A Quantitative Assessment of the Development of Renewable Energy in Taiwan, 1980 to the Present: A Political-Economic Perspective

Kuang-Cheng Chen
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ABSTRACT

This article attempts to use quantitative analysis (regression analyses) to analyze renewable energy development in Taiwan from 1980 to the present using the political-economic perspective. This research found that the “Renewable Energy Supply” and the “Renewable Energy Supply/Total Energy Supply” were impacted by political factors (e.g., “Which party wins half of the seats for county magistrates and city mayors in a given year?”) between 1980 and 1999, but were influenced by economic factors (GDP (PPP) from 2000 to 2007. As regards the “Ratio of CO$_2$ Emissions to the Population,” it was impacted by economic factors (GDP (PPP)) from 1980 to 1999 but was influenced by political factors (“Which party wins half of the seats for county magistrates and city mayors in a given year?”) between 2000 and 2007.

Given these findings, this article proposes that future renewable energy development should be decided by the policies of Taiwanese political parties, and future legislation concerning renewable energy should be conducted using objective forms of assessment. The regression analyses indicate that “Which party wins half of the seats for county magistrates and city mayors in a given year?” is an important factor in determining “Renewable Energy Supply,” “Renewable Energy Supply/Total Energy Supply,” and “Ratio of CO$_2$ Emissions to the Population.” Therefore, implementation by local governments is important for future renewable energy development in Taiwan. Finally, regardless of whether the central or local governments are involved, they should cooperate with each other, because the efficiency of the government is important for the future development of renewable energy.

Keywords: renewable energy, regression analysis, Renewable Energy Development Act, KMT, DPP
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1. INTRODUCTION

1.1 The Introduction of Renewable Energy Development in Taiwan

Taiwan is a small, overpopulated island nation. It lacks natural resources that can be used to supply energy, and Taiwan’s need for energy has continued to increase. The growth rate of total domestic energy consumption in Taiwan from 2004 to 2008 was 6.51%, and total domestic energy consumption in Taiwan between 2004 and 2008 is shown in Table 1.1.  

<table>
<thead>
<tr>
<th>Year</th>
<th>Domestic Energy Consumption</th>
<th>Total Domestic Energy Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10^3 KLOE^2</td>
<td>Growth Rate (%)</td>
</tr>
<tr>
<td>2004</td>
<td>110027.9</td>
<td>4.31</td>
</tr>
<tr>
<td>2005</td>
<td>112613.8</td>
<td>2.35</td>
</tr>
<tr>
<td>2006</td>
<td>115399.1</td>
<td>2.47</td>
</tr>
<tr>
<td>2007</td>
<td>121212.2</td>
<td>5.04</td>
</tr>
<tr>
<td>2008</td>
<td>117685.7</td>
<td>-2.91 (+6.51)^3</td>
</tr>
</tbody>
</table>


The Taiwan Power Company’s report on “Long-Term Electrical Load and The Electrical Development Plan of Taiwan” estimated in 2006 that the percent of the electricity supply in 2025 which will be produced using renewable energy will be 6.4%, but 56.0% of the

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2 KLOE is the abbreviation of “Kilolitre Oil Equivalent,” which is an energy unit.

3 The growth rate of total domestic energy consumption in Taiwan from 2004 to 2008 was 6.51%.
electricity supply will be produced using coal. Therefore, this development plan will not reduce CO₂ emissions in Taiwan, which is one reason why Taiwan must develop renewable energy. The Taiwanese people must understand the importance of renewable energy development. A poll conducted in 2009 by the polling center at Shih Hsin University indicated that 89% of interviewees supported the government’s policy of developing renewable energy. The Taiwanese people exhibit a high degree of consensus on environmental protection, and Taiwanese politicians have found it necessary to propose relevant policies during political campaigns, particularly during presidential elections. During the 2008 presidential election, the two major presidential candidates proposed policies concerning environmental protection and the emission of Greenhouse gases (GHG) in Taiwan.

Policies adopted by the Kuomintang (KMT) when they were the ruling party in Taiwan favored economic development. The KMT’s presidential candidate, Ma, Ying-Jeou,

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7 For example, when the KMT was the ruling party of the central government from the 1950s to the 1960s, it led Taiwan towards high economic growth, which is known as the “Taiwan Miracle.” In 1980, the KMT government proposed the construction of the Fourth Nuclear Power Plant. Beginning in 1995, the Taiwanese government had a plan for “Asia-Pacific Regional Operations Center,” and the Executive Yuan permitted the Bayer Group’s investments in 1995, which was the first investment made under this plan. After the KMT was reelected as the ruling party in 2008, the KMT government signed the “Economic Cooperation Framework Agreement (ECFA)” with China in June, 2010, which promoted close economic cooperation between Taiwan and China. See I-Lin Yang, Taiwan Economic Miracle, http://www.cjhs.kh.edu.tw/social/history/hw/403.htm (last visited Oct. 16, 2010); Encyclopedia of Taiwan, Anti-Bayer Event, http://taiwanpedia.culture.tw/web/content?ID=5252 (last visited Oct. 16, 2010).
proposed policies concerning the reduction of GHG emissions and the development of renewable energy during the 2008 presidential election. For example, he proposed that enterprises pay “energy taxes” to help pay for the reduction of GHG emissions, and proposed that Taiwan enact the “Greenhouse Gas Reduction Act” to enforce the reduction of GHG emissions. He also proposed that CO$_2$ emissions be reduced to their 2008 level by the 2016 to 2020 period, and that CO$_2$ emissions in 2025 be reduced to their 2000 level. CO$_2$ emissions should be reduced to the half of their 2000 level by 2050. He believed that planting forests is one way to help achieve these targets. As regards renewable energy development, he proposed setting up a “CO$_2$ Reduction Fund” and increasing the efficient use of energy. He also proposed enacting the “Renewable Energy Act” in the near future.

As regards political opposition, the Democratic Progressive Party (DPP) has been regarded as the party that favors environmental protection. The DPP’s party constitution indicates that the party’s policy to the effect that there should be no nuclear power plants in Taiwan. The DPP’s president candidate, Frank Hsieh, proposed that CO$_2$ emissions be

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9 Radio Taiwan International, supra note 5.
11 The Broadcasting Corporation of China, supra note 7.
12 The Broadcasting Corporation of China, supra note 7.
reduced to 2005 levels by the 2025 to 2030 period.\textsuperscript{15} He has also said that Taiwan should enact legislation regarding GHG reductions. He proposed that the government extend the powers of the “National Sustainability Development Committee, Executive Yuan” to include examinations of future development plans.\textsuperscript{16} Increasing the efficient use of power, decreasing the number of automobiles and motors, developing natural gas, and paying attention to biodiversity are ways to help achieve the targets for reduced CO\textsubscript{2} emissions.\textsuperscript{17}

Some of the policies proposed by the two parties during the 2008 presidential election are quite similar. However, both of the major parties in Taiwan understand the importance of reducing GHG emissions and developing renewable energy. Taiwan has a long history of renewable energy development, but this subject received little attention until after the Second Oil Crisis began in 1980. The Taiwanese government enacted the “Energy Management Act” in 1980 and began to develop renewable energy technologies.\textsuperscript{18} The Executive Yuan held the 6th “National Science and Technology Conference” and the “National Economic Development Conference” in January, 2001. They decided to enact relevant laws concerning renewable energy and to create actionable plans to encourage the development of domestic energy supplies, attempt to decrease energy imports, and attempt to develop clean energy

\textsuperscript{16} Environmental Protection Policy of Frank Hsieh, supra note 15.
\textsuperscript{17} Environmental Protection Policy of Frank Hsieh, supra note 15.
under the United Nations Framework Convention on Climate Change (UNFCCC).\textsuperscript{19} On June 8, 2005, Meeting No. 2943 of the Executive Yuan passed the “Draft of the Renewable Energy Development Act of Taiwan.”\textsuperscript{20} This draft act was later sent to the Legislative Yuan. The “Renewable Energy Development Act of Taiwan” was passed by the Legislative Yuan on June 12, 2009, and became effective on July 11, 2009.\textsuperscript{21}

Policy development is heavily influenced by political issues. The development of renewable energy policy and the reduction of GHG emissions policy in Taiwan is no exception. The KMT won the 2008 presidential campaign, but this did not guarantee that all of their policies would be implemented in the near future. The implementation of these policies should be evaluated using an objective method (i.e., empirical study), so this article attempts to assess the influence of politics on policy implementation concerning GHG emission reductions, renewable energy development, and economic development in Taiwan.

1.2 The Methodology of This Article

The methodology used in this article is regression analysis, which is used in an attempt to understand interactions involving policy implementation with respect to renewable energy development, GHG emissions reductions, political factors, and economic development in the United States.
Taiwan. The purpose of regression analyses is to determine which variables might be statistically significant with respect to policy implementation concerning renewable energy development and GHG emissions reductions during different periods. The dependent variable and independent variables run by the regression analyses in this article are listed in Table 1.2.

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Meanings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable Energy Supply (kWh)(^{22})</td>
<td>The amounts of all types of renewable energy in Taiwan, including hydropower, geothermal power, solar energy, wind power, biofuel energy, etc.</td>
</tr>
<tr>
<td>Renewable Energy Supply/Total Energy Supply (%)</td>
<td>The ratio of renewable energy supply to total energy supply in Taiwan in a given year</td>
</tr>
<tr>
<td>CO(_2)/Population (t CO(_2) per capita)(^{23})</td>
<td>CO(_2) emissions per capita of Taiwan</td>
</tr>
<tr>
<td>GDP (PPP) (billion $)(^{24})</td>
<td>GDP is measured using purchasing-power-parity (PPP), which reflects the relative cost of living and the inflation rate</td>
</tr>
<tr>
<td>Which party wins half of the seats for county magistrates and city mayors in a given year?(^{25})</td>
<td>This variable indicates which party (KMT or DDP) wins half of the seats for county magistrates and city mayors in a given year</td>
</tr>
</tbody>
</table>

The dependent variables used in the regression analyses in this article are “Renewable Energy Supply” and “CO\(_2\)/Population,” so it is quite important to describe the data regarding renewable energy supply and CO\(_2\) emissions with respect to the population between 1980 and


the present. Appendix Table 1.3 lists the data concerning the renewable energy supply and CO₂ emissions with respect to population from 1980 to the present.

### 1.3 The Purpose of This Article

The purpose of this article is to determine whether or not there is a statistically significant relationship among renewable energy supply, CO₂ emissions per capita, political factors, and economic factors through the use of regression analyses.

This article finds that there is a statistically significant relationship among these variables during different periods in Taiwan. The following sections will both show why these variables are statistically significant and recommend possible policy directions that can help increase future support for renewable energy and decrease future CO₂ emissions per capita in Taiwan.

### 2. RENEWABLE ENERGY DEVELOPMENT IN TAIWAN: 1980-1999

Taiwan enacted the “Energy Management Act” in 1980 and began to develop renewable energy technology. The articles of the “Energy Management Act” regulate the efficient use, conservation, and research and development of energy, but the original articles of this law enacted in 1980 did not mention renewable energy development. However, regulations

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26 Article 1, Section 1 of the “Energy Management Act” regulates that “The purposes of enacting this law are to
concerning the efficient use, conservation, and research and development of energy in this law reflect the Second Oil Crisis, which occurred at that time.\textsuperscript{27} The Taiwanese government had previously paid little attention to energy efficiency, conservation and energy research and development, and began to develop renewable energy technology. Was the enactment of the “Energy Management Act” actually beneficial for renewable energy development?

The KMT controlled the central government (i.e., the office of president) between 1980 and 1999. Did CO\textsubscript{2} emissions increase, renewable energy supplies decrease, and economic development flourish in Taiwan, if the KMT’s policies favored economic development? Regression analysis is one possible way to answer these questions. The regression analysis in this section dates from 1980, the year Taiwan enacted the “Energy Management Act” and began to develop renewable energy, up through 1999, the year before the KMT lost control of the central government. Of course, there is some risk that regression analysis multicollinearity might influence the accuracy of the outcomes of the regression analyses.\textsuperscript{28}

In order to avoid this problem, we will measure the “correlation coefficients”\textsuperscript{29} of variables, listed in Table 1.2 and measure the rank order of variables. We will then delete variables


\textsuperscript{28} If “multicollinearity” is present in the data, the statistical inferences made about the data may not be reliable. See Statistics Solutions, Inc., Data Entry, Cleaning, and Coding: Multicollinearity, \url{http://www.statisticssolutions.com/multicollinearity} (last visited Jul. 31, 2009).

\textsuperscript{29} The “Correlation Coefficient” is also called the “Pearson Correlation Coefficient,” and is defined as being “A number between -1.0 and +1.0 that describes the strength and direction of the linear relationship between two variables. A Pearson Correlation Coefficient (PCC) of -1.0 indicates a perfect negative relationship, while +1.0 indicates a perfect positive relationship. See David Cope, Fundamentals of Statistical Analysis 98 (2005).
which correlate highly with each other and then run regression analyses. When we measure the correlation coefficients of different variables, we find that many variables correlate highly with each other. For example, the variable “Approved Foreign Investment” is “multicollinear” with respect to the variables “GDP (PPP),” “CO₂/Population,” and so on. As a result, we have no choice but to eliminate the variable “Approved Foreign Investment” when we insert these variables into the regression analyses. Appendix Table 2.1 lists the outcomes of correlation coefficients among different variables.

Because there are three dependent variables, the “Renewable Energy Supply,” “Ratio of Renewable Energy Supply to Total Energy Supply,” and “Ratio of CO₂ Emissions to Population,” this chapter has two sections. The purpose of this chapter is to determine which variable is statistically significant, and to describe relevant discussions concerning renewable energy development in Taiwan from 1980-1999.


If the “Renewable Energy Supply” is the dependent variable, and “Which party wins half of the seats for county magistrates and city mayors in a given year?” is the independent variable, the variable “Which party wins half of the seats for county magistrates and city
“Which party wins half of the seats for county magistrates and city mayors in a given year?” is important for determining whether the supply of renewable energy is high or low. Appendix Table 2.2 is the outcome of regression analysis for “Renewable Energy Supply” and “Which party wins half of the seats for county magistrates and city mayors in a given year?”

If we have the data concerning the ratio of renewable energy supply to total energy supply, we can understand the use of renewable energy in Taiwan from 1980 to 1999. The result is Appendix Table 2.3, which shows the regression analysis where “Renewable Energy Supply/Total Energy Supply” is the dependent variable, and “Which party wins half of the seats for county magistrates and city mayors in a given year?” is the independent variable.

We can infer three scenarios from the outcomes of the above regression analyses: First, when the DPP is the ruling party in the local government (county magistrates and city mayors) and the KMT is the ruling party of the central government (president) between 1980 and 1999, the renewable energy supply and ratio of renewable energy supply to total energy supply in that period was at its highest. Second, when the KMT controls both the local governments (county magistrates and city mayors) and the central government (the office of president) between 1980 and 1999, the renewable energy supply and ratio of renewable

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30 The definition of “statistically significant” is that “A result is statistically significant if the probability of its occurring, referred to as the p-value, is less than a predetermined threshold, conventionally 5 percent.” See Robert M. Lawless et al., Empirical Methods in Law 426 (2010).
energy supply to total energy supply during that period was lower than was the case in the first scenario. Third, when neither the KMT nor the DPP controls the local government (county magistrates and city mayors), but the KMT controls the central government (the office of the president) between 1980 and 1999, the renewable energy supply and ratio of renewable energy supply to the total energy supply in that period was the lowest among the three scenarios. Table 2.4 lists three different scenarios concerning the outcomes of the regression analyses in this section.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>KMT</td>
<td>DPP</td>
<td>√</td>
<td>Highest</td>
</tr>
<tr>
<td></td>
<td>KMT</td>
<td>√</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Neither KMT nor DPP</td>
<td>√</td>
<td>Lowest</td>
</tr>
</tbody>
</table>

In the first scenario, the DPP was the ruling party in the local governments and the KMT was the ruling party of the central government from 1998 to 1999. The renewable energy supply during this period (11222789041 and 11383818021 kWh) was actually higher than during the previous year, and the average renewable energy supply from 1998 to 1999 was

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11303303531 kWh.\textsuperscript{32} Although the ratio of the renewable energy supply to the total energy supply was low from 1998 to 1999, it was higher than during the previous year.\textsuperscript{33} In the second scenario, the KMT controlled both the central and the local governments from 1980 to 1997. The average renewable energy supply during the 1990 to 1997 period was 5996181560 kWh.\textsuperscript{34} In addition, the average ratio of renewable energy supply to total energy supply from 1991 to 1997 was 0.007.\textsuperscript{35} As a result, the average renewable energy supply and ratio of renewable energy supply to total energy supply in the first scenario were higher than in the second scenario, and this reflects the same outcome as was shown in the regression analyses.

Although the KMT controlled the central government between 1998 and 1999, this does not mean that the renewable energy supply and the ratio of the renewable energy supply to the total energy supply were low, because the KMT policies favored economic development. How can we explain this? As mentioned in Chapter 1, the DPP’s policies favored environmental protection, and opposed the construction of nuclear power plants in Taiwan. Of course, the DPP’s county magistrates and city mayors paid attention to environmental protection (including renewable energy development) in order to implement the DPP’s policies. Article 19, Section 1, Clause 9 of the “Local Government Act” regulates that “The


self-government matters of counties/cities are as follows: “9. Matters related to health and environmental protection: Health administration in the county/city. Environmental protection in the county/city…” Therefore, counties and cities have self-government powers over environmental protection that they can carry out without interference from the central government, although the ruling party in the central government from 1998 to 1999 was the KMT, the party which has historically favored economic development.

2.2 Regression Analysis on the “Ratio of CO₂ Emissions to Population” from 1980-1999

The previous section discussed regression analyses for the renewable energy supply from 1980 to 1999, and the independent variable – “Which party wins half of the seats for county magistrates and city mayors in a given year?” is “statistically significant” with respect to the dependent variables – “Renewable Energy Supply” and “Renewable Energy Supply/Total Energy Supply.”

In theory, the greater the renewable energy supply, more renewable energy there is available per capita in Taiwan. In other words, we can infer that CO₂ emissions per capita in Taiwan would be low, because people have more opportunities to use renewable energy instead of energy that involves high CO₂ emissions. However, the correlation coefficients

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37 Robert M. Lawless et al., supra note 30, at 426.
listed in Appendix Table 2.1 indicated that the variables “Renewable Energy Supply” and “CO₂/Population” have “positive correlation coefficients”\(^\text{38}\) (0.7516). In other words, the greater the renewable energy supply, the greater the volume of CO₂ emissions per capita in Taiwan. Although we must further analyze the data in order to determine which argument is true, we are already certain that the ratio of CO₂ emissions to the population is related to the supply of renewable energy. As a result, we choose “CO₂/Population” as a dependent variable in the regression analyses in this section when we examine the relationships between CO₂ emissions to the population, political factors and economic factors from 1980 to 1999 in Taiwan.

If “CO₂/Population” is the dependent variable, and “GDP (PPP)” is the independent variable, the variable “GDP (PPP)” is “statistically significant”\(^\text{39}\) with respect to the dependent variable “CO₂/Population.” In other words, “GDP (PPP)” is important for determining the ratio of CO₂ emissions to the population. Regardless of whether the KMT or the DPP controls the central or the local governments, there is no difference with respect to the ratio of CO₂ emissions to the population. Appendix Table 2.5 shows the outcomes for regression analysis for “CO₂/Population” and “GDP (PPP).”

Unlike the previous regression analyses, “Which party wins half of the seats for county

\(^{38}\) The “Correlation Coefficient” is also called the “Pearson Correlation Coefficient,” and is defined as being “A number between -1.0 and +1.0 that describes the strength and direction of the linear relationship between two variables. A Pearson Correlation Coefficient (PCC) of -1.0 indicates a perfect negative relationship, while +1.0 indicates a perfect positive relationship. See Cope, supra note 29, at 98.

\(^{39}\) Robert M. Lawless et al., supra note 30, at 426.
magistrates and city mayors in a given year?” is important with respect to the renewable energy supply. However, the ratio of CO₂ emissions to the population is not decided by political issues but rather by economic factors.

3. RENEWABLE ENERGY DEVELOPMENT IN TAIWAN: 2000-2007

This chapter uses regression analyses to examine the interactions between independent variables and two dependent variables during the 2000-2007 period when the DPP controlled the central government. The DPP ceased to be the ruling party in 2008. This chapter compares the DPP’s implementation of renewable energy development in Taiwan during this period with the KMT’s implementation during previous years. The “Draft of the Renewable Energy Development Act of Taiwan” was passed in 2005, and this section also examines the differences that manifested concerning renewable energy development in Taiwan after the Draft Act was passed.

As mentioned above, “Multicollinearity” influences the accuracy of the outcomes of regression analyses. Therefore, we must measure the correlation coefficients of the variables which are listed in Table 1.2 and measure the rank order of variables. We will then eliminate variables that are highly correlated with each other and then run regression analyses. We must

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41 Statistics Solutions, Inc., Data Entry, Cleaning, and Coding: Multicollinearity, supra note 28.
ensure that each independent variable that is used in the regression analysis is not “multicollinear”\(^{42}\) in order not to influence the outcome of regression analysis. For example, the variable “CO\(_2\)/Population” is “multicollinear”\(^{43}\) with respect to variables such as “GDP (PPP),” “Which party wins half of the seats in the Legislative Yuan in a given year?,” and so on. We thus cannot use these variables in the regression analyses. Appendix Table 3.1 lists the outcomes of “correlation coefficients”\(^{44}\) among different variables.

The purpose of this chapter is to determine which variable is “statistically significant”\(^{45}\) via regression analyses, and to discuss renewable energy development in Taiwan during the period 2000-2007.


If we use “Renewable Energy Supply” as the dependent variable, “Which party wins half of the seats for county magistrates and city mayors in a given year?” and “GDP (PPP)” as the independent variables in the regression analysis, we find that “GDP (PPP)” is statistically significant with respect to the “Renewable Energy Supply.” Appendix Table 3.2 lists the outcomes of regression analysis for the “Renewable Energy Supply,” “Which party wins half of the seats for county magistrates and city mayors in a given year?,” and “GDP

\(^{42}\) Statistics Solutions, Inc., Data Entry, Cleaning, and Coding: Multicollinearity, \textit{supra} note 28.

\(^{43}\) Statistics Solutions, Inc., Data Entry, Cleaning, and Coding: Multicollinearity, \textit{supra} note 28.

\(^{44}\) See Cope, \textit{supra} note 29, at 98.

\(^{45}\) Robert M. Lawless et al., \textit{supra} note 30, at 426.
If we know the data for the ratio of renewable energy supply to total energy supply, we can understand the use of renewable energy in Taiwan from 2000 to 2007. Appendix Table 3.3 is the regression analysis such that “Renewable Energy Supply/Total Energy Supply” is the dependent variable, and “Which party wins half of the seats for county magistrates and city mayors in a given year?” is the independent variable.

The result is that the outcomes of regression analyses regarding the renewable energy supply and ratio of renewable energy supply to total energy supply between 2000 and 2007 show that the political factor – Which party wins half of the seats for county magistrates and city mayors in a given year? – has no influence on the renewable energy supply during this period. These outcomes differ from the outcomes of the regression analyses run in section 2.1, which indicated that “Which party wins half of the seats for county magistrates and city mayors in a given year?” is important for determining whether or not the renewable energy supply and ratio of renewable energy supply to total energy supply are high or low.

3.2 Regression Analysis on the “Ratio of CO₂ Emissions to Population” from 2000-2007

The previous section discussed the regression analyses for the supply of renewable energy from 2000 to 2007. The independent variable – “GDP (PPP)” – is “statistically
significant”\textsuperscript{46} with respect to the dependent variable – “Renewable Energy Supply.” In theory, the greater the supply of renewable energy, the more renewable energy there will be available for use in Taiwan. In other words, we can infer that CO\textsubscript{2} emissions per capita in Taiwan will be low when people have more opportunities to use renewable energy instead of energy that produces high CO\textsubscript{2} emissions. However, the correlation coefficients listed in Appendix Table 3.1 revealed that the variables “Renewable Energy Supply” and “CO\textsubscript{2}/Population” also have “positive correlation coefficients”\textsuperscript{47} (0.9639). In other words, the greater the renewable energy supply, the greater the CO\textsubscript{2} emissions in Taiwan. Although we must further analyze this information in order to determine which argument is true, we are certain that the ratio of CO\textsubscript{2} emissions to the population correlates with the supply of renewable energy. As a result, we choose “CO\textsubscript{2}/Population” to be a dependent variable in the regression analyses in this section when we examine relationships between CO\textsubscript{2} emissions among the population, political factors, and economic factors between 2000 and 2007 in Taiwan.

If “CO\textsubscript{2}/Population” is the dependent variable, and “Which party wins half of the seats for county magistrates and city mayors in a given year?” and “GDP (PPP)” are independent variables, the variables “Which party wins half of the seats for county magistrates and city mayors in a given year?” and “GDP (PPP)” are “statistically significant”\textsuperscript{48} with respect to the dependent variable “CO\textsubscript{2}/Population.” This means that “Which party wins half of the seats

\textsuperscript{46} Robert M. Lawless et al., supra note 30, at 426.
\textsuperscript{47} See Cope, supra note 29, at 98.
\textsuperscript{48} Robert M. Lawless et al., supra note 30, at 426.
for county magistrates and city mayors in a given year?” and “GDP (PPP)” are important in
determining the ratio of CO₂ emissions to the population. Appendix Table 3.4 shows the
outcomes of regression analysis among “CO₂/Population,” “Which party wins half of the
seats for county magistrates and city mayors in a given year?” and “GDP (PPP).”

Analyzing the outcomes of the above regression analysis shows that the outcomes can
be divided into three scenarios: First, if the DPP controls both the local governments (county
magistrates and city mayors) and the central government (the office of the president) between
2000 and 2007, the “CO₂/Population” during that period is completely decided by the “GDP
(PPP).” When “CO₂/Population” is high, “GDP (PPP)” is high. When “CO₂/Population” is
low, and “GDP (PPP)” is low. Second, when the KMT controls the local governments (county
magistrates and city mayors) and the DPP controls the central government (the office of the
president) between 2000 and 2007, “CO₂/Population” during that period will be higher than
in the first scenario. Third, if neither the KMT nor the DPP controls the local governments
(county magistrates and city mayors), but the DPP controls the central government (the office
of the president) between 2000 and 2007, “CO₂/Population” during that period would be the
highest among the three scenarios. Table 3.5 lists three different scenarios concerning the
outcomes of regression analyses in this section.
Table 3.5 Three Different Scenarios Under the Outcomes of Regression Analyses Between 2000 and 2007

<table>
<thead>
<tr>
<th>The Ruling Party of the Central Government</th>
<th>The Ruling Party of the Local Governments</th>
<th>Does the Scenario Reflect the Truth?</th>
<th>The Ratio of CO₂ Emissions to the Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPP</td>
<td>KMT</td>
<td>Yes (2006–2007)</td>
<td>Medium</td>
</tr>
<tr>
<td>Neither KMT nor DPP</td>
<td></td>
<td>Yes</td>
<td>Highest</td>
</tr>
</tbody>
</table>

The DPP controlled both the local governments and the central governments from 2000 to 2001. In the second scenario, the KMT controlled the local governments, but the DPP controlled the central government (the office of the president) between 2006 and 2007. The average “CO₂/Population” from 2006 to 2007 was 11.965 t CO₂ per capita,49 which was higher than the average “CO₂/Population” from 2000 to 2001, which was 10.005 t CO₂ per capita50 (the first scenario). As a result, these arguments reflect the same outcomes shown in the regression analyses. In the third scenario, neither the KMT nor the DPP controlled the local government (county magistrates and city mayors), but the DPP controlled the central government from 2002 and 2005. Although the average “CO₂/Population” from 2002 to 2005 was slightly lower than the average “CO₂/Population” from 2006 to 2007, the annual growth rate of “CO₂/Population” from 2002 to 2005 (2.66%) was higher than the annual growth rate

of “CO₂/Population” from 2006 to 2007 (1.94%). In other words, these arguments also reflect the same outcome that is shown by the regression analyses.

GDP is the index that is commonly used to measure economic development in different countries, but high-income countries usually experience high prices, so people who live in high-income countries are unable to spend additional income to purchase products. If we use “Purchasing Power Parity” (PPP) to examine each country’s GDP, GDP (PPP) is a more accurate way of measuring each country’s economic development than is the case when GDP is used. GDP (PPP) increased 48.74% between 2002 and 2008, but the average Consumer Price Index (CPI) increased only 1.34% between 2002 and 2008. In other words, people who live in Taiwan could afford to spend additional income.

However, questions arise, such as “Which products did they purchase?” and “Did they buy ‘green energy products’ that produce low-carbon emissions?” The answers to both questions are “No,” because the “Ratio of CO₂ Emissions to the Population” was followed by an increase in GDP (PPP) to 15.82% between 2005 and 2007. Although the 2009 poll

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53 International Monetary Fund, World Economic Outlook Database (October, 2009), supra note 24.
described in Chapter 1 indicated that there was a degree of awareness of the importance of renewable energy development, the government did not encourage corporations to manufacture “green energy products.” Moreover, both the KMT and the DPP failed to establish criteria for restricting CO₂ emissions and encouraging the production of “green energy products.” There is no “green energy product label” to which consumers can refer when purchasing products. In other words, people could afford to spend additional income to purchase products, but there were few “green energy products” from which to choose.

To sum up, we know that, although the DPP’s policies favored environmental protection, promoted low-carbon products and low CO₂ emissions per capita, they were not effective when the DPP controlled the central government between 2005 and 2007. The “Taiwan Carbon Label” was launched in March, 2010 to promote the production of low-carbon products in Taiwan. This “Taiwan Carbon Label” strategy was promoted when the KMT controlled the central government. The outcome of regression analysis in this section reflects the ruling party of the central government having no influence over per capita CO₂ emissions. The central government should establish a standard which promotes low-carbon products, and the local governments should be responsible for enforcing this standard. Article 19 of the “Local Government Act” authorizes the local governments to exercise authority over

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environmental protection.  

4. THE RENEWABLE ENERGY DEVELOPMENT IN TAIWAN:  
2008-PRESENT

The KMT won the 2008 presidential election. During the 2008 presidential election, the KMT’s president candidate – Ma, Ying-Jeou proposed policies regarding the reduction of CO₂ emissions and renewable energy development. During the 2009 National Energy Conference, President Ma’s address mentioned that the “Renewable Energy Development Act” had been passed by the Legislative Yuan. The “Renewable Energy Development Act” was passed by the Legislative Yuan on June 12, 2009.

The passage of the “Renewable Energy Development Act” represents the Taiwanese government’s hopes for reducing GHG emissions, reducing energy imports, and encouraging private corporations to develop sources of renewable energy. This Act is the first instance of the political slogans and proposals of either Taiwanese party being written into law, so it is useful to examine this Act in detail. There is insufficient data concerning renewable energy development in Taiwan from 2008 to the present for use in regression analysis, so we must instead refer to the doctrinal discussions and the outcomes of previous

57 Law & Regulations Database of the Republic of China, Local Government Act, supra note 36.
60 GHG is the abbreviation of “Greenhouse gas.” See IPCC AR4 SYR Appendix Glossary, supra note 6.
regression analyses in Chapters 2 and 3.

This chapter has two sections: “An Introduction to the ‘Renewable Energy Development Act’ of Taiwan” and “The Further Analyses Regarding the Future ‘Renewable Energy Supply’ and the ‘Ratio of CO$_2$ Emissions to the Population’ in Taiwan.” The purpose of this chapter is to introduce important issues related to the “Renewable Energy Development Act” of Taiwan, and to describe relevant discussions concerning renewable energy development (renewable energy supply, the ratio of the supply of renewable energy to the total energy supply, and the ratio of CO$_2$ emissions to the population) in Taiwan from 2008 to the present.

4.1 An Introduction to the “Renewable Energy Development Act” of Taiwan

As mentioned above, the history of renewable energy development dates back to 1980. The “Draft of the Renewable Energy Development Act” was passed in 2005, and the final edition of the “Renewable Energy Development Act” was passed in 2009. It required 29 years to complete the legal formalities of renewable energy development in Taiwan.

This does not mean that renewable energy development was nonexistent prior to the passage of the “Renewable Energy Development Act.” For example, Taiwanese solar cell output was 56 hundred million dollars in 2005, and Taiwan’s world market share ratio was

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61 Legislative Yuan, Legal System, Legislation Record: Renewable Energy Development Act, supra note 59.
The value of solar cell output is expected to be 20 to 25 billion dollars in 2010, and Taiwan’s share of the world market would increase from 15 to 20%. Moreover, the northeastern monsoons go on for more than six months in Taiwan, and the wind speed in the coastal areas and offshore islands exceeds 4m/sec, so Taiwan has the potential to develop wind power. For example, the InfraVest Corporation has made numerous investments in wind power stations in Taiwan.

The passage of the “Renewable Energy Development Act” sought to encourage private investments in renewable energy development and provide subsidies to reduce the direct costs to corporations involved in the development of renewable energy. The “Renewable Energy Development Act” has 23 articles. The key articles of this Act include Article 3 – the definition of the renewable energy, and Article 9, which sets the “Wholesale Selling Rate” for electricity. Article 3 of this Act regulates various types of renewable energy (e.g., solar, biomass, geothermal, ocean, wind energy, etc.), but this Article does not take note of the difficulties Taiwan faces in developing geothermal energy. Geothermal resources in Taiwan

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63 The Central News Agency, The Industry Technology Research Institute of Taiwan Expected the Value of Taiwanese Solar Cell Output in 2010 Will Be Increased Four Times, supra note 62.
65 Law & Regulations Database of the Republic of China, Renewable Energy Development Act of Taiwan, supra note 21.
consist of acid and steam ingredients, and these have little value with respect to generating profitable electric power.\textsuperscript{66} The development of ocean energy in Taiwan is undergoing assessment (i.e., ocean thermal energy conversion and wave power) and involves high costs (i.e., tidal power).\textsuperscript{67} This article should include every type of renewable energy and attempt to make renewable energy development in Taiwan viable, but the types of renewable energy listed in this Article are currently face developmental difficulties. This article is thus not a practical guide to the current forms of renewable energy in Taiwan.

Article 9 of the “Renewable Energy Development Act” regulates the “Wholesale Selling Rate” for electricity produced using renewable electric power generation equipment. This article is important for private corporations which have invested in setting up renewable generating electric power stations intended to generate electric power to be sold to the Taiwan Power Company. The “Wholesale Selling Rate” cannot be set below the cost of generating electric power incurred when using fossil fuels.\textsuperscript{68} The purpose of Article 9 is to encourage additional renewable energy investments in Taiwan. The InfraVest Corporation complained that the “Wholesale Selling Rate” was too low, and said that it intended to withdraw its investments from Taiwan.\textsuperscript{69} Given that the “Wholesale Selling Rate” was 2.38 New Taiwan

\textsuperscript{66} Taiwan Power Company, Electric and Life, Electric Power Development Plan: Renewable Energy, supra note 64.
\textsuperscript{67} Taiwan Power Company, Electric and Life, Electric Power Development Plan: Renewable Energy, supra note 64.
\textsuperscript{68} Law & Regulations Database of the Republic of China, Renewable Energy Development Act of Taiwan, supra note 21.
\textsuperscript{69} NOW news, The Wholesale Selling Rate Was so Low, and the InfraVest Corporation Decided to Withdraw Investments from Taiwan, http://www.nownews.com/2010/02/25/91-2573080.htm (last visited Apr. 6, 2010).
Dollars/Kilowatt Hour (NTD/KWh), this rate was less than the rates found in other countries and was even lower than the cost of generating electric power (2.7-2.8 NTD/KWh). The Bureau of Energy, Ministry of Economic Affairs said that it is impossible to satisfy all corporations and to consider only the perspectives of corporations, because having a high “Wholesale Selling Rate” increases the electric charges that are paid by the people.

We can infer the perspectives of Taiwanese politicians, because they typically emphasize the importance of renewable energy development, which was the case with the two presidential candidates who proposed relevant policies in the 2008 presidential election and pushed for the passage of the “Renewable Energy Development Act.” However, these politicians ignored the renewable energy development situation in Taiwan and failed to educate people about how the cost of developing renewable energy in Taiwan increases the price of electricity. For example, Article 7 of the “Renewable Energy Development Act” regulates that government will set up a “Renewable Energy Development Fund.” The source of this fund is certain revenues of the electrical power companies, and this fund is used to provide subsidies to private electrical power corporations to purchase electrical power in accordance with the “Wholesale Selling Rate.” The total amount in the “Renewable Energy Development Fund” is currently 1.56 billion NTD, and approximately 180 billion

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70 NOW news, supra note 49.
72 Law & Regulations Database of the Republic of China, Renewable Energy Development Act of Taiwan, supra note 21.
73 Law & Regulations Database of the Republic of China, Renewable Energy Development Act of Taiwan, supra note 21.
KWh are sold annually.\textsuperscript{74} The Taiwan Power Company should thus charge 0.0087 NTD/KWh, and the cost of electricity for each household would increase by 34 NTD annually.\textsuperscript{75}

### 4.2 Further Analysis of the Future “Renewable Energy Supply,” “Ratio of Renewable Energy Supply to Total Energy Supply,” and “Ratio of CO\textsubscript{2} Emissions to the Population” in Taiwan

The previous section introduced the “Renewable Energy Development Act.” There has been no empirical analysis that examined whether or not the renewable energy supply and ratio of the supply of renewable energy to the decrease in the total energy supply and the ratio of CO\textsubscript{2} emissions to the increasing population when the KMT was the ruling party of the central government starting in 2008. The “Draft of the Renewable Energy Development Act of Taiwan” was passed in 2005,\textsuperscript{76} and this stimulated the renewable energy supply. However, we cannot conduct regression analysis due to the lack of data from 2008 to the present.

The “Renewable Energy Supply” actually decreased 11.57\% from 2008 to 2009,\textsuperscript{77} and the “Renewable Energy Supply/Total Energy Supply” also decreased from 2008 to 2009.\textsuperscript{78}

However, there is no data regarding “CO\textsubscript{2}/Population,” “CO\textsubscript{2}/GDP,” and “CO\textsubscript{2}/GDP PPP”

\textsuperscript{75} Chinatimes.com, supra note 74.
\textsuperscript{76} Executive Yuan, Draft of the Renewable Energy Development Act of Taiwan (June 14, 2005), supra note 40.
during 2008 and 2009. The passage of the “Draft of the Renewable Energy Development Act of Taiwan” did not stimulate the supply of renewable energy and the ratio of renewable energy supply to the total supply of energy, but we cannot judge whether or not a decrease in the renewable energy supply increased the ratio of CO\textsubscript{2} emissions to the population when the KMT was the ruling party beginning in 2008.

Comparing the previous regression analyses in Chapters 2 and 3 allows us to pick up the outcomes of regression analyses in Chapter 2. The research period (1980~1999) is the time during which the KMT controlled the central government. The KMT has controlled the central government and the ruling party in the local governments since 2008. Applying the outcomes of regression analyses in section 2.1 to the political situation from 2008 to the present shows that the supply of renewable energy and ratio of the supply of renewable energy to the total supply of energy would “not” be the lowest point (medium). Because the next presidential election will be held in 2012 and the KMT won the last election in 2008,\textsuperscript{79} the KMT is the ruling party prior 2012. In addition, the KMT won more than half seats (12/17) in the last local government’s election in 2009.\textsuperscript{80} If the KMT lose municipal election in November, 2010,\textsuperscript{81} the KMT still controls half seats (12/22) in the local government prior

2012. As a result, prior to 2012, the political situation was such that when the KMT controls both the central government and the local government, the supply of renewable energy and the ratio of the supply of renewable energy to the total supply of energy remain at the medium level.

The outcome of the regression analysis in section 2.2 showed that regardless of whether the KMT or the DPP controls local governments, no difference exists regarding the ratio of CO$_2$ emissions to the population. The regression analysis shows that when the KMT controls the central government, “Which party is the ruling party in the local government” is not important for determining the ratio of CO$_2$ emissions to the population.

5. RESEARCH FINDINGS AND POSSIBLE DIRECTIONS OF FUTURE RENEWABLE ENERGY DEVELOPMENT IN TAIWAN

This chapter will summarize the outcomes of the regression analyses and arguments from Chapters 2-4 and make recommendations concerning the future development of renewable energy in Taiwan using these outcomes. This chapter has two sections: first, the research findings and, second, possible directions for the future development of renewable energy in Taiwan.

5.1 Research Findings
This article project is a quantitative assessment concerning renewable energy development in Taiwan from 1980 to the present. This article uses regression analysis to examine which variable is statistically significant with respect to the “Renewable Energy Supply,” “Ratio of Renewable Energy Supply to Total Energy Supply,” and “Ratio of CO\textsubscript{2} Emissions to the Population” from different periods when different parties were in power the central government.

The KMT controlled the central government from 1980-1999, and the regression analyses in the Chapter 2 pointed out that the supply of renewable energy and the ratio of the supply of renewable energy to the total supply of energy would differ when different political parties controlled the local governments. This outcome indicated that the renewable energy supply is not related to which party controls the central government and whether or not a political party's policies favored environmental protection (including renewable energy developments). The renewable energy supply is related to which party controlled the local governments, because environmental protection is a self-government concern authorized by the “Local Government Act.”\textsuperscript{82} In addition, the ratio of CO\textsubscript{2} emissions to the population is determined by the GDP (PPP), and is not decided by political factors. However, this article argues that the central government has the responsibility for developing policies concerning people who can afford to spend additional income to purchase low-carbon products, and

\textsuperscript{82} Law & Regulations Database of the Republic of China, Local Government Act, supra note 36.
encourage people to avoid consuming high-carbon products.\textsuperscript{83}

The DPP was the ruling party in the central government for the first time from 2000-2007, and the GDP (PPP) is “statistically significant”\textsuperscript{84} with respect to the supply of renewable energy and the ratio of the supply of renewable energy to the total supply of energy between 2000 and 2007. The existence of a high level of renewable energy supply and ratio of renewable energy supply to total energy supply meant that there must be a high level of need for renewable energy. Therefore, either the public institutions or the private corporations will supply renewable energy in Taiwan, and high levels of renewable energy needs mean that people who have high levels of purchasing power will buy expensive products that operate, or are manufactured using renewable energy, such as solar water heaters, etc. Moreover, the ratio of CO\(_2\) emissions to the population from 2000 to 2007 is determined by the variables “GDP (PPP)” and “Which party wins half of the seats for county magistrates and city mayors in a given year?” When different political parties control the local governments, different ratios of CO\(_2\) emissions to the population are found. As a result, the outcomes of regression analysis in section 3.2 indicated that when the same party controls both the central and the local governments, the ratio of CO\(_2\) emissions to the population would be at the lowest point, such as in the case of the first scenario listed in Table 3.5, when

\textsuperscript{83} For example, the “Taiwan Carbon Label” was launched this March, and this policy was promoted by the Environmental Protection Administration. It is a good policy of the central government that encourages customers to purchase low-carbon products. See EpochTimes.com, Taiwan Carbon Label Will Be Launched on March Next Year, supra note 56.

\textsuperscript{84} Robert M. Lawless et al., supra note 30, at 426.
the DPP controls both the central and local governments.

The KMT has controlled the central government from 2008 to the present. Because there is insufficient data concerning renewable energy development in Taiwan from 2008 to the present, we cannot use regression analysis to examine the “Renewable Energy Supply,” “Ratio of Renewable Energy Supply to Total Energy Supply,” and “Ratio of CO₂ Emissions to the Population.” Moreover, the empirical data show that the supply of renewable energy decreased from 2008 to 2009, and the ratio of the supply of renewable energy to the total supply of energy did not change from 2008 to 2009. However, it would be found at the medium level under the outcome of the regression in section 2.1. Under the outcome of the regression analysis in section 3.2, regardless of whether the KMT or DPP controls the local governments, no difference exists regarding the ratio of CO₂ emissions to the population. Table 5.1 lists the outcomes of this article regarding renewable energy development in Taiwan.

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Time</th>
<th>Which Party is the Ruling Party in the Central Government?</th>
<th>Which Independent Variable is Statistically Significant? (P-value &lt; .05)</th>
<th>P-value</th>
<th>Different Ruling Parties in the Local Government under Various</th>
<th>Research Outcomes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>DPP</th>
<th>The renewable energy supply would be at the highest level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980~1999</td>
<td>KMT</td>
<td>The renewable energy supply would be at the medium level</td>
</tr>
<tr>
<td>2000~2007</td>
<td>DPP</td>
<td>Neither KMT nor DPP</td>
</tr>
<tr>
<td>2008~Present</td>
<td>KMT</td>
<td>N/A</td>
</tr>
<tr>
<td>Renewable Energy Supply</td>
<td>1980~1999</td>
<td>KMT</td>
</tr>
<tr>
<td>Renewable Energy Supply/Tot al Energy Supply</td>
<td>1980~1999</td>
<td>KMT</td>
</tr>
</tbody>
</table>
Table 5.1 (cont.)

<table>
<thead>
<tr>
<th>Period</th>
<th>Party</th>
<th>GDP (PPP)</th>
<th>Ratio</th>
<th>Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000–2007</td>
<td>DPP</td>
<td>GDP (PPP)</td>
<td>0.026</td>
<td>N/A</td>
</tr>
<tr>
<td>2008–Present</td>
<td>KMT</td>
<td>N/A</td>
<td>N/A</td>
<td>KMT</td>
</tr>
<tr>
<td>Ratio of CO₂</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emissions to the Population</td>
<td>1980–1999</td>
<td>KMT</td>
<td>GDP (PPP)</td>
<td>0.000</td>
</tr>
</tbody>
</table>

The ratio of renewable energy supply on total energy supply would be at the medium level.

Neither KMT nor DPP.

The ratio of renewable energy supply to total energy supply would be at the lowest level.

The higher the GDP (PPP), the higher the ratio of renewable energy supply on total energy supply.

The ratio of renewable energy supply on total energy supply did not change, but would be at the medium level.

The higher GDP (PPP) performed, the higher the ratio of CO₂.
| 2000–2007 | DPP | Which party wins half of the seats for county magistrates and city mayors in a given year? | 0.030 | KMT | The ratio of CO₂ emissions to the population would be at the lowest level. |
| 2008–Present | KMT | N/A | N/A | KMT | Regardless of whether the KMT or DPP controls the local government, there is no difference. |
| GDP (PPP) | 0.000 | N/A | The higher GDP (PPP) performed, the higher ratio of CO₂ emissions to the population would be at the highest level. |
regarding the ratio of CO$_2$ emissions to the population

Note: The symbols of N/A mean that there is no statistically significant independent variable in the regression analyses, and that no party wins half of the seats for county magistrates and city mayors in a given year.

5.2 Possible Directions for Future Renewable Energy Development in Taiwan

This article will propose four possible directions for future renewable energy development in Taiwan based on the regression analyses in this article. This article uses the legal perspective to examine renewable energy laws in Taiwan, and uses regression analyses to examine the relationships between politics, economics, and renewable energy development in Taiwan from 1980 to the present. This article uses legal, politic, and economic perspectives as the basis for analysis.

5.2.1 Political parties play active roles in renewable energy development in Taiwan

The “Taiwan Economic Miracle” took place during the 1950s and 1990s, when
economic growth was rapid.\textsuperscript{87} The KMT controlled the central government at that time, and the Taiwanese people believe that the KMT’s policies gave preference to economic development over environmental protection. For instance, the construction plan for the “Fourth Nuclear Power Plant”\textsuperscript{88} was proposed when the KMT controlled the central government.

On the other hand, the Party Charter of the DPP opposes nuclear power plant construction. After the DPP took control of the central government in 2000, the DPP government ended the construction of the “Fourth Nuclear Power Plant.” The Taiwanese people believe that the DPP’s policies give preference to environmental protection over economic development.

Reductions in GHGs\textsuperscript{89} and the promotion of renewable energy development are international issues. Although Taiwan is not a member of UNFCCC,\textsuperscript{90} the Taiwanese government and people have given attention to these issues. Taiwanese politicians have been pushed by these issues to propose policies concerning environmental protection (including GHG\textsuperscript{91} reductions and renewable energy development), such as the research described in the

\textsuperscript{87} I-Lin Yang, Taiwan Economic Miracle, supra note 6.
\textsuperscript{88} Huaxia.com, The Loss for Taiwan Power Company to Cease the Construction of the Fourth Nuclear Power Plant was Amounted to 22 Billion New Taiwan Dollars, http://big5.huaxia.com/xw/twxw/2010/04/1824869.html (last visited Apr. 6, 2010).
\textsuperscript{89} See IPCC AR4 SYR Appendix Glossary, supra note 6.
\textsuperscript{90} “Most countries joined an international treaty – the United Nations Framework Convention on Climate Change (UNFCCC) – to begin to consider how to reduce global warming and to cope with whatever temperature increases are inevitable over a decade ago. A number of nations recently approved the Kyoto Protocol, which has legally binding measures.” See United Nations Framework Convention on Climate Change, Essential Background, http://unfccc.int/essential_background/items/2877.php (last visited Oct. 16, 2010).
\textsuperscript{91} See IPCC AR4 SYR Appendix Glossary, supra note 6.
Chapter 1 to the effect that the two presidential candidates proposed relevant policies during the 2008 presidential election. Therefore, there are no distinguishable differences regarding reductions in GHGs\textsuperscript{92} and renewable energy development policies between the two major parties in Taiwan.

Politicians use the “Renewable Energy Law” as a tool for winning elections. For example, when the DPP was in control from 2000 to 2007, the “Draft of the Renewable Energy Development Act of Taiwan” was passed in 2005. However, if we use empirical data to analyze the supply of renewable energy before and after the passage of the Draft Act in 2005, the growth rate of the supply of renewable energy between 2005 and 2007 (11.96\%)\textsuperscript{93} was lower than the growth rate of the supply of renewable energy between 2000 and 2004 (53.84\%).\textsuperscript{94} Although the average of the ratio of the renewable energy supply to the total supply of energy between 2005 and 2007 (0.016) was higher than the average of the ratio of the supply of renewable energy to the total supply of energy between 2000 and 2004 (0.014),\textsuperscript{95} the growth rate of the ratio of renewable energy supply to the total supply of energy was low (0.002). In other words, the passage of the Draft Act failed to stimulate an increase in the supply of renewable energy, and the problem is that this policy (Draft of the Renewable Energy Development Act of Taiwan) has yet to be objectively assessed. In particular, the

\textsuperscript{92}See IPCC AR4 SYR Appendix Glossary, supra note 6.
KMT and like-minded parties controlled the Legislative Yuan from 2000 to 2007,\textsuperscript{96} and had the political power to pass the “Renewable Energy Development Act of Taiwan.”\textsuperscript{97} The KMT presidential candidate proposed during the 2008 presidential election that the “Renewable Energy Law” would pass in the future because the KMT had the political power to pass the law.

5.2.2 There was no objective assessment of policy prior to the passage of the “Renewable Energy Development Act of Taiwan”

As mentioned above, the passage of the “Draft of the Renewable Energy Development Act of Taiwan” lacked an analytical framework for policy assessment, so the enactment of this policy was rushed. The “Renewable Energy Development Act of Taiwan” does not currently allow for the gathering of a sufficient amount of data that can be used to determine whether or not the passage of the “Renewable Energy Development Act of Taiwan” influenced the supply of renewable energy and the ratio of CO\textsubscript{2} emissions to the population.

The passage of the “Renewable Energy Development Act of Taiwan” was rushed. Taiwan has yet to develop geothermal energy, and ocean-derived energy remains under assessment, but Article 3 of the “Renewable Energy Development Act of Taiwan” includes

\textsuperscript{96} Since the 2001 legislative election, Pan-Blue Coalition (including Kuomintang, People First Party, and New Party) has won half seats in the Legislative Yuan.

\textsuperscript{97} Id.
geothermal energy and ocean energy within the definition of “Renewable Energy.” The regulations of Article 3 are thus idealistic rather than practical. The “InfraVest” case discussed in section 4.1 showed that economic issues can develop out of Article 9 of the “Renewable Energy Development Act of Taiwan.” Article 9 does not regulate the fixed “Wholesale Selling Rate,” but does authorize regulatory agencies to create a committee consisting of representatives from different ministries, experts, and social groups to meet on an annual basis and determine the “Wholesale Selling Rate.” However, this does not mean that the committee that determines the “Wholesale Selling Rate” is satisfied with the current state of renewable energy development in Taiwan. For example, Section 1, Article 9 of the “Renewable Energy Development Act of Taiwan” does not include representatives of corporations.

The passage of the “Renewable Energy Development Act of Taiwan” is beneficial for the development of renewable energy in Taiwan, but the process of passing the “Renewable Energy Development Act of Taiwan” failed to take into account certain practical issues. As a result, regardless of whether the KMT or the DPP controls the central government, future policies regarding renewable energy development should face objective assessment, and amending the insufficiency of regulations in the “Renewable Energy Development Act of Taiwan.”

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98 Law & Regulations Database of the Republic of China, Renewable Energy Development Act of Taiwan, supra note 21.
100 Law & Regulations Database of the Republic of China, Renewable Energy Development Act of Taiwan, supra note 21.
Taiwan” is one practical way to help resolve these issues.

5.2.3 Local government implementation of renewable energy development should be given attention

If we analyze the regression analyses in the Chapters 2 and 3, the variable “Which party wins half of the seats for county magistrates and city mayors in a given year?” is “statistically significant”\(^\text{101}\) with respect to the “Renewable Energy Supply” from 1980 to 1999 and the “Ratio of CO\(_2\) Emissions to the Population” from 2000 to 2007. In other words, when different parties control the central government during different time periods, “Renewable Energy Supply,” “Ratio of Renewable Energy Supply to Total Energy Supply,” and “Ratio of CO\(_2\) Emissions to the Population” will differ depending on which party is in control.

Considering the political influence of “Which party wins half of the seats for county magistrates and city mayors in a given year?” on the “Renewable Energy Supply” and “Ratio of Renewable Energy Supply to Total Energy Supply” shows that Article 110 of the Constitution\(^\text{102}\) and Article 19\(^\text{103}\) of the Local Government Act authorize environmental protection (including the promotion of renewable energy development)\(^\text{104}\) as being a self-government matter that concerns the local governments. Of course, the central

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\(^{101}\) Robert M. Lawless et al., supra note 30, at 426.


\(^{103}\) Law & Regulations Database of the Republic of China, Local Government Act, supra note 36.

\(^{104}\) Law & Regulations Database of the Republic of China, Local Government Act, supra note 36.
government cooperates with the local governments to increase the renewable energy supply. Developing renewable energy requires experts, high technology, and a great deal of money, and the central government has more resources than the local governments for making proper use of resources and for enacting renewable energy policies. In addition, the local governments should play their roles concerning the implementation of renewable energy policies (i.e., legislation and administration) set down by the central government.

For example, the central government attracts investments for renewable energy development, but the local governments help corporations find land where renewable energy stations can be

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105 Article 110, Section 1, Clause 11 of the Constitution regulates that “In the following matters, the hsien (county) shall have the power of legislation and administration…11. Other matters delegated to the hsien (county) in accordance with national laws and provincial self-government regulations.” The term of “national laws” indicates “Article 19 of the Local Government Act,” and Article 19.9 of the Local Government Law regulates that “The self-government matters of counties/cities are as follows:…9. Matters related to health and environmental protection: Health administration in the county/city. Environmental protection in the county/city…” In other words, local governments (counties or cities) shall have the powers necessary to enact self-government regulations and to enforce the use or development of renewable energy (environmental protection). However, the central government is responsible for enacting policies regarding renewable energy. As a result, the central government and local governments shall play their different roles under the laws and cooperate with each other to increase the use and development of renewable energy. See Law & Regulations Database of the Republic of China, Constitution of the Republic of China, supra note 99; Law & Regulations Database of the Republic of China, Local Government Act, supra note 36.

106 Article 7 of the “Renewable Energy Development Act” regulates that government will set up the “Renewable Energy Development Fund” to provide subsidies to private electrical power corporations to purchase electrical power according to the “Wholesale Selling Rate.” The main sources of the “Renewable Energy Development Fund” are electrical charges paid by each household, which causes higher electrical charge to be higher than was the case previously. However, the “Renewable Energy Development Fund” is managed by Ministry of Energy, so the central government has responsibility for allocating these resources to local governments or private sectors for renewable energy development. See Law & Regulations Database of the Republic of China, Renewable Energy Development Act of Taiwan, supra note 21; Chinatimes.com, supra note 74; Bureau of Energy, Ministry of Economic Affairs, Opening Government Information, Laws and Regulations: Regulations of Revenue, Expenditure, Custody, and Operation of Renewable Energy Development Fund, http://www.moeaboe.gov.tw/opengovinfo/Laws/secondaryenergy/LSecondaryMain.aspx?PageId=l_secondary_28 (last visited Oct. 17, 2010).

107 Article 110, Section 1, Clause 11 of the Constitution regulates that “In the following matters, the hsien (county) shall have the power of legislation and administration…11. Other matters delegated to the hsien (county) in accordance with national laws and provincial self-government regulations.” The term of “national laws” within Article 110 of the Constitution points out that “Article 19 of the Local Government Act” regulates that counties or cities’ shall have self-government powers over environmental protection regarding legislation and administration. See Law & Regulations Database of the Republic of China, Constitution of the Republic of China, supra note 99; Law & Regulations Database of the Republic of China, Local Government Act, supra note 36.
constructed and approves their investments in a rapid manner.

On the other hand, if we consider the influence of “Which party wins half of the seats for county magistrates and city mayors in a given year?” on the “Ratio of CO₂ Emissions to the Population,” this article argues that the same relationships exists between “Which party wins half of the seats for county magistrates and city mayors in a given year?” and “Ratio of CO₂ Emissions to the Population.” The result is that the central government cooperates with the local governments in order to reduce CO₂ emissions. The “Taiwan Carbon Label” was launched in March, 2010, and is one part of the policy regarding CO₂ emission reductions that has been promulgated by the central government. However, this policy should be implemented by means of cooperation between the local governments and the central government, and involve self-government matters regarding environmental protection (CO₂ reduction) and consumer protection (purchases of low-carbon products by consumers) on the part of the local governments.

5.2.4 The efficiency of the government should improve

The final edition of the “Renewable Energy Development Act of Taiwan” was passed by the Legislative Yuan in 2009, four years after the “Draft of the Renewable Energy Development Act of Taiwan” was passed by the Legislative Yuan in 2005. The efficiency

108 EpochTimes.com, Taiwan Carbon Label Will Be Launched in March Next Year, supra note 56.
109 Legislative Yuan, Legal System, Legislation Record: Renewable Energy Development Act, supra note 59.
110 Executive Yuan, Draft of the Renewable Energy Development Act of Taiwan (June 14, 2005), supra note 40.
of the central government needs to increase. These arguments mesh with the “Government Effectiveness” score developed by the World Bank. The score decreased from 1.57 in 1996 to 0.88 in 2008, which reflected a decrease of 43.95%. Policy makers should consider the latest knowledge and trends when enacting appropriate policies or regulations concerning renewable energy development.

As regards the role of local government, the regression analyses in this article pointed out that the variable “Which party wins half of the seats for county magistrates and city mayors in a given year?” is statistically significant with respect to the “Renewable Energy Supply” and the “Ratio of Renewable Energy Supply to Total Energy Supply” from 1980 to 1999 and the “Ratio of CO₂ Emissions to the Population” from 2000 to 2007. When the KMT controlled both the central and the local governments from 1980 to 1997, renewable energy technology in Taiwan was not mature, even though the “Energy Management Act” had passed in 1980. When the KMT controlled the central government and DPP controlled the local governments between 1998 and 1999, the DPP implemented its party constitution and self-government policies with respect to environmental protection (renewable energy supply). The technology of renewable energy development between 1998 and 1999 was more mature than was the case between 1980 and 1997. In addition, when the DPP controlled both the

central and local governments from 2000 to 2001, approved foreign investments during 2000 increased 84.37% over 1999. In other words, these investments eventually produced high levels of CO$_2$ emissions despite the DPP’s central government having ceased construction of the Fourth Nuclear Power Plant in 2000.

The central government should enact positive and practical policies and regulations to promote the development of renewable energy, but local governments play an important role in implementing the central government’s policies or regulations and making proper use of their self-government powers to encourage the development of renewable energy in Taiwan. Otherwise, we cannot guarantee that the Bayer situation will not occur again. Although local governments have self-government powers over environmental protection as authorized by Article 110 of the Constitution and Article 19 of the Local Government Act, the central government and the local governments have different perspectives. The different perspectives held by the central government and the local government reduce the overall efficiency of government operations, including those operations that are related to renewable energy development.

6. CONCLUSIONS

115 Encyclopedia of Taiwan, Anti-Bayer Event, supra note 7.
Chapter 1 of this article helps us understand that developing renewable energy is an important election policy for Taiwanese political parties. When a political party becomes the ruling party in the central or local governments, how can we analyze the efficiency of the implementation of their policies renewable energy development regarding renewable energy? Quantitative research is an alternative approach for evaluating renewable energy developments from 1980 to the present when the KMT and DPP were the ruling parties during different periods.

The regression analyses used in this research indicate that the independent variable – “Which party wins half of the seats for county magistrates and city mayors in a given year?” between 1980 and 1999 is statistically significant with respect to the dependent variables “Renewable Energy Supply” and “Renewable Energy Supply/Total Energy Supply,” but the independent variable – GDP (PPP) is statistically significant from 2000 to 2007 with respect to the dependent variables “Renewable Energy Supply” and “Renewable Energy Supply/Total Energy Supply.” In addition, the independent variable of GDP (PPP) during the period from 1980 to 1999 is statistically significant with respect to the dependent variable of “Ratio of CO₂ Emissions to the Population,” but the independent variable – “Which party wins half of the seats for county magistrates and city mayors in a given year?” between 2000 and 2007 is statistically significant with respect to the dependent variable of “Ratio of CO₂ Emissions to the Population.”
Given these findings, we can infer that the development of renewable energy in Taiwan from 1980 to 1999 was led by government policies. More particularly, the local governments (counties/cities) have self-government powers over environmental protection, and the KMT was the ruling party of both the central and local governments at that time. As a result, the central and local governments efficiently enforced coordinated policies for renewable energy. In addition, given the increase in economic development, Taiwan has a high “GDP (PPP)” index, which results from the presence of highly developed industries, business activities, and various types of pollution, all of which involve the consumption of energy. As a result, Taiwan began to develop renewable energy in 2000 and continues this policy. Economic development enhances the development of renewable energy.

This article proposes that future renewable energy development will be decided by the policies of Taiwanese political parties, and future legislation concerning renewable energy should be subject to objective assessment regarding the varieties of renewable energy and the benefits that corporations and investors derive from the “Wholesale Selling Rate.” The regression analyses show that the independent variable “Which party wins half of the seats for county magistrates and city mayors in a given year?” determines the dependent variables the “Renewable Energy Supply,” the “Renewable Energy Supply/Total Energy Supply,” and the “Ratio of CO\textsubscript{2} Emissions to the Population.” Implementation by local governments is thus crucial for the future of renewable energy development in Taiwan. Finally, the central and
local governments should cooperate with each other in a coordinated manner because the efficiency of the government helps determine and promote the future development of renewable energy in Taiwan.

### 7. APPENDIX

#### 7.1 Table 1.3

<table>
<thead>
<tr>
<th>Year</th>
<th>Renewable Energy Supply (kWh)</th>
<th>Ratio of Renewable Energy Supply on Total Energy Supply</th>
<th>CO₂ Emissions to Population (t CO₂ per capita)</th>
<th>GDP (PPP) (billion $)</th>
<th>Which party wins half of the seats for county magistrates and city mayors in a given year?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>N/A</td>
<td>N/A</td>
<td>4.04</td>
<td>59.897</td>
<td>1</td>
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<tr>
<td>1981</td>
<td>N/A</td>
<td>N/A</td>
<td>3.65</td>
<td>69.601</td>
<td>1</td>
</tr>
<tr>
<td>1982</td>
<td>N/A</td>
<td>N/A</td>
<td>3.37</td>
<td>76.413</td>
<td>1</td>
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<tr>
<td>1983</td>
<td>N/A</td>
<td>N/A</td>
<td>3.54</td>
<td>86.044</td>
<td>1</td>
</tr>
<tr>
<td>1984</td>
<td>N/A</td>
<td>N/A</td>
<td>3.68</td>
<td>98.841</td>
<td>1</td>
</tr>
<tr>
<td>1985</td>
<td>N/A</td>
<td>N/A</td>
<td>3.71</td>
<td>106.949</td>
<td>1</td>
</tr>
<tr>
<td>1986</td>
<td>N/A</td>
<td>N/A</td>
<td>4.25</td>
<td>121.873</td>
<td>1</td>
</tr>
<tr>
<td>1987</td>
<td>N/A</td>
<td>N/A</td>
<td>4.46</td>
<td>141.287</td>
<td>1</td>
</tr>
<tr>
<td>1988</td>
<td>N/A</td>
<td>N/A</td>
<td>5.13</td>
<td>157.894</td>
<td>1</td>
</tr>
<tr>
<td>1989</td>
<td>N/A</td>
<td>N/A</td>
<td>5.55</td>
<td>177.706</td>
<td>1</td>
</tr>
<tr>
<td>1990</td>
<td>6765785064</td>
<td>N/A</td>
<td>5.65</td>
<td>195.076</td>
<td>1</td>
</tr>
<tr>
<td>Year</td>
<td>Code</td>
<td>CO2 Emissions (t)</td>
<td>Gdp Per Capita</td>
<td>Party Wins Half Seats</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>--------------</td>
<td>-------------------</td>
<td>----------------</td>
<td>----------------------</td>
<td></td>
</tr>
<tr>
<td>1991</td>
<td>4226448996</td>
<td>0.007</td>
<td>6.06</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td>7068326954</td>
<td>0.01</td>
<td>6.38</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1993</td>
<td>4631503753</td>
<td>0.006</td>
<td>6.8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td>5674928745</td>
<td>0.007</td>
<td>7.13</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>5534314602</td>
<td>0.006</td>
<td>7.41</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>5497315385</td>
<td>0.006</td>
<td>7.72</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>8570828983</td>
<td>0.009</td>
<td>8.25</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td>11222789041</td>
<td>0.011</td>
<td>8.72</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>11383818021</td>
<td>0.011</td>
<td>9.12</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>14150103304</td>
<td>0.013</td>
<td>9.89</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>17408398994</td>
<td>0.015</td>
<td>10.12</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>12231197</td>
<td>0.013</td>
<td>10.43</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>18683320532</td>
<td>0.014</td>
<td>10.92</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>21768689287</td>
<td>0.015</td>
<td>11.28</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>22844309375</td>
<td>0.016</td>
<td>11.54</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>23447082041</td>
<td>0.016</td>
<td>11.85</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>25576655528</td>
<td>0.016</td>
<td>12.08</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>25155968655</td>
<td>0.017</td>
<td>N/A</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>22245035479</td>
<td>0.017</td>
<td>N/A</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Table 1.3 (cont.)


Note: The symbol of N/A means that the data in a given year is not available. The data of “Which party wins half of the seats for county magistrates and city mayors in a given year?” are dummy variable. The value of “0” means there is no party which wins half of the seats for county magistrates and city mayors in a given year. The value of “1” means KMT wins half of the seats for county magistrates and city mayors in a given year. The value of “2” means DPP wins half of the seats for county magistrates and city mayors in a given year.
### 7.2 Table 2.1

Table 2.1  The Correlation Coefficients of the Variables related to the Regression Analysis of the Development of Renewable Energy in Taiwan from 1980 to 1999

<table>
<thead>
<tr>
<th></th>
<th>Renewable Energy Supply (renewa-h)</th>
<th>Renewable Energy Supply/Total Energy Supply (renewa-y)</th>
<th>CO²/Population (co₂-pop-a)</th>
<th>GDP (PPP) (gdppp= n)</th>
<th>Which party wins half of the seats for county magistrates and city mayors in a given year? (whichp-c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable Energy Supply</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(renewablee=h)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renewable Energy Supply/Total Energy Supply</td>
<td>0.9054</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(renewablee-y)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO²/Population</td>
<td>0.8528</td>
<td>0.5570</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(co₂-populat-a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP (PPP)</td>
<td>0.8273</td>
<td>0.5224</td>
<td>0.9970</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>(gdppp= bill-n)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Which party wins half of the seats for</td>
<td>-0.8802</td>
<td>-0.7627</td>
<td>-0.7672</td>
<td>-0.7267</td>
<td>1.0000</td>
</tr>
<tr>
<td>city mayors in a given year?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(whichp-c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
county magistrates
and city mayors in
a given year?

(whichparty~c)

7.3 Table 2.2

Table 2.2  Linear Regression concerning the Renewable Energy Supply and Which party wins half of the seats for county magistrates and city mayors in a given year? from 1980 to 1999

<table>
<thead>
<tr>
<th>Renewable Energy Supply (renewable~h)</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-statistic</th>
<th>P&gt;</th>
<th>[95% Conf. Interval]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which party wins half of the seats for county magistrates and city mayors in a given year? (whichparty~c)</td>
<td>-5.31e+09</td>
<td>1.04e+09</td>
<td>-5.08</td>
<td>0.001</td>
<td>-7.71e+9 to -2.90e+09</td>
</tr>
<tr>
<td>_cons</td>
<td>1.13e+10</td>
<td>9.34e+08</td>
<td>12.11</td>
<td>0.000</td>
<td>9.15e+09 to 1.35e+10</td>
</tr>
</tbody>
</table>
### 7.4 Table 2.3

Table 2.3  Linear Regression concerning the Ratio of Renewable Energy Supply to Total Energy Supply and Which party wins half of the seats for county magistrates and city mayors in a given year? from 1980 to 1999

| Renewable Energy Supply/Total Energy Supply (renewablee~y) | Coefficient | Standard Error | t-statistic | P>|t| | [95% Conf. Interval] |
|---------------------------------------------------------------|-------------|----------------|-------------|-------|---------------------|
| Which party wins half of the seats for county magistrates and city mayors in a given year? (whichparty~c) | -.0037143 | .0011903 | -3.12 | 0.017 | -.006529 to -.0008996 |
| _cons | .011 | .0010498 | 10.48 | 0.000 | .0085177 to .0134823 |

- Number of obs = 9
- F (1, 7) = 9.74
- Prob > F = 0.0168
- R-squared = 0.5818
- Adj R-squared = 0.5220
- Root MSE = 0.00148
7.5 Table 2.5

| CO₂/Population (co₂populat~a) | Coefficient | Standard Error | t-statistic | P>|t| [95% Conf. Interval] |
|-------------------------------|-------------|----------------|-------------|------------------------|
| GDP (PPP) (gdppppbill~n)      | 0.0162469   | 0.005066       | 32.07       | 0.000                  | 0.0151824     | 0.0173113    |
| _cons                        | 2.383252    | 0.1187933      | 20.06       | 0.000                  | 2.133677     | 2.632828     |
### 7.6 Table 3.1

**Table 3.1** The Correlation Coefficients of the Variables related to the Regression Analysis of the Development of Renewable Energy in Taiwan from 2000 to 2007

<table>
<thead>
<tr>
<th></th>
<th>Renewable Energy Supply (renewable~h)</th>
<th>Renewable Energy Supply/Total Energy Supply (renewable~y)</th>
<th>CO\textsubscript{2}/Population (co\textsubscript{2}pop~a)</th>
<th>GDP (PPP) (gdpppp~n)</th>
<th>Which party wins half of the seats for county magistrates and city mayors in a given year? (whichp~c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable Energy Supply (renewable~h)</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renewable Energy Supply/Total Energy Supply (renewable~y)</td>
<td>0.9227</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO\textsubscript{2}/Population (co\textsubscript{2}populat~a)</td>
<td>0.9639</td>
<td>0.8168</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP (PPP) (gdppppbill-n)</td>
<td>0.9426</td>
<td>0.8026</td>
<td>0.9695</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>Which party wins half of the seats for county magistrates and city mayors in a given year? (whichparty~c)</td>
<td>0.2797</td>
<td>0.0629</td>
<td>0.4242</td>
<td>0.2405</td>
<td></td>
</tr>
</tbody>
</table>

### 7.7 Table 3.2

| Number of obs | = 8 |
| F (6, 49) | = 20.55 |
| Prob > F | = 0.0039 |
| R-squared | = 0.8915 |
| Adj R-squared | = 0.8482 |
| Root MSE | = 1.6e+09 |

Table 3.2 Linear Regression concerning the Renewable Energy Supply, Which party wins half of the seats for county magistrates and city mayors in a given year?, and GDP (PPP) from 2000 to 2007

| Renewable Energy Supply (renewable~h) | Coefficient | Standard Error | t-statistic | P>|t| | [95% Conf. Interval] |
|--------------------------------------|-------------|----------------|-------------|--------|---------------------|
| Which party wins half of the seats for county magistrates and city mayors in a given year? (whichparty~c) | 2.63e+08 | 7.08e+08 | 0.37 | 0.726 | -1.56e+09   2.08e+09 |
| GDP (PPP) (gdppppbill~n) | 4.21e+07 | 6869880 | 6.12 | 0.002 | 2.44e+07   5.97e+07 |
| _cons | -3.40e+09 | 3.68e+09 | -0.92 | 0.398 | -1.29e+10   6.07e+09 |
7.8 Table 3.3

Table 3.3 Linear Regression concerning the Ratio of Renewable Energy Supply to Total Energy Supply, Which party wins half of the seats for county magistrates and city mayors in a given year?, and GDP (PPP) from 2000 to 2007

<table>
<thead>
<tr>
<th>Renewable Energy Supply/Total Energy Supply (renewable~y)</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-statistic</th>
<th>P</th>
<th>t</th>
<th>[95% Conf. Interval]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which party wins half of the seats for county magistrates and city mayors in a given year? (whichparty~c)</td>
<td>-.0001997</td>
<td>.0003873</td>
<td>-0.52</td>
<td>0.628</td>
<td>-0.0011953</td>
<td>.0007958</td>
</tr>
<tr>
<td>GDP (PPP) (gdppppbill~n)</td>
<td>.0000117</td>
<td>3.76e-06</td>
<td>3.12</td>
<td>0.026</td>
<td>2.07e-06</td>
<td>.0000214</td>
</tr>
</tbody>
</table>

Number of obs = 8
F (2, 5) = 4.90
Prob > F = 0.0664
R-squared = 0.6621
Adj R-squared = 0.5269
Root MSE = .00088
7.9 Table 3.4

Table 3.4  Linear Regression concerning the CO₂/Population, Which party wins half of the seats for county magistrates and city mayors in a given year?, and GDP (PPP) from 2000 to 2007

| CO₂/Population (CO₂/Population) | Coefficient | Standard Error | t-statistic | P>|t| | 95% Conf. Interval |
|--------------------------------|-------------|----------------|-------------|------|------------------|
| Which party wins half of the seats for county magistrates and city mayors in a given year? (Whichparty~c) | .1853277 | .0615713 | 3.01 | 0.030 | .0270537 .3436017 |
| GDP (PPP) (GDPPPPPBill~n) | .0081681 | .0005976 | 13.67 | 0.000 | .006632 .0097043 |
| _cons | 6.324143 | .3204345 | 19.74 | 0.000 | 5.50044 .7147846 |
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