A Uniform Policy Tool, but with Varied Implementations: Explaining Variations of Incentive Policies for New/Renewable Energy in a Korean Case

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Abstract

**Background/Objectives:** Korea has uniform incentive policies to promote renewable energy development, but these are applied by each local government in different ways. This study addresses which factors make the difference of implementation strength of the incentive policies to promote new/renewable energy development and use. **Methods/Statistical Analysis:** A survey was conducted with the directors of the new/renewable energy departments of all 227 local governments in Korea. The response rate was 72.7 \%, and 92 local governments were employed for the analysis due to missing results. Statistical analysis was executed by the Ordered Logit Model. We diagnosed parallel regression assumptions and cut-off points, and the results showed validity of this method (financial incentives: chi2(32)=37.84 (prob>chi2=0.2199); non-financial incentives: chi2(32)=43.31 (prob>chi2=0.0876); cut-off points (prob>chi2=0.000)). **Findings:** This study shows that interest groups’ influence and new/renewable energy department level of local governments substantially promote both financial and non-financial incentive offer for new/renewable energy. In addition, whereas assemblies’ influence is likely to reduce financial incentive offer; local governments with policies to reduce environmental pollution tend to increase the financial incentive offer. Local governments implementing environmental regulations more stringently and requiring stronger administrative manpower are likely to reduce non-financial incentive offer for new/renewable energy. These finding shows that local governments applying centralized incentive policies are substantially influenced by several critical factors, such as interest groups’ influence and the new/renewable energy department level of local governments, and these factors cause variations in implementing the incentive policies of local governments. **Improvements/Applications:** These findings can provide significant information and rationale to enhance the effectiveness of new/renewable energy policies, to manage them, and indeed to promote new/renewable energy development and use.

**Keywords:** Interest Groups’ Influence, New/Renewable Energy, Renewable Energy Department Level, Uniform Incentive Policies, Varied Incentive Offer

1. Introduction

Current new/renewable energy policies emphasize the need for locally tailored new/renewable energy development and efficient use, and the direct formation and implementation of new/renewable energy policies by local government\(^1\). However, previous studies have focused on exploring and addressing the effects, uncertainty, or limitations of the incentives, or describing actual conditions of new/renewable energy development and use at the unit of analysis of countries or specific incentive programs\(^1,4\). However, influential factors in new/renewable energy policies should be explored for the purpose of optimized formulation, adoption, implementation, and performance of new/renewable energy incentives. Two earlier studies only examined the factors influencing adoption of new/renewable energy policies, and found that political factors significantly increase the adoption\(^5,8\). However, these previous studies have not investigated factors influencing the implementation of these incentives. Therefore, this
study examines the factors influencing implementation of various financial and non-financial incentive policies for new/renewable energy at the level of local government. This study presents the factors significantly influencing application and implementation of new/renewable energy incentive policies by local governments and suggests policy implications to promote the new/renewable energy incentive development and use.

Almost all previous studies related to new/renewable energy incentives examine the effects, uncertainty, and limitations of new/renewable energy incentives\cite{2,4,8-11}. In particular, many studies explore FITs (feed-in tariffs) and RPSs (renewable portfolio standards). Other studies also focus on distinctions of new/renewable energy incentives depending on countries\cite{12}, description of recent new/renewable energy incentives\cite{13-15}, and the processes and design of specific incentives\cite{16-19}. Two previous studies only focused on the factors influencing the adoption of new/renewable energy incentives at the level of U.S. local or state government. These studies emphasized that political factors such as the decision makers’ priorities, administrative manpower, and stakeholders’ influence have a statistically significant influence on the adoption of new/renewable energy policies\cite{22}. However, previous studies did not explain the implementation of incentive policies for new/renewable energy. Policies are generally not likely to be implemented as expected. In particular, Korea’s incentive policies for new/renewable energy are formulated centrally but applied differently by local governments. Therefore, this study addresses why Korea’s central incentive policies for new/renewable energy are applied differently.

\section{2. Research Methods and Variables}

We conducted a survey in Korea’s 227 local governments between May and September 2012. The respondents were the directors in charge of the NRE department of local governments, and the response rate was 72.7% (165 municipal governments), and 92 municipal governments were employed for the analysis due to missing results (41%).

The dependent variables were the extent of financial and non-financial incentive offers for new/renewable energy, and the scale of these variables was (1) never offer to (4) actively offer. Independent variables were categorized into political pressure, institutional conditions, and administrative support, including control variables. Political pressure was measured by three variables: the central/provincial Governments’ Influence (GI), the national/local Assembly’s Influence (AI), and the Interest Groups’ Influence (IGI). We measured the influence of these variables by factor analysis of component variables. Institutional conditions were composed of the seriousness of standardized/unilateral policies of the central and provincial governments on the local autonomy (SSP), existence of policies to reduce environmental pollution in local government (EPEP), the new/renewable energy department level in the local government (REDL), and Stringency of Applying Environmental Pollution Regulations (SAEPR). Administrative support consisted of transparency of communication with central/provincial governments (TC), Deficiency of Administrative Manpower (DAMP), Necessity of Regulation Relief (NRR), and Necessity of Discretionary Power (NDP). The variables of institutional conditions and administrative support were measured by scales of five or three points. Finally, this research model also employed control variables such as Total Revenue (TR), Financial Independence (FI), Population (POP), Urban Area or Rural Area (UARA), and the Extent of Environmental Pollution (EEP).

The analytical model was built as follows:

\begin{equation}
(Y_{FIi} = \text{financial incentive offer from } i \text{ local government})
\end{equation}

\begin{equation}
(Y_{NFIi} = \text{non-financial incentive offer to } i \text{ local government})
\end{equation}

\begin{equation}
(Y_{FIi} = Y_{FII} + Y_{FIII} + Y_{FIV} + Y_{FV})
\end{equation}

\begin{equation}
(Y_{NFIi} = Y_{NFI} + Y_{NI} + Y_{NIV})
\end{equation}

Note: \(i\) is 228 local governments, \(Y_{FIi}\) is the extent of the financial incentive offer from \(i\) local government, \(Y_{NFIi}\) is the extent of the non-financial incentive offer, \(e_i\) is the error term.

Because dependent variables \((Y_{FIi}, Y_{NFIi})\) are categorical variables with four-point scales, the analytical results were drawn by Ordered Logit Model. In order to confirm validity of this analytical method, we used parallel regression assumption. The analytical results show that the financial incentive for NRE development and use is chi\(^2\)(32)=37.84 at prob>chi\(^2\)=0.2199, and the non-financial incentive for NRE development and use is chi\(^2\)(32)=43.31 at prob>chi\(^2\)=0.0876. Thus, we confirmed the validity of the Ordered Logit Model. Diagnosis of cut-off points also show that cut 1, 2, 3 are obviously divided at prob>chi\(^2\)=0.000.
### Table 1. Frequency of Dependent Variables

| Policy Tools                        | Scale      | Freq. | Percent | Policy Tools                        | Scale      | Freq. | Percent |
|-------------------------------------|------------|-------|---------|-------------------------------------|------------|-------|---------|
| Financial Incentives for New/Renewable Energy | Never      | 22    | 14.10   | Non-Financial Incentive Offer for New/Renewable Energy | Never      | 27    | 17.76   |
|                                     | Rarely     | 19    | 12.18   |                                     | Rarely     | 29    | 19.08   |
|                                     | Normally   | 80    | 51.28   |                                     | Normally   | 81    | 53.29   |
|                                     | Actively   | 35    | 22.44   |                                     | Actively   | 15    | 9.87    |
|                                     | Total      | 156   | 100.00  |                                     | Total      | 152   | 100.00  |

### Table 2. Analytical Results

| Determinants of Incentives for New/Renewable Energy | Financial Incentive Offers for New/Renewable Energy | Non-financial Incentive Offers for New/Renewable Energy |
|------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------------|
| Independent Variables                                 | Coef. (Std. Err.) | Odds Ratios (Std. Err.) | Coef. (Std. Err.) | Odds Ratios (Std. Err.) |
| **Political Pressure**                                |                                                      |                                                      |
| Higher-Level Governments’ Influence (GI)             | 0.076 (0.251) | 1.079 (0.271) | -0.351 (0.260) | 0.704 (0.183) |
| Assemblies’ Influence (AI)                           | -0.599** (0.270) | 0.549 (0.148) | -0.441 (0.278) | 0.644 (0.179) |
| Interest Groups’ Influence (IGI)                     | 0.599** (0.249) | 1.820 (0.454) | 0.716*** (0.262) | 2.045 (0.035) |
| **Institutional Conditions**                         |                                                      |                                                      |
| Seriousness of Standardized Policies of Higher-Level Governments (SSP) | -0.507 (0.445) | 0.602 (0.268) | -0.688 (0.457) | 0.503 (0.230) |
| Existence of Policies to Reduce Environmental Pollution (EPEP) | 0.953** (0.475) | 2.594 (1.233) | 0.338 (0.474) | 1.403 (0.665) |
| Renewable Energy Department Level (REDL)             | 2.967** (1.292) | 19.429 (25.111) | 2.932* (1.198) | 18.769 (22.483) |
| Stringency of Applying Environmental Pollution Regulations (SAEPR) | -0.499 (0.306) | 0.607 (0.186) | -0.673** (0.318) | 0.510 (0.162) |
| **Administrative Culture**                           |                                                      |                                                      |
| Transparency of Communication (TC)                   | 0.419 (0.387) | 1.521 (0.589) | 0.648 (0.402) | 1.912 (0.768) |
| Deficiency of Administrative Manpower (DAMP)         | -0.407 (0.328) | 0.666 (0.218) | -0.708** (0.340) | 0.493 (0.167) |
| Necessity of Regulatory Relief (NRR)                 | 0.300 (0.469) | 1.350 (0.633) | 0.167 (0.498) | 1.182 (0.589) |
| Necessity of Discretionary Power (NDP)               | -0.350 (0.444) | 0.705 (0.313) | -0.645 (0.475) | 0.525 (0.249) |
| **Control Variables**                                |                                                      |                                                      |
| Total Revenue per Thousands(log)(TR)                | 0.128 (0.491) | 1.137 (0.558) | 0.053 (0.507) | 1.054 (0.534) |
| Financial Independence (log)(FI)                    | -0.524 (0.702) | 0.592 (0.415) | 0.603 (0.713) | 1.827 (1.303) |
| Population (log)(POP)                               | 0.262 (0.482) | 1.300 (0.627) | 0.040 (0.510) | 1.040 (0.531) |
| Urban Area or Rural Area (UARA)                     | 0.220 (0.697) | 1.246 (0.869) | -0.170 (0.752) | 0.844 (0.634) |
3. Analytical Results

We first checked for multicollinearity among independent variables, and confirmed that the correlations among independent variables were less than 0.5. However, the correlations among control variables, specifically the correlations between the population and the total revenue, financial independence, and urban or rural area (0.85, 0.74, 0.78, respectively), and the correlations between urban or rural area and total revenue, financial independence (0.76, 0.65, respectively), are higher than 0.5. As these variables are control variables that significantly influence financial and non-financial incentives for new/renewable energy, we included these variables in the analytical model.

We analyzed the frequency of dependent variables as shown in Table 1 and found that local governments usually take advantage of non-financial incentives for new/renewable energy more than financial incentives. Analytical results are shown in Table 2. In total, 93 observations out of 156 respondents are used for this analysis due to missing results, and two models show Prob>Chi2 values less than 0.05 and present count R² 0.581 and 0.602, respectively.

Findings show that factors of political pressure and institutional condition usually have a statistically significant influence on the financial and non-financial incentive offers. For political pressure, the influence of higher level governments such as central government and provincial governments on the sustainable energy policies of local governments does not significantly influence financial and non-financial incentive offer for new/renewable energy. However, the influences of national and local assemblies and interest groups on sustainable energy policies of local governments significantly impact financial incentive offer for new/renewable energy. The influence of interest groups on sustainable energy policies of local governments also significantly impacts non-financial incentive offers for new/renewable energy. As members of national/local assemblies have short-term goals due to regular elections, they are not likely to prioritize financial incentives for new/renewable energy, which usually needs long-term support but do not show quick results. Instead, they tend to emphasize visual local economic developments that can show short-term results. Therefore, as the influences of national and local assemblies on the sustainable energy policies of local government increases, we estimate that financial incentive offers for new/renewable energy will decrease. A critical finding is that the interest groups’ influence on sustainable energy policies of local governments has a statistically significant influence on both financial and non-financial incentive offers for new/renewable energy. Even though environmental organizations, residents’ groups, and businesses related to new/renewable energy have different goal functions, they are likely to vitalize both financial/non-financial incentives.

For institutional conditions, the seriousness of standardized and unilateral policies of central and provincial governments on local autonomy has no statistically significant influence on both financial and non-financial incentive offers for new/renewable energy. However, local governments with clear policies to reduce environmental pollution and with a higher level of renewable energy department are likely to significantly increase financial incentive offers for new/renewable energy. In addition, while local governments with energy departments at a higher level are likely to significantly increase non-financial incentive offers for new/renewable energy, local governments implementing stringent environmental regulations tend to significantly decrease those

| Extent of Environmental Pollution (EEP) | 0.514 (0.330) | 1.672 (0.552) | 0.224 (0.328) | 1.251 (0.410) |
| _Cut 1 | 0.641 (5.784) | 0.641 (5.784) | -2.614 (5.932) | -2.614 (5.932) |
| _Cut 2 | 1.732 (5.780) | 1.732 (5.780) | -1.355 (5.922) | -1.355 (5.922) |
| _Cut 3 | 4.684 (5.787) | 4.684 (5.787) | 2.497 (5.927) | 2.497 (5.927) |
| N of Obs. | 93 | 93 | | |
| LR Chi2(16) | 26.79 | 31.74 | | |
| Prob > Chi2 | 0.044 | 0.011 | | |
| Count R² | 0.581 | 0.602 | | |

Note: * p<0.1, ** p<0.05, *** p<0.01, Coefficients are unstandardized coefficients with standard errors in parentheses.
non-financial incentive offers. We estimate that specific and clear environmental conservation policies and plans are likely to promote financial incentive offers for new/renewable energy by local governments. In addition, local governments with energy departments at a higher level usually tend to have higher financial and non-financial capacities and concerns for new/renewable energy, and thus can apply these incentive policies more efficiently and powerfully. However, local governments that more stringently apply environmental pollution regulations prefer this rather than incentives, and do not offer non-financial incentives that require a longer time and more human resources for monitoring and management.

For administrative support, transparency of communication, necessity of regulatory relief, and necessity of discretionary power for new/renewable energy have no statistically significant influence on the both financial and non-financial incentive offer for new/renewable energy. Deficiency of administrative manpower for new/renewable energy only significantly decreases the non-financial incentive offers for new/renewable energy. Non-financial incentive offers for new/renewable energy need sufficient administrative manpower. So, as administrative manpower becomes more deficient, local governments are not likely to provide non-financial incentives for new/renewable energy.

In summary, the interest groups’ influence on sustainable energy policies and the renewable energy department levels of local government tend to increase both financial and non-financial incentive offers for new/renewable energy. Additionally, while the influence of national/local assemblies on sustainable energy policies of local governments tend to decrease the financial incentive offers for new/renewable energy, local governments with clear policies or plans to reduce environmental pollution are likely to significantly increase financial incentive offers. For non-financial incentives for new/renewable energy, both the stringent implementation of environmental regulations and the deficiency of administrative manpower tend to decrease non-financial incentive offer.

4. Conclusion

Many countries build uniform new/renewable energy policies. However, practical application of these policies at the lowest level of government can vary depending on several factors. In Korea, even though the planning and formation of incentive policies for new/renewable energy is achieved centrally, the application or offer of these incentive policies is different and varied. This study explored and addressed which factors influence the extent and variety of incentive offers for new/renewable energy.

This study shows that political pressure and institutional conditions of local governments have a more significant influence than administrative support on causing the variation of new/renewable energy incentive offers. In particular, the influence of interest groups on political pressure and the renewable energy department level of institutional conditions substantially promote both financial and non-financial incentive offers for new/renewable energy. In addition, local governments with clear environmental policies and plans to reduce environmental pollution significantly increase financial incentive offers for new/renewable energy. However, the influence of national/local assemblies on sustainable energy policies of local governments decreases financial incentive offers for new/renewable energy, and stringent application of environmental pollution regulations and deficiency of administrative manpower for new/renewable energy decreases non-financial incentive offers.

These findings suggest that local governments who enhance incentive offers for new/renewable energy need to increase the new/renewable energy department level and the influence of stakeholders such as residents’ group and environmental organizations. Local governments also should build clear environmental policies to reduce environmental pollution, and pay attention to the factors that restrain incentive offers for new/renewable energy. Local governments need to relieve the application of environmental pollution regulation and carefully respond to the influence of national or local assemblies as well as raise administrative manpower. Systematic and synthetic consideration and management of these significant factors is required to promote incentive offers for new/renewable energy.

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