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Distributional employment impacts of renewable and new energy–A case study of China

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ABSTRACT

The main goal of this paper is to argue for the necessity and significance of studying the distributional employment impacts of renewable and new energy development (RNE). Based on the comprehensive review of the methodology and conclusions of existing literatures, this paper builds up an extended input–output model to study RNE's distributional employment impacts on gender and personnel structure. The case study of China's power sector in this paper affirmed earlier doubts that RNE development will indeed aggravate the gender inequality problem and add to the level of mismatch between the structure of labor demand and supply, causing structural unemployment problems. The quantitative analysis in this paper outlined here implies that from 2011 to 2020 the development of RNE will bring about 7 million employment gains, but only 81.8% of which can be realized due to the mismatch problem. The study of China may alert other countries to be less-optimistic about RNE's employment impacts and reaffirm the need to carry out the distributional employment impacts analysis. This paper concludes with policy suggestions such as providing suitable training and equal promotion opportunities for women, offering courses and vocational trainings to RNE-related majors, in order to reduce the structural unemployment problem and further speed up the development of RNE.

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1. Introduction

The world has witnessed an unprecedented growth in renewable and new energy (RNE) during the past decade. The benefits of RNE are widely accepted [1]. Apart from lower greenhouse gas emissions, researchers also confirm that the development of RNE can bring about better environmental quality, enhanced energy security and a larger-scale of green investment [2–4]. In recent years, scholars have turned to exploring renewable and new energy's employment impacts, in order to further ensure its development won't generate unexpected social costs, especially under the pressure of high unemployment rates.

As summarized in previous articles [1,5,6], there are mainly two types of studies which focus on the employment impacts of RNE: (1) those that use largely spreadsheet-based analytical models ("bottom-up"); and (2) those that use a more complex input–output (I/O) model of the economy ("top-down"). Analytical models generally focus on the renewable energy sector alone and collect detailed employment data on its different operation phases (such as construction, installation, operation and maintenance); therefore they are better at analyzing employment changes within the renewable energy sector (i.e., direct employment impacts). I/O models are able to quantify the interdependencies between the renewable energy sector and other sectors in the economy; therefore they are better at analyzing the employment changes in other sectors brought about by renewable energy development (i.e., indirect employment impacts). Although it is believed that in total, renewable energy development will bring net job gains to itself and to other sectors in the economy [5,7], it remains unclear how these total gains in employment are distributed among different job classifications, specialized levels (skilled/unskilled, low/medium/high, or the corresponding educational levels), territorial (local/foreign) or temporary natures (stable or temporary) and even genders (i.e., the distributional employment impacts) [8,9]. To some extent, the assessment of distributional employment impacts (DEI) is even more important than the judgment of the overall employment impacts, because it can testify whether those job gains are comparable to the current personnel structure and educational system, as well as whether they might add to the gender inequality problem. If those "job gains" are proven to be unsupported by the current labor market, they can only be called unrealistic and unattainable "job gains", and the reality might turn out to be just the opposite –net job losses. Therefore, to prevent a completely erroneous judgment about employment impacts, it is critical to carry out the employment impacts assessment from a distributional perspective.

Compared to the total employment impact assessment, there are much less literatures focusing on the DEI, something discussed in Section 2 of this paper. In fact, the various definitions of the distributional impacts (such as level of specialization, territorial and temporal natures, and gender) have added to the difficulties in understanding the DEI issue. As for the methods employed by these studies, it is found that the majority of them have employed analytical methods. However, the bottom-up perspective of analytical models brings two inherent problems. First, analytical models usually rely on questionnaires for their data sources. It is quite possible, for example, that one job is considered as a skilled job in one questionnaire but not in another; it is also possible that in one questionnaire, a job is counted simultaneously as both a manufacturing and a construction job. Therefore, it is very hard to ensure that all the data collected has a unified understanding of the distributional impacts; it is also hard to prevent the occurrence of duplication and omission. Second, the DEI analysis should aim to warn policy makers about the broad-scale structural unemployment problem. The significance of the analysis would be much greater if the warning is given at an economy-wide scale, rather than at the RNE sector alone. In all, these two problems have jeopardized the preciseness and significance of the results from analytical models. On the other hand, I/O models which reveal the economy-wide DEI based on macro-economic top-down data can overcome the aforementioned problems. However the biggest challenge for I/O models is the difficulty of obtaining distributional employment data for all sectors in the economy. Usually only a large-scale social survey can meet such kind of data needs. This is why there are, up to this point, very few DEI analysis based on I/O models.

Fortunately, China completed a national-scale demographic census at the end of 2010 [10] which provides just the right database for the economy-wide DEI. Therefore, this paper intends to focus on China's RNE development through 2020 and study the resulting DEI throughout the whole economy. Due to data availability constraints, only the RNE development in China's power sector is considered (RNE developments in other sectors are ignored).

Table 1 summarizes China's development goals in RNE in the power sector till 2020. This study is of great significance to China, and may also be helpful to other parts of the world. On the one hand, it develops the methodology and sorts out the data needed to measure the economy-wide DEI, which could give valuable reference to other studies. On the other hand, it helps China to avoid being blinded by illusory employment gains and gives her early warnings about the forthcoming structural unemployment problem. Ultimately this could allow the country time to adjust the current personnel and training system.

This paper is organized as follows. Section 2 gives a comprehensive review of the existing studies on renewable energy's DEI. Methodologies for studying the DEI of China's RNE development are introduced in Section 3. Results are displayed in Section 4. Finally, Section 5 draws further conclusions based on those results.

2. Review of the existing studies

Table 2 contains a list of studies reviewed, which have touched upon the DEI of RNE. For those studies employing analytical models, they have two main features. First, most of them [5,13,17] did not have a clear definition on DEI. Besides, there is a lack of systematic methodology to study DEI. Some just used a concept of "distributional factors" to break down the overall employment impacts. Only a few studies [6,18,19] had relatively clear definitions on DEI, but these detailed definitions differ in many ways. Second, even though researchers tend to classify DEI by job categories and life stages, few studies have specified what jobs are included in each category and stage. Therefore, current quantification results are blurry and hard to compare. As shown in

Table 1
The installed capacity and share of each renewable energy in 2011 and 2020 in China's power generation sector.
Source: National Electricity Industry Statistics Briefing 2011 [11]; The 12th five-year plan in the power industry [12].

Type of RNE	2011-Installed capacity (GW)	2020-Installed capacity (GW)	2011-Capacity share (%)	2020-Capacity share (%)
Hydro	232.98	360	22.4	19.2
Non-hydro	66.6	295	6.4	15.7
Nuclear	12.57	80	1.2	4.3
Wind	46.23	180	4.5	9.6
Biomass	5.59	10	0.5	0.5
Solar PV	2.22	25	0.2	1.3
Total	**299.6**	**655**	**28.8**	**34.9**