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RELATION BETWEEN RENEWABLE ENERGY AND UNEMPLOYMENT IN NON-OECD COUNTRIES. "AN ECONOMETRIC ANALYSIS BASED ON THE STUDY OF 11 NON-OECD COUNTRIES"

Abstract

Using a PANEL OLS MODEL, this study evidences the dynamic relationship between the production of renewable energy such as hydroelectric, biomass, wind, solar, geothermal, and the unemployment that was considered as the dependent variable in the 11 non- OECD Countries,over the period 1990-2014.

The paper identifies conditions in which renewable energy contribute to a reduction of unemployment in non-OECD Countries. In Particular this evidence is clear not for all renewable energy but only for Biomass and Solar Power . The explanation for this result is given by the morphology of the non-OECD Regions, and by high skill transferability in renewable energy sector. This result is very interesting, because shows that in developing countries where unemployment is very high, the government could intervene with policies for the increase of renewable energy for the reduction of unemployment.

JEL CLASSIFICATION: E0, E24, E32, E6, F0, F4, F6, F64, F66, O, Q, Q2,Q4, Q5.
KEYWORDS: ALTERNATIVE ENERGY SECTOR, UNEMPLOYMENT, PANEL UNIT ROOTS CAUSALITY, FIXED EFFECTS MODEL.

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1. Introduction

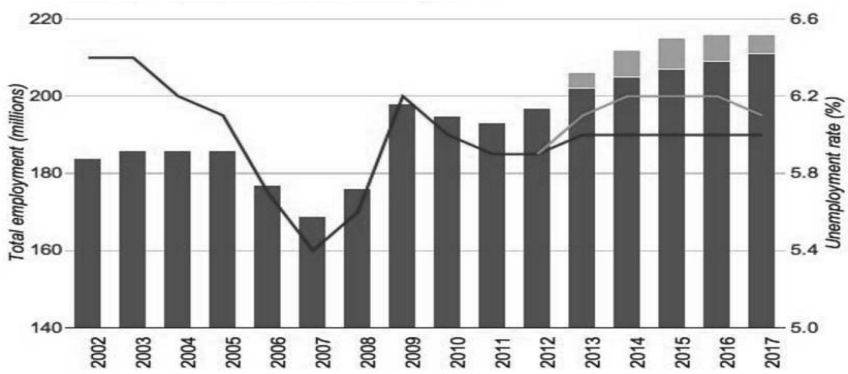
This paper analyzes the macroeconomic effects of renewable energies production on socio-economic variables which contribute to improvement of life in non-OECD countries. In particular, among the economic socioeconomic variables analyzed, the unemployment rate was considered as a driver of a lifestyle improvement, in fact it is assumed that a decrease in unemployment corresponds to an improvement in the lifestyle of the population. This paper assumes that if Governments and businesses from various non-OECD countries are starting to invest in Renewable Energy, they will gain economic improvements, in particular it is assumed that investments in renewable energy have a significant impact on reducing the unemployment rate. It has already been shown that exploitation of renewable energies contributes to a reduction in CO2 emissions, catalyzing a worsening of a country's health and hence a worsening country's economic status. It is proven that in the 11 dimensions of well-being there is quality and quantity of work.

The OECD has outlined the 11 Dimensions of Wellness. One of these, is the availability and quality of work. These are essential for the welfare of the people and can have a very important impact on the material and non-material conditions of life.Having a job is a source of pride and dignity in fact, helps the creation of personal identity. Being unemployed, have a negatively effects on physical and mental health. This suggests that the negative effects of unemployment go well beyond the loss of income and endure over time. The long-term unemployment leads to the loss of skills and additional employment opportunities and exposes people to the risk of social exclusion and poverty.If the job greatly reduces the risk of poverty, does not necessarily remove this risk, because poor families composed of people who work there are significantly in all non-OECD Countries.

The total number of unemployed in the world in 2015 was estimated at 197.1 million, 27 million more than in pre-crisis level of 2007. The amount for 2015 is expected to undergo an increase of about 2.3 million in 2017 and reach the 205.4 million. A large number of workers are having to accept low-paying jobs, not only in emerging economies and developing, but increasingly also in industrialized countries. Although it decreased the number of unemployed in some European Union (EU) and the United States, are always too many people still out of work. In industrialized countries, the unemployment rate fell from 7.1 percent in 2014 to 6.7 per cent in 2015. In

many cases, however, these improvements were not sufficient to eliminate the employment gap caused by the global financial crisis. In addition, the employment prospects have deteriorated now also in emerging and developing, particularly in Brazil, China and the oil-producing countries. The unstable economic environment, the volatility of capital flows, financial markets still mal-functioning and weak global demand, continue to weigh on business and discourage investment and the creation of jobs, "says Raymond Torres, Director of the Department the ILO research. They are 156 million (or 37.7 percent of the total of the reference group) young people who work but live in poverty. These data confirm that poverty affects more young workers and adult (26 percent of working adults living in poverty).

Figure 1 - Global Unemployment Trends



Source: International Labour Organization (2013' Report)

Table 1 - Youth unemployment and young working poor: trends and forecasts until 2017

	2015	2016	2017	
World	12,9	13,1	13,1	
Developed countries	15	14,5	14,3	
Emerging countries	13,3	13,6	13,7	
Developing countries	9,4	9,5	9,4	

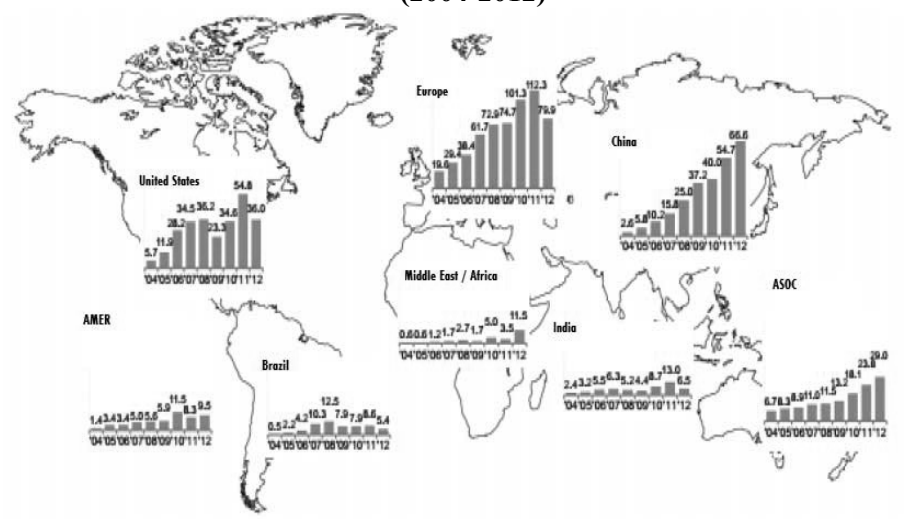
Source: World Employment and Social Outlook 2016: Trends for Youth.

In the second section of this paper, we have defined the research objectives, providing a contribution to existing literature, analyzing the positive relationship between renewable energies and unemployment. The third section shows an analysis of the literature, pointing out that in the past some researchers focused mainly on the relationship between energy and GDP, while only some researchers have focused on the analysis of the relationship between renewable energies and GDP and very few On the existing relationship with the unemployment rate.

2. Research goals

In recent decades they have made good efforts to ensure access to electricity in all countries. The governments of all countries have promoted important electricity grid development programs and support mechanisms to facilitate the diversification of energy sources and has also supported the off-grid production by RES plants in areas where it is more difficult to get the network electricity. A careful national energy planning, characterized by a long-term time horizon, favored the progress of the energy sector and new investments. Unfortunately non-OECD Countries are, the less respectful of environmental regulations, the purpose of this publication is to show that the OECD Countries would agree to not convert their conception of energy passing to a greater use of renewable energies which can 'allow not only improvements in pollution reduction but also in terms of employment.

Figure 2 - Evolution of global investment in renewable energy (2004-2012)



Source : "Global Trends In Renewable Energy Investment 2013" Frankfurt School-UNEP Centre/BNEF

The main purpose of this paper is to study the relationship between renewable energy and economic growth. In particular, between unemployment and renewable energy. This study investigate the dynamic relationship between the production of renewable energy such as hydroelectric, biomass, wind, solar, geothermal, and the unemployment that was considered as the dependent variable in the 11 non- OECDCountries over the period 1990-2014.

3. Literature review

There are many studies related on connection between energy consumption and economy, for example (Sari, Ewing, and Soytas, 2008; Fowowe, 2012; Mercan and Karakaya, 2015; Khatun and Ahamad, 2015; Sharma (2010); Carley, Lawrence, Brown, Nourafshan, and Benami, 2011;

Ramos and Veiga, 2014; Ozturk, 2010; Payne, 2010. In this line of study, there is a clear correlation between economic growth and energy prices. Unfortunately, the studies on renewable energies are not satisfactory especially there are not enough studies that analyze the relationship between renewable energy and jobs or unemployment. Unfortunately, especially in developing countries, they have gone through a period of continued unemployment due to the huge global crisis, the inefficiency of the labor market. Therefore it is crucial to focus on the relationship between energy and work, and especially for renewable energies since footprint was found that would reduce pollution but it is not established that can reduce unemployment. Most studies was based on the analysis of this relationship through the use of the method of the coefficient at fixed or variable effects. Hillebrand for example in 2006 create an analysis with which it has attempted to identify, through the use of input-output model, a relationship between the two variables. His study, analyzing Germany came to the conclusion that favorable policies in a development of alternative energies, can make a positive contribution to employment in the short term, but negative in the medium to long term. Lehrer, conducted a study, for the Germany, he concludes that this relationship between the two variables is positive, especially for a long time a high unemployment rate. Ragwitz in 2009 using the European Union, as a sample studied,was considering variables related to policies aimed at supporting the development of alternative energies. He identified a positive relationship between energy policies and employment.Bohringer, analyzing Canada, tried to identify a relationship with the cost of energy policies. Kuster differing from previous authors in 2007 has examined the impact of investments in alternative energy in the European Union, on economic variables such as unemployment. The conclusion was that the renewable energy sources are added to the unemployment rate. Bovenberg and Mooij , examined the relationship between taxation to environmental policies and employment, they tried to explore the effects of the displacement of the cost of polluting goods on employment and the non-environmental welfare. They found that the increase in costs related to the movement of polluting goods results in an increase in unemployment. Scholz, Bovenberg and Van Der Ploeg, in 1998 and in 1996, analyzed variables that indicate the change in unemployment considering the effect of factors such as the elasticity of tax rates and other factors. In 2009Payne investigates causality between renewable and non-renewable energy consumption and employment using time series data for

the period of 1976-2006 in Illinoi. He reveals a unidirectional causality from energy consumption to employment. In 2011 Menegakiusing a panel causality test European countries over the period 1997-2007, finds a bidirectional causality between renewable energy and employment. Apergis and Payne in 2015 examines the causality between renewable and non-renewable energy consumption and unemployment using panel data of Latin America, Europe, Asia and Africa. They revealed a unidirectional causality from renewable energy consumption to unemployment across all regions, as long as the recent time period is approached.

4. Methodology

In this study we sought to answer the following question:

- Is there a relationship between renewable energy and unemployment?
- Will Renewable energy contribute to development of non-OECD countries?

The methodology adopted for this study followed the following steps:

- creation of a 1 panel with 11 non-OECD countries a bow time goes from 1990 to 2013.
- Dependent Variable: Unemployment.
- Independents Variables: Economics Variables and Renewable EnergyProductions Variables.

For this panel is been adopted the following methodologies to analyze the relationships between the dependent variables and independent variables :

- A - Creation of the regression curve for the variables with OLS Method (Augmented Dickey-Fuller).

In statistics, ordinary least squares (OLS) or linear least squares is a method for estimating the unknown parameters in a linear regression model, with the goal of minimizing the sum of the squares of the differences between the observed responses (values of the variable being predicted) in the given dataset and those predicted by a linear function of a set of explanatory variables. Visually this is seen as the sum of the squared vertical distances between each data point in the set and the corresponding point on the regression line – the smaller the differences, the better the model fits the data. The resulting estimator can be expressed by a simple formula, especially in the case of a single regressor on the right-hand side. The OLS estimator is consistent when the regressors are exogenous, and optimal in the class of linear unbiased estimators when the errors are homoscedastic and

serially uncorrelated. Under these conditions, the method of OLS provides minimum-variance mean-unbiased estimation when the errors have finite variances. Under the additional assumption that the errors are normally distributed, OLS is the maximum likelihood estimator. In the case of a model with p explanatory variables, the OLS regression model writes:

$$Y = \beta_0 + \sum_{j=1\ldots p} \beta_0 X_j + \varepsilon$$

where Y is the dependent variable, β_0, is the intercept of the model, X_j corresponds to the j^{th} explanatory variable of the model (j= 1 to p), and e is the random error with expectation 0 and variance σ^2. In the case where there are n observations, the estimation of the predicted value of the dependent variable Y for the i^{th} observation is given by:

$$y_i = \beta_0 + \sum_{j=1\ldots p} \beta_{j0} X_{ij} + \varepsilon$$

The OLS method corresponds to minimizing the sum of square differences between the observed and predicted values. This minimization leads to the following estimators of the parameters of the model:

$$\beta = (X'DX)\text{-}1\ X'\ Dy\ \sigma^2 = 1/(W - p^*)\ \Sigma_{i=1..n}\ w_i(y_i - y_i)$$

where β is the vector of the estimators of the β_i parameters, X is the matrix of the explanatory variables preceded by a vector of 1s, y is the vector of the n observed values of the dependent variable, p^* is the number of explanatory variables to which we add 1 if the intercept is not fixed, w_i is the weight of the it h observation, and W is the sum of the w_i weights, and D is a matrix with the w_i weights on its diagonal.

4.1. Data set Analysis

The analysis covered a sample of eleven NON OECD nations, the sample used is very homogeneous and linear. The non-OECD nations selected are the following: Argentina, Bolivia, Brazil, China, Chile *, Cuba, Ecuador, Egypt, Guatemala, India, Indonesia.

The dataset constructed combines different sources. For the energy sector, it be collected data on energy balances from the publications of IEA (International Energy Agency), data that contains annual data on final energy consumption for the whole economy and for major sectors such as industry, commerce and public services, transport and residential sectors. All information on the economic performance in the different sectors is taken datasets from the World Bank World Development Indicators (WDI), from IEA(International Energy Agency) Statistic Database (Energy Balance of non-OECD Countries), from World Energy Council (Energy Efficiency Indicators database), from IRENA (International Renewable Energy Agency) database, from REN 21(renewable energy policy network)

4.2. Variables

For the creation of the Panel, we used energy variables and economic variables. The dependent variable used, is the Unemployment Rate . While, as independent variables, have been chosen energy type variables , related to the production of renewable energies, to highlight that whit an increase of renewable energies production, can be depend a reduction of unemployment. Renewable energy variables studied and included in the panel are the follows: Hydroelectric which is synthesized by the acronym HDP, solar energy which is synthesized by the acronym SEP, the energy derived from biomass synthesized by the acronym BMP, and wind energy synthesized with the acronym SEP. In addition, we chose to analyze the existence or not of a dependence on the result of GDP growth and Investments synthesized with the acronym FDI, therefore the most recent economic variables were included among independent variables.

Table 2 - Variables List

VARIABLE	TYPE	UNITS' OF MEASUREMENT	ACRONYM	SOURCE
Unemployment	Economic		UNM	WorldBank ILO estimate
Direct Investment	Economic	MillionDollar	FDI	WorldBank
GDP	Economic	MillionDollar	GDP	WorldBank
Net of Wind Energy Production	Energy	Billion Kilowatt hours	WEP	Eia
Net of Solar Energy Production	Energy	Billion Kilowatt hours	SEP	Eia
Biomass Electric Power	Energy	Billion Kilowatt hour	BMP	Eia
Hydroelectric Power	Energy	Billion Kilowatt hour	HDP	Eia

5. Results

The Panel, gave satisfactory results, in fact, showed no missing observations. Thanks to model Panel, the degrees of freedom ($N * T$) observations increased which, thus allowed the estimation of further observations.

The macroeconomic results of the OLS model used are summarized in table number three. The panel analyzed consists of 259 observations with a length of the time series that ranges from a minimum of 21 to a maximum of 24. As mentioned earlier, the Dependent variable chosen for the creation of the model is the unemployment rate because we want to see how the independent variables chosen react with unemployment. The time period used is from 1990 to 2014. The data used were mostly homogeneous, highlighting the existence of a linear correlation between the variables. The result of linearity obtained is as follows LM: 128 881 with a p-value P (Chi-square (6)> 128 881) = 2.21165e-025.

Table 3 - OLS Method results (1990-2014)

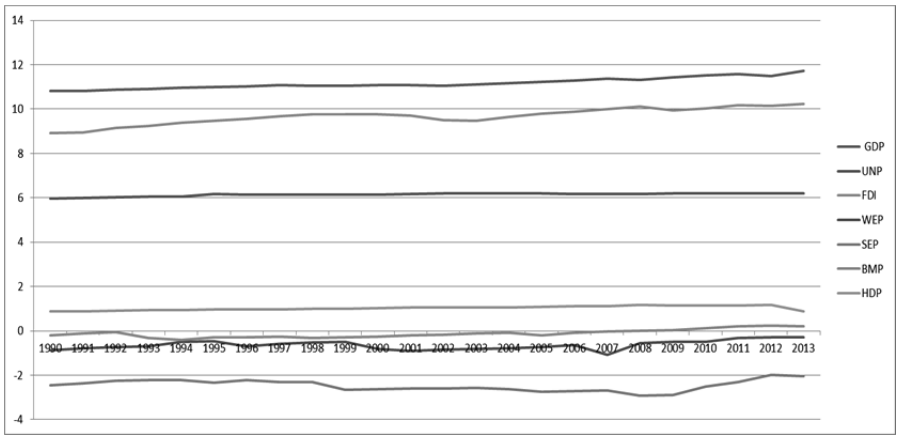
	coefficient	std.error	t-ratio	p-value	
const.	2161+06	446746	4.839	2.27e-06	***
HDP (Hydroelectric)	66568.6	6443.95	10.33	4.34e-021	***
SEP (Solar)	−528448	1.6496+06	−0.3203	0.7490	*
GDP	5501-06	1.814-06	3.033	0.0027	***
BMP (Biomass)	−1.025+06	93230.1	−11.00	3.08e-023	***
WEP (Wind)	111547	111754	0.9981	0.3192	
FDI (Direct Investment)	−0.000103	3,43E+00	−3.007	0.0029	***

R-squared	0.662013

The table shows the specifications of orders and deterministic part of the OLS model through various analyzes that are more suitable results to pursue the object of study, in particular for tracked observations. It can easily notice that already in the OLS model is a clear inverse relationship between the variable UNEMPLOYMENT and variables BMP and SEP.

The result of this research can be considered very positive, in fact we have obtained very low p-value for all variables with a R-squared high. This confirms the existence of a relationship between energy and economic growth in a country. What distinguishes this research from the literature is that, using a quantitative econometric approach, energy variables and, in particular, variables of renewable energies and economic socio-economic variables, such as unemployment and GDP, have been correlated with a sample Referring to non-OECD countries, countries that have always been affected by inadequate energy policies. In particular, the clear evidence of the inverse relationship between unemployment and GDP confirms that policies conducive to the exploitation of renewable energies can increase socio-economic benefits, in fact through the exploitation of renewable energy, we see a reduction in unemployment. Numerically we see SEP with a coefficient of -528448 and BMP with a coefficient of -1.025 + 06.

Figure 4 - Trend of Variables



Source: result of econometric analysis

From this graph it became clear that to have an inverse relationship to the unemployment factor are biomass and geothermal. For another the result of these factors is very important fact:

- BMP (Biomass): Coefficient − 1,025+06 with ***
- SEP (Solar Energy Production): Coefficient −528448 with *

While all other variables (Hydroelectric, Geothermal and Wind) have a positive value and then means they have a direct relationship.

Furthermore, is important the direct relationship between GDP and Unemployment, because it evidence that there isn't' an positive impact between Renewable Energy Variables, and Unemployment.

6. Conclusions

Energy has always played a key role in the development and competitiveness of a Nation, depending on the strategic decisions of Economic subjects such as: Increasing productivity, economic growth, Sustainable Development, Unemployment Rate, Energy investments, energy supply choices and exploitation choices may also depend on the availability of resources and raw materials, regardless of their renewable or fossil nature.With this work we want to prove how production increasing and use

of alternative energies could have a positive impact on the economic growth and the reduction of unemployment.

This research focuses on socio-political aspects(effects of renewable energy on unemployment) related to the energy sector over a 25-year period in non-OECD developing countries such as Argentina, Bolivia, Brazil, China, Chile, Cuba, Ecuador, Egypt, Guatemala, India and Indonesia. In the processed data panel, we have related, as a dependent variable, the level of unemployment, while as independent variables, energy and economic ones, to study the impact they have on the economic growth of non-OECD countries.

The literature shows that the increase in unemployment mainly depends on economic variables such as GDP.In this research, the effects of GDP have been isolated withan OLS analysis that shows a direct relationship between the variation in GDP and the unemployment rate,in this way we have been able to isolate the effects of these ones by giving greater importance to energy variables.

The consequence of this from the OLS model is that there is a relevant significance on all the energy variables such as hydroelectric***, solar*, biomass *** and wind, in particular it is inferred that there is one Reverse relationship between Unemployment and Solar Energy and Biomass.This last result is demonstrated by the fact that for both energy sources, considered as chain and working sub-sectors, also have effects on the level of unemployment, particularly on medium skilled workers. GDP does not affect unemployment, as the variation in GDP has had a significant impact mainly on capital intensive sectors, but investment change has a positive impact on unemployment.

Concluding, it is possible to confirm that renewable energy from biomass and solar energy creates indirect and induced effects that have a positive effect on the NON-OECD countries' economies, and in particular contribute to the reduction of unemployment. Given the result of this work and pointing out that the Biomass and the Solar sectors have a positive effect on the unemployment rate, the indication of Policy on the countries involved calls out for a strengthening of investments in these sectors as each investment in this imply a Reduction of Unemployment.

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