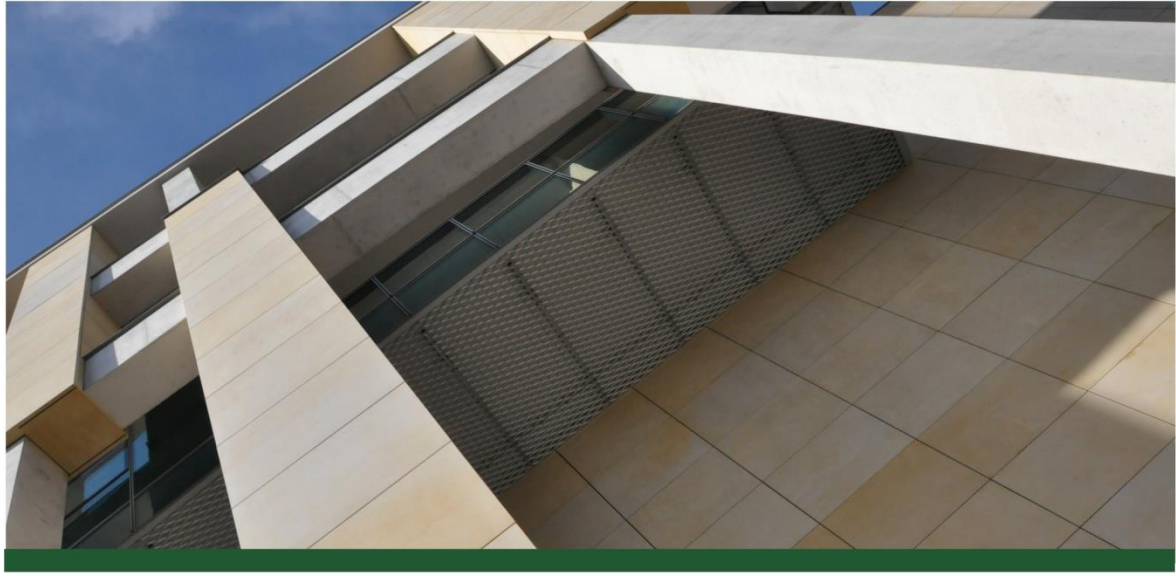

POZNAŃ UNIVERSITY OF ECONOMICS AND BUSINESS

What drives the share of renewable energy in gross final energy consumption in the European Union?

Klaudia Jarno, PhD

The 6th International Conference on Applied Research in Economics
National Research University – Higher School of Economics
Perm, the 21st of September, 2018

Motivation and the research's goal

Ambitious climate change policy implemented by the European Union i.e. adoption of the climate and energy package in 2009 that stipulates legally binding national targets for the share of energy from renewable sources in gross final energy consumption in 2020

The main purpose of the paper:

To examine the relationship between energy prices and share of renewables in gross final energy consumption in EU countries under different energy imports reigimes

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Literature review

Author [year]	Countries	Years	Method	Findings
Sadorsky (2009)	G7 countries	1980-2005	Panel cointegration techniques	GDP, carbon dioxide emissions – positive impact on RE consumption Oil prices – negative impact on RE consumption
Sadorsky (2009)	18 emerging countries	1994-2003	Panel cointegration techniques	GDP – positive impact on RE consumption
Chang et al. (2009)	OECD members	1997-2006	Panel data threshold regression model	Existence of GDP threshold for an influence of energy prices increases on the contribution of renewable energy to energy supply
Apergis and Payne (2010)	20 OECD countries 13 countries in Eurasia	1985-2005	Multivariate panel data framework	Long-run positive relationship between GDP and RE consumption in both the short- and long run
Omri and Nguyen (2014)	Global panel of 64 countries	1990-2011	Dynamic system-GMM panel data model	Positive relationship between carbon dioxide emissions, trade openness, and RE consumption

Method

Non-dynamic panel threshold regression model with individual-specific fixed effects as proposed by Hansen (1999)

$$RES_{it} = \mu_i + \beta_1' GDP_{it} + \beta_2' EIS_{it} + \beta_3' HICP_{it} I(EIS_{it} \leq \gamma) + \beta_4' HICP_{it} I(EIS_{it} > \gamma) + e_{it}$$

Dependent variable: annual share of renewables in gross final energy consumption (RES_{it})

Independent variables:

- Annual economic growth (GDP_{it})
- Energy imports as % of energy use (EIS_{it})
- HICP as it relates to energy ($HICP_{it}$)

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Method: developing a single threshold model (Hansen1999)

- Equivalent representation

$$HICP_{it}(\gamma) = \begin{pmatrix} HICP_{it} I(EIS_{it} \leq \gamma) \\ HICP_{it} I(EIS_{it} > \gamma) \end{pmatrix}, \beta' = (\beta_3' \ \beta_4')$$

$$RES_{it} = \mu_i + \beta_1' GDP_{it} + \beta_2' EIS_{it} + \beta' HICP_{it}(\gamma) + e_{it}$$

- Fixed-effects transformation

$$\overline{RES}_{it} = \mu_i + \beta_1' \overline{GDP}_{it} + \beta_2' \overline{EIS}_{it} + \beta' \overline{HICP}_{it}(\gamma) + e_{it}$$

$$RES_{it}^* = \beta_1' GDP_{it}^* + \beta_2' EIS_{it}^* + \beta' HICP_{it}^*(\gamma) + e_{it}$$

- Estimated of slope coefficients by ordinary least squares (OLS)

$$S_1(\gamma) = \hat{e}^*(\gamma)' \hat{e}^*(\gamma)$$

- Estimation of γ by minimization of the concentrated sum of squared errors $S_1(\gamma)$

$$\hat{\gamma} = \min_{\gamma} S_1(\gamma)$$

Method: determining whether the threshold effect is statistically significant (Hansen 1999)

- H_0: $\beta_3 = \beta_4$ -> no threshold -> non-standard distributions of classical tests
- Using bootstrap to simulate the asymptotic distribution of the likelihood ratio test

$$F_1(\gamma) = \frac{S_0 - S_1(\hat{\gamma})}{\hat{\sigma}^2}$$

- Forming confidence intervals for γ by forming the no-rejection region using the likelihood ratio statistic for tests on γ

$$H_0: \gamma = \gamma_0$$

$$LR_1(\gamma) = \frac{S_1(\gamma) - S_1(\hat{\gamma})}{\hat{\sigma}^2}$$

- The inverse of the distribution function

$$c(\alpha) = -2\log\left(1 - \sqrt{1-\alpha}\right)$$

The 5% critical value is 7.35.

Data

- Countries: all EU member states (28 countries)
- Time frame: 2006 – 2014 (252 observations in total)
- Data sources: Eurostat and World Bank Indicators databases

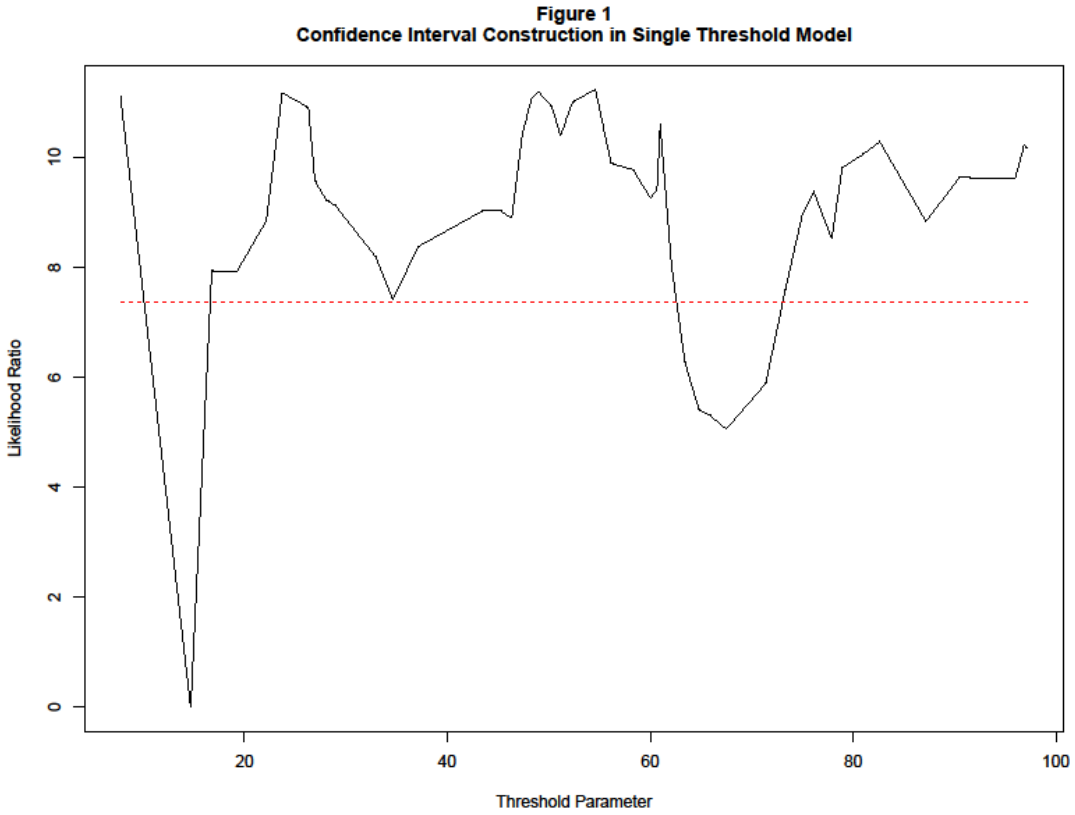
Findings: summary statistics

Variable	Mean (%)	Standard deviation	Minimum (%)	Maximum (%)	Jarque-Bera test (p-value)
Share of renewables in final energy consumption	15.80675	11.15021	0.1	52.5	47.062 (0.0000)
Economic growth	1.31627	4.039863	-14.8	11.9	74.501 (0.0000)
HICP of energy	4.142175	7.375378	-15.66976	32.40495	1.1052(0.5755)
Energy imports	53.77481	28.46848	-45.86116	99.92259	14.85 (0.0006)

Source: author's own computation based on Eurostat and World Bank data.

Findings: threshold estimate

Threshold parameter	Estimate	95% confidence interval	$F(\gamma)$ (10%, 5%, 1% critical values)
$\hat{\gamma}$	14.70555	14.70555, 71.38626	11.31444 (9.8046, 10.5498, 13.5624)



Findings: regression estimates

Variable	Coefficient	OLS standard error	White standard error
GDP_{it}	-0.198107***	0.036627	0.041784
EIS_{it}	-0.006655	0.028074	0.047353
$HICP_{it}I(EIS_{it} \leq \gamma)$	-0.048514**	0.021361	0.020558
$HICP_{it}I(EIS_{it} > \gamma)$	0.354037**	0.128080	0.136196

*, **, and *** denote statistical significance at respectively 10%, 5%, and 1% levels
Source: author's own computation based on Eurostat and World Bank data

Conclusions

- Existence of energy imports threshold that affects the influence of increasing energy prices on the share of renewables

- The empirical findings suggest countries that are dependent on foreign energy sources can make use of carbon tax as the tool of promoting renewable energy sources

- Avenues for further research: including other variables (carbon dioxide emissions statistically insignificant in the EU in the given period), estimation of a double-thereshold panel data regression model

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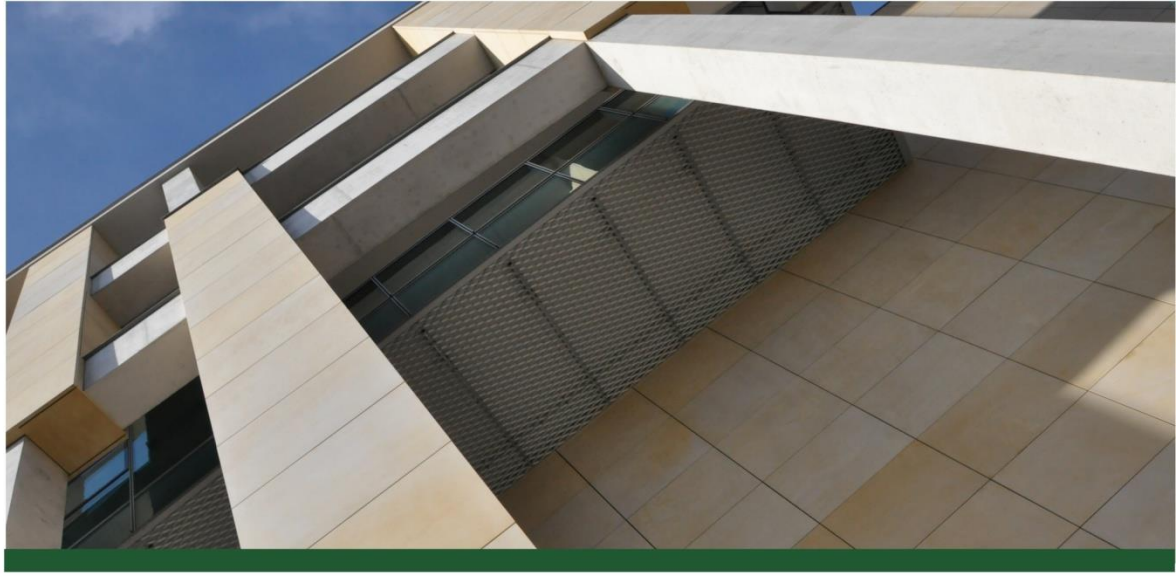

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