Unemployment Persistence in Europe. Evidence from 27 Countries.

by

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Abstract

In this paper we study the persistence of unemployment in the 27 countries that form the European Union. To do so, we use fractional integration. Our results, based on both seasonally adjusted and unadjusted data, show that the series are highly persistent, with order of integration above 1 in the majority of the cases. Thus, using the seasonally adjusted data, Belgium, Luxembourg and Malta are the only countries displaying a degree of mean reversion if the errors are uncorrelated; however, if the autocorrelation is permitted this evidence disappears. On the other hand, working with the unadjusted data, there is some more evidence of mean reversion for a group of countries (Belgium, France, Croatia, Italy, Luxembourg and Malta); in addition, significantly negative time trends are observed in the cases of Bulgaria, Croatia, Malta and Romania, while a positive trend is detected in the case of Luxembourg.

JEL classification: C22; E24; O52

Key words: unemployment persistence; long memory; Europe; fractional integration.

Resumen

En este artículo estudiamos la persistencia del desempleo en los 27 países que forman parte de la Unión Europea. Para ello, usamos la integración fraccional. Nuestros resultados, basados en datos tanto ajustados estacionalmente como sin ajustar, muestran que las series temporales son altamente persistentes, con un orden de integración mayor que uno en la mayoría de los casos. Usando los datos ajustados estacionalmente, Bélgica, Luxemburgo y Malta son los únicos países que presentan un grado de reversión a la media si los errores no están autocorrelacionados; sin embargo, si se permite la autocorrelación esta evidencia desaparece. Por otro lado, si usamos los datos sin ajustar, hay evidencia de reversión a la media para un grupo de países (Bélgica, Francia, Croacia, Italia, Luxemburgo y Malta); adicionalmente, observamos tendencias significativamente negativas en los casos de Bulgaria, Croacia, Malta y Rumanía, mientras que se detecta una tendencia positiva en el caso de Luxemburgo.

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1 Introduction

Unemployment has always been a very important topic for the European economies, especially when we put our focus in the southern countries of the European Union, where we can see that the unemployment is clearly higher, with higher peaks and higher lows. Compared with the US case, when a shock hits these economies, they react faster, with higher unemployment peaks, but it decreases slower, thus creating a lot of social problems, even more in the countries where the unemployment rate is always above the desirable.

These shocks are highly problematic, because they leave a lot of people without a job, which decreases families' income, directly repercussing in consumption, making the problem caused by the shock even worse. The more time it takes to get back to a lower unemployment rate, the worse position these families will have, and the more resources will have to be allocated to the long-term unemployed.

The unemployment rate mean for the period under examination (2000-2020) is 9.1%, with countries that significantly surpass that level, such as Bulgaria, Spain, Greece, Croatia, Lithuania, Latvia, Poland and Slovakia, all of which have a mean higher than 10% (some of them even higher than 15%, such as Spain and Greece). The social problems that this creates is one of the reasons to further study unemployment persistence in Europe.

The drive of this paper comes from the necessity of evaluating the effects of the COVID-19, which was an unexpected shock that we had not seen before, and that has had important consequences on the economy throughout 2020 and 2021. A new actualized study of the persistence of unemployment is necessary, to see for how long this shock will affect the EU economies, individually and as a whole.

We study unemployment persistence in Europe from an econometric viewpoint, using time series and fractional integration methods. We will be interested in estimating the (potentially fractional) differencing parameter, denoted by d, for each of the economies in the European Union. This parameter d is the order of integration of the series, which can be a value between 0 and 1 or even higher than 1 when we use fractional integration. Depending on its value we will be able to determine if there exists mean reversion or not, that is, if shocks are transitory or permanent, and thus, the degree of persistence in the data.

There exist different theories that have studied unemployment and which propose different values for this parameter d. The NAIRU hypothesis, Phelps (1968), Friedman (1968), states that unemployment is a stationary and mean reverting process, so shocks only have transitory effects on it. Thus, according to this theory the differencing parameter should be around 0. Following this hypothesis, it would exist a natural unemployment rate, and after a shock, the unemployment rate would go back to the natural value after some periods of time depending on the magnitude of the differencing parameter. In recent years, this theory has not been proven, at least for the European countries.

Other theory that applies better for European economies is the hysteresis hypothesis proposed in Blanchard & Summers (1986, 1987). This hypothesis states that shocks to unemployment will not allow the unemployment to go back to previous or natural rate. There are some reasons that would explain this and that match much better in the case of Europe, such as the existence of strong unions or the stigma of long-term unemployment. If the d-parameter were placed somewhere between 0.5 and 1, in the long run the unemployment would go back to the previous level, but if that parameter is equal to or higher than 1, the effect would be permanent. The results reported in this work for the EU countries are more in line with theory.

This paper is structured as follows: the next section reviews the literature about the modelling of unemployment persistence in Europe. In section 3 the methodology used in this paper is briefly explained. Section 4 consists of the source and content of the data, followed by the empirical results obtained with the above-mentioned methodology. Lastly, in section 5, we provide our main conclusions.

2 Literature Review

The unemployment rate has been widely studied in the literature. The studies about the persistence of unemployment started being a prolific topic in the late eighties, with the work by Blanchard and Summers (1986). They estimated an unemployment equation which included a lagged unemployment rate and a time trend. They also allowed a moving average component on the error term. They discovered that unemployment in Europe appeared to have high levels of hysteresis, much more than the US, especially in the eighties.

Alogoskoufis and Manning (1988) investigate unemployment persistence in the OECD countries by using a modified and extended version of the Blanchard and Summers model of wage and employment setting. Their evidence suggested that the unemployment display high levels of persistence for the European economies, which might be due to a rise in the natural rate of unemployment as a consequence of the sluggishness in European labour demand.

Barro (1988) studied unemployment persistence by measuring the estimated coefficients in an AR(1) model, and relating it to the degree of unionization and the existence of corporatism. He determined that unionization and size of government have positive effects on persistence among economies where corporatism is not present. Other studies have used more general AR(p) models (Son et al., 2010), panel quantil regressions (Andini and Andini, 2015), dynamic panel data models (Arulampalam, Booth and Taylor, 2000) obtaining in all cases similar evidence in favour of high levels of persistence in unemployment.

However, our focus of attention will be on articles using fractional integration. Thus, Gil-Alana and Henry (2003) studied UK's unemployment, and discovered that when estimating d within a fractionally integrated ARMA model, the unit root hypothesis was decisively rejected, and including regressors such as real oil price and real interest rate, they found that the estimated parameter d was constrained between 0.5 and 1. According to this result, the unemployment rate for the UK was mean reverting, and it would take some time for the effects of a shock to die out.Caporale and Gil-Alana (2007) studied the case of the US. They suggested that a hysteresis model with path dependency was more suitable for US' unemployment, where it does not exist a constant long-run equilibrium rate, and the effects of exogenous shocks not dying away within a finite time horizon, unemployment being nonstationary. Using the NAIRU approach, they discovered that the unemployment rate reverts back to the equilibrium level. In another article, the same authors (Caporale and Gil-Alana, 2008)investigated the issues of fractional integration and structural breaks for the US, the UK and Japanese unemployment. They found that for the US and Japan, a structuralist interpretation based on breaks was more appropriate. However, for the UK, the hysteresis model applied better.

Figuereido (2010) studied Brazilian unemployment dynamics using a fractional integration method. His results showed two different levels of persistence: a nonstationary and non-mean reverting one, and a nonstationary but mean-reverting one. The regional unemployment rate of Brazil tends to converge in the long run, meaning that aggregate and structural factors of regions influence the unemployment rate in the short and long run. Cuestas, Gil-Alana and Staehr(2011) studied unemployment hysteresis, structural changes, non-linearities and fractional integration in European transition economies. This paper worths its mention because it studies some of the economies examined in the present work. Their results from the unit root test do not reject the existence of unit roots, implying that the majority of the countries studied would fulfill the hysteresis hypothesis. However, when using fractional integration methods, they find that the unemployment rates were mean reverting, so they might fulfill the NAIRU hypothesis in some cases.

Shalari, Laho and Gumeni (2015) studied asymmetries and fractional integration for Albania's unemployment rate. They used a fractionally integrated time series model, and found that while there is asymmetry, there is no evidence of persistence. According to their results, negative shocks are proved to have a bigger impact on unemployment rate than the positive ones. In a similar line, Caporale and Gil-Alana (2018) studied the asymmetric behavior of Spanish unemployment persistence, finding that when the economy is expanding and recessing the degree of persistence differs. The estimates of d are higher than 1 in the two cases, thus implying hysteresis, but they tend to be bigger when the economy is in recession.

Other papers using fractional integration and long memory in the context of unemployment rates are those by Koustas and Veloce (1996), Van Dijk and Franses (2002), Lahiani and Scaillet (2009), Kurita (2010), Tule, Oduh, Chiemeke and Ndukwe (2017), etc.

3 Methodology

We use fractional integration, which is a very convenient methodology to determine the degree of persistence in time series. Alternative approaches are those based on autoregressive (AR) processes, such as the coefficient in a simple AR(1) process, or the sum of the coefficient in a general AR(p) model. Nevertheless, the AR structures produce an abrupt change in the behaviour of the series around the unit root case, and most standard methods for testing nonstationary and based on AR approaches have extremely low power if the processes are in fact fractionally integrated (Diebold and Rudebusch, 1991; Hassler and Wolters, 1994; Lee and Schmidt, 1996; etc.). Because of that we have decided to use in this article this long memory approach.

A process is fractionally integrated or integrated of order d (denoted as I(d)) if it can be expressed as:

$$(1 - B)^d x_t = u_t, \qquad t = 1, 2, \ldots, \qquad (1)$$

where B is the backshift operator, i.e., $B^p x_t = x_{t-p}$, and u_t is integrated of order 0 or I(0) which is a covariance stationary process where the sum of all its autocovariances is finite, and that include for instance the stationary AR(MA) processes.

We estimate the differencing parameter by using a testing approach due to Robinson (1994) and that is based on the Whittle function in the frequency domain. This method is quite flexible because it allows the inclusion of deterministic terms like an intercept and a time trend and is not constrained to the stationary range for the values of d (d < 0.5). A full description of this method can be found in Gil-Alana and Robinson (1997).

4 Data and empirical results

The data used in the study is the unemployment rate of the European Union countries, quarterly, from 2000q1to 2020q4. The series comprehends people from 15 to 74 years in the following 27 EU countries: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Spain, Finland, France, Greece, Croatia, Hungary, Ireland, Italy, Lithuania, Luxembourg, Latvia, Malta, Netherlands, Poland, Portugal, Romania, Sweden, Slovenia and Slovakia. We also examine the mean for the European Union as a series, denoted as EU.

We use two different sets of data, one of them seasonally adjusted, and the other one which is the raw unadjusted data. Its source is the Eurostat database, in its appendix called "Unemployment by sex and age (1992-2020) – quarterly data". Eurostat is the statistical office of the European Union, whose mission is to provide high quality statistics and data on Europe.

Tables 1 and 2 display some descriptive statistics. The labor markets of the European Union differ a lot across countries in terms of unemployment, and this is clearly reflected on the data. We observe a wide range in the maximum and minimum values of unemployment across countries. We start by describing the seasonally adjusted data. Looking at the maximum values, we observe a huge difference of 21.4% between the highest (Greece, 27.6%) and the lowest (Austria, 6.2%) unemployment rates. The mean for the EU is 11.4%. For the minimum values there is not such a big difference between the highest and the lowest point, which differ by 6%. The minimum unemployment rate is for Czech Republic (2%), and the maximum is for Spain (8%). The mean for the EU is 6.5%. Looking at the mean, we observe that the minimum value belongs to Netherlands (4.7%), while the maximum corresponds to Spain (15.9%). The mean for the EU is

9.1%. Lastly, for the adjusted data, we observe that minimum standard deviation of 0.46% is for Belgium, and the maximum of 6.60% corresponds to Greece, with a mean for the EU of 1.27%.

Table 1. Descriptive statistics. Seasonally Adjusted Data.

Country	Maximum	Minimum	Mean	Std. Dev.
AT	6.2	3.4	4.92	0.60
BE	8.8	5.1	7.49	0.46
BG	20.7	4.1	10.25	4.21
CY	16.6	3.3	7.84	4.04
CZ	9.2	2	5.94	2.87
DE	11.3	3.1	6.78	2.22
DK	8.2	3.4	5.66	0.89
EE	19.3	4	8.91	3.20
ES	26.3	8	15.9	4.95
EU	11.4	6.5	9.1	1.27
FI	10.5	6.2	8.23	0.55
FR	10.1	6.8	8.72	1.10
GR	27.6	7.6	15.71	6.60
HR	18.1	6.3	12.64	2.74
HU	11.4	3.4	7.07	2.77
IE	16	4	8.07	4.14
IT	12.8	6	9.43	1.33
LT	18.1	4.1	10.62	4.04
LU	7.8	1.9	4.89	1.15
LV	20.9	5.4	11.23	4.23
MT	8.3	3.5	5.96	1.06
NL	7.8	2.2	4.7	0.99
PL	20.4	2.9	10.82	4.28
PT	17.3	3.8	9.08	3.31
RO	9.2	3.8	6.51	1.26
SE	8.9	4.7	6.95	1.24
SI	10.6	4.1	6.78	1.17
SK	19.3	5.7	12.97	4.05

Table 2. Descriptive statistics. Seasonally Unadjusted Data.

Country	Maximum	Minimum	Mean	Std. Dev.
AT	6.3	3.1	4.92	0.87
BE	9.1	4.9	7.49	0.58
BG	22.3	3.7	10.27	4.86
CY	17.7	3.2	7.84	5.07
CZ	9.6	1.9	5.94	2.38
DE	11.5	3.1	6.78	1.34
DK	8.5	3.3	5.67	1.51
EE	19.5	3.9	8.91	2.76
ES	26.9	7.9	15.9	5.48
EU	12	6.4	9.11	1.75
FI	11.1	5.6	822	1.66
FR	10.5	6.7	8.72	0.50
GR	27.9	7.3	15.71	5.97
HR	18.7	5.7	12.65	3.33
HU	11.9	3.3	7.07	1.75
IE	15.9	3.8	8.08	4.26
IT	13.6	5.6	9.43	1.78
LT	18.2	3.8	10.62	4.52
LU	7.9	1.8	4.88	0.55
LV	21.3	5.3	11.23	3.98
MT	8.3	3.5	5.96	1.34
NL	8.1	2.1	4.7	1.14
PL	20.7	2.9	10.83	6.28
PT	17.8	3.8	9.08	2.93
RO	10.3	3.8	6.52	0.38
SE	9.5	4.7	6.96	1.31
SI	11.1	4	6.78	0.95
SK	19.9	5.6	12.98	3.46

Looking now in Table 2 at the unadjusted data we observe that for the maximum, there is a difference of 21.6% between the highest and the lowest unemployment rates. As with the seasonally adjusted data, there is not such a difference for the minimum values between the highest and the lowest point, which is now 6.1%. Looking at the mean, the minimum belongs to Netherlands (4.7%), while the maximum is Spain (15.9%) with a mean for the EU of 9.11%. Finally, the minimum standard deviation is France (0.50%) and the highest once corresponds Poland (6.28%).

Overall, we observe much higher unemployment rates in the southern countries than in the countries from the center and northern Europe. As for the standard deviation, there is no difference between northern and southern countries.

We start now presenting our empirical results. We consider the following regression model,

$$y(t) \;=\; \alpha \;+\; \beta t \;+\; x(t), \qquad t \;=\; 1, 2, \ldots \qquad (2)$$

where x(t) is supposed to be integrated of order d, or I(d) i.e.,

$$(1 - B)^d \, x(t) \;=\; u(t), \qquad t \;=\; 1, 2, \ldots, \qquad (3)$$

where u(t) is I(0) or a short memory process. Then, if d > 0, x(t) displays long memory in the sense that the observations are highly dependent even if they are far distant in time, and the higher the value of d is, the higher the level of association between the observations is.

Across Tables 3 - 5 we display the estimates of d along with the 95% confidence band for the differencing parameter under the three classical assumptions on the unit root literature of i) no deterministic terms, ii) with a constant, and iii) with a constant and a linear time trend, marking in bold in the tables, the selected specification for each country.

We start by looking at the seasonally adjusted data, assuming in Table 3 that u(t) is a white noise process, while in Table 4 we suppose that u(t) is autocorrelated, following here a non-parametric approach due to Bloomfield (1973).

We notice in Table 3 that the time trend coefficient is found to be significant only for a couple of countries, Luxembourg, displaying a positive trend, and Malta, showing a negative coefficient. The estimated values of d are relatively large in all cases, displaying long memory in all countries examined. Evidence of mean reversion, i.e., $d < 1$ is found in the cases of Luxembourg ($d = 0.41$), Malta (0.77) and Belgium (0.81). In all the other cases, the estimated values of d are equal to or higher than 1. The unit root null hypothesis ($d = 1$) cannot be rejected for Romania (0.88), Austria (0.91) and Estonia (1.11) and for the rest of the cases d is significantly higher than 1.

Table 3. Adjusted data. Results based on white noise errors.

Countries	No terms	A constant	A constant and a linear trend
AT	0.90 (0.77, 1.06)	**0.91 (0.77, 1.13)**	0.91 (0.76, 1.13)
BE	0.89 (0.78, 1.05)	**0.81 (0.71, 0.95)***	0.81 (0.70, 0.95)
BG	1.04 (0.92, 1.21)	**1.23 (1.11, 1.38)**	1.23 (1.11, 1.38)
CY	1.28 (1.14, 1.46)	**1.54 (1.39, 1.75)**	1.54 (1.39, 1.75)
CZ	1.03 (0.89, 1.23)	**1.67 (1.48, 1.90)**	1.67 (1.48, 1.89)
DE	1.04 (0.93, 1.20)	**1.41 (1.31, 1.54)**	1.41 (1.31, 1.54)
DK	1.01 (0.88, 1.18)	**1.20 (1.07, 1.38)**	1.20 (1.07, 1.38)
EE	0.98 (0.84, 1.15)	**1.11 (0.96, 1.32)**	1.11 (0.96, 1.31)
ES	1.07 (0.94, 1.25)	**1.73 (1.59, 1.94)**	1.73 (1.58, 1.93)
EU	0.98 (0.85, 1.16)	**1.59 (1.43, 1.82)**	1.58 (1.43, 1.79)
FI	0.93 (0.80, 1.11)	**1.20 (1.04, 1.43)**	1.20 (1.04, 1.42)
FR	0.87 (0.73, 1.06)	**1.14 (1.01, 1.34)**	1.14 (1.01, 1.33)
GR	1.10 (0.98, 1.27)	**1.61 (1.51, 1.74)**	1.61 (1.51, 1.73)
HR	1.08 (0.94, 1.26)	**1.21 (1.10, 1.37)**	1.21 (1.10, 1.37)
HU	1.05 (0.93, 1.21)	**1.24 (1.14, 1.37)**	1.24 (1.14, 1.37)
IE	1.24 (1.13, 1.38)	**1.47 (1.36, 1.62)**	1.47 (1.36, 1.62)
IT	0.90 (0.76, 1.10)	**1.21 (1.11, 1.34)**	1.21 (1.11, 1.33)
LT	1.12 (0.99, 1.30)	**1.55 (1.40, 1.76)**	1.55 (1.40, 1.76)
LU	0.32 (0.22, 0.61)	0.48 (0.41, 0.58)	**0.41 (0.30, 0.55) * (+)**
LV	1.09 (0.95, 1.28)	**1.34 (1.20, 1.53)**	1.34 (1.20, 1.52)
MT	0.97 (0.85, 1.13)	0.80 (0.70, 0.95)	**0.77 (0.63, 0.95)* (-)**
NL	1.14 (1.00, 1.30)	**1.42 (1.27, 1.64)**	1.42 (1.27, 1.64)
PL	1.08 (0.95, 1.24)	**1.52 (1.39, 1.69)**	1.51 (1.39, 1.69)
PT	1.13 (1.04, 1.26)	**1.30 (1.20, 1.43)**	1.29 (1.20, 1.43)
RO	0.97 (0.84, 1.16)	**0.88 (0.73, 1.12)**	0.88 (0.69, 1.12)
SE	0.94 (0.82, 1.11)	**1.21 (1.04 1.43)**	1.21 (1.04, 1.43)
SI	1.01 (0.87, 1.19)	**1.12 (1.02, 1.25)**	1.12 (1.02, 1.25)
SK	1.06 (0.93, 1.25)	**1.78 (1.60, 2.03)**	1.80 (1.60, 2.05)

The values are the estimates of d. In parenthesis, the 95% confidence intervals. In bold, the selected specification according to the deterministic terms. *: evidence of mean reversion at the 95% level; (+) indicates a positive time trend and (-) a negative time trend.

Table 4. Adjusted data. Results based on autocorrelated (Bloomfield) errors.

Countries	No terms	A constant	A constant and a linear trend
AT	1.06 (0.73, 1.47)	**0.75 (0.37, 1.27)**	0.77 (0.44, 1.27)
BE	1.04 (0.80, 1.46)	**1.07 (0.82, 1.42)**	1.07 (0.80, 1.42)
BG	1.12 (0.83, 1.53)	**1.49 (1.17, 1.87)**	1.49 (1.17, 1.89)
CY	1.28 (0.99, 1.70)	**1.37 (1.12, 1.73)**	1.37 (1.12, 1.74)
CZ	0.97 (0.71, 1.35)	**1.34 (0.88, 2.00)**	1.38 (0.89, 2.04)
DE	1.11 (0.90, 1.38)	**1.92 (1.57, 2.23)**	1.92 (1.57, 2.29)
DK	1.12 (0.79, 1.53)	**1.21 (0.86, 1.62)**	1.21 (0.87, 1.68)
EE	1.13 (0.76, 1.63)	**0.97 (0.66, 1.42)**	0.97 (0.63, 1.42)
ES	1.06 (0.79, 1.49)	**1.66 (1.37, 2.16)**	1.67 (1.37, 2.10)
EU	0.98 (0.72, 1.36)	**1.53 (1.23, 2.06)**	1.55 (1.24, 2.02)
FI	0.98 (0.70, 1.43)	**1.14(0.79, 1.70)**	1.14 (0.79, 1.74)
FR	0.85 (0.53, 1.27)	**1.25 (1.00, 1.68)**	1.25 (1.01, 1.72)
GR	1.20 (0.92, 1.55)	**2.02 (1.75, 2.45)**	2.03 (1.76, 2.46)
HR	1.07 (0.76, 1.48)	**1.33 (1.06, 1.67)**	1.33 (1.06, 1.67)
HU	1.07 (0.86, 1.36)	**1.44 (1.21, 1.79)**	1.45 (1.22, 1.80)
IE	1.50 (1.24, 1.87)	**1.71 (1.47, 2.14)**	1.74 (1.47, 2.14)
IT	0.87 (0.53, 1.30)	**1.55 (1.33, 1.95)**	1.54 (1.32, 1.88)
LT	1.17 (0.84, 1.58)	**1.44 (1.09, 1.87)**	1.44 (1.09, 1.88)
LU	0.98 (0.50, 1.33)	0.59 (0.41, 1.11)	**0.71 (0.41, 1.11) (+)**
LV	1.06 (0.73, 1.53)	**1.40 (1.01, 2.10)**	1.40 (1.01, 2.11)
MT	1.10 (0.83, 1.46)	0.80 (0.64, 1.07)	**0.72 (0.40, 1.07) (-)**
NL	1.35 (1.00, 1.87)	**1.21 (0.93, 1.56)**	1.21 (0.95, 1.56)
PL	1.08 (0.86, 1.41)	**1.46 (1.18, 1.80)**	1.46 (1.19, 1.76)
PT	1.63 (1.35, 2.33)	**1.58 (1.36, 1.89)**	1.60 (1.36, 1.91)
RO	0.91 (0.64, 1.29)	0.66 (0.47, 1.03)	**0.58 (0.32, 1.03) (-)**
SE	1.08 (0.79, 1.52)	**1.12 (0.60, 1.74)**	1.12 (0.70, 1.80)
SI	0.97 (0.69, 1.35)	**1.40 (1.14, 1.74)**	1.40 (1.14, 1.77)
SK	1.00 (0.75, 1.37)	**1.45 (1.08, 2.00)**	1.45 (1.09, 2.02)

The values are the estimates of d. In parenthesis, the 95% confidence intervals. In bold, the selected specification according to the deterministic terms. *: evidence of mean reversion at the 95% level; (+) indicates a positive time trend and (-) a negative time trend.

Table 4 displays the estimates of d under the assumption of (Bloomfield) autocorrelated errors. Similarly to the case of white noise errors, only Luxembourg and Malta show significant trends, positive in the former and negative in the latter case, but evidence of mean reversion is now not found in any single case. Thus, according to this specification, shocks are having a permanent effect on the long-term projection of the data, implying very high levels of persistence.

The above results are based on seasonally adjusted data, and the use of seasonally adjusted methods has been criticized by many authors. Their belief is that their statistical properties are difficult to assess from a theoretical point of view. Authors such as Ghysels (1988), Barksy and Miron (1989), Chatterjee and Ravikumar (1992) and Braun and Evans (1995) among many others point out that seasonal adjustment might lead to mistaken inferences about economic relationships between time series data. Also, they argue that these methods can cause a significant loss of valuable information about the behavior of the series. Because of this, we present next the results based on the original data.

Tables 5 and 6 focuses on the seasonally unadjusted data, and based on its quarterly nature we suppose u(t) in (3) follows a seasonal (quarterly) AR(1) process of the form:

$$u(t) \; = \; \phi u(t-4) \; + \; \varepsilon(t), \qquad t \; = \; 1, 2, \ldots \qquad (4)$$

where ε(t) is now a white noise process. The first thing we observe is that there are now more significant time trends than with the seasonally adjusted data. Once more the only positive time trend is found in the case of Luxembourg, however, significant negative trends are now observed in the cases of Bulgaria, Croatia, Malta and Romania. Focusing on d, we notice that mean reversion occurs in Belgium, Croatia, France, Italy, Luxembourg and Malta. The unit root null cannot be rejected for Austria, Bulgaria, Germany, Denmark, Estonia, Finland, Hungary, Ireland, Netherlands, Portugal, Romania, Sweden and Slovenia., while for the rest of the countries (Czech Republic, Spain, European Union, Greece, Lithuania, Latvia, Poland and Slovakia) the estimated value of d is found to be significantly higher than 1.

Table 5. Unadjusted data. Results based on seasonal AR(1) errors.

	No terms	A constant	A constant and a linear trend
AT	0.64 (0.46, 0.84)	**0.70 (0.50, 1.02)**	0.68(0.48, 1.02)
BE	0.81 (0.63, 0.98)	**0.66 (0.54, 0.81)***	0.66 (0.53, 0.81)
BG	0.84 (0.70, 1.05)	0.90 (0.75, 1.12)	**0.90 (0.75, 1.12) (-)**
CY	1.00 (0.83, 1.24)	**1.06 (0.89, 1.32)**	1.06 (0.89, 1.31)
CZ	0.93 (0.74, 1.13)	**1.37 (1.11, 1.70)**	1.37 (1.11, 1.68)
DE	0.89 (0.67, 1.09)	**1.02 (0.87, 1.23)**	1.02 (0.87, 1.22)
DK	0.81 (0.65, 1.02)	**0.93 (0.75, 1.18)**	0.93 (0.75, 1.18)
EE	0.95 (0.80, 1.13)	**1.07 (0.91, 1.28)**	1.07 (0.91, 1.28)
ES	1.05 (0.89, 1.23)	**1.39 (1.21, 1.65)**	1.38 (1.20, 1.62)
EU	0.85 (0.64, 1.08)	**1.34 (1.07, 1.73)**	1.32 (1.07, 1.63)
FI	0.76 (0.56, 1.00)	**1.10 (0.80, 1.45)**	1.10 (0.81, 1.45)
FR	0.76 (0.52, 0.98)	**0.66 (0.46, 0.96)***	0.68 (0.46, 0.96)
GR	0.91 (0.75, 1.13)	**1.19 (1.06, 1.36)**	1.19 (1.06, 1.36)
HR	0.97 (0.76, 1.24)	0.80 (0.69, 0.97)	**0.79 (0.69, 0.97)* (-)**
HU	0.93 (0.78, 1.15)	**0.96 (0.81, 1.20)**	0.96 (0.81, 1.20)
IE	1.03 (0.89, 1.20)	**1.14 (1.00, 1.33)**	1.14 (1.00, 1.33)
IT	0.81 (0.59, 1.06)	**0.69 (0.55, 0.88)***	0.69 (0.55, 0.88)
LT	0.99 (0.82, 1.19)	**1.28 (1.09, 1.56)**	1.28 (1.09, 1.55)
LU	0.32 (0.21, 0.59)	0.46 (0.37, 0.57)	**0.38 (0.25, 0.54)* (+)**
LV	1.06 (0.90, 1.25)	**1.29 (1.13, 1.50)**	1.29 (1.13, 1.50)
MT	0.96 (0.78, 1.13)	0.79 (0.67, 0.96)	**0.76 (0.61, 0.95)* (-)**
NL	0.92 (0.76, 1.11)	**1.22 (1.00, 1.54)**	1.22 (1.00, 1.52)
PL	0.88 (0.69, 1.12)	**1.27 (1.07, 1.56)**	1.27 (1.07, 1.55)
PT	0.98 (0.84, 1.15)	**1.06 (0.93, 1.24)**	1.06 (0.93, 1.24)
RO	0.73 (0.54, 0.95)	0.63 (0.44, 1.04)	**0.65 (0.40, 1.04) (-)**
SE	0.67 (0.48, 0.88)	**1.05 (0.76, 1.46)**	1.05 (0.74, 1.43)
SI	0.88 (0.70, 1.11)	**0.85 (0.71, 1.04)**	0.85 (0.71, 1.04)
SK	0.95 (0.74, 1.18)	**1.31 (1.07, 1.70)**	1.32 (1.07, 1.70)

The values are the estimates of d. In parenthesis, the 95% confidence intervals. In bold, the selected specification according to the deterministic terms. *: evidence of mean reversion at the 95% level; (+) indicates a positive time trend and (-) a negative time trend.

Table 6. Estimated coefficients of the selected models in Table 5.

Country	d	Seasonal	Intercept	Time trend
AT	0.70 (0.50, 1.02)	0.418	4.3701 (10.58)	---
BE	0.66 (0.54, 0.81)	0.452	7.1840 (17.58)	---
BG	0.90 (0.75, 1.12)	0.471	18.7062 (18.62)	-0.1603 (-2.16)
CY	1.06 (0.89, 1.32)	0.729	5.5402 (7.26)	---
CZ	1.37 (1.11, 1.70)	0.619	9.8499 (29.47)	---
DE	1.02 (0.87, 1.23)	0.686	8.2046 (27.31)	---
DK	0.93 (0.75, 1.18)	0.669	5.2559 (11.62)	---
EE	1.07 (0.91, 1.28)	0.120	16.2827 (13.25)	---
ES	1.39 (1.21, 1.65)	0.501	15.1499 (23.92)	---
EU	1.34 (1.07, 1.73)	0.828	10.6031 (35.21)	---
FI	1.10 (0.80, 1.45)	0.930	11.0829 (20.20)	---
FR	0.66 (0.46, 0.96)	0.733	9.4318 (24.14)	---
GR	1.19 (1.06, 1.36)	0.757	12.4815 (20.68)	---
HR	0.79 (0.69, 0.97)	0.743	15.4879 (18.23)	-0.0791 (-1.89)
HU	0.96 (0.81, 1.20)	0.102	6.7687 (7.21)	---
IE	1.14 (1.00, 1.33)	0.435	4.9223 (8.02)	---
IT	0.69 (0.55, 0.88)	0.750	10.7022 (19.71)	---
LT	1.28 (1.09, 1.56)	0.492	16.8506 (18.84)	---
LU	0.38 (0.25, 0.54)	0.144	2.6636 (6.12)	0.0482 (5.39)
LV	1.29 (1.13, 1.50)	0.211	14.3487 (15.52)	---
MT	0.76 (0.61, 0.95)	0..035	6.5810 (10.74)	-0.0296 (-1.90)
NL	1.22 (1.00, 1.54)	0.714	3.3970 (10.74)	---
PL	1.27 (1.07, 1.56)	0.744	16.8843 (32.20)	---
PT	1.06 (0.93, 1.24)	0.511	4.5157 (7.99)	---
RO	0.65 (0.40, 1.04)	0.462	8.1390 (14.09)	-0.0382 (-2.06)
SE	1.05 (0.76, 1.46)	0.812	6.6881 (12.10)	---
SI	0.85 (0.71, 1.04)	0.543	7.0079 (13.71)	---
SK	1.31 (1.07, 1.70)	0.484	19.1342 (33.95)	---

5 Conclusions

In this article we have investigated the degree of persistence in the unemployment rate series is a group of 27 European countries that form the EU. Using quarterly data from 2000q1 to 2020q4, our results, based on fractional integration, indicate that high levels of persistence in all the unemployment rates of the 27 countries. Employing seasonally adjusted data, a small degree of mean reversion is found in the cases of Belgium, Luxembourg and Malta, but this evidence disappears if weak autocorrelation is permitted. With the seasonally unadjusted data, more evidence of mean reversion appears. Thus, countries such as Belgium, France, Croatia, Italy, Luxembourg and Malta display orders of integration significantly lower than 1. In addition, significant negative time trends are found in the cases of Bulgaria, Croatia, Malta and Romania and a positive one for Luxembourg.

Thus, our results support the hypothesis of hysteresis and high level of persistence in Europe being consistent with other works like Blanchard and Summers (1986), Alogoskoufis and Manning (1988), Caporale and Gil-Alana (2008), Cuestas, Gil-Alana and Staehr (2011).

There are several reasons that might explain why unemployment persistence is so high in Europe. Unionization is a reason that matches with our hysteresis hypothesis. Unions are bigger in Europe than anywhere else, and they can cause a big impact when a shock happens by making the economies less flexible to anti-shock measures. The existence of benefits is also a factor to take into consideration. Benefits make the reservation wage of workers higher, thus making them more reluctant to accept the lower wages employments available in times of economic depression. Minimum wages are also related to the reservation wage, because these minimum wages are high in the European economies, thus also making the reservation wage increase. There are some other more psychological factors as the stigma of being a long-term unemployed, which can make companies not want to hire these workers. Also, the high life expectancy in Europe, and thus, the high average age of employees could be a cause explaining this, because older workers are less familiar with new technologies and could have more difficulties adapting to them.

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