



The Effect of Interest in Renewable Energy on US Household Electricity Consumption: An Analysis Using Google Trends

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1. Introduction

- As the penetration rate of computers and smartphones increases, real-time search is becoming possible and obtaining information through Internet searching is rising in popularity
- However, traditional economic and business models rely on the statistics gathered by government data, annual/quarterly reports, and financial statements
- This limits the usefulness of forecasting, especially making novel forecasts, as we can only construct an economic model by using data from a month or a quarter ago (Wu and Brynjolfsson, 2009)
- However, by using related technologies such as Google Trends, we can obtain such information with no time delay, although only for short-term analysis

1. Introduction

- **Google Trends**
 - It shows the search frequency of a keyword globally in real time
 - As Google Trends can use information that has not yet been announced, its data can predict the present
 - For example, recent research using Google Trends has forecast the flu several days before it really happens (Ginsberg et al. 2009)
 - Therefore, if the search frequency is more influential than the existing independent variables, researchers should consider constructing a model based on the frequency of Internet-based searches
- **In this study, we analyze the correlation between interest in US renewable energy and US household electricity consumption by using Google Trends**

2. Methodology

- **Data**
 - Use monthly data on all the states in the United States (51 units including the 50 states and the District of Columbia) from September 2013 to June 2016

Variable	Mean	Std. Dev.	Min	Max
Household electricity consumption (million kWh)	2253.457	2367.554	124.487	17143.150
Price (cents/kWh)	13.125	4.098	7.700	38.270
HDD	171.182	196.030	0.000	942.000
CDD	108.685	125.153	0.000	644.000
"renewable"	36.424	17.720	3.000	100.000
"temperature"	68.254	14.857	28.000	100.000
"weather forecast"	44.557	16.226	12.000	100.000

2. Methodology

- **Panel analysis**

$$E_{i,t} = \alpha + \beta_1 P_{i,t} + \beta_2 HDD_{i,t} + \beta_3 CDD_{i,t} + \beta_4 RE_{i,t} + \mu_i + e_{i,t}$$

$$E_{i,t} = \alpha + \beta_1 P_{i,t} + \beta_2 HDD_{i,t} + \beta_3 CDD_{i,t} + \beta_5 WF_{i,t} + \mu_i + e_{i,t}$$

$$E_{i,t} = \alpha + \beta_1 P_{i,t} + \beta_2 HDD_{i,t} + \beta_3 CDD_{i,t} + \beta_6 T_{i,t} + \mu_i + e_{i,t}$$

- Temperature has been considered to be the most important variable when electricity is used for heating
- We chose “renewable” as a keyword for two reasons
 - the growing interest in renewable energy
 - some end users are not only consumers but also producers
- “weather forecast” and “temperature” were selected as Google search keywords

2. Methodology

- **Panel unit root test**
 - IPS(Im–Pesaran–Shin) test
 - Fisher-type test
- **When estimating static energy demand models by panel analysis, it is common to explain unobserved heterogeneity by using fixed or random effects**
- **Conduct a panel analysis on the unobserved heterogeneity by using the Hausman test**

3. Empirical results

- Unit root test result

Variable	IPS	Fisher-ADF*	Fisher-PP*
Household electricity consumption	-20.735***	-26.330***	-15.491***
Price	-8.293***	-17.047***	-10.079***
HDD	-22.089***	-23.752***	-13.235***
CDD	-23.682***	-21.094***	-17.088***
“renewable”	-16.045***	-19.584***	-21.485***
“temperature”	-18.926***	-18.082***	-21.474***
“weather forecast”	-20.899***	-20.734***	-20.748***

Note: * denotes the inverse normal Z statistic

*** (**) denotes statistical significance at the 1% (5%) level

- Hausman test results

Variable	“renewable” model	“temperature” model	“weather forecast” model
Hausman statistic	66.68***	18.96***	29.03***

3. Empirical results

- Fixed effect results choosing the “renewable” keyword

HOUSEHOLD ELECTRICITY CONSUMPTION	COEF.	<i>t</i> -STATISTIC	<i>P</i> > <i>t</i>
PRICE	-14.604	-1.11	0.266
HDD	1.850	19.56	0.000***
CDD	2.522	15.21	0.000***
“RENEWABLE”	-16.017	-13.68	0.000***
CONSTANT	2437.807	13.08	0.000***

Note: *** (**) denotes statistical significance at the 1% (5%) level

- Fixed effect results choosing the “temperature” keyword

Household electricity consumption	Coef.	<i>t</i> -statistic	<i>P</i> > <i>t</i>
Price	-11.498	-0.83	0.406
HDD	2.218	20.99	0.000***
CDD	3.532	22.43	0.000***
“temperature”	-2.542	-2.14	0.032**
Constant	1814.357	9.09	0.000***

Note: *** (**) denotes statistical significance at the 1% (5%) level

3. Empirical results

- Fixed effect results choosing the “weather forecast” keyword

Household electricity consumption	Coef.	<i>t</i> -statistic	<i>P</i> > <i>t</i>
Price	-12.727	-0.92	0.359
HDD	2.129	20.89	0.000***
CDD	3.609	23.21	0.000***
“weather forecast”	0 .007	0.01	0.994
Constant	1663.447	8.77	0.000***

Note: *** (**) denotes statistical significance at the 1% (5%) level

4. Conclusions

- **Focuses on the correlation of Google Trends, not the price elasticity**
- **Solve the problem that we could not explain due to no quantitative data despite the interest in renewable affected the electricity consumption**
- **Although the electricity consumption patterns of households are influenced by many variables, this study suggests that interest in renewable energy should also be included as a major factor influencing consumption**
- **As searches for “renewable” increases and interest rises, electricity consumption tends to be replaced by renewable energy, reducing total household electricity consumption**
- **If the use of Google search and the cumulative period increases, it may be possible to adopt clearer and more diverse search keywords for the analysis**

Thank you



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