

Gender of Legislators and Renewable Energy

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Motivation

- ▶ Fossil fuel combustion and industrial processes accounts for 78% of the total CO₂ emission for the period 2000-2010 (IPCC, 2014)
- ▶ Decarbonize through large-scale renewable production is key
 - ▶ “ ...the most feasible adaptation options.... Energy generation diversification, including with renewable energy resources and generation that can be decentralised depending on context (e.g., wind, solar, small scale hydroelectric)...” (IPCC, 2022).
- ▶ 74 countries committed to have some percentage of their energy production based only on renewable sources (Raturi, 2019)
- ▶ Study whether having more females policymakers encourages the renewable energy production and investment

Motivation

My hypothesis is based in 2 big blocks:

- ▶ 1) Literature suggest that women:
 - ▶ Care more about the environment: World Value Survey; Mavisakalyan and Tarverdi (2019); Funk and Gathmann (2015); Pearl-Martinez (2014); Shrimali and Kniefel (2011); Ergas and York (2012); McCright (2010); Norgaard and York (2005)
 - ▶ Pass more environmental policies: Fredriksson and Wang (2011); Chattopadhyay and Duflo (2004); Duflo et al. (2004)
 - ▶ Support more public goods: Clots-Figueras (2011); Chattopadhyay and Duflo (2004); Duflo et al. (2004)
 - ▶ Have lower risk preferences: Xiao and McCright (2012)

Motivation

- ▶ 2) Government intervention through regulatory policies and fiscal incentives is the main contributor for the deployment of renewable energy: Crossley (2019)); Liu et al. (2019); Adelaja et al. (2010); Kilinc-Ata (2016); Shrimali and Jenner (2013); Shrimali and Kniefel (2011); Johnstone et al. (2010); Carley (2009); Menz and Vachon (2006)

F.I.T

Hypothesis: women in the Parliament advocate for having more of a specific public good: renewable energy production.

Contribution

- ▶ Literature on the impact of female legislators on large-scale of R.E production “unexplored area” (IPCC, 2014)
- ▶ Decarbonize - through large-scale R.E production can be done more rapidly than in other sectors (IPCC, 2014)
- ▶ It builds up on other cross-country analysis that link women in the parliament with more humanitarian military intervention (Shea & Christian, 2017), stricter climate change policies (Mavisakalyan & Tarverdi, 2019), lower CO2 emissions (Ergas & York, 2012), more protected areas (Pearl-Martinez, 2014), more environmental agreements (Norgaard & York, 2005), more health-expenditure by the government (Clayton & Zetterberg, 2018), more spending on child-care (Weeks, 2019), less corruption and bribe acceptance (Dollar et al., 2001; Swamy et al., 2001)

Data

- ▶ Panel data: for a sub-sample of high-income (W.B) countries for the years: 1990, 1997-2015. Countries
 - ▶ These countries account for 56.19% of the total production of renewable energy (Ritchie, 2017)
 - ▶ Robustness check: Brazil, China and India accounts for 91.26% of the total production of renewable energy (Ritchie, 2017)
- ▶ Two main dependent variables:
 1. Electricity production without hydropower ¹
 2. Change in the net electrical capacity installed - proxy for investment Verdolini et al. (2018)

Data

¹Geothermal, solar, tides, wind, biomass, and biofuels

Descriptive Statistics

	Mean	S.D	Min.	Max
Pct. Ren. energy NH	5.543	7.775	0	65.444
Pct. Ren. ene. prod.	26.876	29.662	0	99.88
Δ Net elect. cap.	0.01	0.014	-0.10	0.11
Quota law	0.152	0.359	0	1
Pct. women leg.	21.4	10.794	1.4	47.3
Log GDP p/c	10.252	0.631	8.309	11.626
Type of party	1.889	0.921	1	3
Right wing	0.485	0.5	0	1
Center wing	0.140	0.348	0	1
Left wing	0.375	0.484	0	1
Civil liberties	1.319	0.537	1	4
Parliamentary	0.799	0.401	0	1
Years since WS	70.82	20.045	14	122

Methodology

My econometric specification is the following (IV - Fixed effects panel):

$$W_{it} = \alpha'_0 + \delta'_i + \gamma'_t + \beta' X_{it} + \phi Z_{it} + \eta_{it} \quad (1)$$

And the second stage:

$$y_{it} = \alpha_0 + \delta_i + \gamma_t + \beta X_{it} + \rho \hat{W}_{it} + \epsilon_{it} \quad (2)$$

- ▶ y_{it} percentage of renewable energy production without hydropower
- ▶ \hat{W}_{it} proportion of women in the Parliament
- ▶ Z_{it} passing a quota law - years since women's suffrage
- ▶ ϵ_{it} cluster at country level
- ▶ P-values via bootstrap

Instrument N¹

- ▶ Why IV? - Endogeneity problem: Women prefer more renewable energy or countries that prefer more renewable energy are also more likely to elect women to the parliament?
- ▶ I only considered quotas that specify a % of seats for females²

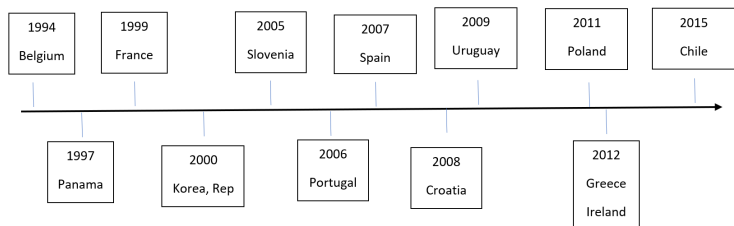


Figure 1: Quota Law

²Eliminate Italy - "male/females should have equal opportunities" (IDEA 2020)

Instrument N¹

IV - Quota law

- ▶ **First Stage**: $Cov(W_{it}, Z_{it}) \neq 0$ Positive and significant: 2.44**
- ▶ Exclusion restriction:
 - ▶ Instrument be as good as randomly assigned, $[E(\epsilon_{it}Z_{it}) = 0]$
 - ▶ Instrument can only affect the % of renewable electricity output by the variable we want to instrument - proportion of women in the parliament.

Results

Percentage of Renewable Energy production (No hydropower)

Prop. Women Parliament	1.33*** (0.748) [0.002]	1.46** (0.739) [0.039]	1.46** (0.761) [0.041]	1.64** (0.875) [0.031]
Log GDP per capita		-8.81 (6.516) [0.109]	-8.95 (6.764) [0.119]	-8.62* (7.518) [0.081]
Right Wing			0.427 (0.905) [0.535]	0.29 (0.951) [0.682]
Center Wing			0.55 (1.516) [0.708]	0.65 (1.628) [0.641]
Civil Liberties				2.87** (2.01) [0.025]
Country fixed effects	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y
N	704	704	704	704

Results

- ▶ I do the same regression but Y_{it} : Renewable electricity production with hydropower - WB (2020) [Results](#)
 - ▶ 1.21* - smaller but significant
 - ▶ Consistent: hydropower is considered a mature energy source
- ▶ I also test whether having more women in the legislature has a more pronounced effect for Parliamentary rather than Presidential regimes -
 - ▶ Similar point estimate: 1.89** [Results](#)
 - ▶ The effect of being in a Parliamentary system is inconclusive

Robustness checks

Percentage Renewable Energy Production (No hydropower)

	Quota _(2yrs lag)	Quota _(4yrs lag)	Quota _{Random}	Quota _(wo/1990)
Prop. Women Parlt.	4.286 (4.539) [0.250]	4.105 (4.756) [0.192]	0.766 (0.625) [0.142]	2.2* (1.240) [0.06]
Log GDP per capita	-12.49 (16.919) [0.204]	-12.225 (16.572) [0.162]	-7.336 (5.954) [0.428]	-14.869* (11.308) [0.091]
Right wing	0.817 (2.057) [0.591]	0.781 (1.978) [0.606]	0.115 (0.762) [0.815]	0.703 (1.123) [0.429]
Center wing	2.11 (3.7) [0.335]	2.013 (3.7) [0.353]	0.164 (1.345) [0.930]	1.448 (1.793) [0.381]
Civil Liberties	7.53 (9.02) [0.122]	7.212 (9.2) [0.145]	1.319 (1.357) [0.118]	3.927** (3.502) [0.047]
Country fixed effects	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y
N	704	704	704	674

Robustness

- ▶ I add three more countries, Brazil, China and India, which together with my sample accounts for 91.26% of the global renewable electricity production without hydropower.
 - ▶ The coefficient of percentage of women in the parliament decreases slightly, goes from 1.64** to 1.46** [Table](#)
- ▶ I add nine more countries: Brazil, China, India, Indonesia, Mexico, Philippines, South Africa, Thailand, and Turkey to my sample. Accounts for 96.11% of all the renewable energy production done worldwide without hydropower.
 - ▶ The coefficient increases from 1.64** to 2.17** [Table](#)
- ▶ Drop each treated country and run the main specification - None of the countries are solely driving the results [Table](#)

Robustness

- ▶ Finally I change the instrument and use: “years from women suffrage” (Grier & Maldonado, 2015; Hicks et al., 2016; Mavisakalyan & Tarverdi, 2019)
- ▶ They show that women suffrage is correlated with having more women in the parliament - Strong First Stage
- ▶ Suffrage expansion should not have any effect on the contemporary production of renewable energy. Women suffrage was approved in average on the year 1933 - Exclusion Restriction

Robustness

- ▶ The first stage: 0.56^{***} has a positive and significant effect [Table](#)
- ▶ For my second stage: the coefficient is 0.74^{***} [Table](#)
- ▶ Using a completely different instrument yields a slightly lower but positive and significant result, aligned with my previous estimation (1.64^{**}).

Net Capacity Install

- ▶ Follow Verdolini et al. (2018) - use as proxy of investment: "Net installed electrical capacity" without hydropower.
- ▶ Good proxy for investment: reflects the expected return of investment and shows the direct and indirect cost of producing electricity

$$\Delta net\ capacity_{it} = \left(\frac{renewables\ net\ capacity_{it}}{total\ net\ capacity_{it}} \right) - \left(\frac{renewables\ net\ capacity_{it-1}}{total\ net\ capacity_{it-1}} \right) \quad (3)$$

Graph

Results

Renewable Δ net capacity

Prop. Women Parliament	0.0019* (0.0014) [0.073]	0.0017* (0.0014) [0.085]	0.0019* (0.0013) [0.098]	0.0019* (0.0015) [0.088]
Log GDP per capita		0.0067 (0.0165) [0.13]	0.0069 (0.0162) [0.154]	0.0079 (0.017) [0.145]
Right Wing			-0.0025 (0.0019) [0.389]	-0.0027 (0.002) [0.399]
Center Wing			-0.0005 (0.0025) [0.816]	-0.0003 (0.0027) [0.711]
Civil Liberties				0.0048* (0.0034) [0.053]
Country fixed effects	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y
N	673	673	673	673

Conclusion

- ▶ More women in policy position increase the production of renewable energy without hydropower (0.74^{***} and 1.64^{**}) and the investment (0.002^*)
- ▶ One way to increase representation is by passing or increasing quota laws - positive externality to the rest of the society
- ▶ An important step towards the decarbonization of the economy

Thank you!

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Appendix

► Countries: [Data](#)

Australia	Japan	Croatia	New Zealand
Austria	Korea Republic	Cyprus	Norway
Bahamas	Latvia	Czech Republic	Panama
Barbados	Lithuania	Denmark	Poland
Belgium	Luxembourg	Estonia	Portugal
Canada	Malta	Finland	Slovak Republic
Chile	The Netherlands	France	Slovenia
Germany	Spain	Greece	Sweden
Hungary	Trinidad and Tobago	Iceland	United Kingdom
Ireland	United States	Italy	Israel
Uruguay			

Appendix

- ▶ Renewable electricity production without hydropower - (WBI.b, 2020)
 - ▶ Proportion of electricity generated by renewable plants over the total production of electricity
- ▶ R.E production with hydropower - (WBI.b, 2020)
- ▶ Net electrical capacity installed - (UN, 2020) division
- ▶ Proportion of women in the Parliament - (WBI.a, 2020)
 - ▶ Percentage of parliamentary seats in a single or lower chamber held by women
- ▶ Quota law - (IDEA, 2020; ECLAC, 2020)
- ▶ Logarithm of the GDP per capita at constant 2010 dollars - (WB.c, 2020)
- ▶ Civil Liberty Index - (House, 2020)
- ▶ Political Orientation - (Cruz et al., 2016)
- ▶ Women suffrage - Link

First Stage

Pct. Of Women in the National Parliament

Quota Law	2.7*** (1.003)	2.66*** (1.03)	2.70*** (1.059)	2.44** (1.113)
Log GDP per capita		0.93 (3.44)	1.17 (3.49)	0.89 (3.77)
Right Wing			-0.27 (0.47)	-0.17 (0.44)
Center Wing			-0.76 (0.69)	-0.74 (0.7)
Civil Liberties				-1.53** (0.65)
Country fixed effects	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y
N	704	704	704	704

Standards errors cluster at country level in parentheses.

Results

Prop. of Renewable Energy Production with hydropower

Results

Prop. Women Parliament	0.716*** (0.839) [0.0]	0.977* (0.642) [0.119]	1.04* (0.632) [0.116]	1.096* (0.711) [0.072]
Log GDP per capita		-17.17 (4.876) [0.638]	-17.3 (4.78) [0.655]	-17.2 (4.86) [0.959]
Right Wing			1.858 (0.974) [0.166]	1.815 (0.989) [0.225]
Center Wing			0.93 (1.625) [0.758]	0.961 (1.635) [0.659]
Civil Liberties				0.886* (1.89) [0.053]
Country fixed effects	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y
N	704	704	704	704

Results

Pct. Renewable Energy Production (No hydropower)

Results

Prop. Women Parliament	1.89** (0.828) [0.053]
(Parliamentary*prop. women Parliament)	-0.739 (0.504) [0.17]
Log GDP per capita	-5.91 (6.842)
Right Wing	0.423 (0.812)
Center Wing	0.522 (1.40)
Civil Liberties	2.2 (1.865)
Country fixed effects	Y
Year fixed effects	Y
N	704

Standards errors cluster at country level in parentheses.

Significance levels: ***0.01 **0.05 *0.1

Appendix

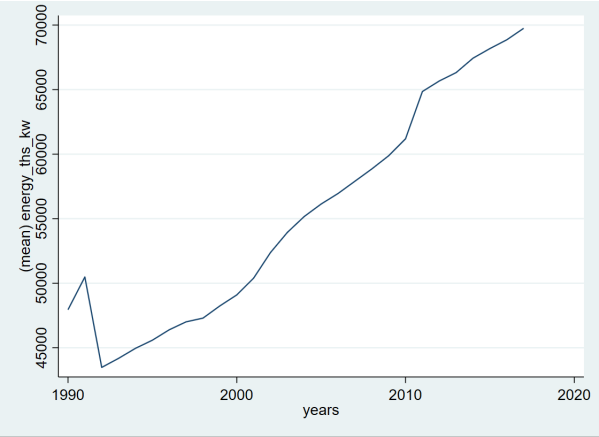


Figure 2: Total net Capacity

Robustness

Prop. of Renewable Energy Production (No hydropower)	
Prop. Women Parliament	1.459** (0.768) [0.025]
Log GDP per capita	-2.301** (5.573) [0.05]
Right Wing	0.096 (0.801) [0.89]
Center Wing	0.096 (1.473) [0.93]
Civil Liberties	2.052 (1.486) [0.111]
Country fixed effects	Y
Year fixed effects	Y
N	763

Robustness

Prop. of Renewable Energy Production (No hydropower)	
Prop. Women Parliament	2.171** (1.382) [0.041]
Log GDP per capita	1.332* (9.127) [0.077]
Right Wing	0.826 (1.262) [0.506]
Center Wing	0.04 (1.876) [0.911]
Civil Liberties	3.182 (2.715) [0.124]
Country fixed effects	Y
Year fixed effects	Y
N	831

First stage - Women suffrage

Pct. Of Women in the National Parliament Results

years since women's suffrage	0.622*** (0.061)	0.582*** (0.114)	0.577*** (0.116)	0.564*** (0.119)
Log GDP per capita		1.714 (3.387)	1.875 (3.467)	1.464 (3.777)
Right Wing			-0.319 (0.473)	-0.199 (0.438)
Center Wing			-0.552 (0.578)	-0.554 (0.594)
Civil Liberties				-1.765 (0.662)
Country fixed effects	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y
N	704	704	704	704

Second Stage - Women suffrage

Percentage of Renewable Energy production (No hydropower)

Results

Prop. Women Parliament	0.44 (0.0) [0.001]	0.725*** (0.278) [0.002]	0.725*** (0.291) [0.0]	0.741*** (0.298) [0.0]
Log GDP per capita		-7.545* (6.07) [0.060]	-7.566** (6.402) [0.035]	-7.299** (6.351) [0.05]
Right Wing			0.191 (0.699) [0.891]	0.11 (0.728) [0.956]
Center Wing			0.141 (1.339) [0.807]	0.15 (1.378) [0.836]
Civil Liberties				1.275 (1.23) [0.354]
Country fixed effects	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y
N	704	704	704	704

F.I.Ts

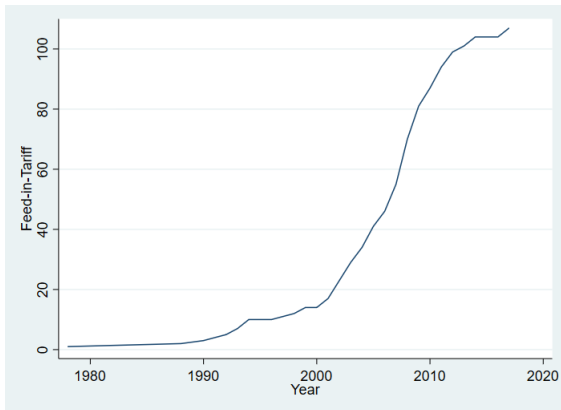


Figure 3: Number of countries to adopt a feed-in-tariffs (Cumulative).
Source: Raturi (2019)

Table 2: IV Estimation of R.E prod.: Dropping each country at a time

Prop. of renewable energy production (no hydropower)	
Main specification	1.64**
Belgium	1.75**
Croatia	1.67**
France	1.56**
Greece	1.74*
Ireland	1.29*
Rep. of Korea	1.89**
Panama	1.60**
Poland	1.66**
Portugal	1.56*
Slovenia	2.11**
Spain	1.48*
Uruguay	1.20*
Country fixed effects	Y
Year fixed effects	Y

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