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THE ROLE OF FISCAL INCENTIVES FOR RENEWABLE ENERGY ON ECONOMIC GROWTH

Arbolino Roberta[♣]
University of Naples L'Orientale

Romano Oriana
Independent expert

De Simone Luisa
University of Naples L'Orientale

ABSTRACT

The European Union and National governments have been largely promoting the use of renewable energy sources through financial incentives, to boost investment projects in the sector. The aim of the paper is to assess the use of incentives for renewable energy in Italy and understand its role, as a determinant of economic development, through panel data 2008-2014. The gap between issued and allocated funds shows the difficulty of Italian regions in efficiently using the funds. However, empirically analyses carried out in this study show that even in the case of allocation of the total funds, investments in renewable energy could not be considered as a strong vehicle of economic development.

***Keywords*:** Fiscal Incentives; Renewable Energy; Regional Development; Energy Policy.

1. INTRODUCTION

Renewable energy[1] is at the core of the European Union 'environmental policy. Europe has committed to become a highly energy-efficient, low carbon economy by 2020, reducing by 20% EU greenhouse gas emissions from 1990 levels, raising the share of EU energy consumption produced from renewable resources to 20% and improving by 20% the EU's energy efficiency. Under the Renewable Energy Directive (Directive 2009/28/CE), Member States have established national targets to reach these goals. Italy committed to attain 17% of energy from renewable sources. While heavily relying on energy import (84% of Italy's energy needs), Italy has reached high environmental standard, by being *one of the world's most energy-efficient countries (with primary energy intensity 14% lower than the European average in 2010).* Domestic production from renewables covers 10% of the national demand (Ministero dello Sviluppo Economico 2013, p.18).

A wide array of measures is in place to improve energy efficiency and promote renewable energy sources (e.g. white certificates, requirements for buildings). After careful consideration of the instruments promoting renewable energy, but also generating market distortion (e.g. fixed tariffs), the European Commission is pushing forward greater integration of renewable energy into the market, through

♣ Corresponding author: Dr. Roberta Arbolino, Department of Social Sciences, University of Naples L'Orientale, Largo S- Giovanni Maggiore 31, 80134, Naples, Italy. Email: rarbolino@unior.it

[1] The Directive establishes that energy from renewable sources' means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases.

competitive bidding procedures, which will concern grants to support all the new installations from 2017(EC 2014).

Energy is one of the subjects of the "European Cohesion Policy", which supports the shift towards a low-carbon economy. Cohesion Policy Funds are a crucial tool for helping Member States to achieve Europe 2020 objectives, by promoting investments for increasing the use of renewable energy; decreasing energy use; promoting smart energy systems and encouraging an integrated approach to policy-making and implementation[2]: The Italian Government establishes grants for supporting renewable energy, linked to enhancing the innovation, development or revitalization of entrepreneurship. Funds for national calls for tender are in the general budget of line ministries and allocated according to established criteria, upon the availability of funds.

The Renewable Energy Directive (Directive 2009/28/CE) states that *when favouring the development of the market for renewable energy sources, it is necessary to take into account the positive impact on regional and local development opportunities, export prospects, social cohesion and employment opportunities (p.2).* Despite the relevance of the subject, several scholars (see next paragraph) highlight the lack of empirical evidences in the field, which encourage further research.

By analyzing 84 calls for tenders for allocating funds to promote the use of renewable energy sources and energy efficiency in the years 2008-2014, the paper sheds light on the efficiency in the use of funds and their effectiveness in reaching pre-defined objectives at regional level.
The paper is structured as follows. Section 2 will provide a description of the role of incentives and renewable energy on economic development; Section 3 describes data and methodology, while Section 4 will offer concluding comments.

2. THE ROLE OF INCENTIVES AND RENEWABLE ENERGY ON ECONOMIC DEVELOPMENT

Energy is the engine of global economic development, as it contributes to improve people well – being and quality of life. In truth, energy availability and use conditions affect the competitiveness of production systems. Thus, energy may be treated as a feature of economic and social dimension of the development (Teraoui et al. 2011; Cowan et al., 2014; Baranzini et al., 2013).

When it comes to renewable energy, different studies have analyzed the impacts of renewable energy on rural communities (El Bassam and Maegaard, 2004), local development (Reddy, Uitto, Frans, Matin, 2006), employment (Kammen et al. 2004, Heavner, del Chiaro, 2003, Hillebrand et al. 2006), economic and social dimensions of sustainable development (Bhattacharya et al., 2016; Apergis et al., 2012; Del Rio et al., 2010; Del Rıo and Burguillo, 2008). The general agreement is on the benefit of renewable sources on employment and environment. However, Carley et al 2011 noted that despite the significant amount of stimulus funds in the United States, there is still scarce empirical evidence on the link between energy and economic development. In showing the benefits of renewable energy deployment on local sustainability in Spain Del Rio and Burguillo (2008), highlight how previous analyses have been too *abstract, generic and aggregated* (Ibidem, p.2). This paper aims to contribute in filling this gap, by looking at whether or not grants for renewable energies have had an impact in terms of economic development, while benefitting the environment.

[2] http://ec.europa.eu/regional_policy/sources/docgener/informat/2014/fiche_low_carbon_en.pdf

Thus, renewable resources generate several positive impacts, that explain why decision makers interest is increased in the last years. Many different support policies are put into action in the world (Nicolini et al., 2017; Behrens et al., 2016; Kitzing et al., 2012; Haas et al., 2011). A large number of fiscal and economic tools exist to achieve the goals of any energy policy. In our analysis, we consider both incentives and subsidies and investments in energy infrastructure. Several studies concentrated on analyzing the impacts of grant and subsidies used in industrial policy to reduce imbalances in lagging areas (Martin 1998, Harris and Trainor 2005, Bronzini and de Blasio 2006), to stimulate employment and economic growth (Carlton 1991, Walker and Greenstreet 1991, Wishlade 1996; Driehuis and. van den Noord 1988, Gabe and Karybill 2002) and to influence location decisions (Evans and Karras, 1994; Eberts, 1990; Faini and Schiantarelli 1987; King and Fullerton, 1984; Hall and Dale, 1967). Yet, a wide consensus on the effectiveness of the incentives is far to be reached (Cerqua and Pellegrini 2014). By aligning objectives of economic agents (Bolton and Dewatripont, 2005; Hart, 1995), incentives can be set to promote innovation, to enhance environmental sustainability, to affect technical changes.

Another way to encourage renewable energy development is increasing investment in energy infrastructure, as a tool to promote economic development by increasing factors productivity and promoting growth (Wüstenhagen et al., 2012; Akuru, et al.; 2014) . Better provision of infrastructure lowers the cost of acquisition, being the source of positive externalities on endogenous development (Barro, 1990). The economic literature includes investments in renewable energy in the aggregate production function (Zeng et al., 2017; Ming at al., 2014; Tang at al., 2014). However, there is not an agreed result in terms of effects of investments from renewable energy sources. Several scholars (Mazziotta and Di Palma, 2003; Maziotta, 2005; Calderon et al., 2011, Munnell, 1993; Paci and Saddi, 2002) have raised doubts on this regard, assuming that often analyses have been carried out with respect to large areas, for which the coefficient of elasticity was too high and of scarce relevance. Italy, which is characterized by a huge economic difference across areas these arguments are particularly well suited.

3. DATA AND METHODOLOGY

The analysis took into account 56 European and 28 national calls for tender for the promotion of renewable, issued from 2008 to 2014 for 20 Italian regions. Analyses have been carried out in two steps: i) descriptive frequency analysis; ii) panel data regression.

The descriptive frequency analysis has been done at disaggregate level in order to have a comprehensive picture on distribution and allocation of funds. By observing the distribution, each call for tender was classified with respect to the region, the type of renewable promoted and recipients: individuals, governments and businesses. Then, the construction of two indexes, allowed to measure the gap between issued and allocated funds: 1) the first one refers to the grant that can be potentially allocated; 2) the second refers to the actual allocated resources. The difference between them measures the share of resources not allocated due to the lack of participants to the calls or the lack of requisites for the allocation of funds. This quantifies the ineffectiveness of the demand or the inability to benefit from available resources.

The second step of the procedure focuses on the role that the investments would have had on the economic development of the considered areas if they had been all used. In order to do this, we have included the level of potential investments as a determinant of economic development in the aggregate production function (Aschauer, 1989; Biehl, 1994): by assuming that, following the completion of the selection, all the allocated resources were used to the implementation of the planned projects by the recipients.

To calculate the coefficient of elasticity of the investment, the actual disbursements of grants received and the total capacity of the investment have been taken into consideration. In fact, national tenders take the form of grants and in the call this is defined as a percentage of the costs incurred to be reimbursed and the maximum refundable amount. The growth rate of GDP *per capita* represents the dependent variable. For each function the most significant explanatory variables relatively to the use of renewable energy are also identified. This allows to demonstrate the correlation between indicators of economic development and energy infrastructure, highlighting whether or not networks and technological systems can contribute to the improvement of productivity.

In our econometric analysis we used a panel data approach as it is easily possible to suppose that there is heterogeneity among Italian regions, and therefore we estimated two different models: the fixed effect model takes into consideration the error term as correlated to the regressors and the Random effect model assumes that the former element is not correlated to the second ones. In both equations we introduced a lag, as we hypothesised that the investment and the energy production at time *t*-1 affect the GDP coefficient at *t* time. Moreover, the introduction of a lag for each of the explained variables allows us to overcome the causality problem. The Hausman test allowed us to reject the hypothesis of correlation between the error term and the regressors. The calculated Hausman (0.4) and Breusch Pagan statistic (0.002) indicate that the RE is also preferred over FE.

$$\Delta y_{it},t = \beta_0 + \beta_1 ProdENi_{i,(t-1)} + \beta_2 ConsEn_{i,(t-1)} + \beta_3 InvEN_{i,(t-1)} + \alpha_i + \eta_t + \nu_{i,t} \qquad (1)$$

where Δy_{it}, our dependent variable, is the annual growth rate of regional per capita GDP of the period 2007-2013, β_0 is a regression constant, β_1, β_2, and β_3 are regression coefficients, which considers respectively the influence of energy's percentage produced by renewable sources on total energy production *(RenEN)*, energy consumption by renewable sources (*ConsEn)*; the potential eco-sustainable investments (*InvEN);* i means the number of observations, *t* marks the years observed (2008-2014); v_{it} presents an error term of the regression; α e η are the coefficients describing the time and the regions.

Then, we estimated equation (1) on the total of the territory and on both two sub-areas considered (Italy 1, South-Island 2[3], North-Centre 3).

4. DESCRIPTIVE ANALYSIS

The descriptive analysis shows that (table 1): calls for tender financed by the European Structural Funds (ERDF) concerned all the 20 Italian regions, while the national funding have concerned only 14 regions; from 2008 to 2014,84 projects have been funded, of which 56 European and 28 national. In most of the cases, public bodies have obtained major contributions, amounting to more than half of the total (54%), while the contribution for private companies amounted at 44% of the total. The quota allocated to individuals - only to national calls for tender - is 9% of national account. The greater number of resources have been allocated to Sicily (21%) and Puglia (27.7%) in the South, Umbria (both about 10% of total contributions) and Lazio in the Centre and Piedmont (7%) and Emilia Romagna (6%) in the North.15 projects concern investments for energy efficiency to be achieved through the establishment of Renewable

[3] The considered regions are for South –Island : Basilicata, Calabria, Campania, Molise, Puglia, Sardegna, Sicilia ; for North- Centre area: Emilia Romagna, Friuli Venezia Giulia, Liguria, Lombardia, Piemonte, Valle d'Aosta, Veneto, Trento, Toscana, Abruzzo, Lazio, Umbria, Marche, Molise.

Energy Sources (RES) systems, 7 concern energy efficiency, including public lights and research, 16 for solar, 5 geothermal, 10 biomass, 2 wind power.

In terms of territorial aggregations the following considerations can be drawn:

1. The highest number of funded projects (37) has been allocated in the North of Italy. However, they have got the least of the total contributions (26%), compared to the South and the Islands (43% of the funding allocated to 19 projects), and compared to the Centre (28 projects and 31% of the grants);
2. Comparing the allocation among the beneficiaries, on the basis of contributions made at aggregated level, in the South, local authorities and businesses have obtained 48% of the total resources of each category;
3. Resources allocated to private individuals have been allocated mainly to the Centre (63%) and the North (27%).

Finally, the analyses at regional level show that:

- Sicily is the region that received greater funding at both European and national level (43% of the funds allocated), 67% of which allocated to enterprises (67%). Umbria follows with 10% almost exclusively in favour of local authorities (92%) and Lazio with equal percentage; Finally, Puglia and Piedmont, both with 7% of the total allocated grants.
- In the majority of the analysed cases (13 regions) grants are issued almost exclusively in favour of public entities and at the expense of enterprises, while the opposite is true with reference to the regions of Lazio, Liguria, Trento, Umbria, Puglia and Sicily.

Tables below show results by geographical area and region, the number of calls for tender issued by Regions, the percentage of allocated resources, the percentage of the total investment (resources from the call for tender and beneficiary contribution) and the percentage of total investment hypothetically achievable between beneficiaries.

Table 1: Disaggregated analysis of European and National calls for tender

% North	N.	% tot. contrib.	% tot. Invest.	% contr. to individuals	% contr. enterprises	% contr. Public entities	% Individual invest	% Entreprise invest.	% Public invest.
North									
Emilia Romagna	4	5.65%	7.18%	0.00%	0.74%	2.62%	0.00%	1.57%	4.53%
Friuli V.Giulia	5	2.39%	1.75%	0.28%	0.47%	1.31%	0.00%	0.66%	1.13%
Liguria	8	3.35%	3.25%	0.00%	1.59%	1.73%	0.00%	1.62%	1.59%
Lombardia	7	3.31%	4.83%	0.00%	2.33%	0.98%	0.00%	3.96%	1.49%
Piemonte	4	7.27%	5.59%	0.00%	3.71%	3.49%	0.00%	2.36%	3.78%
Trento	4	0.81%	0.80%	0.00%	0.74%	0.44%	0.00%	0.79%	0.38%
Valle D'Aosta	2	0.00%	0.00%	0.00%	0.07%	0.00%	0.18%	0.00%	0.00%
Veneto	3	2.81%	3.10%	0.36%	0.00%	2.18%	0.42%	0.00%	1.89%
Total North	37	26%	26%	1%	10%	13%	1%	11%	15%
Centre									
Abruzzo	6	4.61%	6.30%	0.40%	0.81%	2.72%	0.57%	1.29%	4.26%
Lazio	7	9.61%	7.24%	0.69%	6.51%	2.62%	0.66%	4.99%	1.89%
Marche	6	0.39%	1.27%	0.00%	0.44%	0.22%	0.00%	0.50%	0.20%
Toscana	4	6.73%	6.03%	0.00%	4.08%	2.37%	0.00%	3.54%	2.82%
Umbria	5	10.07%	10.52%	0.00%	1.21%	7.85%	0.00%	2.17%	7.56%
Total Centre	28	31%	31%	1%	13%	16%	1%	12%	17%
South and Island									
Basilicata	2	1.39%	1.75%	0.00%	0.61%	0.87%	0.00%	0.77%	0.38%
Calabria	2	2.39%	1.51%	0.00%	0.54%	1.31%	0.00%	0.77%	0.76%

Table 1: Disaggregated analysis of European and National calls for tender (cont.)

% North	N.	% tot. contrib.	% tot. Invest.	% contr. to individuals	% contr. enterprises	% contr. Public entities	% Individual invest	% Entreprise invest.	% Public invest.
Campania	3	4.04%	3.99%	0.00%	0.00%	5.67%	0.00%	0.00%	3.78%
Molise	2	2.42%	1.60%	0.00%	0.74%	1.74%	0.00%	0.39%	1.13%
Puglia	1	7.27%	13.56%	0.00%	8.17%	0.00%	0.00%	12.98%	0.00%
Sardegna	5	4.58%	5.71%	0.00%	0.94%	4.35%	0.00%	2.42%	2.19%
Sicilia	4	20.93%	14.02%	0.00%	10.16%	11.94%	0.00%	9.55%	8.11%
South and Islands	19	43%	42%	0%	21%	26%	0%	27%	16%
Italy	**84**	**1**	**1**	**2%**	**44%**	**54%**	**2%**	**50%**	**48%**

Once defined the difference between the potential allocation of resources and the actual allocation, it can be highlighted that 43% of the total resources has been allocated (55% out of the 100% of the available funds). Of the 84, 56 projects had obtained funds.

Table 2 shows the fund actually allocated in the rankings at the end of the procedure and the weight out of the total; the contributions issued and those remaining in absolute values; the weight of contributions not issued (B / A) and the distribution of financial contributions not issued among the different types of beneficiaries, in relation to each of their share of allocated resources, either because resources have not been requested or because beneficiaries were not suitable.

The *Mezzogiorno* is the area that could have benefited from the higher proportion of grants equal to 42% of resources, of which 78% were not used. In particular, Sicily, to which the greater resources at both national and European levels had been set, is the region with the highest deficit of demand (only 3% of resources allocated): private individuals did not use resources at all, while local authorities used 50% of their allocated shares; followed by Campania (only 25% of used resources), in which only the public entities benefited of the funds (83%). Even the Centre of Italy had a great difficulty in the allocation of funds (27% of resources allocated) regardless of the regions. Finally, Liguria and Piemonte in the North are among the least virtuous, since 42% and 50% of resources have not been allocated, respectively.

Table 2: Ranking of calls for tender – total allocation of European and national funds

	Fund	%	Allocated (A)	Remaining (B)	Remaining B/A
North					
Emilia Romagna	€ 77.000.000	14%	€ 62.511.902	€ 14.488.098	**19%**
Friuli V. Giulia	€ 23.861.712	4%	€ 15.337.016	€ 5.351.718	**22%**
Liguria	€ 23.400.000	4%	€ 16.464.022	€ 9.722.948	**42%**
Lombardia	€ 34.300.000	6%	€ 17.098.366	€ 17.201.634	**50%**
Piemonte	€ 5.000.000	1%	€ 4.953.948	€ 46.052	**0%**
Trento	€ 2.500.000	0%	€ 2.500.000	€ 0	**0%**
Valle D'Aosta	€ 500.000	0%	€ 379.798	€ 120.202	**24%**
Veneto	€ 29.710.630	5%	€ 23.790.102	€ 5.920.529	**20%**
Total North	€ 196.272.342	35,4%	€ 143.035.155	€ 52.851.180	**27%**
Centre					
Abruzzo	€ 6.654.102	1%	€ 1.879.108	€ 4.837.793	**73%**
Lazio	€ 35.770.000	6%	€ 8.589.185	€ 27.180.815	**76%**
Marche	€ 6.955.519	1%	€ 1.976.723	€ 4.978.796	**72%**
Toscana	€ 67.605.372	12%	€ 18.870.894	€ 48.734.478	**72%**
Umbria	€ 6.500.000	1%	€ 1.826.573	€ 4.673.427	**72%**
Total Centre	€ 123.484.993	22,3%	€ 33.142.483	€ 90.405.309	**73%**
South and Island					
Basilicata	-	-	-	-	-
Calabria	€ 6.133.333	1%	€ 3.121.048	€ 3.012.285	**49%**

Table 2: Ranking of calls for tender – total allocation of European and national funds (cont.)

	Fund	%	Allocated (A)	Remaining (B)	Remaining B/A
Campania	€ 50.000.000	9%	€ 12.720.449	€ 37.279.551	**75%**
Molise	€ 28.917.097	5%	€ 17.144.998	€ 11.772.099	**41%**
Puglia	-	-	-	-	-
Sardegna	€ 28.626.081	5%	€ 16.651.861	€ 11.974.220	**42%**
Sicilia	€ 121.448.431	22%	€ 3.053.385	€ 118.329.600	**97%**
Total South and Island	€ 235.124.942	42,4%	€ 52.691.741	€ 182.367.755	**78%**
Italy	**€ 554.882.277**	**100%**			
Convergence regions	€ 50.772.556		€ 30.349.971	€ 20.422.585	**40%**

Table 3: Multiple regression (2008-2013) Dependent variable: GDP per capita

	1	2	3
GDP per capità	0.0230*** (0.0032)	0.0253*** (0.0029)	0.0220*** (0.0045)
L.Pot	-0.0039* (0.0022)	-0.0042 (0.0039)	-0.0040 (0.0033)
Renewable Consumption	-0.0024*** (0.0008)	-0.0025 (0.0019)	-0.0023** (0.0011)
Potential Investment	-0.0000* (0.0000)	-0.0000*** (0.0000)	0.0000 (0.0000)
Investments in renewable	0.0000*** (0.0000)	0.0000 (0.0000)	-0.0000 (0.0000)
Energy by renewable source	-1.1322*** (0.1612)	-1.3604*** (0.2450)	-0.9755*** (0.1559)
_constant	1.1312*** (0.1876)	1.4405*** (0.2066)	0.8841*** (0.1377)
N	98	40	58
R^2	0.752	0.796	0.744

Notes: Robust standards errors in parenthesis: *** p<0.01, ** p<0.05 *p<0.1

Finally, table 3 shows the results of the regression. It reveals that the relationship between energy sustainable indicators and growth rate per capita is negative. This means that an increase in the use of renewable energy (both through consumptions and production) reduces the regional growth rate with the exception of the investments. The result remains the same, regardless of the area we considered. The above mentioned relationship is always negative and significant. This is higher in the South area, and the R^2 is very high both in the South and in the North-Centre.

It is worth noting how the impact of investment in renewable coefficient on the level of regional per capita GDP is statistically significant in the whole territory while on the contrary the potential investments reach a significative value just if we look separately for each territorial area. However, this value is positive for the Southern area and negative on the rest of Italian territory.

This phenomenon can be substantially justified by the fact that, in the South, being characterized by a negative phase of the economic cycle, investments have the tendency to decrease and any incentive regarding employment produces an effect on the economy.

This also depends by the massive structure of investments that it is substantial in many of the regions belonged to the Convergence Objective".

5. CONCLUSION

The 2007-2013 programming period of the Structural Funds has planned for all countries of the European Union a total investment of about 308 billion Euros to support sustainable development by strengthening growth, competitiveness, employment and social inclusion, protecting and improving the quality of the environment.

Currently, in Italy there is a decrease of demand for electricity and an increase for from hydroelectric, photovoltaic and geothermal sources (Terna's monthly Report of March 2014[4]). This shows the relevance of the subject in accounting for impacts of investments in the renewable energy sector. However, our results show the inability of Italian regions (overall for those in the Centre and South Italy) to use a tools to promote the local economy.

In fact, among the several support instruments defined by the national government, grants for the implementation of renewable energy sources would have played a double role: i) reduction of the exploitation of the fossil energy, in line with the environmental objectives; ii) asa component of the aggregate demand, in line with the models of economic. Instead, results have confirmed the historical difference of the economic growth between the dynamic and stagnant regions: the Northern area is characterized for its ability to manage and to consolidate position of prominence, while this does not occur in the *Mezzogiorno* area, less able to take advantage of these instruments to raise its economy. The capacity of Italian institutions to manage these funds will need to be enhanced and upgrade. (Ministero dello Sviluppo Economico 2013).

Moreover, the absence of a relationship among the endowment of renewable sources and the failure to use the destined funds has also been confirmed by the results of the regression analysis: in this a negative relationship among the regional rates of growth per capita and almost all the chosen variables descriptive of renewable energies has been verified (energy produced by renewable sources; gross efficient power of the renewable sources; consumptions of electric energy covered by renewable sources, PIL for you understand); this relationship has induced us to have to justify so much not the question deficit.

This results need to justify the lack of demand not in an oversupply of the renewable energies but making petition to other motivations, among which the presence of "factors of structural weakness that can influence the ability of (missed) resiliency of the region and produce effects of hysteresis if not eliminated in the phase of growth " (Marani 2014). These issues have been emphasises by the economic crisis of the 2008. Other possible causes of lack of efficient use of funds are: the formulation of the call; the amount of investment required; the complexity of administrative process and the lack of clear targets.

Nevertheless, the analyses show that the complete use of the funds would not have allowed to obtain an impact on the GDP *per capita*. Results show that investments in renewable energies are neither good determinants of the GDP, nor a way to reduce the divergences among areas, but they lead to environmental and social benefits.

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