The Effects of Google Trends Data on Household Electricity Consumption

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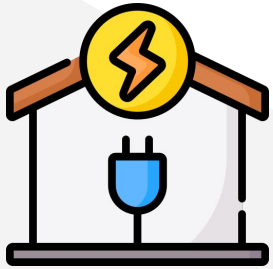

EE 406 : Contemporary Economic Issues

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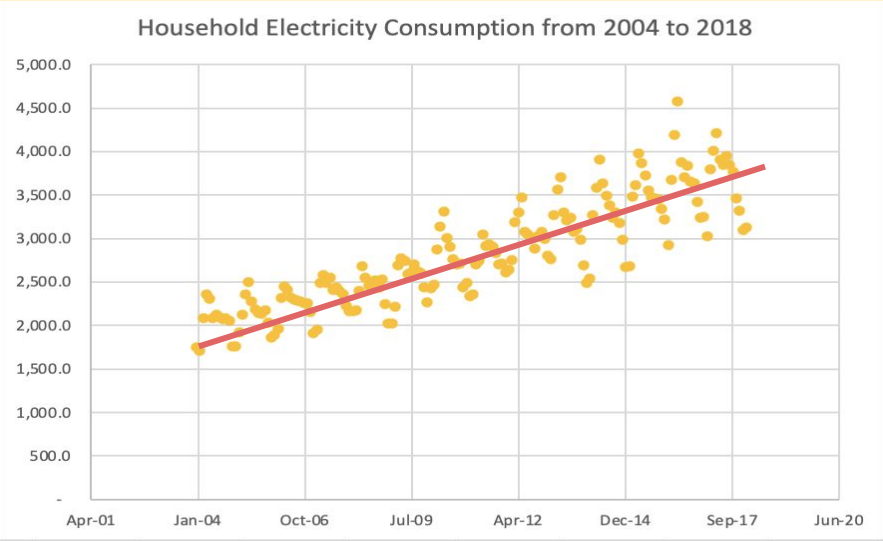
Household Electricity Consumption has been increasing over the past years.

Thailand's Figure

- The overall electricity consumption in the household was **35,624.37 GWh** in the year **2018.**
- The trend of household electricity consumption is **upward sloping**.



Note that the figure has been reclassified by the Metropolitan and Provincial Electricity Authorities according to the volume of consumption (load pattern), effective December 1991.

Facts about the electricity consumption of Thai households from the provincial electricity usage database

1. Determinants of household electricity consumption

- Household electricity consumption varies with temperature, seasons, and income level.
- The level of electricity consumption in population density (urban) areas is higher than that in rural areas. Tourist attraction areas have the highest electricity consumption.

2. Disparity

- The disparity in electricity usage continues to rise, especially in population density (urban) and tourist attraction areas.

3. Price Elasticity

- Households that use a lot of electricity (high income) have lower price elasticity than households that use less electricity (low income).

The information of conventional and alternative indicators is collected from two sources of data.

Household Electricity Index

Household electricity index . Bank of Thailand (statistical data). (n.d.). https://www.bot.or.th/App/BTWS_STAT/statistics/BOTWEBSTAT.aspx?reportID=108&language=ENG

The determination of keyword research is based on **three structural factors** that statistically influence the energy consumption in the residential sector:

- The number of end use of electricity consumption
- The number of residential in the house
- The number of floor in the house

Google Trends Index (13 Keywords)

ร้อน, พัดลม, โทรทัศน์, ประหยัดไฟ, เบอร์5, ไฟฟ้า, หม้อหุงข้าว, หม้อหุงข้าวไฟฟ้า, เครื่องทำน้ำอุ่น, คอม, เครื่องปรับอากาศ, ค่าไฟฟ้า, ค่าไฟ

Step-by-step Process by using Four Analytical Methodologies

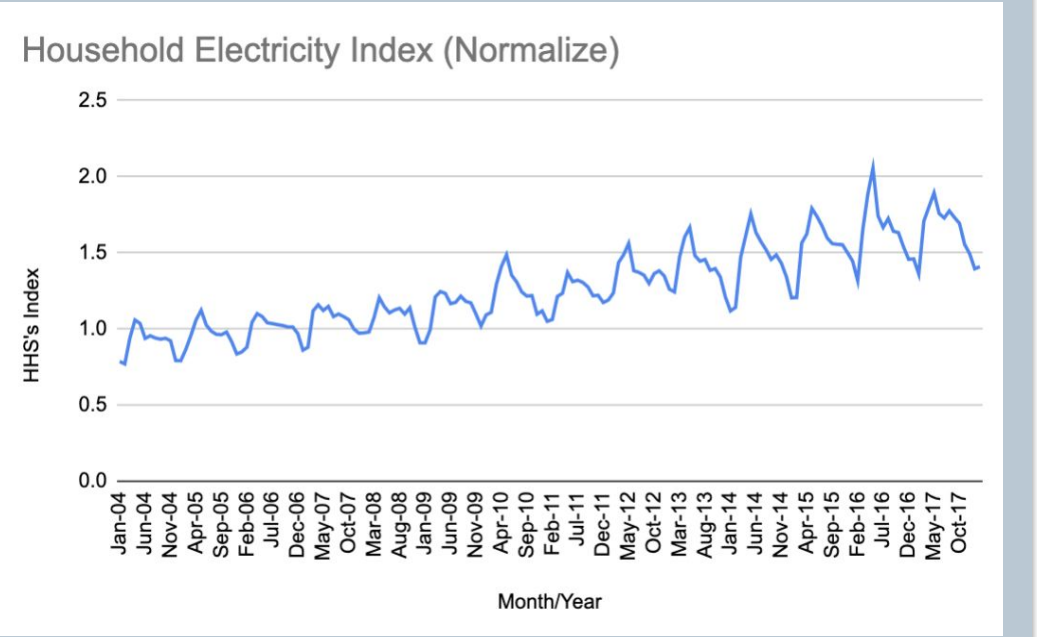
- **Google Trends** → gained insights from search trends feature that show how frequently the given **13 search terms** are entered into Google's search engine relative to the site's total search volume over a given period of time.

- **Google Mobility** → analyzed movement trends of workplace and residential in Thailand

- **Microsoft Excel** → normalized the data from the base year (Nov, 2007)

- **STATA** → analyzed the OLS regression results and scatter plot

The overall electricity consumption in households has been increasing over the decade.

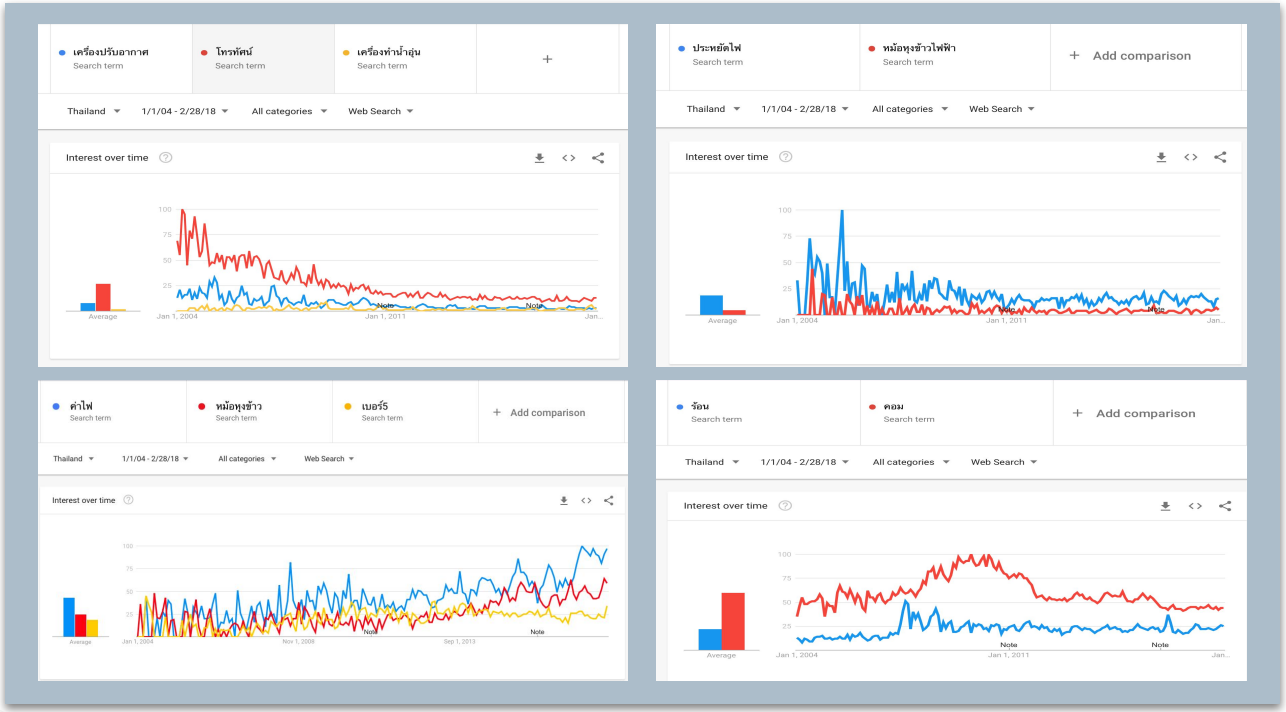


Time period : 2004 to 2021

- Household electricity consumption reach its peak during summer than during other times of the year.
- Overall, the index has been doubling within 18 years.

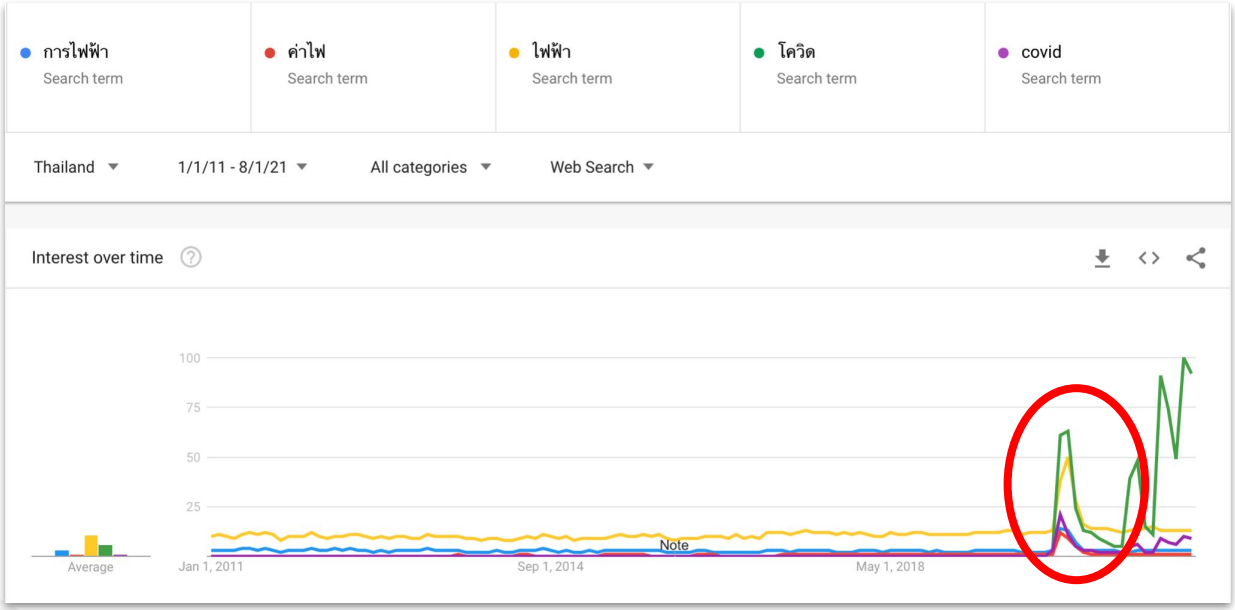
Although only some alternative indicators have the same patterns to each other, the conventional indicator has a positive correlation with all of them.

(as shown in the part of the STATA result)



Time period : 2004 to 2021

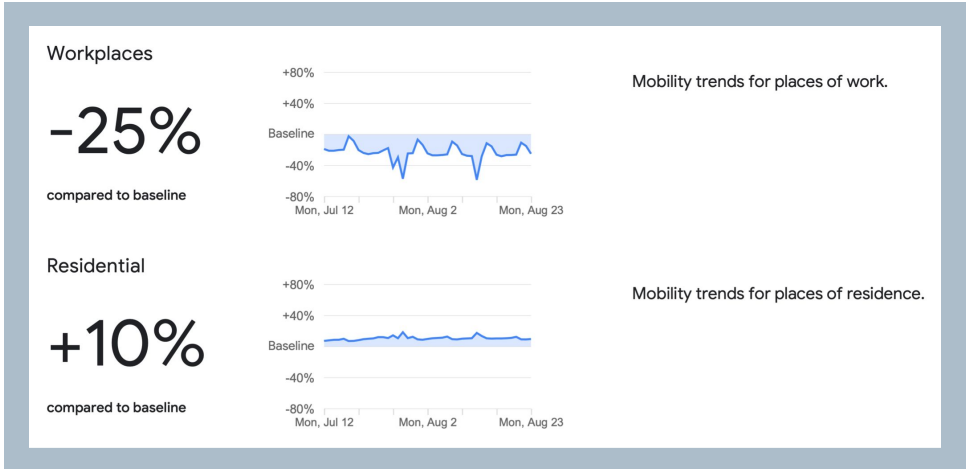
Search terms related to electricity has become a popular trend during the COVID-19 pandemic



Time period : 2011 to 2021

- During the COVID-19 pandemic, the trends in search terms related to electricity have been ***increasing*** as more people are interested in the factors of household electricity consumption.
- As a result, an increase in electricity consumption leads to higher expenditure; this causes ***negative impacts***, to everyone, including educational sector.

With greater use of electrical appliances, the COVID-19 pandemic led to a surge in the longer term use of household electricity for working and studying from home due to the social distancing norms.



Mobility trends for places of residence and work

- The ‘Workplaces’ category shows that the number of visitors to workplaces has ***decreased by 25%*** compared to baseline.
- The ‘Residential’ category shows that the duration of time spent at home has ***increased by 10%*** compared to baseline.

Simple Regression Model by using the OLS method

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_{13} X_{13} + \varepsilon$$

where Y = Household Electricity Index (Conventional Indicator)

$X_1, X_2, X_3, \ldots, X_{13}$ = 13 Keywords Index (Alternative Indicators)

β_0 = Y Intercept or Constant

$\beta_1, \beta_2, \beta_3, \ldots, \beta_{13}$ = Coefficients

Highly positive linear relationship between conventional and alternative indicators

Source	SS	df	MS		
Model	11.5121454	13	.885549646	Number of obs	= 170
Residual	1.27274281	156	.008158608	F(13, 156)	= 108.54
				Prob > F	= 0.0000
				R-squared	= 0.9004
				Adj R-squared	= 0.8922
Total	12.7848882	169	.075650226	Root MSE	= .09033

hhssindex	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
รอนsIndex	-.0733693	.0428344	-1.71	0.089	-.1579795	.011241
พลลมsIndex	.1512574	.0159703	9.47	0.000	.1197115	.1828033
โทรทศนsIndex	-.0813352	.0332258	-2.45	0.015	-.1469657	-.0157047
ประหยดไฟsIndex	.0257998	.0198204	1.30	0.195	-.0133513	.0649509
เบอร5sIndex	.0113444	.007238	1.57	0.119	-.0029527	.0256416
ไฟฟาsIndex	-.1509371	.0523102	-2.89	0.004	-.2542647	-.0476094
หมอหงขาวsIndex	.0324259	.0161872	2.00	0.047	.0004516	.0644002
หมอหงขาวไฟฟาsIndex	-.0801554	.0337732	-2.37	0.019	-.1468672	-.0134436
เครองทอนอซนsIndex	-.1723391	.0300671	-5.73	0.000	-.2317303	-.112948
คอมsIndex	-.1167876	.034229	-3.41	0.001	-.1843998	-.0491754
เครองปรบอากาศsIndex	-.0321725	.0153084	-2.10	0.037	-.062411	-.001934
คาไฟฟาsIndex	.064338	.0276917	2.32	0.021	.0096389	.1190371
คาไฟsIndex	.0442536	.0087963	5.03	0.000	.0268784	.0616289
_cons	1.276493	.0620826	20.56	0.000	1.153862	1.399124

Base year : Nov 2007

Time period : Jan 2004 - Feb 2018

- **R-squared = 0.9004** (very close to 1) means that about 90.04% of variation in the conventional indicator is explained by variation in alternative indicators.
- This implies that conventional and alternative indicators are a **better fit**.
- Overall, the slope coefficients are **statistically significant** at 0.05 level since they are different from zero.

The keyword “พัดลม” (Fan) is the most influential indicator, followed by “ค่าไฟ” (Electricity Price) and “โทรทัศน์” (Television) respectively

```
. reg hhssindex พดลมsIndex

      Source |       SS       df       MS              Number of obs   =       170
-------------+------------------------------           F(1, 168)       =    344.21
       Model |  8.59157516     1  8.59157516            Prob > F        =    0.0000
    Residual |  4.19331305   168  .024960197           R-squared       =    0.6720
-------------+------------------------------           Adj R-squared   =    0.6701
       Total |  12.7848882   169  .075650226           Root MSE        =    .15799

------------------------------------------------------------------------------
   hhssindex | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
พดลมsIndex |   .3261047   .017577    18.55   0.000     .2914045    .360805
       _cons |   .8473931   .0256512   33.04   0.000     .7967528    .8980333
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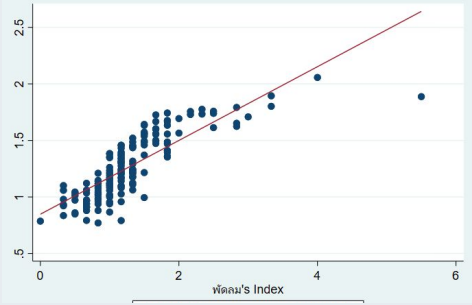

By using only the keyword “พัดลม,” the value of R-squared is already 0.672 or 67.2%, implying that it is quite fit in the regression model.

```
. reg hhssindex ค่าไฟsIndex

      Source |       SS       df       MS              Number of obs   =       170
-------------+------------------------------           F(1, 168)       =    311.44
       Model |  8.30499399     1  8.30499399            Prob > F        =    0.0000
    Residual |  4.47989421   168  .026666037           R-squared       =    0.6496
-------------+------------------------------           Adj R-squared   =    0.6475
       Total |  12.7848882   169  .075650226           Root MSE        =    .1633

------------------------------------------------------------------------------
   hhssindex | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
ค่าไฟsIndex |   .1499998   .0084996    17.65   0.000      .13322    .1667797
       _cons |   .8530302   .0265841   32.09   0.000     .8005483    .9055122
------------------------------------------------------------------------------
```

```
. reg hhssindex โทรทัศนsIndex

      Source |       SS       df       MS              Number of obs   =       170
-------------+------------------------------           F(1, 168)       =    181.68
       Model |  6.64254456     1  6.64254456            Prob > F        =    0.0000
    Residual |  6.14234365   168  .036561569           R-squared       =    0.5196
-------------+------------------------------           Adj R-squared   =    0.5167
       Total |  12.7848882   169  .075650226           Root MSE        =    .19121

------------------------------------------------------------------------------
   hhssindex | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
โทรทัศนsIndex |  -.414304   .0307372   -13.48   0.000    -.4749849   -.3536231
       _cons |   1.551992   .0257406    60.29   0.000     1.501175    1.602809
------------------------------------------------------------------------------
```

Base year : Nov 2007

Time period : Jan 2004 - Feb 2018

Google Trends Data can be used for the prediction of Household Electricity Consumption

1	**The seasonal factor influences the price level of electricity.** The higher use of electricity corresponds to the higher search of terms related to electricity. For example, the prices of electricity increase during Summer, especially in April.
2	**Adding more alternative indicators to the regression model tends to increase the accuracy of the test.** Using only three keywords which are "**พัดลม**," "**ค่าไฟ,**" and "**โทรทัศน์**" would reflect a bias of this analysis so other effective indicators related to electricity should be included.
3	**Household electricity consumption is continuously increasing even after the COVID-19 pandemic.** The industrialization process develops quickly. Based on geographical distribution of Thai households, more and more people in rural areas are getting access to electricity which improves socio-economic conditions, e.g., poverty, in the country.

Summary and Policy Recommendation

Subsidies :

- reduce the initial investment cost for energy efficiency changes in a household, such as offering tax deductions for more efficient appliances.

- to education during lock-down period, allowing students to get access to internet and devices.

Standards :

- set out a minimum level of energy efficiency, such as minimum requirements for thermal insulation in a home.

Taxes :

- can be used to penalise the use of inefficient technologies.

Poor Supports :

- distribute electrical appliances for the poor

Research & Development (R&D) :

- reduce the cost of electrical products and save electricity or energy conservation