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Abstract

This paper investigates the statistical features and the macroeconomic determinants of youth unemployment in a number of European countries. First, it explores its short and long memory properties by estimating both autoregressive and fractional integration models. This type of analysis sheds light on the degree of persistence of the series, and on whether policy actions are required for highly persistent series. Second, it investigates the main determinants of youth unemployment in Europe by estimating fractional cointegration models. The evidence suggests that this series is highly persistent in all the countries examined, and that in some of them there is a statistically significant long-run equilibrium relationship linking it to macroeconomic variables such as GDP and inflation.

JEL-Code: C220, C320, J640.

Keywords: youth unemployment, fractional integration, fractional cointegration.

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1. Introduction

Youth unemployment has attracted significant attention in recent years, especially in Europe, where it is particularly high relative to adult unemployment (see, e.g., Perugini and Signorelli, 2010), and has been affected even more than the latter by financial crises (see Choudhry et al., 2012a). Some key factors driving it that have been identified include the relatively low human capital of young people (see OECD, 2005), the "youth experience gap" (see Caroleo and Pastore, 2007), and the mismatch between the skills acquired through education and those required by employers (see, e.g., Quintini et al., 2007). Policy recommendations have been put forward both in the academic literature (see, e.g., Brunello et al., 2007) and by the European Commission (2008).

This paper investigates the main statistical features and the macroeconomic determinants of youth unemployment in a number of European countries. It is well known that an important feature of unemployment in Europe is itsrelatively high degree of persistence, which suggests that a hysteresis model (Blanchard and Summers, 1986, Gordons, 1988) might be appropriate. This appears to be a feature also of European youth unemployment (see, e.g., Heckman and Borjas, 1980, Ryan, 2001, and Caporale and Gil-Alana, 2013). Therefore, first of all we examinethe degree of persistence of the series (which sheds light on whether appropriate policy actions are required for highly persistent series)by estimating both autoregressive AR(1) processes and long memory (fractional integration) models. Second, we investigate the main macroeconomic determinants of youth unemployment in Europe by means of a fractional cointegrationmodels including variables such as GDP and inflationpossibly explaining its behaviour. The layout of the paper is as follows. Section 2 outlines the econometric framework. Section 3 presents the data and the empirical results. Section 4 offers some concluding remarks.

2. The econometric framework

As mentioned in the introduction, our main analysis is based on the concept of fractional integration, which allows the differencing parameter d making a series stationary I(0) to be a fraction as well as an integer. Therefore, the series of interest can be represented as

$$(1 - L)^d x_t = u_t, \quad t = 0, \pm 1, \ldots, \qquad (1)$$

whereu_t is assumed to be an I(0) process, defined as a covariance stationary process with a bounded positive spectral density function. Note that this approach includes the unit root case as a particular case when d = 1.

Given the above parameterisation, one can consider different cases depending on the value of *d*. Specifically, if $d = 0$, $x_t = u_t$, x_t is said to be a “short memory” or I(0) process, and in the case of autocorrelated (AR) disturbances the autocorrelation is “weak”, i.e. the autocorrelation function decays at an exponential rate; if $d > 0$, x_t is said to be a “long memory” process, so called because of the strong association between observations far apart in time. In this case, if *d* belongs to the interval (0, 0.5) x_t is still covariance stationary, while $d \geq 0.5$ implies nonstationarity. Finally, if $d < 1$, the series is mean-reverting, with the effects of shocks disappearing in the long run, in contrast to the case with $d \geq 1$ when these persist forever.

Two methods of estimation of the fractional differencing parameter are employed here: one is a Whittle parametric approach in the frequency domain (Dahlhaus, 1989), while the other is a semiparametric “local” Whittle method (Robinson, 1995; Abadir et al., 2007). In addition, a simple AR(1) model is also considered as an alternative to measure persistence as the autoregressive coefficient. Other more general AR(p) processes could be considered, with persistence then being defined as the sum of the AR coefficients. However, given the relatively small sample size in our case, a simple AR(1) specification is adequate to describe the short-run dynamics of the series.

The fractional integration framework can be extended to the multivariate case by estimating a fractional cointegration model. Specifically, we follow the approach developed in Gil-Alana (2003), which is a natural generalisation of the Engle and Granger's (1987) procedure allowing for fractional parameters. In particular, we estimate a linear regression of youth unemployment against its macroeconomic determinants, and check the significance of the estimated coefficients as well as the order of integration of the residuals; if this is smaller than for the individual series, then cointegrationholds and there exists a long-run equilibrium relationship between the variables which can be interpreted as the steady state in economic terms. In addition, a Hausman test for the null of no cointegration against the alternative of fractional cointegration, as suggested by Marinucci and Robinson (2001) is also carried out.

3. Empirical results

The dataset used includes the total youth unemployment rate in 15 countries, namely Austria, Belgium, Denmark, Finland, France, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, and the United Kingdom. This variable is defined as the number of unemployed in the 15-24 years age group divided by the labour force for that group, and has been obtained from the International Labor Organisation (ILO).For GDP and inflation,output and consumer price series from the World Development Indicators are used. All series are annual and span the period from 1980 to 2005.

As a preliminary step we estimate a simple AR(1) process to measure the persistence of the series as its AR(1) coefficient. The results for the three series are displayed in Table 1.

[Insert Table 1 about here]

It can be seen that the autoregressive coefficients are much higher for youth unemployment and inflation compared to GDP. In the case of youth unemployment, the highest values are found for the peripheral (Northern and Southern) countries: Ireland (0.94), Finland (0.92), the Netherlands (0.89), Spain (0.89), Norway (0.88), Sweden (0.88), Italy (0.87) and Greece (0.86). This high level of persistence is consistent with the empirical evidence on total unemployment in most European countries, suggesting the relevance of hysteresis models in the European case (see, e.g., Gordon, 1989, Graafland, 1991, Lopez et al., 1996).

Next, we estimate the fractional differencing parameter d and the corresponding 95% intervals for each of the three series (youth unemployment, inflation and GDP) in each country using the parametric approach based on the Whittle function in the frequency domain. In all cases, an intercept is included in the model and the d-differenced process is assumed to be a white noise process. We report in bold in Table 2 the cases where the unit root null (i.e., d = 1) cannot be rejected.

[Insert Table 2 about here]

This happens in five countries (UK, Italy, Norway, Sweden and Ireland) for all three series. In the case of youth unemployment, rejections of the null (in favour of higher degrees of integration) only occur for Finland, the Netherlands, Portugal and Spain (the latter two countries having some of the highest youth unemployment rates in the sample). For inflation, the unit root null cannot be rejected in any case. For GDP, this hypothesis is rejected in favour of explosive behaviour (d > 1) in Finland, the Netherlands, Portugal and Spain, whilst evidence of mean reversion (d < 1) is found for Austria, Belgium, Denmark, France, Greece and Luxembourg.

[Insert Table 3 about here]

Table 3 focuses on the semiparametric results using three different bandwidth parameters. For each series there is at least one case when the unit root null cannot be rejected. Given the evidence of nonstationarity, the estimation was carried out using first differences, then adding one to the estimated values to obtain the integration orders. Overall, this evidence suggests nonstationarity and the presence of a unit root in all three series in all countries examined.

The following step is the estimation of a multivariate (cointegration) model. We started by including the same set of variables as in previous studies such as Jacobsen (1999), Blanchflower and Freeman (2000), Choudhry et al. (2012a). In particular, there is a large literature emphasising the impact of output (growth) on unemployment (the so-called Okun's law – see for example Lee, 2000, and Solow, 2000). Also, it appears that youth unemployment is even more sensitive to macroeconomic (and labour market) conditions than total unemployment (see Choudhry et al., 2012b). However, since regressors such as FDI and openness were found not to be significant, the results reported below are those obtained from a model including GDP and inflation only as the macroeconomic determinants of youth unemployment, namely

$$y_t \;=\; \alpha + \beta x_{1t} \;+\; x_{2t} \;+\; x_t; \qquad (1-L)^d\, x_t \;=\; u_t\,, \quad t \;=\; 1, 2, ..., \qquad (6)$$

where y_t stands for the youth unemployment rate, x_{1t} for inflation and x_{2t} for GDP. The error term u_t is assumed to be a white noise or have an autocorrelated structure in Table 4 and 5 respectively.

[Insert Table 4 about here]

Table 4 shows that for six countries (Italy, Belgium, Denmark, France, Greece and Luxembourg)the estimated value of d is smaller than 1; however, in all these cases the confidence intervals are so wide that the unit root null cannot be rejected. In fact, the only rejections of the unit root null occur in the cases of Finland, the Netherlands, Portugal and Spain, but always in favour of higher orders of integration.[1] Therefore, there is no evidence of cointegration of any degree under the assumption of uncorrelated errors. As for the estimated coefficients, they are all negative and more significant for inflation than GDP.

[Insert Table 4 about here]

Next, we analyse the case with autocorrelated disturbances. Specifically, we consider a simple AR(1) process, the reason being that, given the small number of observations, higher orders would lead to overparameterised models. In this case all the estimated values of d are below 1 and close to 0 in many cases, implying mean-reversion and therefore cointegration. The low fractional differencing parameter is now combined with a very large AR coefficient, implying that the errors are still very persistent. Only for Finland is d significantly above 0. As for the estimated coefficients, the inflation one is significant and negative in all cases except Spain, whilst the GDP one is significant in half of the cases. Given the differences in the results depending on the specification of the error term, we also estimated d in equation (6) using a log-periodogram semiparametric estimator. These additional results (not reported) suggest that the differencing parameter is very sensitive to the bandwidth parameter, although in most cases lies in the interval between 0.5 and 1, implying fractional integration, nonstationarity and mean-reverting behaviour.

[1] These countries also display orders of integration above 1 in the univariate analysis.

Finally, we perform the Hausman test proposed by Marinucci and Robinson (2001). This is specified as follows:

$$H_{is} = 8\,s\left(\hat{d}^{*} - \hat{d}_{i}\right)^{2} \rightarrow_{d} \chi_{1}^{2} \qquad \frac{1}{s} + \frac{s}{T} \rightarrow 0, \qquad (7)$$

where i = x, y and zstands for each of the series under examination (youth unemployment, inflation and GDP) in turn, s is the bandwidth parameter (we set s = $(T)^{0.5}$), $\hat{d}_i$ are the univariate estimates of the parent series, and $\hat{d}^{*}$ is a restricted estimate obtained in the multivariate representation under the assumption that $d_x = d_y = d_z$. The results using this approach are displayed in Table 6.

[Insert Table 6 about here]

The test statistics indicate the presence of fractional cointegration in seven out of the fifteen countries examined, with statistical significance for youth unemployment and inflation in the majority of cases. It is also noteworthy that the estimated order of integration in the cointegrating regression is in the interval (0.5, 1) in all cases, implying nonstationary mean-reverting behaviour. The highest degree of cointegration is found in the case of Italy and Portugal, where the estimated d is equal to 0.576 and 0.577 respectively, followed by the UK (0.634), Luxembourg (0.646), the Netherlands (0.746), Ireland (0.771) and Sweden (0.810). For the remaining countries, this approach provides no evidence of cointegration.

4. Conclusions

Both academics and policy makers have recently focused on the challenge represented by European youth unemployment, which has become even higher relative to adult unemployment following the recent financial crisis and appears to be very persistent. This paper has investigated its stochastic properties as well as its macroeconomic determinants by using annual data on total youth unemployment in 15 countries and estimating autoregressive and long memory (fractionally integrated) models as well as fractional cointegration ones. The evidence confirms that youth unemployment is highly persistent in all European countries examined, which suggests the relevance of hysteresis models (Blanchard and Summers, 1986, Gordon, 1988) in a European context and the need for active labour market policies aimed at preventing short-term unemployment from becoming structural (long-term). These could include better "school-to-work transition" institutions as well as educational, placement and training schemes (see Choudhry et al., 2012a).

As for the macroeconomic factors driving European youth unemployment, the fractional cointegration results are rather sensitive to the method applied. Specifically, when following the approach of Gil-Alana (2003), the findings are different depending on the underlying assumptions about the error term: if the errors are assumed to be uncorrelated, no evidence of cointegration is found in any case; by contrast, under the assumption of autocorrelated errors, cointegration appears to hold in all cases. When using the semiparametric method of Marinucci and Robinson (2001) some evidence of (fractional) cointegration is obtained in some cases with its estimated order in the interval (0.5, 1). A plausible explanation for the sensitivity of the results to the method employed is the relatively small size of the sample used.

Nevertheless, the analysis provides some useful evidence on the existence of long-run relationships between youth unemployment in Europe and two key macroeconomic determinants, namely GDP and inflation. It confirms in particular the importance of the linkage between output (growth) and unemployment (the so-called Okun's law), and the sensitivity of youth unemployment (even more than total unemployment) to overall macroeconomic conditions (see Choudhry et al., 2012b). Of course a key role is also played by macroeconomic (as well as labour market) policies and institutions, as, for instance, stressed by the OECD (2006), but recommending the specific actions required to address the so-called “euro-sclerosis” (or poor employment performance of most European countries) is an issue beyond the scope of the present study, whose aim is simply to offer some evidence on the persistence of youth unemployment in Europe and its relationship with output and inflation.

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Table 1: Estimated AR coefficients for each series in each country

Country	Youth unemploym.	Inflation	GDP
UNITED KINGDOM	0.838	0.683	0.586
ITALY	0.872	0.978	0.443
AUSTRIA	0.848	0.607	0.194
BELGIUM	0.715	0.765	0.061
DENMARK	0.605	0.876	0.173
FINLAND	0.925	0.935	0.608
FRANCE	0.763	0.969	0.345
GREECE	0.866	0.937	0.488
IRELAND	0.940	0.764	0.567
LUXEMBOURG	0.795	0.697	0.112
NETHERLANDS	0.893	0.791	0.648
NORWAY	0.888	0.908	0.487
PORTUGAL	0.839	0.929	0.639
SPAIN	0.892	0.963	0.626
SWEDEN	0.885	0.849	0.434

Table 2: Estimatesof d and 95% confidence intervals for the individual series

Country	Youth unemployment	Inflation	GDP
UNITED KINGDOM	**1.37 (0.31, 2.10)**	**0.53 (0.31, 1.35)**	**0.72 (0.02, 1.61)**
ITALY	**1.15 (0.94, 1.45)**	**1.43 (0.47, 1.83)**	**0.29 (-0.07, 1.10)**
AUSTRIA	**1.09 (0.71, 1.50)**	**0.44 (0.12, 1.02)**	0.08 (-0.30, 0.57)
BELGIUM	**0.81 (0.31, 1.31)**	**0.97 (0.01, 1.54)**	-0.15 (-0.62, 0.39)
DENMARK	**0.59 (0.27, 1.35)**	**0.25 (-0.08, 1.12)**	0.05 (-0.34, 0.55)
FINLAND	1.96 (1.31, 2.72)	**1.02 (0.49, 1.58)**	**0.72 (0.19, 1.46)**
FRANCE	**1.09 (0.44, 1.61)**	**1.33 (1.00, 1.67)**	0.23 (-0.24, 0.80)
GREECE	**1.01 (0.42, 1.52)**	**0.72 (0.55, 1.27)**	0.26 (0.04, 0.53)
IRELAND	**1.29 (0.92, 1.84)**	**0.97 (0.10, 1.47)**	**0.47 (0.24, 1.05)**
LUXEMBOURG	**1.16 (0.28, 1.76)**	**1.26 (-0.14, 1.88)**	0.05 (-0.34, 0.47)
THE NETHERLANDS	1.76 (1.31, 2.25)	**1.08 (0.42, 1.60)**	**0.91 (0.42, 1.68)**
NORWAY	**1.41 (0.78, 2.16)**	**0.72 (0.49, 1.29)**	**0.41 (-0.11, 1.84)**
PORTUGAL	1.69 (1.10, 2.32)	**1.31 (0.77, 2.14)**	**0.81 (0.24, 1.46)**
SPAIN	1.62 (1.19, 2.14)	**0.99 (0.65, 1.37)**	**0.78 (0.34, 1.37)**
SWEDEN	**1.33 (0.91, 1.92)**	**0.51 (0.33, 1.06)**	**0.33 (-0.04, 1.04)**

In bold: Evidence of unit roots (d = 1) at the 5% level.

Table 3: Estimates of d based on a local Whittle semiparametric method

Country	Youth unemployment			Inflation			GDP		
	4	5	6	4	5	6	4	5	6
U. K.	**0.701**	**1.169**	1.453	**0.762**	**1.004**	**0.770**	**0.733**	**0.889**	**1.166**
ITALY	**1.386**	1,500	1.363	1.423	1.500	1.500	**1.137**	0.511	0.572
AUSTRIA	**0.932**	**0.965**	**1.220**	**1.078**	**0.669**	0.645	0.500	0.521	**0.668**
BELGIUM	**0.926**	**0.955**	**1.171**	**0.719**	**0.925**	**1.052**	**0.588**	**0.664**	0.563
DENMARK	**0.901**	**1.208**	**0.806**	**0.899**	**0.881**	**1.077**	**0.598**	0.534	**0.710**
FINLAND	**1.095**	1.388	1.500	**0.838**	**1.198**	**1.084**	0.500	**0.782**	**1.008**
FRANCE	**1.408**	**1.149**	1.393	**1.220**	1.500	1.500	0.500	**0.882**	0.524
GREECE	0.500	0.605	**0.878**	0.500	0.517	**0.730**	0.500	**0.701**	0.500
IRELAND	**1.174**	**1.335**	1.500	1.500	1.455	**1.194**	**0.725**	**0.958**	0.569
LUXEMBOURG	**1.163**	**1.294**	**1.261**	**0.915**	**1.131**	**1.256**	0.500	**0.934**	**1.100**
NETHERLANDS	**1.222**	1.500	1.500	1.430	1.500	**1.178**	**0.664**	**0.682**	**0.928**
NORWAY	0.582	**0.655**	**0.996**	0.500	**0.774**	**0.785**	0.505	0.500	**0.788**
PORTUGAL	**0.592**	**1.159**	1.455	**0.678**	**0.907**	**1.141**	**0.765**	**0.994**	**1.238**
SPAIN	0.507	**1.189**	1.500	1.487	**1.019**	**1.188**	0.500	**0.999**	**0.864**
SWEDEN	**0.637**	**1.199**	1.421	**0.748**	**0.802**	**0.777**	**0.612**	**0.641**	0.507
Lower I(1) interval	0.588	0.632	0.664	0.588	0.632	0.664	0.588	0.632	0.664
Upper I(1) interval	1.411	1.367	1.335	1.411	1.367	1.335	1.411	1.367	1.335

Table 4: Parameter estimates in the cointegrating relationship with uncorrelated errors

	d	A	β_1	B_2
UNITED KINGDOM	1.25 (0.47, 1.89)	**23.233 (27.93)**	**-0.610 (-4.44)**	-0.018 (-0.16)
ITALY	0.89 (0.73, 1.19)	**32.965 (9.04)**	**-0.434 (-2.64)**	**-0.452 (-2.08)**
AUSTRIA	1.09 (0.71, 1.52)	**5.285 (3.68)**	-0.026 (-0.14)	0.013 (0.09)
BELGIUM	0.81 (0.29, 1.31)	**23.813 (5.76)**	-0.056 (-0.12)	-0.042 (-0.11)
DENMARK	0.89 (0.16, 1.46)	**14.436 (3.71)**	**-0.738 (-1.43)**	**-0.707 (-3.13)**
FINLAND	1.98 (1.28, 2.91)	**9.732 (2.45)**	-0.263 (-0.80)	0.227 (1.51)
FRANCE	0.91 (0.43, 1.55)	**25.247 (4.86)**	**-0.702 (-1.99)**	-0.249 (-0.74)
GREECE	0.91 (0.54, 1.38)	**23.435 (6.32)**	**-0.358 (-2.55)**	-0.069 (-0.38)
IRELAND	1.08 (0.82, 1.81)	**26.755 (7.42)**	**-0.649 (-2.29)**	**-0.330 (-2.36)**
LUXEMBOURG	0.15 (0.18, 1.80)	**7.926 (2.14)**	-0.093 (-0.28)	-0.058 (-0.52)
THE NETHERLANDS	1.78 (1.30, 2.30)	**10.004 (3.20)**	-0.496 (-1.42)	0.243 (0.82)
NORWAY	1.34 (0.59, 2.16)	**9.742 (4.04)**	**-0.410 (-2.62)**	-0.194 (-1.38)
PORTUGAL	2.02 (1.29, 2.90)	**21.066 (9.50)**	**-0.159 (-1.74)**	**-0.358 (-3.10)**
SPAIN	1.63 (1.14, 2.18)	**35.311 (5.12)**	**-0.664 (-1.66)**	**-0.603 (-1.75)**
SWEDEN	1.29 (0.82, 2,03)	**10.011 (2.31)**	-0.239 (-1.02)	**-0.353 (-1.73)**

In bold, significant coefficients at the 5% level.

Table 5: Parameter estimates in the cointegrating relationship with autocorrelated errors

	d	α	β_1	B_2	AR
U.K.	0.11 (-0.24, 0.38)	**44.244 (42.89)**	**-0.174 (-1.88)**	0.319 (1.49)	0.742
ITALY	0.02 (-0.26, 0.43)	**-54.025 (-64.11)**	**-0.143 (-1.80)**	**1.496 (4.69)**	0.810
AUSTRIA	-0.07 (-0.37, 0.29)	**42.765 (35.134)**	**-0.413 (-1.85)**	**-0.516 (-1.96)**	0.895
BELGIUM	0.01 (-0.36, 0.33)	**65.367 (4.17)**	**-0.612 (-1.82)**	0.014 (0.03)	0.664
DENMARK	0.07 (-0.36, 0.29)	**34.287 (32709)**	**-0.984 (-3.75)**	**-0.299 (-1.97)**	0.655
FINLAND	0.58 (0.14, 0.89)	**28.789 (8.74)**	**-1.272 (-4.26)**	-0.015 (-0.07)	0.710
FRANCE	0.10 (-0.29, 0.47)	**7.693 (6.74)**	**-0.551 (-4.50)**	-0.312 (-0.85)	0.744
GREECE	0.01 (-0.37, 0.39)	**-254.69 (-167.89)**	**-0.387 (-4.71)**	-0.077 (-0.28)	0.863
IRELAND	0.04 (-0.34, 0.45)	**122.00 (50.82)**	**-0.723 (-2.04)**	**-1.220 (-4.98)**	0.708
LUXEMBOURG	-0.04 (-0.57, 0.18)	**43.189 (30.14)**	**-0.370 (-2.28)**	**-0.470 (-2.39)**	0.499
NETHERLANDS	0.14 (-0.23, 0.37)	**39.544 (18.41)**	**-0.516 (-1.94)**	-0.134 (-0.28)	0.735
NORWAY	0.05 (-0.28, 0.39)	**22.147 (35.38)**	**-0.665 (-9.68)**	**-0.258 (-1.88)**	0.712
PORTUGAL	0.21 (-0.07, 0.44)	**1.772 (1.41)**	**-0145 (-1.99)**	**-0.214 (-1.85)**	0.792
SPAIN	0.16 (-0.14, 0.47)	**-1.679 (-0.46)**	0.081 (-0.27)	-0.649 (-0.96)	0.931
SWEDEN	-0.11 (-0.22, 0.41)	**15.842 (12.34)**	**-1.196 (-8.26)**	**-1.060 (-2.90)**	0.736

In bold, significant coefficients at the 5% level.

Table 6: Testing the null of no cointegration with the Hausman test of Robinson and Marinucci (2001)

UNITED KINGDOM	ITALY	AUSTRIA
$H_{xs}: = 11.449^{*}$ $H_{xs} = 5.475^{*}$ $H_{xs} = 2.601$ **d = 0.634**	$H_{xs}: = 23.104^{*}$ $H_{xs} = 28.696^{*}$ $H_{xs} = 0.064$ **d = 0.576**	$H_{xs}: = 0.025$ $H_{xs} = 0.585$ $H_{xs} = 2.140$ d = 0.957
BELGIUM	DENMARK	FINLAND
$H_{xs}: = 0.625$ $H_{xs} = 0.361$ $H_{xs} = 1.102$ d = 0.830	$H_{xs}: = 3.387$ $H_{xs} = 0.051$ $H_{xs} = 1.714$ d = 0.917	$H_{xs}: = 0.064$ $H_{xs} = 0.392$ $H_{xs} = 0.331$ d = 1.099
FRANCE	GREECE	IRELAND
$H_{xs}: = 0.134$ $H_{xs} = 0.665$ $H_{xs} = 0.275$ d = 1.091	$H_{xs}: = 0.784$ $H_{xs} = 3.317$ $H_{xs} = 3.019$ d = 1.018	$H_{xs}: = 12.678^{*}$ $H_{xs} = 7.7157^{*}$ $H_{xs} = 1.398$ **d = 0.771**
LUXEMBOURG	NETHERLANDS	NORWAY
$H_{xs}: = 16.796^{*}$ $H_{xs} = 9.409^{*}$ $H_{xs} = 3.317$ **d = 0.646**	$H_{xs}: = 9.063^{*}$ $H_{xs} = 7.464^{*}$ $H_{xs} = 1.324$ **d = 0.746**	$H_{xs}: = 0.108$ $H_{xs} = 2.766$ $H_{xs} = 2.704$ d = 1.048
PORTUGAL	SPAIN	SWEDEN
$H_{xs}: = 13.548^{*}$ $H_{xs} = 4.355^{*}$ $H_{xs} = 6.955^{*}$ **d = 0.577**	$H_{xs}: = 0.0144$ $H_{xs} = 3.193$ $H_{xs} = 1.747$ d = 1.208	$H_{xs}: = 12.144^{*}$ $H_{xs} = 14.161^{*}$ $H_{xs} = 12.144^{*}$ **d = 0.816**

*: Statistical evidence of cointegration at the 5% level.