dynamics. On the other hand, when the rate of growth is lower than a threshold, the economy is subject to a cumulative process because point B is a saddle point. The effective demand failure is then a permanent problem, as shown in Keynes’s *General Theory* (Aspromourgos, 2012).

The mechanism of a crisis is as follows. We have seen in the previous part of the paper that a decline in growth becomes a crisis when it is of such a scale that the impact of the initial unemployment it induces leads in turn to additional braking. Furthermore, during a crisis, complete uncertainty prevents a rebound of investment even after a long period of low growth (Akerlof and Shiller, 2009), whereas during a ‘normal’ cycle, when a recession has begun a long time before, entrepreneurs ultimately expect a recovery. The current crisis in the euro area was the manifestation of this mechanism reinforced by the weight of the public and private debt. In the proposed model, this means that the derivative ψ'_u increases during a crisis to such an extent that it reverses the hierarchy of the slopes between relation (1) and relation (2). This threshold effect corresponds to the crossing of the stability corridor.

In addition, under the effect of the sharp degradation of the expectations of entrepreneurs, the impact of growth on the rate of unemployment (Okun’s coefficient φ'_g) may become more important. In this type of situation, declining growth leads to an unemployment rate increase

that is larger than before. The value of ϕ_g' increases, which means that the absolute value of the slope of relationship (1) decreases. The crossing of the instability threshold is accelerated.

4. THE MODEL AND THE REAL WORLD

The previous analysis has limitations. The assumption that Okun's Law does not shift when the economy moves from recession to depression may be seen as particularly adventurous. At the beginning of a crisis, labor hoarding and short time working arrangements have not disappeared and the responsiveness of unemployment to growth is lower. However, these assumptions do not call into question the conclusions of the model for the following reasons.

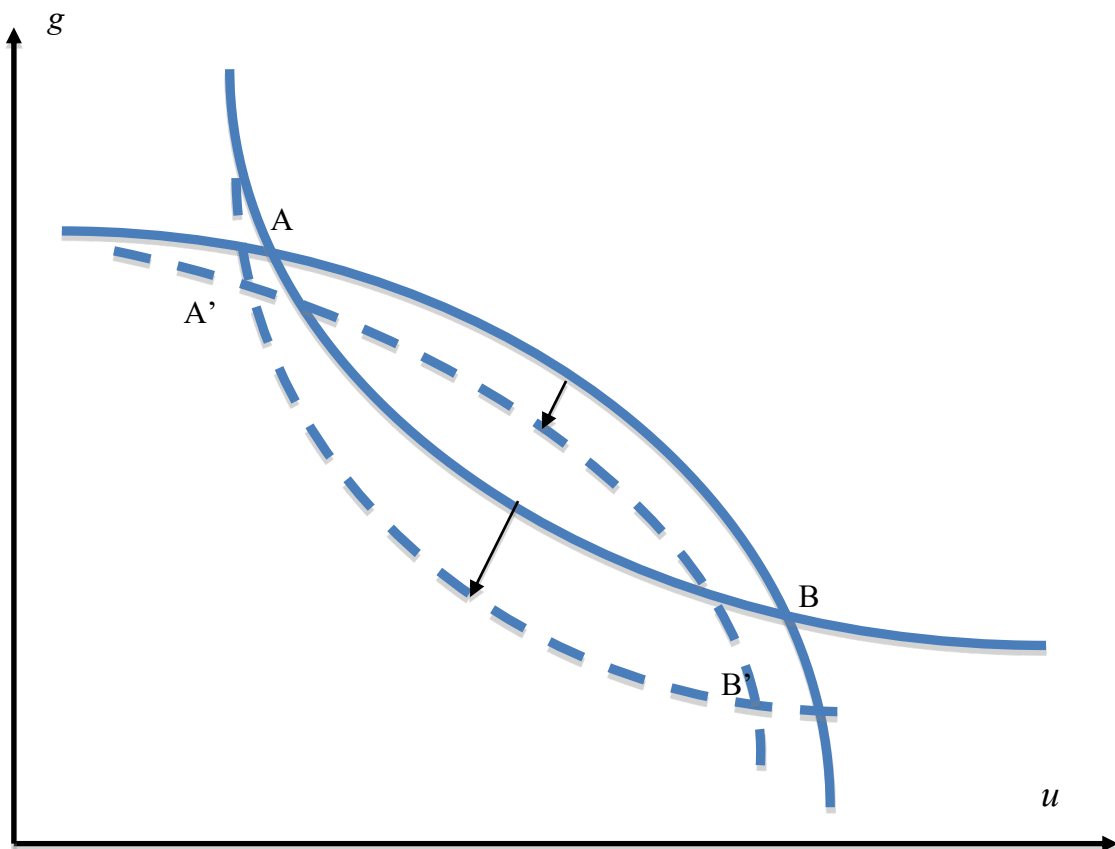
First, a recent study by the ECB's economists (ECB, 2012) offers important results in this field. According to this study, in the euro area, the Okun relationship has moved since the beginning of the crisis: the Okun coefficient estimate whose value was typically -0,4 dropped to around -0,3. However, the authors of the paper note that the responsiveness of the unemployment rate to GDP dynamics has recently returned to its pre-crisis level. It is likely that the duration of the crisis has thus eliminated labor hoarding and brought on this return.

Second, even if the relationships in equations 1 and 2 move, we know in what direction they move. During a crisis, relationship (1) may temporarily swivel in a clockwise movement due to the steeper slope of the Okun relationship when unemployment is high, as we have seen it. Relationship (2) may shift downward due to stronger credit restrictions, lower buffers and shock absorbers and so forth. In any case, these displacements do not change the main features of the two dynamic equilibria (Figure 3). The first initial dynamic equilibrium A has become A' and A' is still a stable equilibrium. The other initial equilibrium B has similarly moved toward B', which is an unstable equilibrium. The main difference from the initial

situation is that the instability threshold has been reached at a lower unemployment rate. However, if relationship (1) is the only one to be modified when the economy moves from recession to depression, the main result of this displacement is a drop in the lower equilibrium growth rate.

Figure 3

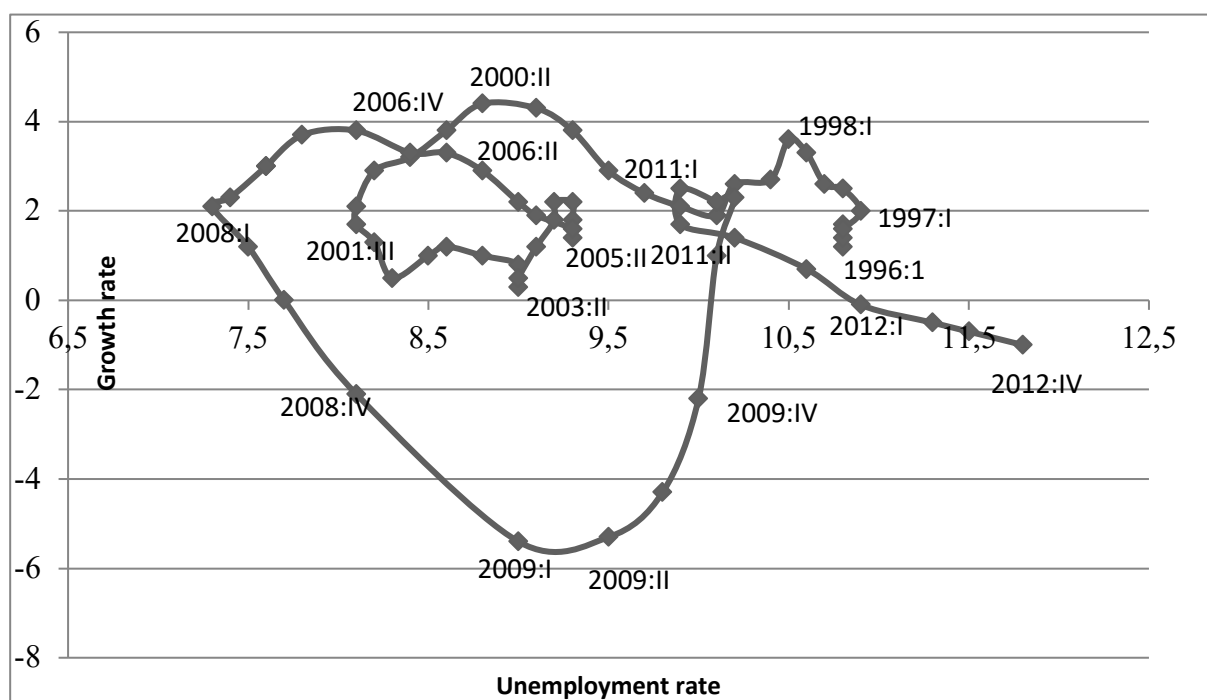
Dynamic Equilibria and Shifts of the Curves



Third, whatever the changes in relationships (1) and (2), the actual trend of the unemployment and growth rates in the euro area for the past two decades seems to be a good illustration of the two distinct economic dynamics studied in this paper. Figure 4 shows the Eurostat data on the unemployment rate in the euro area since 1996 and the corresponding growth rates of this area. The time path of the euro area (symbolized by a line joining two successive points) is contrasting. Before the crisis, it progressed in a cyclical way with an unemployment rate in the range of [7,3 %; 10,8%] and a growth rate in the range of [0,3%; 4,4%]. After the first quarter of 2008, the unemployment rate in the euro area increased permanently (except stabilizing for a short period from 2010:III to 2011:II) and the range of variation of the growth rate was very large (from -5,4% to 2,5%). During the period 2008–2012, no feedback forces were observed and the European economy evolved towards depression. This could be the clue that an instability threshold had been crossed.

Figure 4

Unemployment and Growth Rates in the Euro Area (1996:I–2012:IV)



5. CONCLUSION

In economies that are already suffering from mass unemployment and slow growth, austerity programs *can trigger* a cumulative process of declining activity when a threshold of weak aggregate demand is crossed. In addition, because of the lack of feedback forces at the macroeconomic level in such economies, more labor market flexibility (the ‘remedy’ to achieve recovery according to conservative economists) could be inefficient or even make the situation worse. From this perspective, macroeconomic policies such as those of European countries in the recent period have run a serious risk of failure.

APPENDIX

The stability of system (1)–(2) is dependent on the characteristics of the Jacobian matrix:

$$J = \begin{pmatrix} \varphi'_u & \varphi'_g \\ \psi'_u & \psi'_g \end{pmatrix}$$

The phase diagram excludes the case of an unstable eigenspace. Thus, no unstable node can exist as a dynamic equilibrium and the determinant of J (denoted $\det(J)$) cannot be greater than 1. We note that this determinant $\det(J)$ is equal to $\varphi'_u \psi'_g - \varphi'_g \psi'_u$ with $\varphi'_u > 0$, $\psi'_g > 0$, $\varphi'_g < 0$ and $\psi'_u < 0$. The trace of J (denoted $\text{tr}(J)$) is: $\varphi'_u + \psi'_g$.

In a two-dimensional case, a dynamic equilibrium is locally stable if the following conditions are fulfilled (Medio and Lines, 2001):

$$|\det(J)| < 1 \text{ or } \left| \varphi'_u \psi'_g - \varphi'_g \psi'_u \right| < 1$$

$$1 - \text{tr}(J) + |J| > 0 \text{ or } 1 - (\varphi'_u + \psi'_g) + (\varphi'_u \psi'_g - \varphi'_g \psi'_u) > 0.$$

$$1 + \text{tr}(J) + |J| > 0 \text{ or } 1 + (\varphi'_u + \psi'_g) + (\varphi'_u \psi'_g - \varphi'_g \psi'_u) > 0.$$

The first condition is always true in this model, as we have already seen. We observe too that the last condition is useless because in our model:

$$1^\circ) 1 + \varphi'_u + \psi'_g > 1 \text{ (considering that } \varphi'_u > 0 \text{ and } \psi'_g > 0) \quad |$$

$$2^\circ) |\det(J)| < 1, \text{ which means that } \left| \varphi'_u \psi'_g - \varphi'_g \psi'_u \right| < 1.$$

Thus, the only discriminating condition to have a stable dynamic equilibrium is $1 - (\varphi'_u + \psi'_g) + (\varphi'_u \psi'_g - \varphi'_g \psi'_u) > 0$. In addition, we have seen in the text that such an inequality means that at point A, the slope of relationship (1) is lower in algebraic value than the slope of the other relationship.

Now, in dynamic system (1)–(2), equilibrium B is a saddle point if the following two conditions are fulfilled:

$$1^\circ) \text{tr}(J)^2 - 4\det(J) > 0$$

$$2^\circ) [1 - \text{tr}(J) + \det(J)] \cdot [1 + \text{tr}(J) + \det(J)] < 0 \text{ which implies:}$$

$$\left[1 - (\varphi'_u + \psi'_g) + (\varphi'_u \psi'_g - \varphi'_g \psi'_u) \right] \cdot \left[1 + (\varphi'_u + \psi'_g) + (\varphi'_u \psi'_g - \varphi'_g \psi'_u) \right] < 0$$

The first inequality is always verified in this model because in the two-dimensional case, the eigenvalues are real. Indeed, in a saddle-point equilibrium, the eigenvalues have different moduli, which is impossible for a pair of complex eigenvalues. Thus, there are two real eigenvalues.

The second condition is verified for the following reasons:

- The inequality $1 - (\varphi'_u + \psi'_g) + (\varphi'_u \psi'_g - \varphi'_g \psi'_u) < 0$ is verified because it is equivalent to a greater slope in relationship (1) at point B to that of relationship (2), which is the case.

- The inequality $1 + (\varphi'_u + \psi'_g) + (\varphi'_u \psi'_g - \varphi'_g \psi'_u) > 0$ is verified because $1 + \varphi'_u + \psi'_g > 1$ and $|\det(J)| < 1$.

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