



Renewable generation across Italian regions: Spillover effects and effectiveness of European Regional Fund



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ARTICLE INFO

JEL classifications:

C21
C23
Q42
Q48

Keywords:

Determinants of RES Investments
Spatial Econometrics
Panel Estimation

ABSTRACT

This paper investigates on the determinant factors that drive the Italian regions toward a sustainable development path and evaluates the effectiveness of European Regional Development incentives in promoting investments in renewable energy sources (RES). Starting from the consideration that there are spillover effects between similar regions, first we identify the factors that capture these similarities, then we use them to evaluate their relevance in determining the success of the investments in RES. An econometric analysis, based on the use of spatial panel specification model, is implemented to support the hypotheses. Two important results emerge from the study. The first is the identification of regional determinants of RES production, that are driven by the similarities between regions, and that can be interpreted as guidelines in the policy choices in support of investments. The second is the lack of effectiveness of the incentives in support of RES. Results indicate that the capacity of some regional governments to direct the funds allocated by the central government or European Commission towards efficient production of renewable energy is likely limited, and these incentives have been undone.

1. Introduction

The production of energy by renewable sources, originally developed to support agriculture and manufacturing sectors, it is now widely recognized as a well-defined industry. The process started in the wake of oil shortages aimed the 1970s energy crisis, when the major industrial countries of the world sought out an array of energy security strategies to reduce energy and oil dependence (Storai and Cristofari, 2014). In recent years, renewable energies have grown in rank to become one of the largest economic motors for the industry and employment. With increasing frequency, the government's public policies are oriented to attract foreign direct investments (FDI), generate new jobs and implement regional policies in support of renewable energies. Jones and Wren (2008) note that, under the EU Regional Operational Programmes (ROP), regional grants are one of the few means by which states can attract FDI and resolve under-employment problems.¹ They help Member States, regions, local

government and cities to implement much needed investments in energy efficiency in buildings, renewable energy, smart distribution electricity grids or sustainable urban transport, as well as research and innovation in these areas.

Environmental quality and the sustainable and efficient use of natural resources are key factors for competitiveness and attractiveness for local development. The recovery of regional differences in the distribution and efficiency of services and environmental infrastructure for the population and businesses is a priority area of intervention for regional policy, which favors the activation of productive chains and the development of activities related to research and innovation.

In this paper, we extend the analysis to a lower level of competence at the local country and want to i) determine the key factors that drive the Italian regions toward an increasing generation from renewable energy sources (RES) and ii) study the effectiveness of the European Regional Development (ERDF) incentives to promote RES generation.

Following these research questions, we first identify factors that

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¹ The ROP are co-financed by the European Structural & Investment Funds, which are instruments of European cohesion policy. Their aim is to compare different levels of development among regions and between the European Union and Member States, and these funds are managed regionally. One of the main Funds is the European Regional Development Fund (ERDF)

drive policymakers to locally allocate funds in support of RES, and then evaluate the effectiveness of the Regulation (EC) No 1828/2006. With this regulation the European Commission wants also to pursue the promotion of a sustainable and efficient use of natural resources as condition for a better quality of life and to guide social and economic development.² In particular, we want to study the relation between EC Regulation and the regional shares of RES³ generation.

To reach these aims, a dataset of 19 Italian regions in the 2007–2013 period is analyzed. Given regions with different features across social, economic and cultural points of view, first a hierarchical cluster analysis of a set of exogenous variables, identified as proximity factors, is computed to extract the distance Euclidean matrix to quantify the unobserved proximities. Second, the distances are used as weights to estimate a panel weighted regression model to explain the regional relevance of the factors considered in RES generation and the effectiveness of the public incentives. In order to check the suitability of the option to use spatial model, the results are then compared with those of classical panel models (panel corrected standard error, random-effect, dynamic).

The paper is structured as follows: Section 2 provides a brief literature review and description of the Italian RES generation framework. Section 3 presents the theoretical framework based on the distance matrix and panel regression models while Section 4 describes the data used for estimation. Section 5 presents the results of the empirical analyses and provides robustness check of the results, and Section 6 contains some concluding remarks and policy implications.

2. Background and literature review

2.1. Italian RES generation system

The Italian policies relating to the production of energy from renewable sources are, generally, restricted by regulations issued by the European Union. This could be a signal of a lack of strategy and of a scarce ability to adapt supranational resolutions to the features and to the peculiar potentials of the country. In particular, it has to be noticed that the 2009/28/EC Directive indicated the final consumption share (both electrical and thermal) that has to be covered by renewable sources: according to that Directive, the Italian goal of the share to be reached in 2020 was set at 17%. In particular, for what concerns the electricity generation, the goal that had to be reached, already in 2010, had to be equal to 22%. In the period from 2010 to 2015 (estimated), the gross final consumption of primary energy from renewable sources increased from 17.36 Mtep to 21.14 Mtep, where the final total gross consumption passed from 133.32 Mtep to 122.21 Mtep. With these data, the share of consumption from renewable sources (17.3%) seem to be in line with the preset targets, even if the estimated share in the mentioned years are supported by a substantial decrease in total generation and consumption (−8.3%), partly due to the improvement of energy efficiency, but partly attributable to the persistent economic crisis. As noted by Bigerna et al. (2017), there are roughly two periods of pre and post diffusion of RES in the Italian market. In the period 2004–2009 the electricity generated by RES gas been modest (below 3%). Since 2010 the RES share increased approximately to 3.3% in

² The energy objective concerns the actions supported by: *i*) activation of productive chains and the development of research and innovation activities, *ii*) installation of new renewable source plants, *iii*) promotion of energy savings in productive sectors, such as the civil and public administration sectors, *iv*) development of widespread cogeneration (electricity and heat) and trigeneration (electricity, heat and cold), and *v*) widespread use of district heating or cooling networks.

³ More specifically, we will refer to all projects that have priority issues number 39, 40, 41 and 42 (topics in support of renewable energy production) of the Regulation no. 1828 as their primary purpose and the specific goal 3.1.1 (diversification of energy sources and increasing energy from renewable sources) of the 2007–2013 National Strategic Framework. The actions to be implemented under this priority contribute to the goal of greenhouse gas emissions (GHG) reduction.

2010, and continuously increasing approximately from 6.9% in 2011 to 36% in the first half of 2014.

The share of consumption met by renewable sources (21.14 Mtep) is driven by the source (7.69 Mtep), followed by the hydroelectric source (3.94 Mtep), by heat pumps (2.58 Mtep), photovoltaic energy (1.96 Mtep), and wind energy (1.31 Mtep). These last two sources are those showing the best dynamics in the period under consideration. According to International Energy Agency (IEA) surveys, in fact, Italy is the world leader in the generation and consumption share covered by the photovoltaic energy.

The Italian source of financing of policies aimed at encouraging the production of primary energy from RES is essentially composed by revenues deriving from taxes on electricity consumption to be paid by end users, the so-called "tariff component A3". Considering also the estimated data for 2015 and 2016 by the *Gestore Servizi Energetici* (GSE), the A3 financing needs grew from 3.1 billion € in 2009 to 14.4 billion € in 2016, with an exponential increase of 365%. This trend will decline in the following years, as an effect of the end of the incentive period of a few large plants.

The incentive measures used in Italy for the generation from RES are quite articulate, and they adapt themselves both to the various available sources, and to the size of the plants. Through these mechanisms, approximately 1,133,809 conventions in total were managed (preliminary estimate by 2015) with a gross production that reached its peak in 2014 (120,679 GWh) to get to the estimated 106,606 GWh for 2015. The production decrease is mostly attributable to the expiry of the agreements signed in the past. Always in 2015, the total gross production from renewable sources relates to the hydroelectric plants for 41.2%; to wind power plants for 14.0%; to solar plants (photovoltaic and thermal) for 21.4%; to geothermal plants for 5.8%; to bioenergy plants for 17.7%.

In particular, the interventions on energy policy aimed at increasing production from renewable sources encouraged in 2015 a total energy amount equal to 96.8 TWh, and they can be grouped as follows:

1. *Energy account*: this is a program introduced by the European Directive 2001/77/EC, which is especially dedicated to the promotion of photovoltaic plants, integrated continuously into the national power grid. From 2005–2013, this had five different legal frameworks. It committed during the years over 6.7 billion € for about 551,000 conventions (48.6% of the total) and 21.2 TWh of subsidized energy in 2015 (21.9% of the total).
2. *CIP 6*: this is a plan of the Interministerial Committee on Prices, started on 1992. It served to encourage the production of electricity from renewable and assimilated sources excluding solar sources: cogeneration, waste heat, production waste and minor deposits of fossil sources. Through this plan 45 conventions have been managed (0.004% of the total) for a total of about 9.2 TWh of subsidized energy in 2015 (9.5% of the total).
3. *Green Certificates*: these are marketable securities that attest the production of electricity from qualified IAFR renewable sources. These certificates can be purchased from producers of energy from non-renewable sources to meet the obligation imposed by the regulations to meet the mandatory share of production from renewable sources. The conventions managed through the green certificates were 1984 (0.18% of the total) for a subsidized energy equal to 34.8 TWh in 2015 (36.0% of the total).
4. *All-inclusive Tariff*: this is an incentive tariff which is an alternative to the Green Certificates and which is approved for plants powered by renewable sources with a nominal power of less than 1 MW (0.2 MW for wind farms). With this mechanism 2875 conventions were handled (0.3% of the total) for a subsidized energy in 2015 equal to 8.9 TWh (9.2% of the total).
5. *Electric FER*: established by Ministerial Decree on 07/06/2012 for plants different the photovoltaic ones with a power not exceeding 1 kW. The program has managed 1869 conventions (0.16% of the

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