

Policy Lessons from Okun's Law for African Countries

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Abstract:

The main objective of this work is to measure the reaction of unemployment to growth in some African countries. It comes to estimate the Okun's coefficient, test its validity and measure its intensity. The results presented in this work propose that gross domestic unemployment and production be weakly linked or untied in the majority of the examined countries, regardless of the model used to estimate the Okun's. Another objective was to determine the origins of the Okun's coefficient variability within Africa. The literature informed us that these origins are in principle of structural, demographic and/or economic nature. In addition, our empirical approach confirmed the relevance of the demographic factors, the level of competition in the domestic market, and the rule of law.

JEL Classification: E24, E32

Keywords: Okun's law, Unemployment, Employment, Informal, Economic Structure.

I. Introduction and literature review

In his original study, published in 1962, Okun suggested the existence of an empirical relationship linking unemployment to growth (now, known as the Okun's law). Since then, numerous studies have followed, justifying the existence of the Okun's coefficient, either by adopting a methodology addressing one country (Evan, 1989 ; Weber, 1995 ; Caraianni, 2006), a panel of countries (Fouquau, 2008) or a regional dataset (Freeman, 2000 ; Guisinger et al., 2015). A striking result of these works is a remarkable stability of the Okun's coefficient in the United States (coefficient that is less stable when estimates are conducted on other countries, as we will see later). Even using different methods. While the empirical relationship presented by Okun (1962) proposed a simple linear model of the unemployment/growth relationship, Evans (1989)¹ used the Vector-Autoregressive (VAR) model applied to the United States economy (1950-1985), and found that Okun's coefficient is equal to $-3,3$, which confirms Okun's (1962) results.

Weber (1995)² has also sought to determine the Okun's coefficient for the United States (1948-1984) using different econometric methods: the ordinary least squares, the Autoregressive-Distributed Lag (ARDL), and then, the VAR proper to the approach of Blanchard (1989). Besides, the author has tested the existence of a cointegration relationship between unemployment and growth. Its findings show the presence of a negative relationship relying these two variables, and confirmed, therefore, the validity of the Okun's law for the American economy. In this context, Weber noted that the value of the Okun's coefficient ranges from -0.22 to -0.31 .

Not far from the United States, Lee (2000) tried to investigate the existence of the Okun's law, and to measure its intensity and robustness, in 16 OECD countries (Organisation for Economic Co-operation and Development), during the after war period (1955-1996). Its results were in favor of the validity of the Okun's law in this set of countries. However, the author noted a decrease in its intensity relatively to the results reported by a later study of Okun (1970). Lee (2000) also noted the sensitivity of the found results to the methods of estimation and of decomposition (point also made by Weber (1995)). In the same logic, Fouquau (2008) has sought to analyze the Okun's law for 20 OECD countries, between 1970 and 2004. His

¹Evans G.W (1989):«Output and unemployment dynamics in the United States: 1950-1985». *Journal of Applied Econometrics*, Vol. 4, No. 3 (Jul. - Sep., 1989), pp. 213-237

²Weber C, E (1995): «Cyclical output, cyclical unemployment, and Okun's coefficient: A new approach». *Journal of Applied Econometrics*, Vol. 10, No. 4 (Oct. - Dec., 1995), pp. 433-445

approach has the originality of relying on regime-switching models that allow capturing the asymmetry and the instability of the relationship over time. That way, Fouquau found a non-linear and asymmetric relationship.

At the regional level, Freeman (2000)³ tested the Okun's law for the eight US regional economies during the period 1958-1998. Its goal was to analyze regional differences with regard to the effect of production growth on unemployment reduction. The author concluded that there are slight interregional differences in the value of the Okun's coefficient which ranges from -1,84 to -3,57.

In a recent work, Guisinger et al. (2015) have tried to estimate the Okun's law for all of the States constituting the United States and found a negative and significant coefficient ranging from -1,67 to -4,38. The authors stressed, however, a certain sensitivity of the results to the methods of decomposition of growth and unemployment series. In addition, they showed that some indicators such as the presence of more flexibility within the labour market, the qualification level of the workforce, and the non-manufacturing sectors share in total employment affect the value taken by the Okun's coefficient in each State.

In Europe, Christopoulos (2004)⁴ has revisited the law for the 13 Greek regional economies and found that the Okun's law stand for six of the studied regions, and that the Okun's coefficient was comprised between -0,37 and 1.70.

José Villaverde and Adolfo Maza (2007)⁵ estimated the Okun's coefficient for the 17 Spanish regions during the period 1980-2004. They highlighted the validity of the Okun's law for the majority of these regions (15 out of 17), and concluded that the adoption of a policy focused on aggregate demand is suitable for unemployment reduction in the fifteen regions in hand. The authors also noted that the differences in the Okun's coefficients between regions are remarkable and statistically significant.

In a case dealing with the validity of the Okun's law for the Baltic States for the period 1997-2007, Rubcova (2010)⁶ mobilized the cointegration analysis and applied the error correction model in order to examine Okun's proposition (the author also employed the difference

³ Freeman, D. (2000) : «Regional Tests of Okun's Law». *International Advances in Economic Research* 6, 557-570.

⁴Christopoulos, D. (2004) : «The relationship between output and unemployment: Evidence from Greek regions». *Papers in Regional Science*, 83, 611–620.

⁵Villaverde J, Maza A (2007) :«Okun's law in the Spanish regions». *Economics Bulletin*, Vol. 18, No. 5 pp. 1-11

⁶Robcova A (2010) :«Okun's Law: Evidence from The Baltic States». *SSE Riga Student Research Papers* 2010:9(126), ISSN 1691-4643, ISBN 978-9984-842-36-3.

specification and the gap specification in which cyclical components were extracted using Hodrick-Prescott filter). Its results did not indicate any persistent evidence of a strong relationship between output and unemployment. Two explanations were advanced: data reliability and labor market features.

In Asia, Lal et al. (2010)⁷ tested for the validity of the Okun law in some Asian countries between 1980 and 2006. The authors adopted the Engle-Granger cointegration technique (1987) in order to establish a long-term relationship, so that the error correction model was used for the short-term. Lal et al (2010) showed that this law cannot be valid in all the analyzed Asian countries.

In Africa, we have collected many studies seeking to estimate the Okun law. Most of them have adopted an approach addressing one country.

In Algeria, Furceri (2012) has explored the impact of the Algerian labour market institutions on the relationship between unemployment and growth, using data covering the period 1980-2008. The results of his work have shown the presence of a negative relationship between employment and output-gap. However, the value of the Okun's coefficient was low and no more than -0.05. The author explains this weak relationship by the economic structure that is characterized by the dominance of low-job-growth sectors and the rigidity of the Algerian labour market. For its part, Driouche (2013) used data covering the period 1980-2011 in order to determine what rate of growth is necessary to absorb the long-term unemployment in Algeria. Unfortunately, his results indicated the absence of a cointegration relationship between unemployment rate and growth.

Elshamy (2013) tried to verify the presence of the Okun's law in Egypt using data for the period 1970-2010. His paper proposed an analysis of the cointegration between unemployment and growth in order to estimate the Okun's law for the long run, and an error correction model to estimate it for the short run. Elshamy's results indicated that the Okun's coefficient was negative and statistically significant regarding the long and short run. Before Elshamy (2013), Moosa (2008) found a negative relationship between unemployment and growth in Egypt. However, it was very low. Then, fighting against unemployment requires, for Moosa (2008), the implementation of employment policies that give more importance to professional and vocational training, labour market flexibility and private sector. Another study, conducted by

⁷Lall .Sulaiman M; Jalil A; Hussain A (2010): «Test of Okun's Law in Some Asian Countries Co-Integration Approach». European Journal of Scientific Research, 40(1), pp.73–80.

the World Bank (2014), tried to estimate the Okun's coefficient for Egypt considering the period ranging from the first quarter of 2003 to the first quarter of 2013. Using the differences specification and the output gap specification, the study showed that growth has a negative impact on the national and female unemployment rate. The Okun's coefficient for men, although it was negative, was not significant. Unlike the first study, Alhdiy et al. (2015) mobilized quarterly data covering the period 2006-2013, and indicated the absence of a long-term relationship between growth and unemployment. They showed, however, that there was a short-term relationship. Alhdiy et al. (2015) associated the absence of a meaningful relationship between growth and unemployment to the fact that the Egyptian domestic production depends strongly on the intensive use of capital at the expense of labour, and recommended to focus on high job-growth sectors (services, construction, and agriculture).

In Ghana, Baah-Boateng (2013) shows that the importance of low jobs-growth sectors in the whole economy tends to reduce the intensity of economic growth in jobs. Thus, his study indicates that employment policies, in Ghana, should focus on the consolidation of growth in sectors with strong jobs creation. Another study realized by the same author in 2016, supports the previous results indicating that weak growth of high jobs-growth sectors, such as agriculture, together with the high growth of the mining and hydrocarbons, largely explains the low correlation between the unemployment and the growth rates in the country

The finding is the same in Botswana with a mining industry that realizes the critical part of growth, against a weak growth in labour-intensive sectors (Yinusa and Ajilore, 2011). Thus, to say that the Okun's law is valid in Botswana seems to be insignificant. This seems to be clearer in the case of the study of Leshoro (2014), which has mobilized data covering the period 1980-2011 in order to investigate the relationship between economic growth and national employment. His results indicate a negative relationship between the two variables, findings that indicates, according to the author, a gain in productivity within capital-intensive industries, such as the mining sector.

In Morocco, Agénor and El Aynaoui (2003) argue, in a context of high and persistent unemployment, that the pursuit of economic growth must be accompanied by some labour market reforms. They show that a reduction in the minimum wage and the income tax would lead to the absorption of the unqualified employment in short-term. In the long term, these measures must be dosed by offsetting fiscal policies to promote private investment, at the same time. Moosa (2008) said that the Okun's law is invalid in Morocco, and that a policy oriented

to the promotion of professional and vocation training, and the fight against the rigidities within the labour market, are needed to reduce the unemployment. Another study conducted jointly by the Government of Morocco, the African Development Bank and the Millennium challenge corporation in 2014, reported that Moroccan economy is a low job-growth one. Indeed, estimates show that employment to growth elasticity range from 0.3 to 0.5; so, a growth that does not effectively contribute in the absorption of unemployed as well as the flows of new entrants. It is also reported that the rigidity that marks the labour market tends to amplify this problem of low intensity of growth in employment. Recently, and based on the Okun's law and the arc-point elasticity specifications, Ezzahidi and El Alaoui (2014) tried to establish a link between economic growth and unemployment using data for the period 1999-2009. Their results show that an additional one percent of growth was transformed to a 0.14% decreases of the unemployment rate in average during the period in hand. Agénor and El Aynaoui (2015), using a quantitative macroeconomic model, calibrated for Morocco, highlighted the lack of private investment in some key sectors and the institutional rigidities as factors that amplify labour market problems in Morocco.

The investigation of the causes of unemployment in Namibia between 1971 and 2007 has been the subject of a study realized by Ashipala and Eita (2010). The study indicated the absence of the Okun's law in Namibia. However, it has been shown that investment growth and wages flexibility enhancing tend to reduce the unemployment rate in this country. Kanyenze and Lapeyre (2012) highlighted the impact of the workforce qualification. They connected the unemployment rate to the level of education of the population, and showed that the probability of being unemployed decreases with the level of education. They added that the importance of the informal sector and mining (low growth-jobs sectors) played an important role regarding the high rate of unemployment in the country.

Just like many exporters of natural resources in Africa, Bankole and Fatai (2013) showed that the Okun's law is not valid in Nigeria. Their results were based on a cointegration analysis applied on data for the period 1980-2008. Equally, a study conducted by Adenuga, Babalola, and Saka (2013) indicated that the Okun's law is not applicable in Nigeria for data covering the period 1980-2012. More recently, Akanbi (2015) produced the same result, demonstrated by two previous studies, regarding the validity of the Okun's law. He also pointed out that unemployment is negatively correlated with foreign direct investment, inflation rate and the ratio of credit to private sector.

The use of quarterly data for the period 1990-2014, and a cointegration analysis, helped Bouaziz and El Andari (2015) demonstrate that the Okun's law is valid in Tunisia. This result is contrast with those reported by Moosa (2008) which advocates that the relationship is negative but not significant in Tunisia, and that vocational training and labour market flexibility are of great importance regarding the reduction of unemployment in Tunisia. It should be noted that this last work used data covering the period 1990-2005.

In South Africa, Geldenhuys and Marinkov (2007) showed, using different methods of decomposition of time series, that the Okun's law has been present in the country between 1970 and 2005. They also highlighted that the law were asymmetric during periods of recession. In contrast, Moroke and al. (2013), using quarterly data from 1990 to 2013, have found that the law is not valid. Similarly, Phiri (2014) showed, using data covering the period 2000-2013, that growth may not act on unemployment in the long term; and underlined the importance of labour market policies regarding the reduction of unemployment in South Africa.

To summarize, we underline that the Okun's law is not valid all the time for the African countries, and that unemployment is often related to some features related to the structure of the economy, the labour market legislation, and the availability of competencies. It should also be noted that the Okun's law seems to be sensible to data coverage and frequency as well as the method of decomposition and estimation.

The following table gives an overview relating to the review of empirical literature concerning Okun's law in Africa.

Empirical review of the Okun's law in Africa.

Authors	Specification and research methodology	Sample	Main results
North Africa			
Furceri (2012)	Output-gap modeling. Regression in static panel (MCO) and dynamic panel (GMM)	Algeria 1980-2008	Validity of the law, but weakness in the Okun's coefficient (-0.05). The dominance of low growth-jobs sectors and the rigidity of labour market institutions have a great impact on unemployment and its reaction to growth.
Driouche (2013)	Output-gap and differences modeling. Analysis of the cointegration (ECM)	Algeria 1980-2011	Lack of a cointegrating relationship between the unemployment rate and the growth rate.
Elshamy (2013)	Output-gap modeling. Analysis of the cointegration (ECM)	Egypt 1970-2010	The Okun's coefficient is negative and statistically significant with regard to the long and short term.
The World Bank (2014)	Output-gap and differences modeling.	Egypt 2013q1-2013q1	Growth has a negative impact on the national and female unemployment rate. For men, the relationship is negative but not significant.
Alhdiy et al. (2015)	Differences modeling. Analysis of the cointegration (ECM)	Egypt 2006q1-2013q2	The lack of long-term relationship between growth and unemployment is attributed to the dominance of capital-intensive sectors.
Ezzahidi and El Alaoui (2014)	Differences modeling.	Morocco 1999-2009	An additional point of growth makes decrease the rate of unemployment by 0.14%.
Bouaziz and El Andari (2015)	Output-gap modeling. Analysis of the cointegration (ECM)	Tunisia 1990q1-2014q1	The Okun's law is valid in Tunisia, with a coefficient that is around -0.7.
Moosa (2008)	Output-gap modeling. Analysis of the cointegration (ARDL)	Algeria/Egypt/ Morocco/Tunisia 1990-2005	The Okun's law is invalid for three reasons: the mismatch between labour supply and demand, the rigidity of the labour market institutions, and the dominance of public, oil and gas and mining sectors.

Southern Africa

Leshoro (2014)	Analysis of the cointegration (ECM)	Botswana 1980-2011	Presence of a negative relationship between employment and growth because of the dominance of the mining sector in national employment.
Ashipala and Eita (2010)	Output-gap modeling. Analysis of the cointegration (ECM)	Namibia 1971-2007	Absence of the relationship of Okun in Namibia. However, the growth of investment and the wages flexibility tend to reduce the unemployment rate.
Geldenhuys and Marinkov (2007)	Output-gap modeling.	South-Africa 1970-2005	Okun's law is valid in South Africa
Leballo and Mouroke (2013)	Output-gap and differences modeling. Analysis of the cointegration (ECM)	South-Africa 1990q1-2013q1	The lack of causality between growth and unemployment in South Africa
Phiri (2014)	Output-gap and differences modeling. Analysis of the cointegration (MTAR)	South-Africa 2000-2013	In the long term, growth may not reduce unemployment in South Africa.

West Africa

Baah-Boateng (2013)	A Probit model on a cross section	Ghana 1991-2006	the importance of the low growth-jobs sectors reduce the intensity of economic growth in employment
Baah-Boateng (2016)	Kapsos' employment elasticity (2005)	Ghana 2005-2013	The weak growth in agriculture and services, coupled to the high growth of the mining and hydrocarbons, largely explains the weak unemployment to growth relationship
Bankole and Fatai (2013)	Output-gap and differences modeling. Analysis of the cointegration (ECM)	Nigeria 1980-2008	Okun's law is not valid in Nigeria.
Adenuga, Babalola and Saka (2013)	Output-gap and differences modeling. Analysis of the cointegration (ECM)	Nigeria 1980-2012	Okun's law is not valid in Nigeria
Akanbi (2015)	Output-gap and differences modeling. Analysis of the cointegration (ECM)	Nigeria 1985-2010	Okun's law is not valid in Nigeria. However, the unemployment is negatively correlated with the foreign direct investment, the inflation rate and the ratio of credit to the private sector.

According to this empirical review, in which we have tried to present some of the research that has marked the history of Okun's law, we have seen that the law is valid in most of the developed countries, while it is not for a significant part of the developing countries such as the Asian countries reported by Lal et al. (2010). Our empirical review indicates that the law is not valid for some African countries. In addition, our analysis underlined some of the potential determinants of the intensity of Okun's law in Africa. Therefore, our work aims to explain the differences observed at the level of the intensity of the relationship between economic growth and unemployment within the African continent. It will try to find out why unemployment reacts differently to economic growth, from one country to another, in this continent.

The interest of this investigation lies on the fact that the identification of the determinants of the intensity of this relationship is carrying useful information in the field of programs and policies to combat unemployment, particularly in countries where the reaction to growth is considered to be low. Indeed, to know the elements that could influence, positively or negatively, the reaction of unemployment to growth will help at the level of the quest for a better growth/unemployment relationship.

In this perspective, our work proposes an approach in two main steps:

- A first, at the level of which we will try to measure the reaction of unemployment growth in each of the countries of our sample. Here, it comes to estimate the Okun's coefficient for these countries using four specifications (output-gap and differences modeling that we will develop subsequently).
- A second stage that will connect coefficients issued from the first stage with a set of structural, demographic and economic variables in order to explain the observed variations, from one country to the other, at the level of the Okun's coefficient.

As well mentioned above, the estimation of Okun's coefficients, for every country in our sample, will be conducted using four different specifications. The first is a specification in difference in which changes in the unemployment rate are a linear function of changes in the logarithm of real domestic production. In the second, we replace the variations of the natural logarithm of the real domestic production by its rate of growth⁸. Although these specifications

⁸ As the growth rate is a variable that tends to 0, the change of the logarithm of the production may be replaceable by the growth rate: $\Delta \log(Y) = \log(Y_1/Y_0) = \log(1+g)$; when g tends to 0, $\log(1+g)$ tends to g .

allow linking the dynamics of unemployment to the cyclical fluctuations in output, they assume that potential growth and potential unemployment are constant in the country in hand. However, there is no reason to predict a constancy of the volume of production associated with the structural values of an economy, namely the productivity of factors, the workforce volume and the hours of work to name a few. In response to this limit, we have used a second and third specification that assume, both of them, a dynamic potential production and potential unemployment rate. This is why at the level of the third specification we have mobilized the HP filter to separate economic cycles and the potential trend. By allowing the values constituting the trend component to vary, but according to a relatively smooth way, the use of this filter is part of a dynamic logic of the potential production and the potential unemployment. However, many researchers have criticized this method of decomposition due to the presence of two main limits: it comes first to the choice of the smoothing parameter, but especially to the bias associated with the estimation of the ends of economic time series. Therefore, the HP filter and some low-pass filters⁹ can lead to work on false cycles. Aware of this limit, we used a fourth approach in which the smoothing parameter is different.

Once the series are decomposed and the Okun's coefficients obtained, for each countries of the sample we are studying, we conducted the second step that aims to identify the factors that explain the differences observed between countries at the level of the estimated Okun's coefficients. To do this, we have been regressing the estimated Okun's coefficients on a set of variables reflecting demographics, economic structure and the workforce features within the studied countries. These explanatory variables were all collected from the literature review concerning the growth/jobs relationship in Africa. We considered the employment structure in the African countries, including the share of the informal sector (Kanyenze and Lapeyre, 2012 ; Golub and Hayat, 2014); the domestic production structure and the importance of sectors that rely on natural resources (Leshoro, 2014 ; Baah-Boateng, 2016); the growth stability and predictability; the domestic market competitiveness (ball et al, 2013); the labour market efficiency (Furceri, 2012); the mismatch between labour supply and demand (Moosa, 2008) ; and the demographic pressure¹⁰.

⁹ A low pass filter is a filter that passes low frequencies and attenuates high frequencies.

¹⁰ Given that the female labour force is low-skilled and generally operates in the agricultural sector, we use women's participation as a proxy of the adequacy as well as the demographic pressure. Indeed, 38% (about 153 million) African adults are illiterate and two-thirds of them are women according to UNESCO.

The rest of the paper will be organized as follows. The second section will present the data and specifications used in order to estimate the Okun's coefficients. We use, as we noted previously, four specifications. The third section will discuss the obtained coefficients in terms of validity and intensity before trying to identify the determinants of the variability observed at the level of these estimates. The fourth section will conclude.

II. Data and methodology:

1. Data:

We used data on unemployment rates from the International Labour Office (ILO) database, and real GDP from the World Bank's World development indicators. The dataset cover the period 1991-2015. At the first stage, 46 countries have been used in this study. In the second stage, only 39 countries were retained, in particular because of the non-availability of data. The sample of the studied countries is as follows: (i) Algeria, Egypt; Morocco and Tunisia; (ii) Botswana, Namibia, and South Africa; (iii) Angola, Cameroon, Centre Africa, R.D. Congo, Congo, Guinea. Equatorial, Gabon, and Chad; (iv) Burkina-Faso, Cape Verde, Ivory Coast, Gambia, Ghana, Guinea, Guinea-Bissau, Mali, Mauritania, Liberia, Niger, Nigeria, Senegal, Sierra Leone, and Togo; (v) Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Seychelles, Tanzania, Uganda, Zambia, and Zimbabwe.

2. Methodology:

As suggested by Okun (1970), there are two classes of specifications of the Okun's law: the first difference models and the gap models. According to the first-difference model, the relationship between the logarithm of actual observed real production (y) and the observed rate of unemployment (u) is given by the expression:

$$(u_t - u_{t-1}) = \alpha + \beta(y_t - y_{t-1}) + \varepsilon_t \quad (1)$$

Or :

$$\Delta u_t = \alpha + \beta \Delta y_t + \varepsilon_t$$

Where α is the change in the unemployment independently of the change in growth, β is the Okun's coefficient and ε is the error term.

As the growth rate is a variable that tends to 0, so we have:

$$\Delta \log(y_t) = \log(y_t/y_{t-1}) = \log(1+g)$$

$$\lim_0 \{\log(1+g)\} = g$$

And :

$$\Delta u_t = \alpha + \beta g_t + \varepsilon_t \quad (2)$$

If g approaches 0, $\log(1+g)$ tends to g (g is the growth rate). Thus, the (1) model can be approximated by (2)

From the point of view of the gap model, the specification is given by the expression:

$$(u_t - u^*_t) = \alpha + \gamma(y_t - y^*_t) + \omega_t$$

Where y^* represents the potential real domestic production, u^* is the natural rate of unemployment, and the other symbols have the same meaning as in equation (1). In this last specification, the left term represents the unemployment gap, and the right one indicates the output gap. The difference between the actual and the potential observed GDP captures the cyclical level of production, similarly, the difference between the observed and natural unemployment rate represents the cyclic rate of unemployment.

A major problem with this last specification is that there is no observable data on y^* and u^* , and so they must be estimated, which means that it is necessary to generate trends of the series y and u , a problem then arises regarding to the choice of the method of elimination of the trends. To overcome this problem, relatively, and in order to test the robustness of the coefficients of Okun, we used the filter of Hodrick - Prescott (HP) to breakdown both y and u in their trend and cyclical components, using two smoothing parameters:

$$(u_t - u^*_t) = \alpha + \gamma(y_t - y^*_t) + \omega_t \text{ with } (\lambda = 100) \quad (3)$$

$$(u_t - u^*_t) = \alpha + \gamma(y_t - y^*_t) + \omega_t \text{ with } (\lambda = 12) \quad (4)$$

Box :

Many time series in economics and finances have a trend. These series are then non-stationary. And, it is often helpful to retrench this long-term tendency that can mask some cyclical effects. Then, econometrics provides many trend-cycle decomposition methods such as Hodrick-Prescott, Beveridge-Nelson, Baxter-King,...

In practice, it is relatively difficult to know what method to use, each one have weaknesses and qualities (see Guay and St-Amand, 1997). In this paper, we use the Hodrick-prescott

decomposition method. The HP filter allows to break down a vector (X_t) of dimension ($K \times 1$) into two orthogonal components of dimension ($K \times 1$), the trend (T_t) and the cycles (C_t) :

$$X_t = T_t + C_t$$

The HP filter isolates the cyclic component of X_t by solving the problem of minimization of the following penalized cyclic variance:

$$\hat{T}_t = \arg \min \sum_{K=1}^K (X_t - T_t)^2 + \lambda \sum_{K=2}^{K-1} [(T_{t+1} - T_t) - (T_t - T_{t-1})]^2$$

What amounts to minimize the following expression according to T_t :

$$\hat{T}_t = \arg \min \sum_{K=1}^K (X_t - T_t)^2 + \lambda \sum_{K=2}^{K-1} [(T_{t+1} - 2 * T_t + T_{t-1})]^2$$

In matrix form, we have:

$$\min_{T \in R^K} \{(X - T)'(X - T) + \lambda T' H' H T\}$$

With :

$$- X_{K \times 1} = (X_1, X_2, X_3 \dots, X_K)' \quad - \quad T_{K \times 1} = (T_1, T_2, T_3 \dots, T_K)'$$

$$H = \begin{pmatrix} 1 & -2 & 1 & 0 & 0 & \dots & 0 & 0 & 0 \\ 0 & 1 & -2 & 1 & 0 & \dots & 0 & 0 & 0 \\ 0 & 0 & 1 & -2 & 1 & \dots & 0 & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \dots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & 0 & \dots & 1 & -2 & 1 \end{pmatrix}_{(K-2) \times K}$$

The solution of the minimization problem is given by:

$$\hat{T}_t = (I_K + \lambda H' H)^{-1} X$$

Once the series are broken down and the Okun's coefficients obtained for each of the studied countries, we move to the second stage of our empirical approach. This last is to identify the factors that explain the differences observed between countries at the level of the estimated Okun's coefficients. To do this, we regress the estimated Okun's coefficients on a number of variables characterizing the demographics, the economy and the labour market of the studied countries. The equation to be estimated in this case is given by:

$$\beta_n = \theta X_n + v_n \tag{5}$$

$$v_n \sim N(0, \sigma_\beta^2)$$

- ▶ X_n : Matrix containing k columns (k determinants)
- ▶ θ : Vector of coefficients associated to each of the determinants

The determinants were collected according to the literature review on the growth/jobs relationship in Africa (see next section).

III. Results and discussions

1. Validity and intensity of the Okun's law in Africa

In this section, we investigate the validity of the Okun's law, and measure its intensity, using the formulations developed in the preceding section.

North Africa:

We tried to estimate the relationship of Okun, test its validity, and measure its intensity referring to the four specifications which we have had the time to develop the foundations in the previous sections. To achieve this goal, we have, firstly, reduced the number of countries to four namely: Algeria, Egypt, Morocco and Tunisia. The exclusion of Libya from the scope of our analysis is justified by the fact that the country has experienced many turbulences since the 2011's revolution resulting in a big volatility of its economic indicators. For example, Libyan real GDP jumped 105 percent in 2012, after a contraction of 62 percent in 2011, before backing up slightly in 2013 (-5,1%).

The table below shows the estimated Okun's coefficient issued from the four specifications. These estimates indicate a negative relationship between economic cycles and unemployment rates in the studied countries. They also indicate that the Okun's coefficient is statistically significant for Egypt and Tunisia. In the case of Algeria and Morocco, the coefficient is only significant with regard to the third specification.

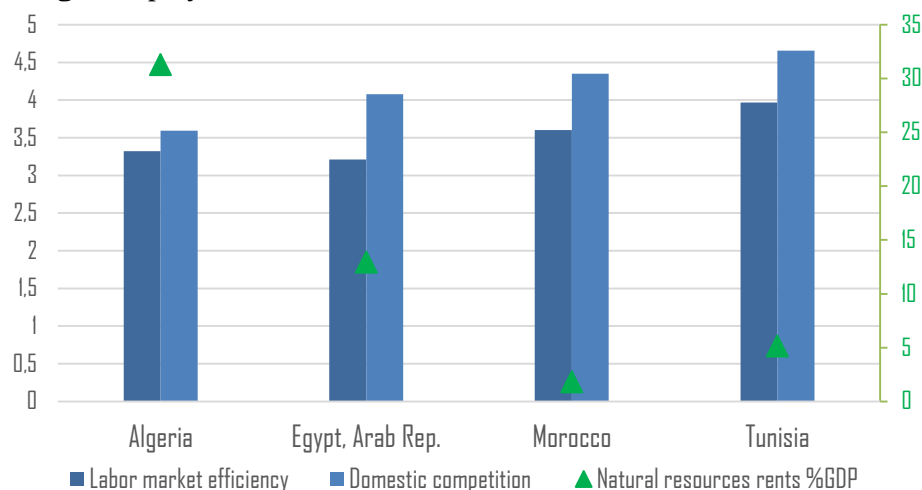
Estimation of the Okun's law in North Africa (1991-2015)

	(1)	(2)	(3)	(4)
Algeria	-.4151225	-.2018745	-1.018737***	-.3199856
Egypt	-.9530386***	-.2468521***	-.8364007***	-1.085196***
Morocco	-.093174	-.0392438	-.1955748**	-.0985461
Tunisia	-.6277196**	-.2629395**	-.5633337**	-.7453274***

Source: author's calculations

The results reported in the table also show the sensitivity of the coefficients to the specifications. In fact, the estimates based on output gap models often result in coefficients that reflect a stronger relationship (compared with the specifications in difference).

Factors affecting unemployment in North Africa



Source: the World Economic Forum, the World Bank

Taking the countries one by one, we underline that although a negative relationship is present between growth and unemployment in the Algeria, the Okun's relationship in this country is only valid regarding the Model 3 that predicts that an additional point of growth makes reduce unemployment by, approximately, the same proportion. However, this last result is not in line with previous research on the Okun's law in Algeria (Keller and Nabil, 2002 ; Moosa, 2008 ; Yousefat, 2011 ; Driouche, 2013). These works highlighted the absence of a dependence between the two macroeconomic quantities in question and attributes the movements of unemployment in Algeria to other variables such as the predominance of activities that are related to the oil and gas sector (53% of value added in 2011 according to national statistics) and the lack of flexibility within the labour market (Furceri, 2012). Indeed, mining and oil extraction are generally low growth-jobs activities, and the labour market rigidity can harm labour demand (see measures in the figure above). In Egypt, the relationship is valid regardless of the specification retained. For this country, the Okun's coefficient varies from -0.95 to -1. This means that economic growth usually result into a reduction of unemployment. In terms of the intensity of the relationship, the coefficients are in line with the existing literature on Okun's law in Egypt (Moosa, 2008 ; Elshamy, 2013 ; World Banque, 2014 ; Alhdiy et al, 2015). However, we note that there is no consensus over the existence of a long-term dependency of unemployment to growth (Elshamy, 2013 ; World Banque, 2014 ; Alhdiy et al, 2015). For the case of the Morocco, it seems that the growth and unemployment are negatively correlated. However, Okun's law is only significant with regard to the model 3. To explain the weakness of the relationship between unemployment and growth in Morocco, many analysts mention the mismatch between labour supply and demand : at a moment when the structure of employment

in the Morocco is changing, the structure of skills fail to follow (Moosa, 2008 ; Masood et al, 2012 ; CESE-Maroc, 2013 ; World Bank, 2013 ; Bougroum et al, 2014). Some others underline the rigidity of the labour market (Agénor et El Aynaoui, 2003 ; World Bank, 2011 ; Bougroum et al. 2014). We add the volatility of growth in the 1990s as a factor explaining the lack of dependence of unemployment to economic growth in Morocco (annexes). Finally, estimates indicate that Okun's law is valid in Tunisia for the four specification; the Okun's coefficient ranges from -0.26 to -0.75. These estimates are comparable with the results reported by Andari and Bouaziz (2015), although the latter are estimated using quarterly data. Conversely, the results of Moosa (2008) contradicts the fact that the law is valid in Tunisia. However, the scope of Moosa's results may be limited because of two interdependent dimensions. The first is that our study covers the period 1991-2015, while that of Moosa (2008) mobilizes data for the period 1990-2005. The second lies on the fact that connection between unemployment and economic growth has become stronger Tunisia since 2000. In fact, this last observation is somewhat shared by North Africa's countries as shown in the table below (see annexes).

Estimation of the Okun's law in North Africa by Sub-period

	(1)		(2)		(3)		(4)	
	91-2000	2000-15	91-2000	2000-15	91-2000	2000-15	91-2000	2000-15
Algeria	.587	-.651	.253	-.3271	-.795	-1.58***	.242	-1.141
Egypt	-1.281	-.798***	-.0622	-.337***	-1.56***	-.758***	-1.24**	-.973***
Morocco	-.0186	-.580***	-.008	-.240***	-.112	-.887***	-.074	-.614***
Tunisia	.343	-1.11***	.169	-.483***	.357	-.792***	.261	-1.20***

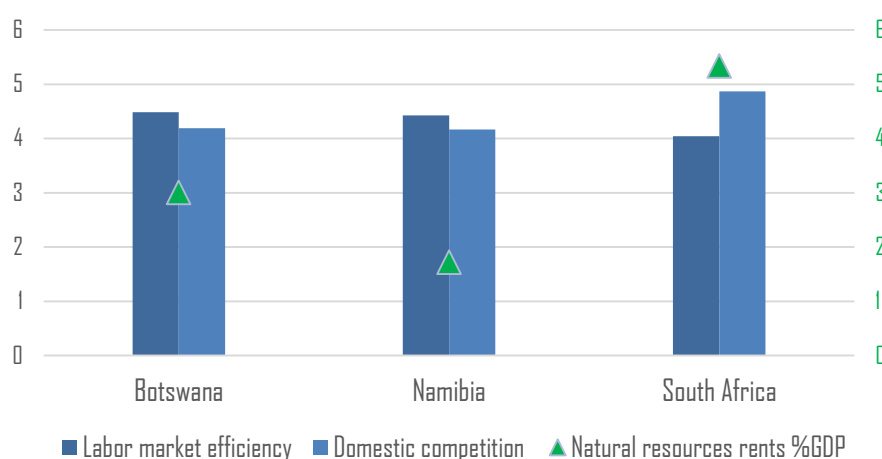
Source: author's calculations

To summarize, we found that the Okun law is valid for Egypt and Tunisia. It is valid for Algeria and Morocco considering the output-gap specification ($\lambda = 100$). In addition, unemployment reduction appears to become more related to growth since 2000.

Southern Africa

In our investigation of the validity of the Okun's law in southern Africa, we have concentrated on three countries: Botswana, Namibia and South Africa. These countries are characterised by a greater labour market efficiency and more competitiveness within the domestic market (compared to North Africa).

Factors affecting the labour market in southern Africa region



Source : the World Economic Forum, the World Bank

The table below displays estimates for Southern Africa. The reported coefficients indicate a negative relationship between economic cycles and the variations in unemployment rates in the studied countries. However, the Okun's coefficient is statistically significant only for South Africa, in the case of filter-based models. This is somewhat online with a work of Sumra (2016) focusing on the relation between potential growth rate and overall demand in Sub-Saharan Africa's countries. Based on Specification 2, Sumra (2016) showed that the Okun coefficients are negative for Botswana (-0.041), Namibie (-2.039), and South Africa (-0.170).

Estimation of the Okun's law in Southern Africa (1991-2015)

	(1)	(2)	(3)	(4)
Botswana	-.1634106	-.0396918	-.3854795	-.2912193
Namibia	-.9194918	-.5733584	-.8811069	-1.020046
South Africa	-.4403561	-.1929082	-.9208836***	-.9325683**

Source : Authors calculations

The invalidity of the Okun's Law in Botswana is, firstly, attributed to the very volatile nature of its growth (Leshoro, 2014). Secondly, it is important to underline that, despite the fact that natural resources revenues accounted for only about 3% of Botswana's GDP, their contribution to the value-added remains significant, with a mining sector that contributed with 34.7% in 2011 (the most contributor sector to the value-added formation). Given the low job-growth nature of this latter sector, it is normal that a large part of the growth does not result on a reduction of the unemployment rate. In fact, the employment elasticity to growth in the mining sector is only about 0.01 (Ajilore and Yinusa, 2011).

For Namibia, it turns out there is a negative correlation between unemployment and growth. However, the Okun's coefficient is not statistically significant. While it is important to increase

production in order to reduce unemployment, some studies emphasize the need for more flexibility, at the level of the institution of wages, to reduce unemployment in Namibia (Ashipala and Eita, 2010). Another reason of the invalidity of the Okun's law in Namibia is the importance of the informal sector in overall employment. In 2008, the informal accounted for 23% of the economically active population, and 48% of the overall employment (Namibia Labour Force Survey 2008). In fact, the important weight of the informal sector in overall employment is known among many neighbouring countries, including South Africa and Botswana (Kanyenze and Lapeyre, 2012). Finally, the size of the mineral sector is another factor that play a crucial role regarding the lack of unemployment reaction to growth in Namibia (voir Mhone, 2000).

In South Africa, the Okun's law is valid according to two specifications (3 and 4). Although there is no consensus: while many studies have emphasized the validity of the law in this country (Geldenuys and Marinkov, 2007 ; Biyase and Bonga-Bonga, 2008 ; Phiri, 2014 ; Loungani and Mishra, 2015), Moroke et al. (2014), using quarterly data for the period 1990q1-2013q1, rejected the law. Note that political and economic instability were impeding the cyclicity of unemployment to growth, especially with the impact that they may have on foreign investment (Fielding, 2000). In addition, considering the year 2000 as the beginning of the period makes the law valid in South Africa, with a coefficient that varies from -0.25 to -1.25.

Estimation of the Okun's law in South Africa (2000-2015)

	(1)	(2)	(3)	(4)
South Africa	-.5931284***	-.2579015***	-1.266892***	-.9595485**

Source : Authors calculations

It is clear that the relationship between unemployment and growth is negative in Southern Africa. However, it is difficult to say that the Okun's law is valid for the countries of this region. Indeed, analysts underline a number of obstacles preventing a better adjustment of unemployment rate to growth in these countries. These obstacles are mainly related to the importance of the mining sector in the overall production, the large part of the informal sector in the overall employment, and the need to improve the flexibility of the labour markets.

Central Africa

The estimates shows that the Okun's law is valid for the majority of Central Africa's countries. The table below indicates that the Okun's law is absent only in Cameroon and the Democratic Republic of the Congo. However, we point out his weakness.

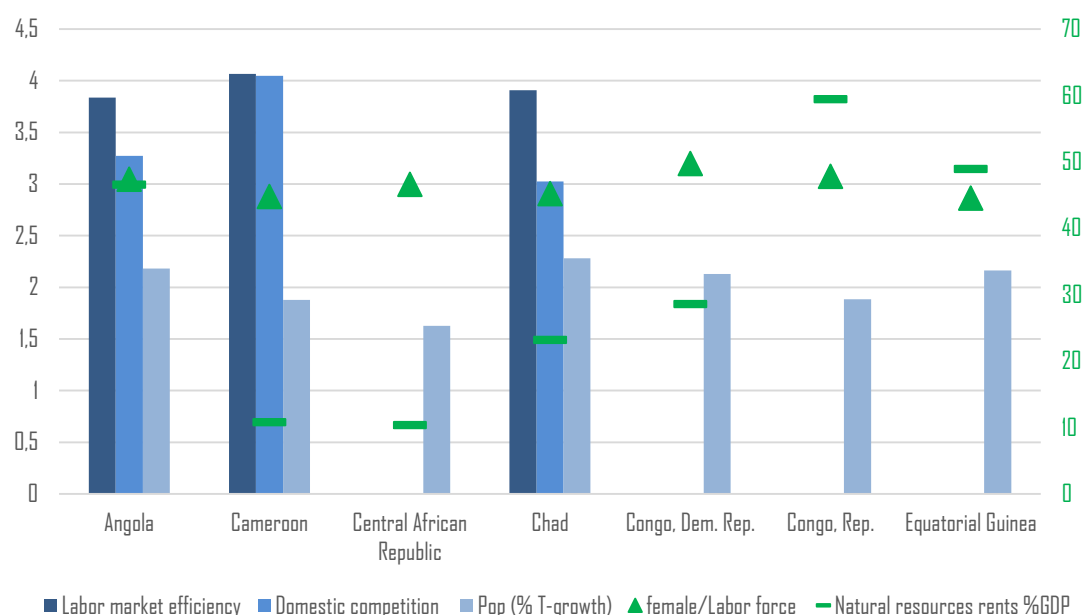
Estimation of the Okun's law in Central Africa (1991-2015)

	(1)	(2)	(3)	(4)
Angola	-.0163041***	-.0087052***	-.0082044	-.0163291***
Cameroun	.0591685	.0588867	.133494	.1910203
Centre Afrique	-.0356187***	-.0202316***	-.0208676***	-.0325742***
R.D. Congo	.0029681	.0013617	-.0011528	-.0038141
Congo	-.0395305***	-.0167459***	-.0332694***	-.0407931***
Guinée. EQ	-.0306259***	-.0102467***	-.0146418	-.0287735***
Gabon	-.0540563***	-.0269845***	-.0125426	-.046766***
Tchad	-.0145587***	-.0108587***	-.0078339	-.0123628***

Source : Authors calculations

Despite the significance of Okun's coefficients in Central Africa's countries, the latter remains very low and reflect a weak response of unemployment to growth. This weakness may be attributed to many factors, including the low content of growth in jobs. The finding is normal in countries where natural resource-related sectors constitute a significant proportion of GDP (as noted before). Coupled with the low efficiency within labour and domestic markets, as well as a low diversification of the productive fabric (see figure below), the importance of natural resource-based sectors is weakening the Okun's law in the countries in question. Adding to this range of factors the relatively large participation in the economic activity, particularly among women, as well as the importance of informal sector in the overall employment.

Factors affecting the labour market in Central Africa



Source: the World Economic Forum, the World Bank

Breakdown of employment by sector in Sub-Saharan Africa

	Year	Public sector	Formal private sector	Informal sector
Benin	2005	2.6%	2.1%	95.3%
Burkina-Faso	2005	4.3%	1%	94.7%
Cameroon	2005	4.9%	4.7%	90.4%
Congo	2005	6.3%	1.8%	91.9%
Ethiopia	2005	3.9%	6.2%	89.9%
Ghana	2010	6.4%	7%	86.4%
Mali	2007	3.1%	0.4%	96.5%
Nigeria	2004	8%	0.3%	91.8%
Rwanda	2006	3.7%	1.2%	95.1%
Senegal	2001	1.8%	6.1%	92.1%
Botswana	2006	25%	37%	38%
South Africa	2007	16%	45.6%	38.4%

Source : Stephen Golub and Faraz Hayat (2014)

West Africa

For West Africa, the law is absent in the majority of countries. In fact, it is valid only for the Gambia (the coefficient varies from -0.6 to -0.13), Guinea-Bissau (-0.01 to -0.02), and to a lesser extent for Liberia, Niger, Sierra Leone and Togo (Bankole et Fatai, 2013 ; Adenuga et al, 2013 ; Sumra, 2016).

Estimation of the Okun' s law in West Africa (1991-2015)

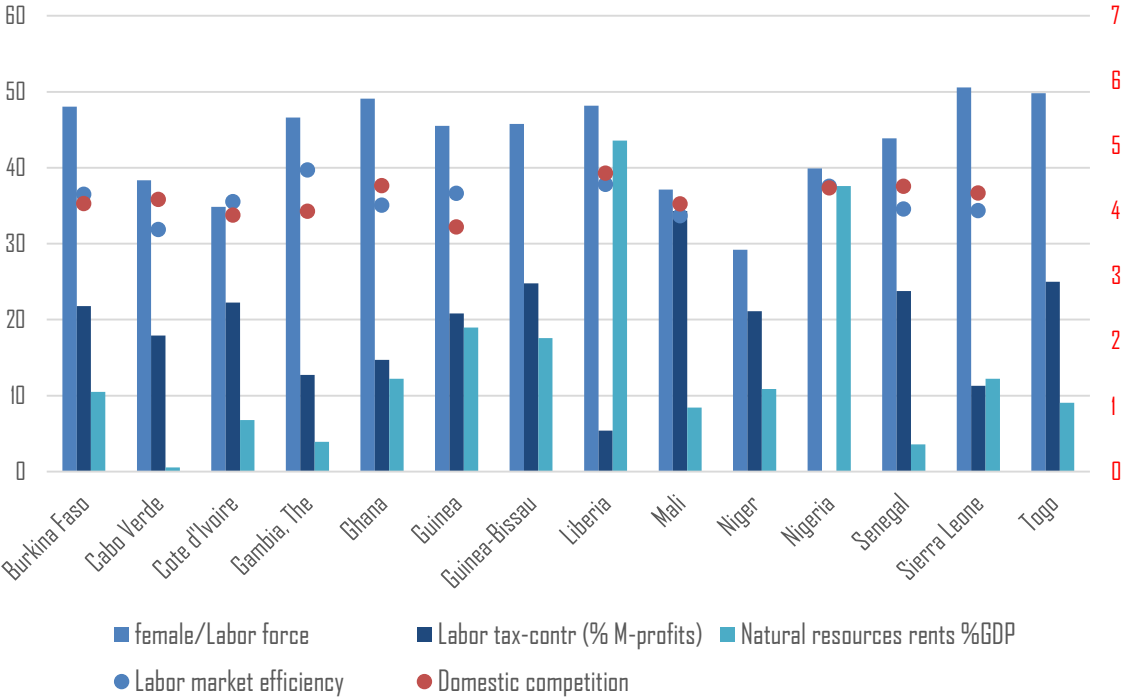
	(1)	(2)	(3)	(4)
Burkina-Faso	-.007876	-.0150898	-.015239	-.049158
Cape Verde	-.0093421	-.0097053	-.016717	-.0032598
Cote d' Ivoire	.0002041	-.0014748	.0026088	.0007798
Gambia	-.1316879***	-.0581494***	-.0630453***	-.1004056***
Ghana	-.4804331	-.2362658	-.3624152	-.561739
Guinea	.0470731***	.0213441***	.0376777*	.0489215***
Guinea-Bissau	-.0286895***	-.0284903***	-.0116383	-.0168615**
Mali	-.1749884	.0077574	-.004817	-.0024988
Mauritania	-.0262928	-.0771943	-.1224925	-.1002108
Liberia	-.0048073***	-.0103518	-.0266933	-.0332178
Niger	-.1749628	-.1008788***	-.1479084	-.1816626
Nigeria	-.0139761	-.0144667	.0185441	-.0196709
Senegal	.2300996	.1042651	.0808887	.3284954
Sierra-Leone	-.004353	-.0035081***	-.001497	-.0035298
Togo	-.0385255***	-.019924***	-.0091863	-.0192337

Source : Authors calculations

According to estimates, growth plays a weak role regarding unemployment reduction. Then, the fight against unemployment in West Africa should be done in a framework encouraging the promotion of more efficiency at the labour market level. In fact, the lack of labour market flexibility in these countries plays an important role regarding the development of new unemployed and the reinforcement of the informal sector (Golub and Hayat, 2014 ; Sumra, 2016). In addition, it is crucial to improve the competitiveness within the domestic market.

In addition, the dominance of low growth-jobs sectors appeal for a greater diversification of the economies in hand (AfDB, 2007 ; Ogbeide et al, 2015 ; Baah-Boateng, 2013 et 2016 ; Aryeetey and Baah-Boateng, 2016). In this context, the importance of the demographic factor (economic participation, especially for women) can only be in favour of a weak growth-jobs correlation.

Factors affecting the labour market in West Africa



Source: the World Economic Forum, the World Bank

East Africa

In East Africa, the law is only valid for six countries among sixteen. With the exception of Seychelles, where the coefficient of Okun exceeds -0.2 , the Okun's coefficient is very low for the other five countries. Indeed, despite the negative sign and the statistical significance, with regard to the five countries in question, the reaction of the unemployment to growth remains weak with a coefficient that does not exceed -0.1 .

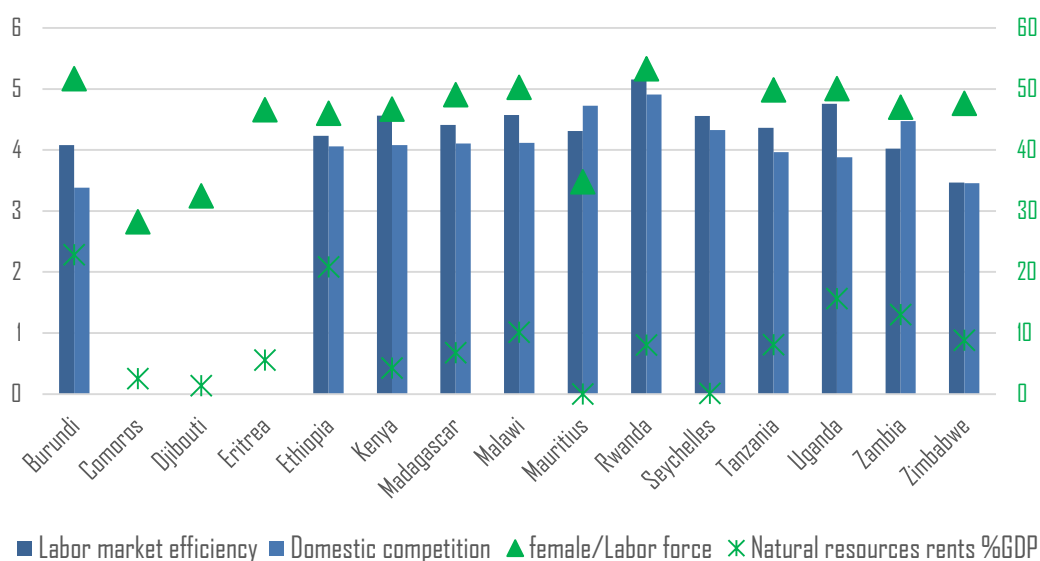
Estimation of the Okun' s law in East Africa (1991-2015)

	(1)	(2)	(3)	(4)
Burundi	-.0016634	.0005155	.0010088	.0039883
Comoros	-.1004894***	-.0684698***	-.0474545**	-.089378***
Djibouti	-.1185652	-.0197327	.9025161	-.4741153
Eretria	-.0104247	-.0145525***	-.0188663	-.0360025***
Ethiopia	-.0236364	-.0247771	-.0158336	-.0387181
Kenya	-.0313492***	-.0121384***	-.0322804***	-.0420483***
Madagascar	-.009742	.0001613	-.0374346	-.0623661
Malawi	-.0562087***	-.0234787***	-.0624432***	-.0397695**
Maurice	-.5737579	-.3053218	-.7188945	-.8605168
Mozambique	-.0834548***	-.0474617***	-.0292317	-.0473159***
Rwanda	.0093868	.006128	.0245613	.0285919
Seychelles	-.2085825***	-.0587492	-.2265838***	-.2860882***
Tanzania	-.2313352	-.1049956	-.2653473*	-.2333456
Uganda	.2862464*	.0393655	.1749765	.1709179
Zambia	.1611819	.062428	.0014347	.0201028
Zimbabwe	.08835	.0563124	.1551695	.1684214

Source : Authors calculations

In addition to the weak response of the unemployment rate to growth in East Africa, labour markets suffer from precarious jobs due to the importance of the informal sector (see table of the breakdown of employment by sectors in sub-Saharan Africa). In fact, informal markets are known by unfavourable conditions of work, whether it comes to the quality of the tasks or the number of them (UEMOA, 2002 ; World bank, 2013). This is also a contributory factor in the little reaction of unemployment to growth. In some cases, a significant proportion of growth may be associated with the increase in the number of hours worked in the informal sector (this is even more important knowing that this sector is representing more than 80% of employment in most eastern countries). In addition to this factor, the significant participation in the labour market, including women participation, coupled with the low employment elasticity to growth and the importance of natural resources-based sectors play an important role regarding the current configuration of East Africa's labour markets. Finally, the low efficiency of the labour markets as well as the need to improve the competitiveness of the domestic market of goods and services are factors that impede the strengthening of the relationship between unemployment and growth.

Factors affecting the labour market in West Africa



Source: the World Economic Forum, the World Bank

In sum, the results presented in this section propose that unemployment and gross domestic production are weakly linked or unrelated in the majority of the studied countries (no matter what model is used to estimate the Okun's law).

Validity Specifications	Valid	Valid but weak	Not valid
Four specifications	Egypt, Tunisia (2/46)	Centre Africa, Congo, Gambia, Guinea, Comoros, Kenya, Malawi (7/46)	Botswana, Namibia, Cameroun, R.D. Congo, Burkina-Faso, Capo Verde, Cote d'Ivoire, Ghana, Mali, Mauritania, Nigeria, Senegal, Burundi, Djibouti, Ethiopia, Madagascar, Maurice, Rwanda, Zambia, Zimbabwe
Less than four specifications	Algeria, Morocco, South Africa (3/46)	Angola, Guinea. Eq, Gabon, Chad, Guinea-Bissau, Liberia, Niger, Sierra-Leone, Togo, Eretria, Mozambique, Seychelles, Tanzania, Uganda (14/46)	

These findings are contrasting with the results found for most advanced economies. Obviously, the structures of the economies and the configurations of the labour markets of the countries examined in this study differ from those of the advanced countries where the Okun's law seems to work pretty well as an empirical regularity.

Based mainly on previous developments regarding the relationship between unemployment and growth in Africa, six reasons may be proposed to explain the variability of Okun’s law among the studied countries:

1. The structure of the real domestic production and the importance of natural resources-based sectors.
2. Domestic production volatility.
3. Domestic market competitiveness and the diversification of the economy.
4. The mismatch between labour supply and demand, i.e. the structure of labour supply does not follow the changes of the structures of needed skills.
5. The low efficiency of labour markets.
6. The importance of the informal sector.

From developments mentioned in the literature, and findings highlighted in the current section, the following sub-section will try to identify the determinants of the Okun’s coefficient in Africa. Before reaching this point, we first present a general overview of the correlation between the coefficients issued from our four specifications.

Correlation between Okun’s coefficients

	Model (1)	Model (2)	Model (3)	Model(4)
Model (1)	1			
Model (2)	0,84026134	1		
Model (3)	0,80759423	0,8028038	1	
Model (4)	0,9257938	0,86886466	0,77334521	1

Source : Authors calculations

The correlations matrix reveals a strong correlation between the four used specifications. This is a synonym of a convergence of the results reported by our estimates.

2. The determinants of the Okun’s coefficient in Africa

In order to identify potential factors that affect the value of the Okun’s coefficient in Africa, we used indicators reflecting the variables cited in the literature. In fact, we choose:

- The importance of natural resources-based sectors that we quantified using the average share of natural resources rents in overall GDP (WDI¹¹).
- The volatility of real domestic production that we measured using the standard deviation of growth (WDI).
- The domestic markets competitiveness that we measured by the index of the domestic competition (GCI¹²).
- The efficiency of the labour market that we measured by the index of the efficiency of the labour market (GCI).
- The mismatch between labour supply and demand that is measured, here, by the rate of participation of women in the economic activity (ILO: International Labour Organization). This choice is justified by the fact that the female workforce is poorly qualified. In fact, 38% of African adults (about 153 million) are illiterate and two thirds of them are women according to UNESCO. In addition to this dimension, women's participation is also a demographic factor.
- The importance of the informal sector has been measured by a proxy variable, which is the rule of law index (GGI¹³). In general, the greater the presence of the rule of law in one country, the more regulated its production and employment structure.
- Political stability (GGI) captures the effect of turbulence experienced by many countries in Africa in the 1990s and early 2000s.

The following table presents the data mobilized, their sources and the treatments made before integrating them into our analysis.

Dimensions	Variables	Sources	Expected sign	period
Importance of natural resources-based sectors	Natural resources rents (% GCP)	WDI	+	Average 1991-2015
Stability and predictability of growth	Growth volatility	WDI	+	Average 1991-2015
Domestic market competitiveness	Domestic market efficiency	GCI	-	Average 2007-2015
Rigidity of the labour market	Labour market efficiency	GCI	-	Average 2007-2015

¹¹ World Development Indicators database of the World Bank.

¹² Global Competitiveness Index of the World Economic Forum (data are only available since 2007).

¹³ Global Governance Indicators of the World Bank.

Demography/adequacy	Female participation	OIT	+	Average 1991-2015
Political stability	Political stability	GGI	-	Average 1996-2015
Informal sector	Rule of law	GGI	-	Average 1996-2015

We initially analyze the correlations between the Okun's coefficients and the variables in the table above. Second, we proceed to the analysis of the multicollinearity in order to identify the variables that can be integrated at the level of the regression, which should be the last step of our approach.

Correlation between Okun's coefficients and potential determinants

	Beta (1)	Beta (2)	Beta (3)	Beta (4)
Domestic market efficiency	-0.250643	-0.276438*	-0.297817*	-0.344284**
Female participation	0.375083**	0.251047	0.432710***	0.296408***
Growth volatility	0.164515	0.183987	0.186852	0.134464
Labour market efficiency	0.169126	0.031146	0.188591	0.089312
Natural resources rents (% GCP)	0.109140	0.129522	0.072673	0.098547
Political stability	-0.198237	-0.274477*	-0.192684	-0.214853
Rule of law	-0.379738**	-0.466573***	-0.450174***	-0.429927

Source : Authors calculations

The correlation matrix shows the existence of a negative relationship between the value of Okun's coefficient, on the one hand, and domestic competitiveness, the rule of law and political stability, on the other hand. The signs of the correlation are in principle consistent with the literature, with an effect of reinforcing of the unemployment/growth linkage with any improvement in the domestic competitiveness, the rule of law and/or the political stability; and a negative impact of the demographic factor and the mismatch on the linkage in hand. On the contrary, the labour market efficiency and the dependence on natural resources, as well as the growth volatility seem not to be significantly related to the configuration of the unemployment/growth linkage. This is perhaps due to the similarity of both labour markets structures and diversification degrees of economic activities, for the first two variables. Volatility, meanwhile, can be regarded as a resulting variable of the important alliance on commodities in number of African economies. The fact that some of the potential determinants are related to each other can result in an exclusive influence of some variables, without others, on the values taken by the Okun's coefficient. To address this issue, we proceed to an analysis

of the multicollinearity. The table below reported the correlations between the potential determinants.

Correlations between the potential determinants

	Domestic market efficiency	Female participation	Growth volatility	Labour market efficiency	Natural resources rents	Political stability	Rule of law
Domestic market efficiency	1						
Female participation	0.073	1					
Growth volatility	-0.203	-0.035	1				
Labour market efficiency	0.421***	0.657***	-0.197	1			
Natural resources rents	-0.41***	-0.152	0.52***	-0.247	1		
Political stability	0.345**	0.025	-0.181	0.039	-0.57***	1	
Rule of law	0.535***	-0.15	-0.395**	0.109	-0.63***	0.81***	1

Source : Authors calculations

Of 20 correlations, half of the coefficients are significant and exceeds 40% in absolute value. According to the results indicated in the correlation matrix, we have ensured that our estimates do not gather collinear variables. Then, the analysis of multicollinearity led us to consider the following estimates:

Dependent variable: Okun' s Coefficient								
	Beta (1)		Beta (2)		Beta (3)		Beta (4)	
Domestic market efficiency	-0.207*		-0.097*		-0.275**		-0.35***	
Female participation	0.013***		0.004		0.017***		0.014**	
Labour market efficiency		0.143		0.015		0.165		0.091
Natural resources rents		-0.004		-0.003		-0.009		-0.009
Rule of law		-0.27***		-0.15***		-0.39***		-0.42***
Constant	0.190	-0.778	0.178	-0.152	0.278	-0.907*	0.738	-0.598
Observations	39	39	39	39	39	39	39	39
R ² -adjusted	0.217936	0.138431	0.103149	0.196885	0.259257	0.252079	0.178673	0.181225

F	5.016023	3.035188	3.185233	4.105253	7.649913	5.269163	5.133308	3.803607
Σ^2	0.289523	0.296186	0.133418	0.126234	0.306214	0.307618	0.372306	0.372567

Source : Authors calculations

The estimates show that all models are significant, overall (Fisher), and that the R^2 ranges from 10% to 30%; in addition, the errors of the models estimated are normal, thing that reinforces the robustness of the latter;

In addition, the significant variables had the expected signs. Indeed, estimates show the presence of a significant positive effect of the rule of law and domestic competitiveness on the Okun's coefficient. On the other hand, as we have predicted, female participation in the economic activity is a factor hindering the improvement of the growth/unemployment linkage.

IV. Conclusion

The main objective of this work is to measure the reaction of unemployment to growth in some African countries. It comes to estimate the Okun's coefficient, test its validity and measure its intensity. The results presented in this work propose that gross domestic unemployment and production be weakly linked or untied in the majority of the examined countries, regardless of the model used to estimate the Okun's coefficient (the law is valid for all specifications in 9 out of 46 countries; and invalid for all specifications in 20 out of 46 countries). This is contrasting with the results found for most advanced economies (Ball et al, 2013). Obviously, economic structures and configurations of the labour markets of the studied countries differ from those of developed countries where the Okun's law seems to work pretty well as an empirical regularity. In addition, we note the sensitivity of the intensity and the validity of the Okun's law to the different used specifications.

A second main objective of this work was to determine the origins of the Okun's coefficient variability within Africa. The literature informed us that these origins are in principle of structural, demographic and/or economic nature. In addition, our empirical approach confirmed the relevance of the demographic factors, the level of competition within domestic markets, and the rule of law. In the case of Morocco, the analysis has raised the relevance of the volatility of growth (see annexes).

Lastly, we insist on placing the need to take account of the structure of growth (breakdown of GDP: agricultural/non-agricultural, with and without the contribution of natural resources), to produce composite indicators that measure the inadequacy, to open the black box of the informal sector, to search for appropriate proxy variables, and to test the linearity of the Okun's law at the heart of future extensions and methodological developments.

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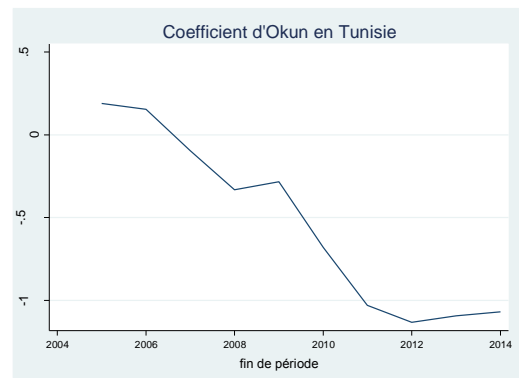
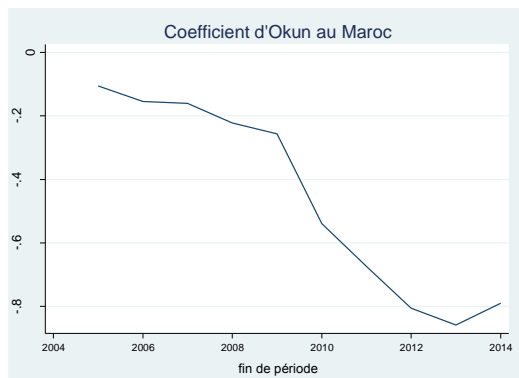
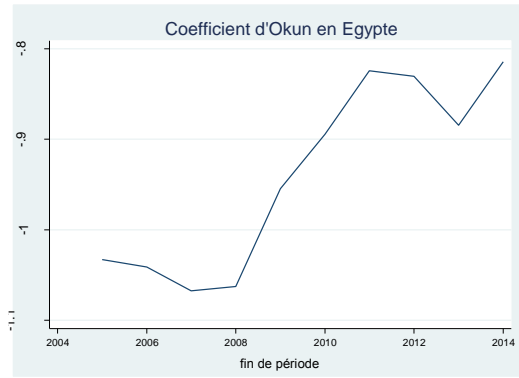
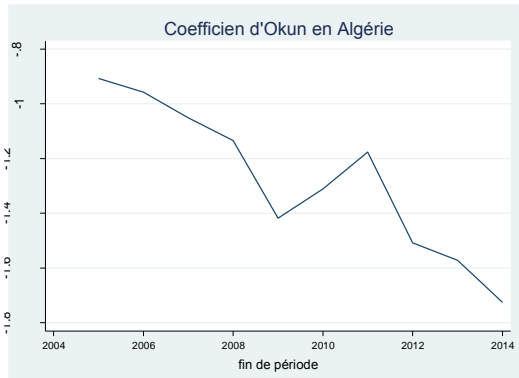
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Annexes

15 years rolling estimates :



Growth Volatility and Okun's Coefficient in Morocco

