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UNEMPLOYMENT IN AFRICA:
A FRACTIONAL INTEGRATION APPROACH

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Abstract

This paper estimates long-memory models to analyse the stochastic behaviour of unemployment in eleven African countries (Botswana, Ethiopia, Ghana, Kenya, Malawi, Mauritius, Nigeria, Senegal, South Africa, Tanzania and Zambia) from the 1960s until 2010. The empirical results provide very strong evidence of lack of mean reversion in all series under examination. This suggests that hysteresis models are the most relevant for the African experience (not surprisingly, given the rigidities in their labour markets). Therefore in such countries shocks hitting the unemployment series will have permanent effects, and policy makers should take appropriate action to reverse the effects of negative shocks.

Keywords: Unemployment, Africa, Fractional integration

JEL Classification: C22, C32, E24

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1. Introduction

There are two main ways of thinking about unemployment in the existing literature. The natural rate theory (see Friedman, 1968, and Phelps, 1967) implies that it should fluctuate around a stationary equilibrium level, known as the natural rate or NAIRU, which is determined by economic fundamentals. In "structuralist" models (see Phelps, 1994) this can shift over time as a result of infrequent shocks due to changes in economic fundamentals; once these shifts are taken into account mean-reversion appears to characterise unemployment. This type of models have been found generally to be appropriate for the US experience. By contrast, hysteresis models (see Blanchard and Summers, 1986, 1987, and Barro, 1988) appear to fit better the European countries, where unemployment exhibits a high degree of persistence, and its dynamic behaviour can be captured by long memory models with a (near) unit root.

The empirical literature testing unemployment theories initially replied on standard unit root tests (such as Dickey and Fuller, ADF, 1979, or Phillips-Perron, PP, 1988), and subsequently used panel approaches to deal with the well-known problem of the low power of standard unit root tests (see, e.g., Leon-Ledesma, 2002), or fractionally integrated (ARFIMA) models to test for long memory in unemployment (see, for instance, Gil-Alana, 2001, 2002). Caporale and Gil-Alana (2007, 2008) also allowed for breaks in a fractional integration framework, and Caporale et al. (2016) took into account the possible correlation between the unemployment series. The advantage of a fractional integration framework compared to the classical I(0)/I(1) dichotomy is that since the fractional parameter can take any real value no arbitrary restrictions are imposed on the stochastic behaviour of the series and therefore the model allows for a much richer dynamic structure that might suit the unemployment series particularly well.

The present paper applies fractional integration techniques to model unemployment in eleven African countries (see the following section for details). To our knowledge, it is the first academic paper analysing the stochastic behaviour of unemployment in the African continent using state-of-the-art econometric methods. One reason for such lack of studies is of course the limited data availability and its unreliability. However, the University of Groniger has recently made a huge effort to construct the most complete dataset on African unemployment to date (see De Vries et al., 2013), which we will use for our purposes.

2. The Data

The series analysed is the number of unemployed (in thousands) in eleven African countries, namely Botswana, Ethiopia, Ghana, Kenya, Malawi, Mauritius, Nigeria, Senegal, South Africa, Tanzania and Zambia. The frequency is annual and the starting date is 1960 for Ghana, Nigeria, South Africa and Tanzania; 1961 for Ethiopia; 1964 for Botswana; 1965 for Zambia, 1966 for Kenya and Malawi, and 1970 for Mauritius and Senegal; the sample ends in 2010 for all countries. The data source is the African Sector Database (Output and Labour Data) from the University of Groninger (for details, see De Vries et al., 2013).

3. Empirical Results

Table 1 displays the estimates of the fractional differencing parameter d in the following model,

$$y_t = \theta_1 + \theta_2 t + x_t; \qquad (1-L)^d x_t = u_t, \qquad t = 1, 2, ... \qquad (1)$$

where y_t represents the total number of unemployed in each country, θ_1 and θ_2 are unknown coefficients on the intercept and a linear time trend respectively, and x_t is assumed to be I(d) where d can be any real value. We report the estimates of d for the three cases of i) no deterministic terms (when θ_1 and θ_2 are assumed to be equal to 0 in (1)), ii) with an intercept (θ_1 is unknown and θ_2 is assumed to be equal to 0), and iii) with an intercept and a linear trend (with both θ_1 and θ_2 unknown), and assume in turn that the error term, u_t in (1) is a white noise process (in the upper part of Table 1) or autocorrelated as in the model of Bloomfield (1973) (in the lower part of the table). Also reported are the 95% confidence bands of the non-rejection values are based on the LM tests of Robinson (1994).

[Insert Table 1 about here]

The most appropriate model specification for each series is shown in bold in the tables. In the white noise case, the time trend is required for all countries except for Botswana and Kenya; under the assumptions of autocorrelated disturbances the exceptions are instead Kenya and South Africa. As for the differencing parameters, in the white noise case the estimates of d are above 1 for all countries, and the unit root null (i.e. d = 1) cannot be rejected only for South Africa (1.09) and Mauritius (1.14); in the remaining cases, the estimates are significantly higher than 1 ranging from 1.31 (Ghana) and 1.69 (Senegal). With autocorrelated disturbances the values become substantially smaller, and only for three countries are the estimates significantly higher than 1 (Tanzania, Kenya and Ethiopia), while for the remaining eight countries the unit root null cannot be rejected.

[Insert Table 2 about here]

Table 2 displays the estimates of d for different bandwidth parameters using a semi-parametric "local" Whittle method proposed in Robinson (1995). The order of integration is found to be equal to or higher than 1 in all cases. Evidence of unit roots is found in the cases of Botswana, Ghana, Malawi, Mauritius, Senegal and South Africa; for the remaining countries the orders of integration are significantly higher than 1.

4. Conclusions

This paper estimates long-memory models to analyse the stochastic behaviour of unemployment in eleven African countries (Botswana, Ethiopia, Ghana, Kenya, Malawi, Mauritius, Nigeria, Senegal, South Africa, Tanzania and Zambia) from the 1960s until 2010, being the first academic study to do so. The empirical results provide very strong evidence of lack of mean reversion in all series under examination. This suggests that hysteresis models are the most relevant for the African experience, which is not a very surprising result if one considers the low degree of economic (financial development) of most of the countries in the sample as well as the existence of various types of rigidities in their labour markets. Therefore in such countries shocks hitting the unemployment series will have permanent effects, and policy makers should take appropriate action to reverse the effects of negative shocks.

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Table 1: Estimates of d. Parametric methods (Dahlhaus, 1989; Robinson, 1994)

i) No autocorrelation			
	No det. terms	A constant	A linear time trend
BOTSWANA	0.89 (0.72, 1.23)	**1.48 (1.18, 1.88)**	1.50 (1.23, 1.89)
ETHIOPIA	1.03 (0.87, 1.26)	1.43 (1.32, 1.62)	**1.52 (1.41, 1.66)**
GHANA	1.08 (0.89, 1.33)	1.28 (1.09, 1.55)	**1.31 (1.14, 1.54)**
KENYA	0.86 (0.54, 1.19)	**1.57 (1.40, 1.81)**	1.55 (1.38, 1.70)
MALAWI	0.98 (0.76, 1.26)	1.34 (1.11, 1.62)	**1.34 (1.13, 1.61)**
MAURITIUS	0.96 (0.66, 1.30)	1.16 (0.91, 1.47)	**1.14 (0.95, 1.42)**
NIGERIA	1.07 (0.92, 1.29)	1.40 (1.23, 1.67)	**1.40 (1.23, 1.67)**
SENEGAL	0.97 (0.76, 1.28)	1.76 (1.50, 2.10)	**1.69 (1.42, 2.04)**
SOUTH AFRICA	0.83 (0.65, 1.08)	1.08 (0.97, 1.27)	**1.09 (0.93, 1.30)**
TANZANIA	1.00 (0.84, 1.26)	1.47 (1.32, 1.75)	**1.60 (1.48, 1.81)**
ZAMBIA	0.97 (0.79, 1.23)	1.38 (1.19, 1.68)	**1.44 (1.26, 1.69)**
i) Autocorrelated (Bloomfield)			
	No det. terms	A constant	A linear time trend
BOTSWANA	0.67 (0.56, 1.06)	0.99 (0.83, 1.48)	**0.93 (0.44, 1.49)**
ETHIOPIA	0.96 (0.73, 1.38)	1.45 (1.18, 1.83)	**1.52 (1.27, 1.79)**
GHANA	0.86 (0.56, 1.39)	1.20 (0.74, 2.01)	**1.20 (0.53, 1.96)**
KENYA	0.47 (0.39, 1.23)	**1.52 (1.19, 1.94)**	1.47 (1.18, 1.91)
MALAWI	0.75 (0.45, 1.47)	0.90 (0.57, 1.86)	**0.93 (0.10, 1.83)**
MAURITIUS	0.45 (0.36, 1.33)	1.18 (0.79, 1.87)	**1.11 (0.69, 1.86)**
NIGERIA	1.11 (0.78, 1.52)	1.10 (0.33, 1.53)	**1.09 (0.57, 1.51)**
SENEGAL	0.75 (0.53, 1.39)	0.93 (0.47, 1.98)	**0.93 (0.02, 1.81)**
SOUTH AFRICA	0.69 (0.46, 1.13)	**1.23 (0.98, 2.31)**	1.34 (0.95, 2.36)
TANZANIA	0.89 (0.67, 1.31)	1.38 (1.19, 1.86)	**1.51 (1.25, 1.82)**
ZAMBIA	0.86 (0.57, 1.35)	1.02 (0.65, 1.51)	**1.03 (0.46, 1.52)**

Note: The values in bold refer to the selected models. In parentheses the 95% confidence bands of the non-rejection values of d.

Table 2: Semi-parametric estimates of d

m	5	6	7	8	9	10	11	12
BOT	**0.824**	**0.923**	**1.040**	**1.179**	1.351	1.395	1.392	1.420
ETH	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500
GHA	**0.681**	**1.052**	1.470	1.500	1.500	1.500	1.500	1.500
KEN	1.416	1.444	1.500	1.500	1.500	1.500	1.500	1.500
MLW	**0.751**	**1.031**	**1.198**	1.336	1.335	1.490	1.489	1.500
MAT	**1.077**	**1.239**	1.322	1.417	1.295	1.321	1.375	1.401
NIG	1.414	1.494	1.500	1.500	1.332	1.332	1.368	1.362
SNG	**1.114**	1.337	1.439	1.500	1.500	1.500	1.500	1.500
SAF	1.375	**1.134**	**1.168**	**1.219**	1.288	1.375	1.459	1.500
TAN	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500
ZAM	**1.051**	**1.235**	1.429	1.500	1.493	1.500	1.500	1.500
Low 5%	0.632	0.664	0.689	0.709	0.725	0.739	0.752	0.762
Up 5%	1.367	1.335	1.310	1.290	1.274	1.260	1.247	1.237

Note: m is the bandwidth parameter. In bold evidence in favour of the unit root null, i.e., d = 1