HOW TO MEASURE UNEMPLOYMENT? IMPLICATIONS FOR THE NAIRU*

*Mário Centeno***

*José R. Maria***

*Álvaro A. Novo***

1. INTRODUCTION

In Portugal, between 1998 and 2009, the number of unemployed workers available to work, who did not search for a job, remained relatively stable at around 80 000 individuals. The standard definition of unemployment, by invoking the concept of "actively searching" for a job, does not include these individuals in the 530 000 unemployed workers identified in *Inquérito ao Emprego* in 2009. However, a comprehensive discussion of the concept of unemployment, both from an economic and a social policy perspective, requires a thorough analysis of the behavior of all non-employed workers.

The job flows approach to the labor market appeals to the concept of "waiting" for a new job to define unemployment (Blanchard and Diamond, 1992). The relevant distinction between activity and inactivity is no longer based on "actively searching" employment, focusing instead on the "productivity" of the periods of non-employment, measured for example by the transition rates to employment. In this paper, we show that individuals available to work, who did not search for a job, are much closer to the standard unemployment state than the inactivity state. However, this group of workers, designated as "marginally attached", constitutes a distinct labor market state. Additionally, using the non-accelerating inflation rate of unemployment (NAIRU), we show that a broader concept of unemployment – that includes the marginally attached – can be used to better explain the dynamics of inflation and output in Portugal.

The NAIRU can also be interpreted as the natural rate of unemployment, i.e. the rate that prevails in the economy given the microeconomic structures of the labor and product markets (see "Box 3 The increased competition in labor markets and product and its macroeconomic impact, "of this Bulletin). In the last decade, the NAIRU, calculated with the broad definition of unemployment increased continuously, reaching 9.2 per cent in 2009, far from the average of 7.3 per cent during the 80s and 90s. The NAIRU estimated with the standard definition of unemployment rose from 5.5 per cent in the same period to 8.1 per cent in 2009.

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** Banco de Portugal, Economics and Research Department.

From a statistical viewpoint, the standard definition of unemployment follows a set of principles established by the International Labor Organisation (ILO). The definition of unemployment is based on the concept of job search. A worker without a job is considered unemployed if (s)he is available to work and has actively searched for a job during the reference period (usually the four weeks preceding the interview); otherwise, the worker is considered inactive. This definition may not capture all relevant dimensions of unemployment (Jones and Riddell 1999, Brandolini, Cipollone and Viviano 2006).

In the job flows approach to the labor market by Mortensen (1986), Pissarides (1990) and Blanchard and Diamond (1992), the notion of "active job search" is replaced by "productive waiting" for a new job. In these models, jobs are formed through the matching of workers available to work and the stock or the flow of job vacancies (Coles and Smith, 1998). This theoretical concept is more encompassing than the standard definition of unemployment based on active job search. The job flows approach assumes that the process of finding a job has an endogenous duration, which determines unemployment and wages.

The degree of heterogeneity in the pool of unemployed workers plays a crucial role in the context of the job flow approach. For example, unemployed workers differ in terms of duration of unemployment. Suppose, without loss of generality, that there are two levels of job search effort, low and high, and that short-term unemployed workers exert a greater effort while searching for jobs. The unemployment rate relevant to the functioning of the labor market would correspond to the sum of the two groups, weighted by the respective job search intensity. The job prospects of a newly unemployed worker improve with the proportion of those with low job search intensity. The same reasoning applies to the impact of unemployment insurance. There is ample evidence that individuals who receive unemployment insurance search with less intensity, resulting in longer periods of unemployment (Centeno and Novo, 2009a). Thus, a greater number of subsidized individuals results in a lower level of effective search, improving the employment prospects of the uninsured workers.

Marginally attached workers represent a significant proportion of the working population, about 20 per cent of unemployment in Europe (Brandolini *et al*. 2006). The relevance of the "active search" concept in the standard definition of unemployment in Portugal is widely discussed in Centeno and Fernandes (2004). Using the same approach in a more recent period, we show that the probability of transition to the employment of the marginally attached is quite close to that of the unemployed workers. However, the probability that an unemployed worker exits the labor force is much smaller. The differences in transition rates of marginal attached workers relatively to other inactive workers are quite significant, particularly the transitions to employment. Thus, a more detailed analysis of the behavior of marginally attached workers in the labor market seems justified.

In the most recent period, the observed increase in the unemployment rate was the result of a much lower rate of transition to employment of unemployed workers and a higher retention rate in unemployment. The behavior of the marginally attached group is much more stable over the business cycle; the rate of transition to employment of the marginally attached decreased much less during the recent recession, and in some quarters is even higher than the unemployed's. This could imply that

the use of the cyclical properties of the standard unemployment rate as an indicator of labor market conditions may fall short. In these circumstances, a definition of unemployment that includes the marginally attached workers could be a better measure to explain the dynamics of inflation.

2. ARE YOU UNEMPLOYED OR MARGINALLY ATTACHED?

This section characterizes marginally attachment and unemployment in Portugal. We highlight the differences in terms of national statistics treatment of the two groups of workers and test how behaviorally close these two groups are. The boundary of unemployment is thus discussed and we formally test the adequacy of a three state model of the labor market (with employed, unemployed and inactive workers) compared with a four state model (with employed, unemployed, marginally attached and other non-employed workers). Although the state of marginally attached is closer to the unemployed state than to the other non-employed workers, the groups are distinct, which points to the validity of a four-state model.

2.1. Recent evolution

An unemployed is defined as a non-employed person who wants to have a job and is actively searching for one. This concept gives rise to the standard definition of the unemployment rate, which is simply the ratio between total unemployment and the labour force.

Chart 1 depicts the breakdown of total unemployment by age groups. The most significant development over the last decade took place in the lower- and upper-tail of the age distribution. The share of old unemployed workers (above 45 years) increased from around 22 per cent in 1998, to around 30 per cent in 2009. Conversely, the share of young unemployed workers (below 25 years) decreased from levels around 30 per cent towards 18 per cent in 2009.

The standard definition of unemployment neglects marginal attached workers. These workers are also defined as non-employed persons who want to have a job, but did search actively for a job in the reference period.

The share by age of marginal attached workers reveals some regularities and proximities to unemployed workers. The differences in shares by age between the two are depicted in Chart 2. There are proportionally less unemployed workers than marginal attached workers among older workers (above 45 years), a gap that has been increasing over time, from -3 to -8 percentage points. The differential in the younger age bracket (below 25) decreased from 6 to 1 percentage points. The most significant change took place in the age group between 25 and 34, which increased from 1 to 7 percentage points.

Chart 3 depicts the breakdown of total unemployment according to four education levels: “no education”, “basic”, “secondary” and “college”. The increase in the education levels of the Portuguese workers took place in the “basic” and “college” groups (Alves, Centeno and Novo 2010). In 2009, these groups accounted for 17 and 15 per cent, respectively, which implies an increase of 7 percentage

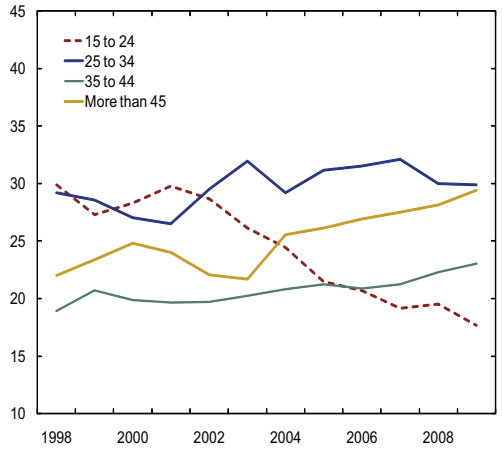
points in each group against the levels prevailing in 1998. The share of unemployed workers who have "basic" education levels decreased from 73 per cent in 1998, to 69 per cent in 2009, remaining with an higher weight on total unemployment than in the labour force. On the contrary, the share of unemployed workers who have "college" is lower in the labour force, although they increased 4 percentage points.

The differences between the shares of unemployed and marginal attached workers by education groups are depicted in Chart 4. Overall, the marginal attached are slightly less educated than the unemployed.

Chart 1

UNEMPLOYMENT BREAKDOWN, BY AGE

Shares in total unemployment, per cent

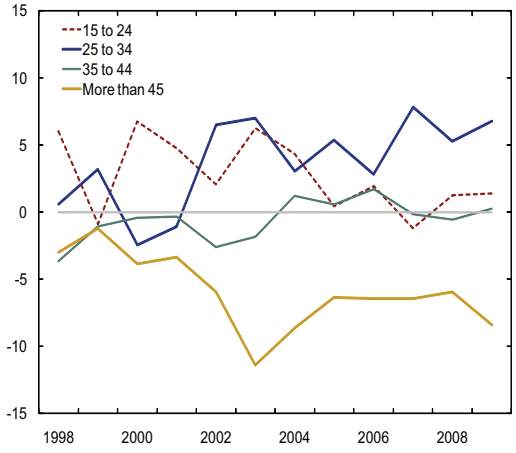


Source: *INE* (*Inquérito ao Emprego*).
Note: Annual data.

Chart 2

DIFFERENCES BETWEEN UNEMPLOYED AND MARGINAL ATTACHED, BY AGE

Differences of shares, percentage points

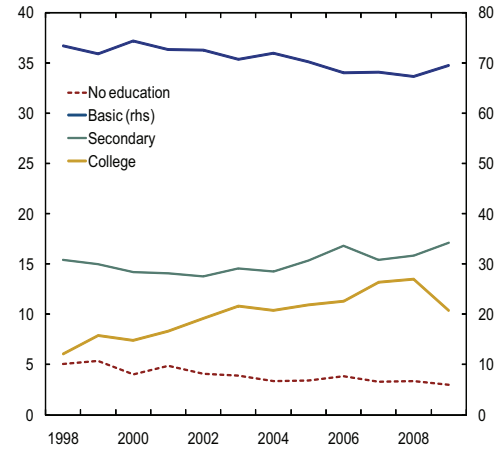


Source: *INE* (*Inquérito ao Emprego*).
Note: Annual data.

Chart 3

UNEMPLOYMENT BREAKDOWN, BY EDUCATION

Shares in total unemployment, per cent

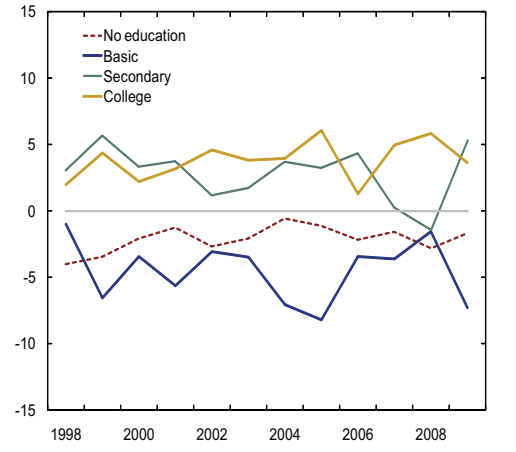


Source: *INE* (*Inquérito ao Emprego*).
Note: Annual data.

Chart 4

DIFFERENCES BETWEEN UNEMPLOYED AND MARGINAL ATTACHED, BY EDUCATION

Differences of shares, percentage points



Source: *INE* (*Inquérito ao Emprego*).
Note: Annual data.

The number of unemployed workers decreased between 1998 and 2000, but registered an upward trend thereafter, reaching almost 530 thousands workers in 2009 (Chart 5). The number of marginal attached workers decreased also between 1998 and 2000, but contrary to the number of unemployed workers, it remained relatively stable until 2009 (slightly below 80 thousand). As a result, the ratio between the two sets, which was around 35 per cent in 1998, decreased to less than 14 per cent in 2009.

2.2. The equivalence between unemployment and marginal attachment

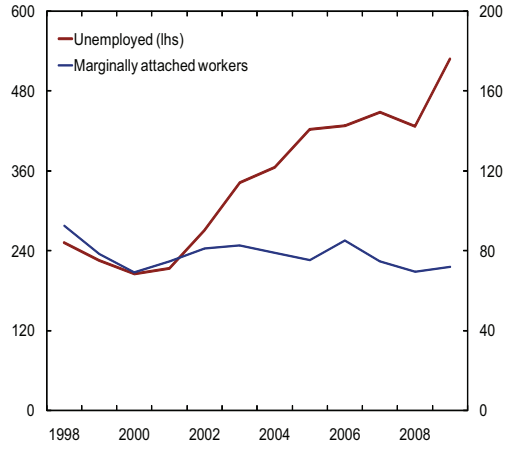
The approach follows the basic reference of Flinn and Heckman (1983) and has been applied to a number of countries. Jones and Riddell (1999) study the US and Canadian labor markets and Brandolini *et al*. (2006) study several European countries. This approach has been applied to Portugal in Centeno and Fernandes (2004).

We consider the existence of four distinct labor market states; employment E, unemployment U, marginal attached M, and non-attached to the labor force N. The states E and U use the conventional labor force survey definitions, and M and N are obtained by splitting non-participants into two subsets. The M group is defined as comprising all workers that, although not currently searching for a job, report they want a job.

The assessment of whether two labor market states are behaviorally equivalent amounts to testing whether the transition probabilities out of the two states to a third state are equal, either unconditionally or conditional on a set of observable variables. Let pUE denote the quarterly transition probability from U to E, and analogously for the other states. The equivalence of M and U states can be inferred by testing jointly the following conditions:

Chart 5

TOTAL UNEMPLOYMENT AND MARGINAL ATTACHED WORKERS
Thousands



Source: *INE* (*Inquérito ao Emprego*).
Note: Annual data.

$$pME = pUE, \quad (1)$$

$$pMN = pUN. \quad (2)$$

If M and U transit into both E and N at the same rates, then they can be pooled into a single state without any loss of information; behaviorally there will be no significant differences between M and U. If this is the case, the usual definition of unemployment based on the job search activity should be replaced by one based on the desire to work.

Similarly, we can also assess the equivalence of M and N by testing jointly the following conditions:

$$pME = pNE, \quad (3)$$

$$pMU = pNU. \quad (4)$$

If we fail to reject these hypotheses, the usual pooling of the M and N states into a single state, out-of-the-labor force, would be appropriate. It is unlikely that the marginal attached are both equivalent to the employed and the non-attached, but not that they differ from both the other two states. In the latter case, the U, M and N are distinct states in terms of labor market transitions, resulting in a case to consider them separately.

Table 1 reports the average exit rate from the three non-employment states (U, M, N) into the four labor market states (E, U, M, N). The top panel presents averages for the whole period (1998-2009), and the two remaining panels present averages for two sub periods (1998-2003, a booming period and 2004-2009, a recessive period). Overall, the M state represents an intermediate state between U and N. The marginally attached are quite close to the unemployed in terms of transitions into employment (14.4 versus 18.7 per cent), but they are much more likely to become employed than the non-attached individuals (only 1.1 per cent). However, they differ greatly from the unemployed in terms of labor force withdrawal; indeed their chances of moving to the non-attachment state are two times larger than those of unemployed workers (11.7 *versus* 25.5 per cent).

Chart 6 shows in greater detail the dynamics of the transition rates. During the sample period, and in line with macroeconomic developments, it is noticeable the reduction of the transition rates of unemployment to employment (pUE) and the increased retention rates in unemployment (pUU). By contrast, during the whole period, the transition rates involving M are much more stable.

To test the joint equivalence hypotheses, we estimate multinomial logit models of the determinants of transition probabilities into employment and the non-employment states. The method examines whether two different origin states give sets of estimated coefficients that are statistically non-significantly different from one another. The results are presented in Table 2. The estimated multinomial logit model contains as explanatory variables: age, gender, marital status, education and region of residence. The models are estimated separately for each quarter and we report the likelihood ratio statistics.

The tests clearly reject the equivalence of $M = N$ and $M = U$. Indeed, for all quarters, the large values of the likelihood ratio test statistics in columns (1) and (2) imply that we reject the equality hypothesis with confidence levels in excess of 99 per cent. This confirms that U, M and N are distinct

Table 1

AVERAGE TRANSITION RATES (QUARTERLY)
In proportion of total transitions from the state of origin

Transitions	To	E	U	M	N
From					
			1999-2009		
U		0.187	0.635	0.062	0.117
		0.036	*0.061*	*0.015*	*0.021*
M		0.144	0.221	0.380	0.255
		0.029	**0.039**	*0.047*	*0.036*
N		0.011	0.007	0.003	0.978
		0.003	*0.002*	*0.001*	*0.003*
			1999-2003		
U		0.218	0.576	0.074	0.131
		0.022	*0.031*	*0.012*	*0.021*
M		0.155	0.194	0.396	0.254
		0.033	*0.033*	*0.049*	*0.039*
N		0.013	0.006	0.003	0.977
		0.002	*0.002*	*0.001*	*0.004*
			2004-2009		
U		0.160	0.683	0.051	0.106
		0.020	*0.029*	*0.006*	*0.012*
M		0.135	0.243	0.367	0.255
		0.022	*0.029*	*0.041*	*0.033*
N		0.009	0.008	0.004	0.979
		0.001	*0.001*	*0.000*	*0.003*

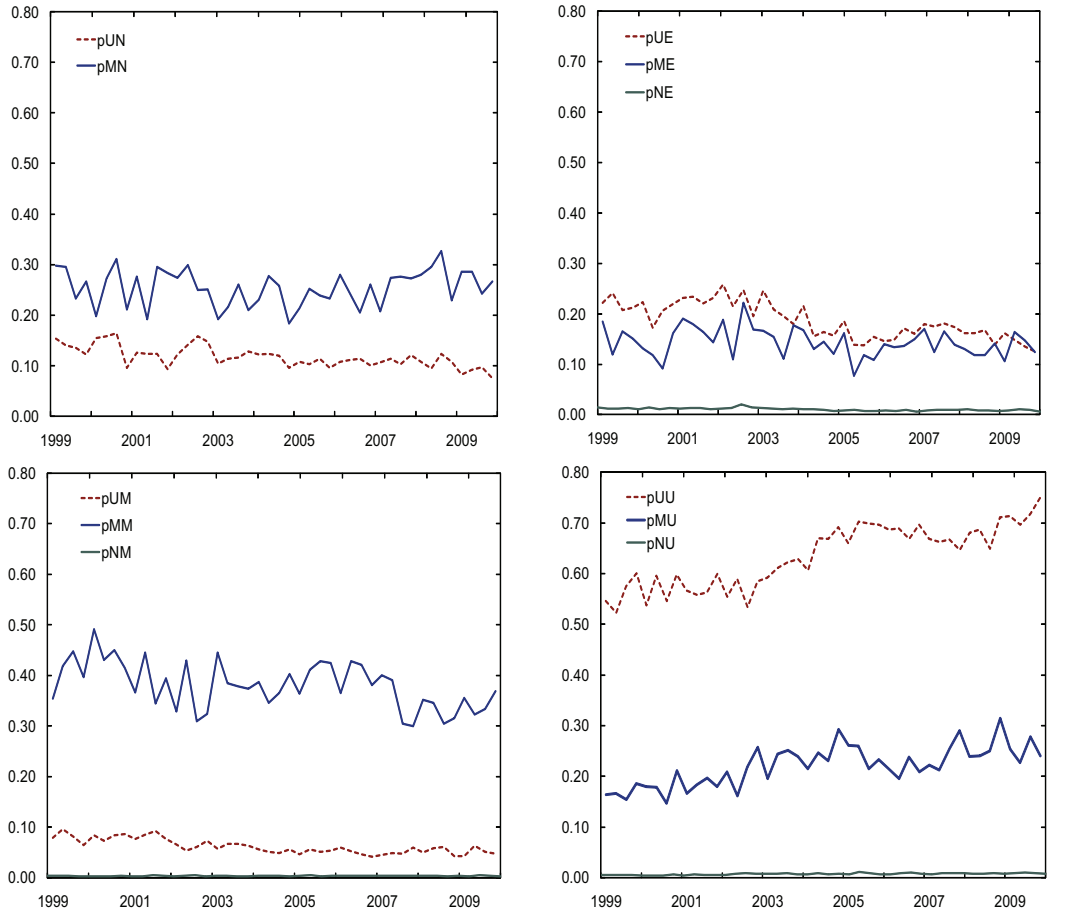
Source: *INE* (*Inquérito ao Emprego*).
Notes: E - Employed, U - Unemployment, M - Marginally active, N - Non-attached to the labour force. Standard deviations in italic. The transitions rates are computed from quarterly hazard rates of individuals in two consecutive surveys.

states. We obtain the same conclusions when estimating the models by gender (columns (3)-(6)). We also estimated binary logit models of transition rates into employment alone. The pattern of the test statistics is very similar, but we are not able to reject the equivalence of U and M in some quarters. An indication that the marginal attached may be closer to the labor market than what is implied by the formal definition of unemployment. The results reject the three-state model for the Portuguese labour market.

Next, we estimate the NAIRU for the Portuguese economy, using both the standard and the broader definition of unemployment, which incorporates marginally attached workers. We do a preliminary statistical assessment of which of the two definitions results in better fits for the inflation dynamics of the Portuguese economy in the sampling period.

Chart 6

TRANSITION RATES



Source: *INE* (*Inquérito ao Emprego*).
Notes: Quarterly data. For example, the transition rates pUN and pMN are the empirical hazard rates to non-participation from unemployment and marginal attachment, respectively.

3. NAIRU ESTIMATES

The NAIRU is computed using quarterly data for inflation, output and unemployment, the latter augmented with marginally attached workers. This database is presented in Section 3.1 Given the absence of a consistent time series for the unemployment rate over this time period, using the broad definition, this section recalls available data sets and clarifies the methodology behind its construction. The NAIRU is estimated in a system of equations based on a Phillips curve and an Okun's law. This approach is presented in Section 3.2 The framework draws on Apel and Jansson (1999a, 1999b), and has been used by Fabiani and Mestre (2004) and Centeno, Maria and Novo (2009), with euro area and Portuguese data, respectively. Finally, Section 3.3 reports the outcome and compares it with the previously computed NAIRU estimates that are based on the conventional definition of the unemployment rate.

Table 2

TEST STATISTICS FOR LIKELIHOOD RATIO TEST OF EQUIVALENCE

		Test		Test – Men		Test – Women	
		M = N	M = U	M = N	M = U	M = N	M = U
1999	Q1	3 700.7	1 118.1	2 099.6	544.5	1 547.7	579.1
	Q2	3 392.5	1 083.8	1 889.2	541.4	1 517.4	593.7
	Q3	3 364.5	839.5	1 856.8	368.9	1 470.6	453.6
	Q4	3 244.8	728.6	1 674.5	278.8	1 513.4	432.3
2000	Q1	2 473.3	933.1	1 326.0	394.1	1 111.6	554.6
	Q2	3 191.0	641.5	1 615.8	313.0	1 538.5	315.1
	Q3	2 938.5	837.3	1 657.7	467.0	1 265.2	370.0
	Q4	3 972.6	707.7	2 367.5	364.6	1 563.5	337.6
2001	Q1	2 855.6	778.4	1 573.4	391.0	1 246.2	359.7
	Q2	3 510.9	762.0	2 025.5	429.2	1 445.9	342.5
	Q3	3 454.5	741.9	1 989.9	376.3	1 464.4	384.1
	Q4	2 958.3	669.8	1 623.1	326.3	1 338.5	355.1
2002	Q1	3 290.0	971.7	1 868.2	459.0	1 445.6	520.4
	Q2	3 797.1	861.6	2 138.1	397.5	1 636.8	468.6
	Q3	4 847.4	1 125.4	2 766.7	574.1	2 060.6	534.1
	Q4	3 383.5	1 159.0	1 973.0	616.9	1 433.1	541.1
2003	Q1	3 670.0	1 462.6	2 098.0	693.5	1 560.4	722.0
	Q2	3 502.2	1 481.5	2 157.9	784.4	1 331.1	706.7
	Q3	3 539.8	1 483.7	2 019.9	735.6	1 501.0	728.8
	Q4	3 523.4	1 624.5	1 969.1	789.9	1 565.3	863.6
2004	Q1	2 709.9	1 386.4	1 403.7	697.3	1 296.2	714.7
	Q2	3 857.8	1 427.5	2 214.3	702.4	1 645.9	727.3
	Q3	3 233.6	1 638.3	1 756.9	853.2	1 482.4	785.3
	Q4	3 025.8	1 686.0	1 736.8	829.1	1 278.3	843.9
2005	Q1	3 032.8	1 966.1	1 712.2	1 046.8	1 310.4	899.3
	Q2	3 956.0	1 679.3	2 360.1	839.1	1 568.9	817.8
	Q3	2 589.8	1 565.3	1 479.8	827.2	1 085.6	746.9
	Q4	2 572.5	1 709.5	1 703.3	913.2	856.5	807.5
2006	Q1	2 746.7	1 609.3	1 601.1	838.6	1 163.6	800.6
	Q2	2 911.4	1 424.2	1 757.5	607.5	1 167.2	813.6
	Q3	3 333.9	1 548.4	1 840.5	768.7	1 492.1	754.2
	Q4	2 319.4	1 606.3	1 339.7	846.2	969.5	749.7
2007	Q1	2 505.5	1 819.5	1 436.1	959.2	1 067.6	859.2
	Q2	3 054.5	1 676.4	1 829.6	897.3	1 215.2	742.3
	Q3	2 950.3	1 603.9	1 763.3	851.9	1 170.8	745.0
	Q4	3 156.2	1 805.4	1 792.4	1 035.5	1 381.3	789.5
2008	Q1	3 045.5	1 739.2	1 784.5	893.6	1 269.2	870.6
	Q2	2 789.6	1 576.7	1 599.4	838.2	1 215.6	756.2
	Q3	2 716.9	1 588.0	1 601.9	939.0	1 113.1	659.6
	Q4	2 603.9	1 457.5	1 389.5	785.5	1 202.6	668.2
2009	Q1	2 870.6	1 809.0	1 745.4	916.7	1 113.3	887.2
	Q2	3 495.8	2 018.9	2 034.2	920.2	1 490.8	1 119.2
	Q3	3 121.3	1 837.7	1 824.5	923.6	1 300.9	930.7
	Q4	2 238.7	1 830.5	1 303.5	990.9	938.0	920.2

Source: *INE* (*Inquérito ao Emprego*).
Note: Quarterly data.

3.1. Database

Chart 7 plots inflation developments over the last 25 years, measured by the change in the private consumption deflator. It shows a pronounced downward trend with inflation rates decreasing from more than 20 per cent in the mid-80s to levels below 3 per cent over the 1996-2008 period. In 2009, against the international background of a severe economic and financial crisis, the inflation rate was negative, like in other advanced economies, including in the euro area.

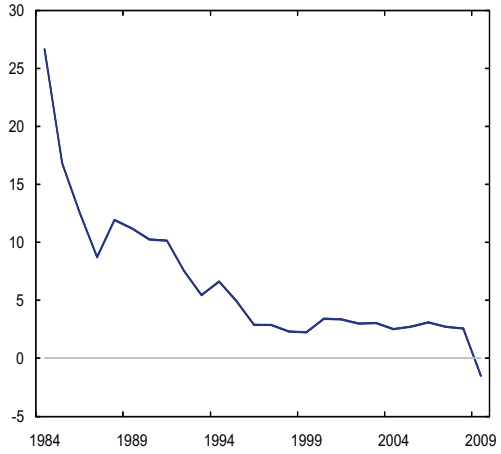
Real GDP displays an upward trend over the last 25 years (Chart 8). However, more recently, the economy has been marked by relatively low growth. In 2009, GDP contracted severely, similarly to developments in other advanced economies.

Chart 9 plots the conventional unemployment rate based of Banco de Portugal (BP) and of *Inquérito ao Emprego* (*IE*). Although both series are in line with international standards and coincide from 1998 onwards, they are different early on. The methodology behind the construction of the Banco de Portugal database can be found in Castro and Esteves (2004). This series was used to estimate the natural rate of unemployment in Centeno *et al*. (2009).

Early on the sample period, the unemployment rate does not depict a clear low frequency movement. However, this changed dramatically more recently. The unemployment rate recorded a highly persistent upward movement and in annual terms surpassed, since 2005, the previous maximum of 7.4 per cent, recorded in 1986, reaching 9.5 per cent in 2009.

Chart 7

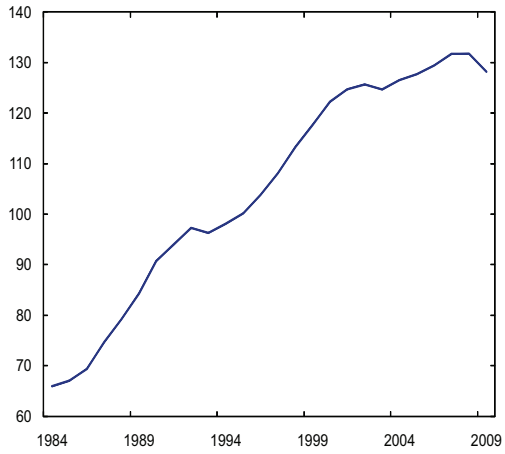
INFLATION RATE
Per cent



Source: Banco de Portugal.
Note: Annual data.

Chart 8

GROSS DOMESTIC PRODUCT
Real, EUR millions



Source: Banco de Portugal.
Note: Annual data.

The evolution of the unemployment rate according to the broad definition is plotted in Chart 10. There are two time series. The first is retrieved from the labor force survey. The series "Pinheiro (1999) and author's calculations" was constructed by assuming that:

i) between 1998 and 2009, all annual data coincide with *IE* data;

ii) between 1995 and 1997, the ratio between the marginally attached workers and the conventional definition of unemployed in *IE* data is the same as in the Banco de Portugal database;

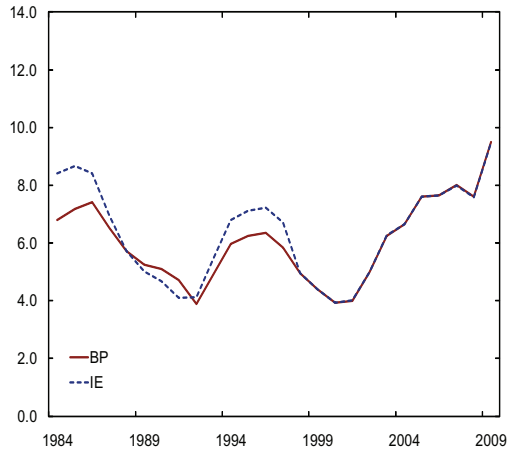
iii) before 1995: all data is derived from the rates of change included in Pinheiro (1999).

The computed annual figures are in general lower than those published by *IE* before 1998, as in the previous case (Chart 9). By including marginally attached workers, these unemployment rates are naturally higher than the standard unemployment rates.

Changes in the computed unemployment rate according to the broad concept have a negative correlation with the growth rate of real GDP, a feature already present using the standard definition. This resembles the simplest formulation of the Okun's law, which can be simply stated as a rule in which output and unemployment evolve in opposite directions (Mankiw 2003). As expected, Chart 11 confirms that the relationship between the unemployment rates, using the broad and the standard definition, is rather linear. However, this relationship is steeper than the 45 degrees line, which indicates that when the unemployment rate without marginally attached workers increase(decrease), the unemployment rate using the broad concept includes a tendency to increase(decrease) by more.

Chart 9

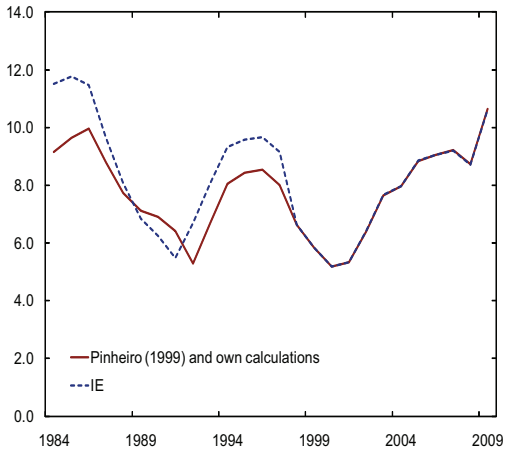
UNEMPLOYMENT RATES – STANDARD DEFINITION
Percentage of the labour force



Sources: *INE* (*Inquérito ao Emprego*). and Banco de Portugal.
Note: Annual data.

Chart 10

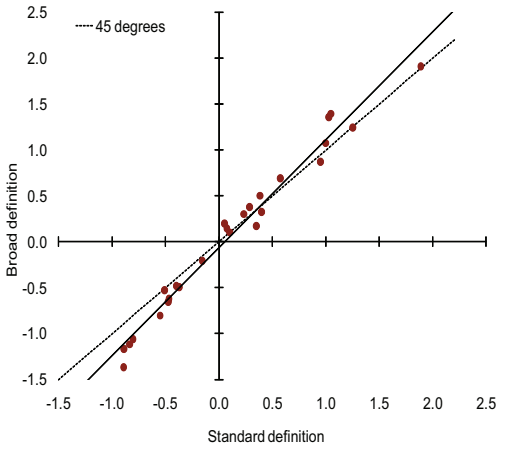
UNEMPLOYMENT RATES – BROAD DEFINITION
Percentage of the labour force, including marginally attached workers



Sources: *INE* (*Inquérito ao Emprego*), Pinheiro (1999) and authors' calculations
Note: Annual data.

Chart 11

UNEMPLOYMENT RATES – STANDARD AND BROAD DEFINITIONS



Source: Authors' calculations.
Note: Annual data.

3.2. Estimation framework

The NAIRU is estimated in a system of equations based on a Phillips curve and an Okun's law. The Phillips curve, linking inflation and unemployment, and Okun's law, linking output and unemployment, generate NAIRU estimates in which demand pressures with an impact on inflation are consistent with output developments.

The system of equations used herein has the following form:

$$\pi_t - \pi_t^e = A(L)(\pi_{t-1} - \pi_{t-1}^e) + \gamma(L)(U_{t-1} - \tilde{U}_{t-1}) + \delta(L)z_t + \varepsilon_t, \quad (5)$$

$$y_t - \tilde{y}_t = \theta(U_{t-1} - \tilde{U}_{t-1}) + \nu_t, \quad (6)$$

$$\tilde{U}_t = \tilde{U}_{t-1} + \zeta_{1t}, \quad (7)$$

$$\tilde{y}_t = \tilde{y}_{t-1} + \Delta_{t-1}, \quad (8)$$

$$\Delta_t = \Delta_{t-1} + \zeta_{2t}, \quad (9)$$

where:

i) π_t is actual inflation;

ii) π_t^e represents expected inflation and is assumed to be given by lagged inflation, *i.e.* $\pi_t^e = \pi_{t-1}$;

iii) $A(L)$, $\gamma(L)$ and $\delta(L)$ are polynomials in the lag operators;

iv) U_t is the actual rate of unemployment;

v) $\tilde{U}_t$ is the NAIRU;

vi) z_t is a vector of variables capturing supply shocks (which typically includes exogenous variables such as import prices);

vii) y_t is observed real output;

viii) $\tilde{y}_t$ represents potential output;

ix) θ is an unknown parameter (expected to be negative);

x) ε_t and ν_t are $i.i.d.$error terms.

xi) $\zeta_{1t} \sim N(0, \sigma_{\tilde{U}})$ and $\zeta_{2t} \sim N(0, \sigma_{\Delta})$ are independent error terms assumed to follow normal distributions, with unknown standard deviations $\sigma_{\tilde{U}}$ and σ_{Δ}, respectively;

Both $\tilde{U}_t$ and $\tilde{y}_t$ are treated as unobserved variables. The natural rate of unemployment $\tilde{U}_t$, originally envisaged in the seminal works of Friedman (1968) and Phelps (1968), can be assessed as a long-run or steady-state concept, around which the actual unemployment rate fluctuates. Potential output $\tilde{y}$ is an estimate of the level of output when the economy is operating at a high rate of resource use, without inflationary pressures (Arnold 2009).

Equation (5) represents a Phillips curve, and is based on the well-known "Triangle model" (Gordon 2008). The vertices of the triangle are "generalized inertia" $A(L)(\pi_{t-1} - \pi^{e}_{t-1})$, "demand pressures" $\gamma(L)(U_{t-1} - \tilde{U}_{t-1})$, and "supply shocks" $\delta(L)z_t$. "Generalized inertia" is presumably capturing the formulation of expectations and the impact of several microeconomic features of the economy such as existing contracts or input-output supply chains. Equation (5) assumes that $(U - \tilde{U})$ is lagged relatively to the dependent variable $\pi - \pi^{e}$, as in Laubach (2001) and Llaudes (2005), and not contemporaneous, as in the work of Gordon (2008).

The explicit treatment of "supply shocks" is another relevant feature of equation (5). If these shocks were not explicitly included in z, they would be subsumed in the error term (Katz and Krueger 1999), and the NAIRU would inherit, to some degree, the evolution and volatility of z. Moreover, it may not be possible to explain higher inflation without excess demand. On the contrary, if z is included, it could capture the sources of higher inflation even with a receding demand (see, for example, Layard, Nickell and Jackman (1991)).

In a Phillips curve framework, if the unemployment rate decreases to levels below the NAIRU, inflationary pressures from a tight labor market are expected to mount and higher inflation will emerge in the future. The converse also applies. In the long-run, without supply shocks, inflation converges to a stable value (although undefined), with the unemployment rate converging to the NAIRU.

Equation (6) represents an Okun's law. The structural relationship is basically assuming that cyclical developments in output $\left(y_t - \tilde{y}_t\right)$ should be captured by cyclical developments in unemployment $(U_{t-1} - \tilde{U}_{t-1})$. The first component is the output gap, the second the unemployment gap In this framework, if excessive strain is placed in the nation's resources, than the unemployment rate decreases to levels below the NAIRU, and this would be associated with output increasing above potential. Although Okun's law is usually taken as a relationship between output and unemployment, the link with inflation can be traced back to Okun (1962).

The economic relationships behind equations (5) and (6) do not include any information regarding the stochastic processes defining the behavior of the NAIRU $\tilde{U}_t$, or potential output $\tilde{y}_t$. The full system of equations is then completed with equations (7), (8) and (9) which are standard atheoretical laws of motion.

Equation (7) is a pure random walk (without any drift). This may be seen as an acceptable approximation to capture the presence of frequent permanent shocks (King and Morley 2007). The NAIRU estimates is conditioned by the values of the standard deviation $\sigma_{\tilde{U}}$. If $\sigma_{\tilde{U}} = 0$, then the NAIRU is constant throughout the entire sample. In this limiting case, changes in the unemployment gap are solely determined by changes in the actual unemployment rate. If $\sigma_{\tilde{U}} > 0$, the outcome would be closer to the view of Friedman (1968), who admitted that the natural rate varies over time. However, if $\sigma_{\tilde{U}}$ is too high, the NAIRU may depict excess volatility. The system can also be estimated in the intermediate situation where $\sigma_{\tilde{U}}$ is assumed to be higher then 0, from the outset, but under the a priori consideration that the estimated behavior of the NAIRU should be relatively smooth. The motivation behind the atheoretical law of motion (7), which assumes in particular that the NAIRU is integrated of order 1 and not 2, although the former is also common in the literature (Laubach 2001, Fabiani and Mestre 2004), is the absence of a low frequency movement over the sample period (see Chart 10).

Developments in potential output are defined in equations (8) and (9), which interact with equation (6). Given the absence of an error term in equation (8), this set up represents a restricted version of the standard "local linear trend" model (Harvey 1990). The objective is to estimate a smoother potential output. The interpretation of σ_{Δ} is similar to that of $\sigma_{\tilde{U}}$, but now applies to the change of potential output (given by Δ_t). The trend would be linear if $\sigma_{\Delta} = 0$.

3.3. Empirical results

The system of equations was written in state-space form and all unknown parameters and time series of the NAIRU and potential output were estimated using the Kalman flter and Maximum Likelihood (Harvey 1990, Hamilton 1994). These unobserved variables were computed using the Matlab toolbox E4 (Jerez, Sotoca and J. Casals 2007) and correspond to the smooth estimates Initial conditions for the filter are clarified in Casals and Sotoca (2001). Initial values for the parameters are derived by least squares, assuming a NAIRU and a potential output given by an HP filter. All variables not statistically significant were dropped out. The choice of the standard deviation $\sigma_{\tilde{U}}$, which has a discussion somehow akin to the choice of the smoothness parameter of an HP filter, was solved in the light of Gordon (1997, p 22), who stated that the "natural rate can move around as much as it likes, subject to the qualification that sharp quarter-to-quarter zig-zags are ruled out".

The sample period, which includes observed data ranging from 1984 Q1 to 2009 Q4, was extended until 2011 Q4 with autoregressive and moving average models for π_t, U_t and y_t, using procedures built in the TSW software (Caporello and Maravall 2004). There are two main motivations for doing this. First, to mitigate the end-point bias typical of the filters used in the estimation of latent variables. Second, to incorporate into our estimates the recent evolution of the Portuguese economy. This procedure projects low GDP growth and a moderate increase in the unemployment rate until the end of 2011.

Table 3 reports the parameter estimates underlying the NAIRU estimation. Chart 12 reports NAIRU estimates over the last 25 years using the broad definition of unemployment rate, and confronts it with the computed NAIRU presented in Centeno *et al*. (2009).

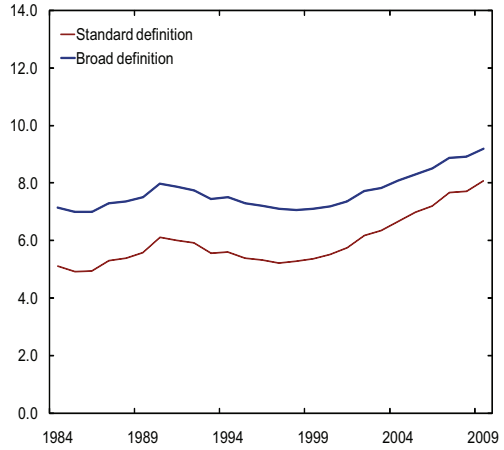
The reported NAIRU based on the standard definition of the unemployment rate fluctuates around 5.5 per cent until the late 90s, increasing thereafter to values slightly above 7 per cent. The estimates for the earlier period are consistent with the traditional view of a relatively stable outcome over the 80s and the 90s. The reported NAIRU based on the broad definition fluctuates 2 percentage points above over this period, and includes an upward shift in comparison with the former. In addition, the results point towards a greater proximity between the two over the last years. The differential was in 2009 around 1 percentage point.

Chart 13 plots the unemployment gap obtained from the system estimation and confronts it with the results obtained in Centeno *et al*. (2009). The differences are rather negligible, except that the unemployment gap based on the broad definition is slightly more volatile. Chart 14 depicts the expected negative correlation between the output and the unemployment gap. After a period where both the output and unemployment gaps were almost closed (2003-2008), recent developments indicate a widening similar to previous episodes of the business cycle.

It is important to measure the performance of both measures of unemployment in the system of equations. We would be attempting to answer the question of which unemployment measure fits better with the other aggregate variables included in the model. We re-run the system in (5) − (9) for the broad and standard unemployment measures without imposing a restriction on the $\sigma_{\tilde{U}}$ and σ_{Δ} parameters. Then, we evaluate the goodness of the two models using the Akaike and the Schwarz information criteria. In both cases, the broader NAIRU performs better, which can be seen as an indication that it is a more informative aggregate to understand the pressures of those out-of-work on other aggregate economic outcomes.

Chart 12

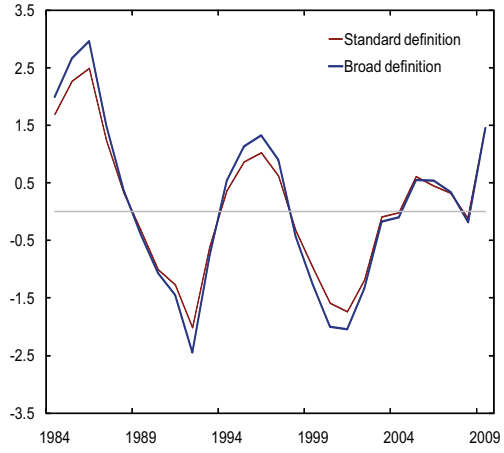
NAIRU ESTIMATES



Sources: *INE* (*Inquérito ao Emprego*) and autors' calculations.

Chart 13

UNEMPLOYMENT GAP
Percentage points



Sources: *INE* (*Inquérito ao Emprego*) and autors' calculations.
Note: Annual data.

Table 3

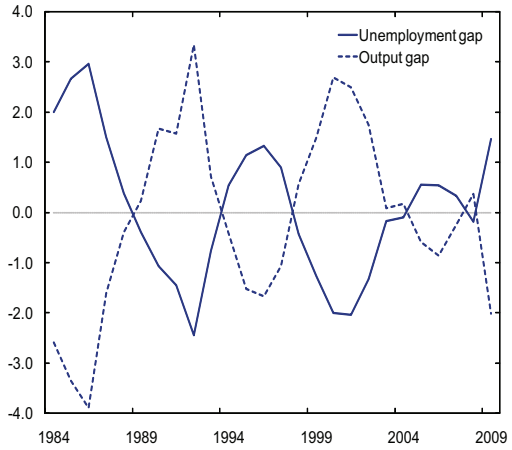
PHILLIPS CURVE AND OKUN'S LAW

	Phillips curve	Okun's law
Variable	$\Delta\pi_t$	$(y-\tilde{y}_t)$
	(1)	**(2)**
$\Delta\Delta\pi_{t-4}$	-0.7845 (0.0662) *0.0000*	
$\Delta\Delta\pi_{t-7}$	-0.1497 (0.052) *0.0049*	
$\Delta\Delta\pi_{t-8}$	-0.4931 (0.0751) *0.0000*	
$\Delta\Delta\pi_{t-12}$	-0.1568 (0.0528) *0.0037*	
$z_{1,t}$	0.4408 (0.1082) *0.0001*	
$z_{1,t-4}$	0.4270 (0.0987) *0.0000*	
$z_{2,t}$	0.1788 (0.0712) *0.0136*	
$(U_{t-1}-\tilde{U}_{t-1})$	-0.3064 (0.0412) *0.0000*	-1.3460 (0.0314) *0.0000*
Estimation period	1984 Q1–2011 Q4	1984 Q1–2011 Q4
Number of observations	112	112

Note: Standard errors in parentheses and p-values in italics. π is defined in yearly terms by the log change of the personal consumption deflator; $(U_{t-1}-\tilde{U}_{t-1})$ is the unemployment gap, defined as the difference between actual and the natural rate of unemployment; $(y-\tilde{y}_t)$ is the output gap, defined as the difference between actual and potential output; z_1 is defined in yearly terms by the log change in the ratio between the overall imports deflator and the whole economy GDP deflator; z_2 is defined in yearly terms by the log change in the relative consumer prices of energy and unprocessed food items.

Chart 14

OKUN'S LAW
Percentage points



Source: Authors' calculations.
Note: Annual data.

4. CONCLUSION

The concept of unemployment plays a central role in debates on economic and social policy. The difficulty of finding a definition of unemployment that captures all relevant aspects of this phenomenon should be interpreted as reflecting the great diversity of workers without a job searching for work. This is reflected in recent labor market theoretical approaches – efficiency wages and segmented labor market – that devote much attention to the heterogeneous behavior of the non-employed when they move between jobs.

In the Portuguese case, we showed that the conventional measure of unemployment may be insufficient to capture all the relevant boundaries of a measure of non-employment, both for economic and a social policy. Apart from the unemployed workers and inactive agents, we identified the marginally attached workers – those who want to work but did not actively search for a job – as a distinct group in the population. These individuals behave differently from the unemployed workers and other non-participants. They should not exclude from the analysis.

From a microeconomic perspective, the inclusion of these workers provides more adequate descriptions of the high degree of heterogeneity present in the labor market and the possible consequences for labor market policies, notably the unemployment insurance system. From a social policy perspective, it provides a more precise definition of policy objectives of social welfare.

Finally, from a macroeconomic perspective, the broad unemployment rate can be used to explain the dynamics of inflation, through the estimation of a NAIRU and potential output in the context of a system of equations that includes a Phillips curve and an Okun's Law.

The labor market of the 80s and 90s, characterized by low unemployment and high employment,

attracted to the work force large numbers of unskilled workers. This, in conjunction with the increased in demand for skilled labor due to technological development, generated a degree of wage inequality in Portugal, which is among the highest in modern economies (Alves *et al*. 2010) and could not be reversed with wage-setting institutions such as collective bargaining and minimum wage (Centeno and Novo 2009b). This market demand for higher qualifications generated incentives important to raise the level of education in the Portuguese labor market, reflecting the extraordinary increase of workers with higher education since the mid 90s. However, these processes are slow to build, and are not a solution for many workers already in employment.

More recently, the institutional scenario – which promotes the duality between permanent and fixed-term contracts – in interaction with global supply and demand, paved the way to the segmentation and polarization of the labour market. In fact, the signs of a significant and growing segmentation are evident in specific groups of workers with fixed-term contracts, self-employment and long-term unemployment. Workers with intermediate qualifications will probably be negatively affected, in the coming years, by the polarisation of labour demand, which is characterized by net job creation concentrated in low and high qualifications. None of these events will help alleviate the pressure on the NAIRU.

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