



Examining the spatial patterns of green industries and the role of government policies in South Korea: Application of a panel regression model (2006–2012)

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ABSTRACT

Driven by global competition for economic growth, green industries and green jobs have become an important economic engine for sustainable and environmentally-friendly development. Most of the existing literature on green industries has focused on defining the green industry and its economic impacts. However, little empirical research has been conducted on the spatial patterns of green industries, such as their locational preferences. We examined the spatial patterns of green industries in South Korea over time and across municipal-level administrative units (si-gun-gu) using the Survey of Business Activities (2006–2012), which includes longitudinal, establishment-level employment data collected by the Korea National Statistical Office. We employed a panel data regression model to analyze green industries and their locational decisions. The spatial analysis showed that green industries tend to locate in areas where conventional manufacturing industries were previously concentrated. We also identified a new, emerging geographic cluster of green industries. The panel regression models indicated that some green industries, such as the advanced green city industry sector, tend to locate either within or near big cities. In contrast, the renewable energy industry sector tends to locate far from major cities. In addition, we confirmed that the 2009 “Framework Act on Low Carbon and Green Growth” law enacted by the Korean government had a significant impact on the growth of the green industry. However, the act’s impact ceased after 2010, indicating the importance of both subsequent policy initiatives and the creation of a private market for green industries and green jobs.

1. Introduction

As the issues of energy and climate change have grown increasingly important, significant attention has been focused on the green industry as a potential solution to these problems. In addition, green industries and green jobs are emerging as a new economic engine for sustainable and environmentally-friendly development all around the world, driven by the global competition for economic growth.

An increasing number of studies have shown the positive economic impact of green industries and green jobs [1–6]. Some of these studies have examined the impacts of government policies and programs targeting green economic development on the growth of green jobs [7,8]. Several studies have also examined the effectiveness of policies in green industries and the impacts on South Korea’s economy and regional competitiveness [9–12].

Although many studies have examined green industries’ economic impacts on national or regional economies, very little empirical

research has been conducted on green industries’ spatial patterns and locational preferences. Recently, Yi and Liu [13] tried to address the perspective of green industries’ regional variations in China. However, their studies were limited to insights into the locational determinants for green industries at the local municipality level. Some studies in South Korea have explored the spatial distribution patterns of green industries at the municipality level [14,15], but these studies have not identified specific reasons why those industries tend to locate in certain regions.

Using longitudinal employment data, we aimed to examine the changing spatial patterns of green industries and analyze their locational factors over time across municipal-level administrative units in South Korea. Specifically, we addressed the following research questions in our locational factor analysis. First, we examined whether a spatial concentration of existing industry activities is an important locational factor in determining the location of a green industry. Second, we explored whether and in what way locational preferences

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differed by subsectors of green industries. Finally, we examined whether government policies and programs promoting the green economy and green industries positively influenced green industry establishments' location decisions in South Korea.

2. Literature review

Over the past several decades, green industries and green jobs have emerged as a priority to foster sustainable development and a green economy. Many state and local governments in the United States, China, and European countries have initiated public policies to stimulate the growth of clean energy industries [16–19]. At the local level, many cities and counties participate in the International Council for Local Environmental Initiatives (ICLEI), an international association of local governments focused on sustainable development and the reduction of greenhouse gas [8].

Several studies have examined green industries' impact on economic development and the creation of green jobs [1–5]. Hodges et al. [1] examined green industries' economic contributions in the U.S. from 2007 to 2008, using economic multipliers and documented direct and indirect impacts of green industries in each state. The researchers' analysis showed that green industries directly employed 1.2 million full-time and part-time workers. Wei et al. [20] indicated that in the U.S. power sector, non-fossil fuel technologies utilizing renewable energy, energy efficiency, and a low carbon footprint, created more jobs than conventional fossil fuel technologies using coal and natural gas. Lehr et al. [3] analyzed the labor market implications of large investments into renewable energy based on a couple of renewable energy scenarios from 2009 to 2030 in Germany. They reported that the expansion of renewable energy will create 150,000 new jobs by 2030.

Researchers have also evaluated the effects of government policies and programs such as Renewable Portfolio Standards (RPS), in fostering green industries and green jobs [7,8]. The results have been mixed. Yi [8] evaluated the employment effects of state and local clean energy and climate policies in metropolitan areas in the U.S. The results showed a positive association between clean energy policies and green jobs. Yi also found a positive association between a city or county's ICLEI membership and green jobs. Mundaca and Richter [21] reported that green energy economy stimulus programs in the U.S. have positive employment effects and generally offer better job quality. However, they claimed stimulus programs were poorly targeted to the issue of job distribution in both demographic and geographic terms.

Yi and Liu [13] investigated the policy drivers of China's green economy. The researchers suggested that, all else being equal, cities located in provinces with clean energy policies had 54.3% more green jobs and 61.8% more green businesses than cities without these policies. Similarly, Yin and Powers [22] argued that RPS policies have had a significant and positive effect on in-state renewable energy development. As a mixed conclusion, Bowen et al. [7] suggested that the presence of RPS has no discernible effect on a state's green job growth; however, over time, RPS has had a positive impact on the number of green businesses. However, Carley [17] argued that RPS implementation is not a significant predictor of the percentage of renewable energy generation. Frondel et al. [23] also pointed out that Germany's renewable energy policy of feed-in tariffs imposes high costs, allegedly without positive impacts on employment, energy security, or emissions reductions.

While there are many studies on the impact of green industries on economic development and on the effectiveness of government policies and programs encouraging green industries, there is little empirical research on the spatial patterns of green industries by sector or on the various driving forces of green industry growth. Yi [24] analyzed the drivers of green business growth in the U.S. using panel data from 1998 to 2007 from the 48 contiguous states. Yi reported that the major driving forces of green business development in the U.S. were the

adoption of renewable energy policies, renewable energy credits for imports, stringency of minimum wage legislations, and presence of clean energy business associations. Although that study addressed the importance of non-spatial factors in green business, it did not provide information on spatial factors in green business. Jin and Ryu [14] analyzed the spatial distribution of green industries in South Korea from 1997 to 2007 at the municipal level. The results indicated that green manufacturing industries have been rapidly developed near the agglomeration centers of existing manufacturing industries in the local municipalities. However, their study did not provide specific explanations as to why some green industries tended to locate in certain regions. In contrast, Yoon [9] explored the spatial characteristics for the spatial agglomeration of green energy industry in Korea's Daegu metropolitan region. Based on a questionnaire survey of environmental experts, Yoon concluded that the locations of the green energy industries were associated with transportation and communication convenience, spatial proximity within the green energy industries, and local demands. Recently, Yi and Liu [13] investigated the regional variations and policy drivers of China's green economy. This study showed that green industries and green jobs were unevenly distributed across China's provinces. A simple thematic mapping of green jobs in China's provinces indicated that the green jobs were concentrated in China's coastal regions, including the major metropolitan areas.

Although there are many studies on the driving forces of green industries, the existing studies have a few limitations. First, due to the wide uses of the term, the definition of green industry should be clarified by green industrial sectors. In particular, the green industry's spatial pattern and driving forces vary across green industrial sectors. Second, the locational characteristics of green industries have very critical policy implications. However, less attention has been directed to the spatial dimension of green industries. Third, most existing studies have used states or regions as their spatial unit of analysis. Although there are advantages to examining the effects of state-wide or regional-wide policies, these studies are limited when addressing the locational factors of green industries. Finally, most studies on the locations of green industries have relied on cross-sectional data from provincial-level or municipal-level administrative divisions and thus have not addressed long-term dynamic changes. In addition, due to the limitations of the cross-sectional data, the relationships between green industries and government policies were not conclusive. This study's longitudinal analysis allowed us to examine the long-term effectiveness of government policies and programs on green industries.

3. Methodology

3.1. Definition of green industries

While there is no single definition of green industries, OECD-Eurostat [25] defined the environmental industry as “the environmental goods and services industry [consisting] of activities which produce goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems.” However, the definition of green industries varies across countries [5]. For instance, the United Kingdom government defines the green industry as a “thriving low-carbon and environmental goods and service sector,” and the U.S. Bureau of Labor Statistics defines it as “businesses that produce goods or provide services that benefit the environment or conserve national resources” [26].

In this paper, we adopted the definition from the 2010 “Framework Act on Low Carbon, Green Growth” enacted by the Korean government, a comprehensive law addressing climate change and energy issues, as well as promoting sustainable development through foresting and supporting the green economy and green industries [27,28]. The Act defines the term “green industries” as “all industries for achieving low carbon, green growth by producing goods and providing services for

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