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A Comparative Study on Green Investment in Japan, Korea and China

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This study aimed to assess the economic impacts, job creation impacts and environmental impacts of green investment in Japan, Korea and China. Using input-output analysis, a case study on the economic and job creation impact assessment of green investment in environmental goods and services sector (EGSS) in Japan was conducted. Another case study on China's renewable energy development was conducted using multi-region input-output analysis for assessing the impacts of the implementation of renewable energy and efficiency targets. Research results indicated that on the one hand, with higher multiplier effects, EGSS can be considered as a new engine and competitive edge of Japan's sustainable economic growth. On the other hand, the promotion of renewable energy policy will benefit wind and solar sectors but at the costs of fossil fuel sectors, however the results are short-term estimates without taking into account of the benefits for the environment and energy security improvement.

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１．研究開始当初の背景

A green economy is one whose growth in income and employment is driven by public and private investments that reduce carbon emissions, enhance resource efficiency, and prevent the loss of biodiversity and ecosystem services. These investments are so-called "green investment", which is vital to transformation change in conventional economy which is built on unsustainable use of energy and natural resources.

It is important to assess the economic, social and environmental effects of green investment which can provide technical support to policy making related to how to effective use of public expenditure, tax reforms and regulation changes. However, there are several gaps in the assessment of green economy policies, including: lacking of clear definition of green sectors; inconsistency in statistical methods; and different scopes of impacts identified to estimate policy impacts on the economy, job creation and the environment, including direct impacts, indirect impacts, or both. To address these methodological gaps in policy assessment, this study will examine and compare current policies and institutions in Japan, Korea and China in promoting green investment and derive good experiences and practices with success factors.

２．研究の目的

By conducting case studies in Japan, Korea and China on green investment policy, this study aimed to assess the economic impacts, job creation impacts and environmental impacts of green investment focusing on the following issues: i) How green investment can help make structural change towards low carbon and resource efficient growth; ii) How green investment helps create new and decent jobs; and iii) Investment in which sectors are more important to deliver the expected impacts.

３．研究の方法

Three major methods were used in the case studies in Japan, Korea and China on green investment policy.

(1) Policy review on green economy and green investment was conducted for three countries including the overview of green economy transition, policy landscape and specific policy measures (please see Zhou, 2015a; Kim and Zhou, 2015; Li, et al., 2015b).

(2) Input-output analysis (IOA) was used to assess the impacts of green investment on the economy, employment and the environment related to the promotion of environmental goods and services sector (EGSS) in Japan (see Zhou and Moinuddin,

2015a) and multi-region input-output (MRIO) analysis was used to assess the impacts of the renewable energy and efficiency targets in China's 30 regions (see Zhou and Stott, 2015).

(3) Life cycle analysis (LCA) based on the field surveys of manufacturing firms from supply chain perspective was used to assess the environmental impacts as well as economic costs/benefits and the employment impacts generated from the investment in renewable energy (including solar PV and wind power project) in China (see Li, et al., 2015a).

４．研究成果

(1) Impact assessment of renewable energy and efficiency targets implemented in China's 30 regions

China set region-specific energy efficiency targets in terms of energy consumption per unit GDP as 20% reductions compared with the 2005 levels at the national level in its 11th Five-Year-Plan (FYP) (2006-2010) and 32% reductions compared with the 2005 levels in the 12th FYP (2011-2015). In addition, renewable energy targets were set as 10% in the fuel mix of electricity generation by 2010 and 15% by 2020.

Three policy scenarios were set for two time points (2010 and 2015) in this study:

① Base case: Assume energy efficiency rates and the share of renewable energy in fuel mix the same as previous time period but current levels of final demand for electricity ($X_{current} = (I-A)_{previous}{}^{-1} FD_{current}$);

② Case of Energy Efficiency (EE) target: Assume current level of energy efficiency rates (the same as the regional targets), share of renewable energy in the fuel mix the same as previous time period and current levels of final demand for electricity ($X_{current} = (I-A)_{current}{}^{-1} FD_{current}$);

③Case of Energy Efficiency and Renewable Energy (EE&RE) targets: Assume current level of energy efficiency rates (the same as the regional targets) and increased share of renewable energy in the fuel mix (the same as the national targets for solar PV and wind power)) and current levels of final demand for electricity ($X_{current} = (I-A)_{current}{}^{-1} FD_{(current,renewable)}$);

Electricity generation sector was disaggregated into six sub-sectors based on energy resources: Coal, Oil & Natural Gas, Hydro, Nuclear, Wind and Solar PV. Results of policy assessment using MRIO analysis for 30 regions are shown in Figures 1 – 2 (Zhou and Stott, 2013).
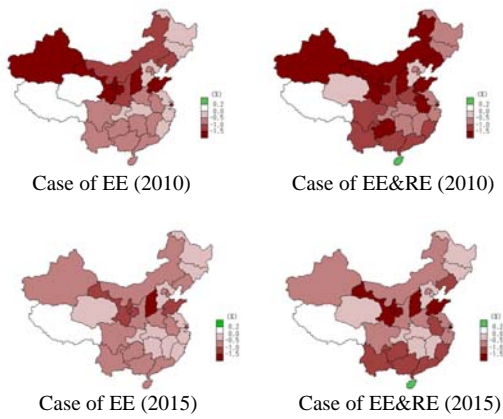
Case of EE (2010) Case of EE&RE (2010)

Case of EE (2015) Case of EE&RE (2015)

Figure 1 Economy-wide total output changes by region compared with the Base case

Solar PV (2010) Solar PV (2015)
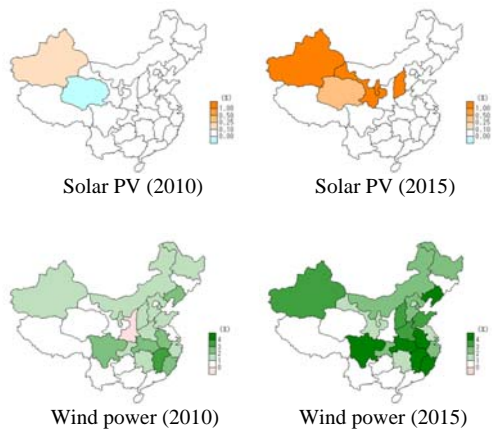
Wind power (2010) Wind power (2015)

Figure 2 Output changes in renewable energy sub-sectors under EE&RE compared with the Base case

Major findings include:
- For China, the results indicate that there are negative economy-wide impacts from developing renewable energy and the impacts vary from region to region.
- The promotion of renewable energy policies will benefit the wind and solar sectors in some regions but at the costs of fossil fuel sectors.
- However, the results are short-term estimates and the benefits for the environment and energy security improvement are not taken into account.

(2) Economic and employment impact assessment of green investment in EGSS in Japan

In Japan's green economy-related national strategies, technological innovation and the role of environmental industry as new engine for economic growth have been stressed as priority areas for transition to a green economy. Environmental Goods and Services Sector (GESS) is therefore a key element of the policies on the promotion of green economy. Assessing the economic and employment impacts of EGSS has been considered as an effective way of measuring the progress in "greening" the economy.

The purpose of this study is to assess the development trend of environmental industry in Japan and the direct and indirect impacts on the economy (in terms of output change) and employment (in terms of job headcount). Economic output multiplier analysis and employment multiplier analysis were conducted based on detailed Japanese statistics on environmental industry (2000-2012) and Japan's IO tables (2000, 2005, 2009, 2010, 2011 and 2012, respectively).

Major achievements are summarized as follows:

① Developed the methodology for mapping EGSS classification with IO sector classification which helped fill in the gap in the existing methodologies (see Figure 3).
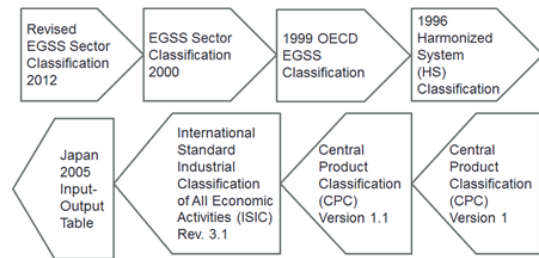

Figure 3 Steps to build the correspondence between EGSS and IO sectors

② Economy-wide output impacts of EGSS development in Japan

EGSS is classified into 4 categories, i.e. A: Pollution prevention and control; B: Measures combating climate change; C: Solid waste management and effective resource utilization; and D: Conservation of nature environment. In 2012, Category B had the largest output multiplier (2.23). For sectors, eco-cars have the highest multiplier effect (more than 3) and the sector of reform and repair of buildings had the largest economy-wide indirect output effects (about JPY 12 trillion) in 2012. See Figure 3.
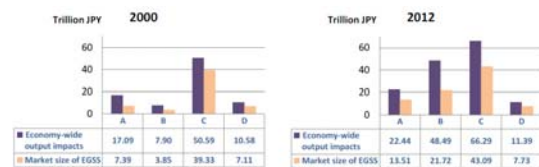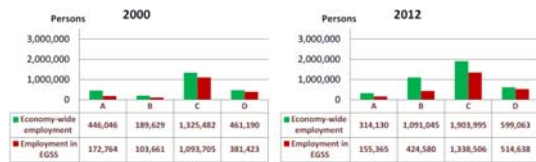

Legend: ■ Economy-wide impacts; ■ direct impacts;

Figure 3 Comparison of direct and economy-wide output impacts of EGSS (2000 vs. 2012)

③ Direct and induced employment impacts of EGSS development in Japan

In 2012, among all EGSS sectors, eco-cars (9.3) and sulphur-free petroleum (6.5) had the highest employment multipliers. The building sector (reform and repair) had the largest indirect employment, engaging about 1 million persons (see Figure 4).

Legend: ■Economy-wide impacts; ■direct impacts;

Figure 4 Comparison of direct and indirect employment impacts of EGSS (2000 vs. 2012)

③ Occupational distribution of employment in EGSS in Japan

In 2012, workers in the extraction and construction (code 120) accounted for the largest share (23%) followed by machine operators (code 100, 21%). From structural change viewpoint, more workers were in the extraction and construction in 2012 compared with 2000, but less workers in the sales (code 040) and service sector (code 050). See Figure 5.
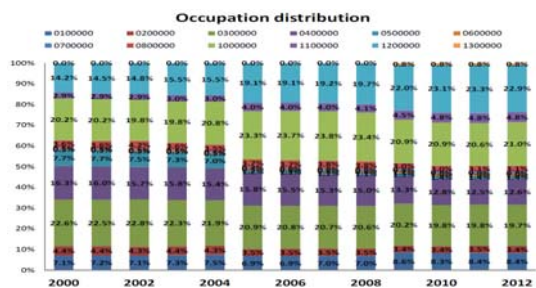

Figure 5 Occupational distribution of economy-wide employment related to EGSS

Major findings:
- EGSS in Japan, accounting for 10% of total output and 8% of value added and providing 2.4 million jobs in 2012, is a key and potential area of economic growth.
- From economy-wide impact perspective, EGSS generated JPY 150 trillion and absorbed nearly 4 million workers directly and indirectly in 2012, which in some sense achieved the 2020 goals set by the 2010 New Growth Strategy.
- The higher average multipliers of EGSS, in terms of both output and employment multipliers, than the economy-wide average levels, indicated that EGSS can be considered as a new engine and competitive edge of Japan's sustainable economic growth.

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