Gender of Legislators and Renewable Energy

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Abstract

Do female policymakers encourage the production and investment of renewable energy? The literature has shown that female politicians provide more public goods and care more about the environment than male politicians. I study this question in a cross-country analysis of 41 high-income countries for the years 1990 and 1997 to 2015. I use passing a quota law or years since women's suffrage as instruments for the proportion of women in Parliament. I find that a 1 percentage point increase in the proportion of women in the legislature increases the renewable energy production between 0.74 and 1.64 percentage point. Furthermore, it also increases the net renewable electricity capacity, a proxy for renewable energy investment, by 0.0019 percentage points. This study suggests that fostering policies that increase women's participation in policy-making positions is highly recommended, especially considering its positive spillovers to other countries.

Keywords: Female political representation, energy economics, climate change

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1 Introduction

Fossil fuel combustion and industrial processes accounted for 78% of the total CO_2 emissions for the period 2000-2010 (Pachauri et al., 2014). The *Renewable Global Status Report* (Raturi, 2019) established that 74 countries have committed to having some percentage of their energy production based solely on renewable sources. A rapid way of decarbonizing the economy is via large-scale renewable energy production. Equally important, in recent years, female representatives have increased worldwide. In 2019 the proportion of women in the national legislature was 24.64% (WBI.a, 2020). Therefore, I study whether females in the legislature encourage the production and investment of renewable energy production.

The literature suggests that women care more about the environment, support more public goods, pass more environmental policies, and have lower risk preferences than men. Chattopadhyay and Duflo (2004) and Duflo et al. (2004) find that female legislators push for policies aligned with women's preferences and provide more public goods relative to males. Fredriksson and Wang (2011) show that female legislators push for stricter environmental policies. Furthermore, Xiao and McCright (2012) find that women have a lower preference for risk than men. Finally, the median female voter has increased her concern towards the environment and the responsibility she places on the government to reduce environmental pollution (Inglehart et al., 2018A, 2018B). I also present evidence showing that governments are among the main contributors to the rapid deployment of renewable energy around the world, through the introduction of different laws and policies (Adelaja et al., 2010; Crossley, 2019; Johnstone et al., 2010; Kilinc-Ata, 2016; Shrimali & Kniefel, 2011).

I analyze whether having more women in the legislature increases the renewable energy production and investment, by using a cross-country analysis of 41 high-income countries for the years 1990 and 1997 to 2015. However, the following problem arises: do women prefer to produce more renewable energy? Or are countries that prefer more renewable energy also more likely to elect women to the legislature because they are intrinsically more progressive?

To overcome this issue, I construct a panel data with country and year fixed effects and instrument the endogenous variable using two different sets of instruments, passing a quota law and number of years since women's suffrage.

My research suggests and supports that females in the legislature encourage the investment and production of renewable energy. Using two different sets of instruments and two different data sets, I find that a 1 percentage point increase in the proportion of women in parliament increases the production of renewable energy between 0.74 and 1.64 percentage points. Furthermore, they also increase the delta net renewable electricity capacity, a proxy for renewable energy investment, by 0.0019 percentage points, after controlling for a rich set of variables.

A plausible concern is that the instrument could still not be exogenous. Therefore, I test whether there is some anticipatory or placebo effect, by changing the quota law by two and four years, or making it random. In order to allow for serial correlation within countries, I cluster the error term at country level, which reduces my sample to 41 clusters. Consequently, I adjust my standard errors using the wild bootstrap (Cameron et al., 2008). Furthermore, I test the robustness of my results by dropping each country at a time, they are still significant and close to the main result. Finally, my results are almost unchanged by expanding the analysis to also consider Brazil, China, India, Indonesia, Mexico, the Philippines, South Africa, Thailand, and Turkey. These countries account for 96.11% of all the renewable energy production done worldwide without hydropower (Ritchie, 2017).

This paper contributes to the literature at different levels. Firstly, it contributes to the literature on the impact of female legislators on the large-scale production of renewable energy, a particular public good which, according to Pearl-Martinez (2014), is still an unexplored area. Secondly, decarbonize the economy through large-scale renewable energy production is key and can be done more rapidly than in other sectors (Pachauri et al., 2014). Thus, I show evidence that promoting the election of women in the legislature could produce and accelerate this positive externality. Nevertheless, caution must be applied if we want to extrapolate these results to other countries. High-income countries are intrinsically different from middle-income or low-income countries. Finally, my project contributes to extending the literature of cross-countries analyses that link the presence of women in the legislature with more humanitarian military interventions (Shea & Christian, 2017), stricter climate change policies (Mavisakalyan & Tarverdi, 2019), lower CO_2 emissions (Ergas & York, 2012), more protected areas (Pearl-Martinez, 2014), more environmental agreements (Norgaard & York, 2005), more health-expenditure by governments (Clayton & Zetterberg, 2018), more child-care expenditure policies (Weeks, 2019), and less corruption and bribe acceptance (Dollar et al., 2001; Swamy et al., 2001).[1]

The remainder of this article is organized as follows. In sections 2 and 3, I describe the link between female participation in parliament and the production of renewable energy. The data and descriptive statistics are presented in section 4. The econometric analysis is described in section 5. Sections 6 and 7 present the estimation results and the robustness checks. Finally, I present my conclusion in section 8, adding possible future research opportunities.

2 Previous literature on female leaders

In this section, I review some of the papers which are most related to the topic of my study. As remarked by Hessami and da Fonseca (2020), the literature has moved from the idea of politicians "just" reflecting the median voter preferences in order to continue in their seats, to a more accepted idea that some characteristics of the politician, such as gender and race, matter when implementing policies. In the same vein, using League of Conservation Voters data for the period 1970-1995, Fredriksson and Wang (2011) show that voters do not "affect" environmental policies pushing them to the middle. Instead, they "elect" politicians who

[1] Find a summary of these papers in Table 10 the Appendix.

are aligned with their preferences and concerns, opposing the median voter theory. Affecting environmental policies makes politicians move closer to the median voter. Finally, Besley and Case (2003) analyze whether women legislators prioritize different policies from men in the USA. They find that women in power positions pass more laws regarding family assistance and child support.

Some papers also find that women are more likely than men to provide public goods, favoring their own gender and pushing for policies that represent their own gender preferences. Chattopadhyay and Duflo (2004) exploit a natural experiment in rural India that proves this point. In the designated villages, one-third of the seats in the councils and for the *Pradhan* (village chief) position are reserved for women. The authors find that women in these power positions encourage policies that benefit their own gender the most. For example, they improve water reservoirs and roads. Similarly, Weeks (2019) analyzes how a gender quota law affects public expenditure in a sample of 22 countries. She finds that the introduction of a quota law increases childcare spending by 0.6 percentage points, and this policy favors women because it increases their job opportunities. Likewise, Clots-Figueras (2011) analyzes whether more women in parliament implies having a different provision of public goods, policies, and differences in expenditure in India. The findings show that, despite the fact that women, in general, spend more on schools, education, and hospitals than men, the type of policies they support differ, depending on the women's background. Interestingly, women from Scheduled Castes or Scheduled Tribes invest more on laws that help to reduce the gender gap between men and women. For example, they advocate for policies for women to have the same inheritance rights as men. On the contrary, "general female legislator" (i.e. not having caste-reserved seats) do not support these kinds of policies.

Another relevant piece of literature for my study considers the relationship between gender and environmental consciousness. McCright (2010), using the Gallup survey from 2001 to 2008, finds that women manifest more concern and have more knowledge about climate change than men. Similarly, Xiao and McCright (2012), also using the Gallup survey, find that women care more about health problems caused by changes in the environment. The authors show that this greater concern is due to women having different risk perceptions than men. Moreover, Funk and Gathmann (2015) study the differences between men's and women's preferences by analyzing how their votes differ in several topics in Switzerland. The authors find that women are 10 percentage points more likely to spend money on policies that protect the environment, in comparison to men. Thus, it could be that female legislators are taking action to protect the environment because they are acting on behalf of women's interests.

There is also some literature which links women legislators with environmental policies. For example, Fredriksson and Wang (2011) using League of Conservation Voters for the years 1970 to 1995 show that female legislators push for stricter environmental policies than men, independently of what party they belong to. Similarly, Mavisakalyan and Tarverdi (2019) using a panel for 91 countries from 2005-2012, find that more female representation in the parliaments leads to stricter climate change policies, reducing CO_2 emissions. Pearl-Martinez (2014) shows in the "2011 Human Development Report" that countries with a higher number of women in Parliament are correlated with more protected land areas, considering a sample of 90 countries. Similarly, Norgaard and York (2005) study 130 countries and find that countries that have more women in Parliament are more likely to ratify environmental treaties. In the private sector, McElhaney and Mobasseri (2012) analyze whether having more women on their corporate board changes the company's environmental performance, using data for 1500 firms. The authors find that companies with a higher proportion of women on their boards invest more in renewable energy production and try to reduce their carbon footprint (e.g. by using more recycled packaging).

Recent concerns of women towards the environment have also increased through time. Using the "World Values Survey" (Inglehart et al., 2018A, 2018B), I focus on the evolution of the answer to two questions. Firstly, "what are the most serious problems in the world?". Secondly, "should the government reduce environmental pollution?". Further, I focus on two specific waves: 2005-2009, and 2010-2014[2]. In the first wave, 9.3% of the female sample stated environmental pollution is the principal problem of the world. The same question for the second wave shows an increase of 31.2%, 12.2% of female participants believe pollution is a major concern. Regarding the degree of the government responsibility in reducing environmental pollution, the respondents had six categories: strongly agree, agree, disagree, strongly disagree, and no answer/don't know[3]. Over time, female respondents have changed their concern; strongly agree and agree have increased, while disagree and strongly disagree has decreased. In summary, women around the world have increased their concern over environmental pollution and the degree of responsibility assigned to the government.

3 Energy and the Government

Countries around the world are trying to reduce the amount of CO_2 produced by human activity. A possible way to accomplish this is by investing in renewable energy. Fossil fuel combustion and industrial processes accounted for 78% of the total CO_2 emissions for the period 2000-2010 (Pachauri et al., 2014). The *Renewable Global Status Report* (Raturi, 2019) established that 74 countries have committed to having some percentage of their energy production based solely on renewable sources.

Figure 1 and Figure 2 illustrate the evolution of (average) renewable energy production over time for all countries around the world and high-income countries, respectively. Figure 1 shows that the production of renewable energy across all countries had a spike in 1994, then fell until 2006, and increased steadily thereafter. When focusing only on high-income countries, their renewable energy production was volatile until 2005 and, after that, it increased

[2]The question: "what are the most serious problems in the world?" was not asked in the 1990-1994 survey

[3]In the 2005-2009 wave, they add another category "Not asked by the interviewer"

greatly. Thus, low- and middle-income countries drove most of the growth of renewable energy production between 1990 to 2005, and high-income countries took the lead from 2005 onward.

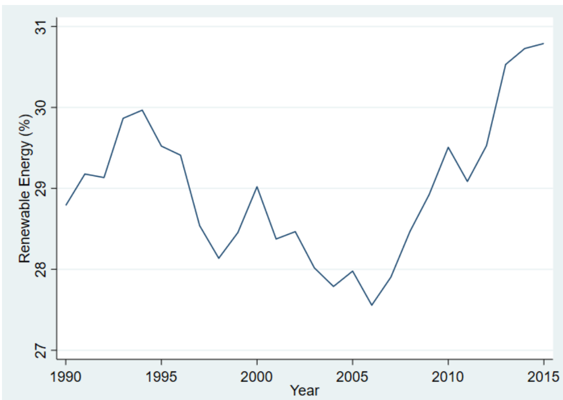


Figure 1: Percentage of renewable energy production for all countries. Source: WBI.b (2020).

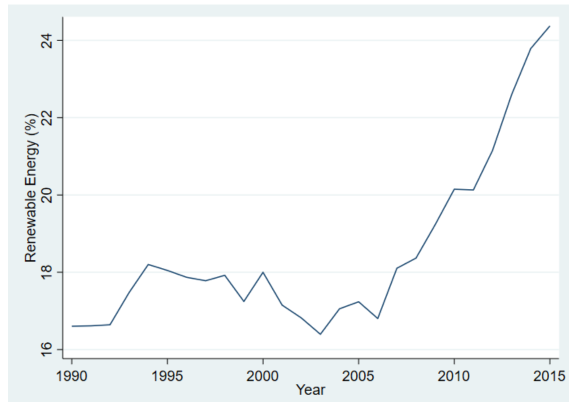


Figure 2: Percentage of renewable energy production for High-income countries. Source: WBI.b (2020).

Countries use regulatory and fiscal policies to promote the entrance and distribution of renewable energy production (Raturi, 2019). Regulatory policies include feed-in-tariffs (FITs), electric quota obligations (also known as renewable portfolio standards), net metering, and tendering (Raturi, 2019). Fiscal policies include investment or tax incentives and public financing, such as public investment, loans, grants, and capital subsidies. Several studies using different samples, time spans, and policies conclude that governments around the world, pushing for regulatory policies and fiscal incentives, are the main motor for the rapid increase in renewable energy production in the world. For example, Crossley (2019) gathers legislations from 113 countries that promotes renewable energy production. The author finds that countries pass these laws for several reasons. For example, 37 countries state as an objective in their renewable energy laws to promote sustainable development; 35 countries state as an objective the reduction of fossil fuel use and the reduction of oil dependency from other countries (Huang, Alavalapati, Carter, & Langholtz, 2007); 55 countries declare as an objective the protection of the environment; and 24 countries have laws supporting the expansion of the renewable energy production industry *per se*. Johnstone et al. (2010) do a panel data analysis of 25 OECD countries over the period 1978-2003. The authors analyze the effect that several public policies have on renewable energy innovation, using patent counts as a proxy for innovation.[4] They conclude that public policy are major contributor to renewable energy innovation. Furthermore, Adelaja et al. (2010) and Kilinc-Ata (2016) reach the same conclusion; Adelaja et al. (2010) study the wind energy market in the United States, while Kilinc-Ata (2016) does a cross-country analysis for 27 countries of the EU and the United States. Similarly, Shrimali and Kniefel (2011) show that different policies (RPS, State Government Green Power Purchasing, and Clean Energy Fund) play an important role in the deployment of renewable energy production for the United States.

Figure 3 illustrates the evolution of feed-in-tariffs (FITs). This type of policy gives a preference fixed-price for each unit of renewable energy produced or connected to the grid.[5] The graph shows the (cumulative) number of countries which have decided to adopt FITs. Although less than 20 countries had applied this policy before 2000, the number has reached 107 countries in 2017 (Raturi, 2019). Feed-in-tariffs and other types of regulatory or fiscal incentives policies are binding; thus, there is a real interest of governments around the world in increasing the production of renewable energy.

Another important policy in this realm is the "quota obligations." A quota obligation (or renewable portfolio standard, RPS) states that energy suppliers are obligated by law to produce a percentage of their production by renewable sources. Chandler (2009) discusses that an RPS is a "bottom-up" policy that helps to switch from fossil fuel to renewable energy sources. In 2019, 33 countries had a national or subnational policy of this nature (Raturi, 2019). In figure 4, we can see the evolution of such a policy for a sub-sample of the high-income countries. National policies are represented with solid lines, while subnational policies

[4] Wind, solar, ocean, geothermal, biomass, and waste

[5] The unit is usually defined as kWh or MWh

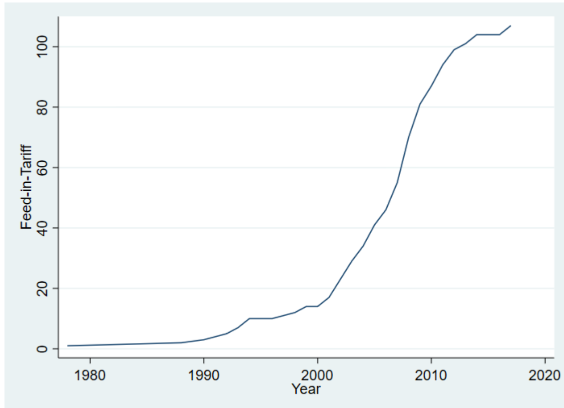


Figure 3: Number of countries to adopt a feed-in-tariffs (Cumulative). Source: Raturi (2019).

are represented with dashed lines. The timing of the adoption of a quota obligation varies widely within the sub-sample. Several studies analyze the effect of this policy on the deployment of renewable energy. For example, Menz and Vachon (2006) and Adelaja et al. (2010) find that the adoption of renewable portfolio standards encourages the production of wind energy for the United States. Similarly, Carley (2009) studies the effect of RPS in renewable energy production in the United States for the years 1998 to 2006. The author concludes that this type of policy helps to increase the deployment of renewable energy. Shrimali and Kniefel (2011) expand Carley's work by differentiating between types of renewable energy production.[6] The authors use a panel for the years 1991 to 2007 for the United States and find that RPS are especially important for the adoption of geothermal and solar energy.

Another set of policies governments implement in order to switch to renewable energy production is fiscal incentives and, at a household level, net metering. Among fiscal incentives, I highlight tax credits and public financing policies. In the Appendix, the figures of tax credit and public investment (9 and10, respectively) are presented. Tax credits give back full or partial tax payments. Countries usually use two types of tax credits: investment tax credits and production tax credits. The rebate on the former depends on the amount spent

[6]Includes wind, solar photovoltaic, biomass, and geothermal.

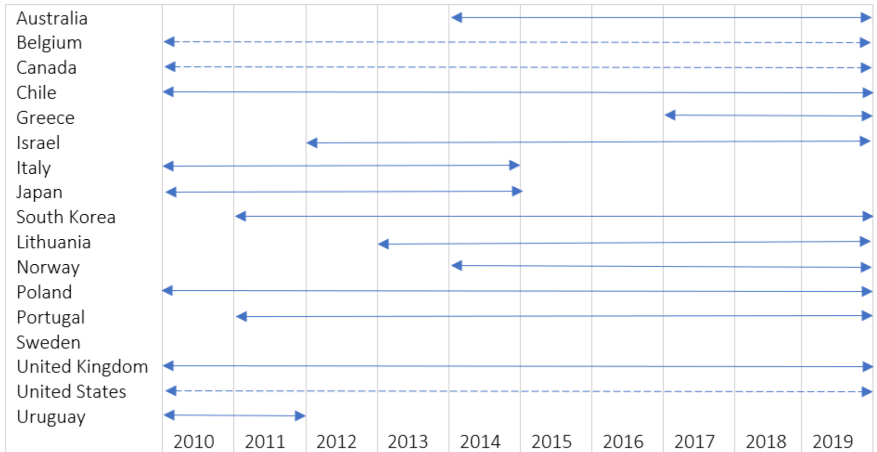


Figure 4: Renewable portfolio standards.

This figure shows the time span over which each country has implemented a renewable portfolio standard. National policies are represented with solid lines, while subnational policies are represented with dashed lines. For example, Australia has been implementing an RPS from 2014 until present day, at a national level. Source: Raturi (2019).

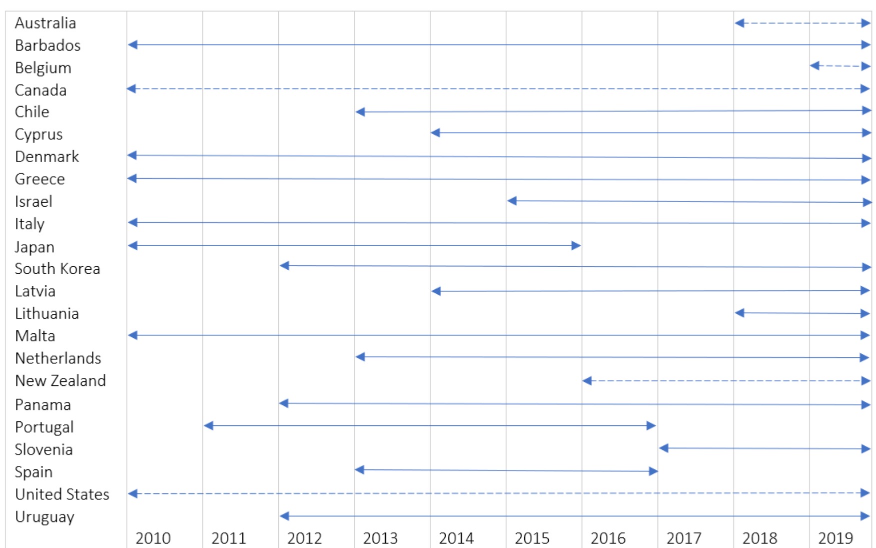


Figure 5: Net metering.

This figure shows the time span over which each country has implemented a net metering scheme. National policies are represented with solid lines, while subnational policies are represented with dashed lines. For example, Australia has been implementing a net metering policy from 2018 until present day, at a subnational level. Source: (Raturi, 2019).

on renewable energy production, whereas the rebate on the latter depends on the amount of electricity produced. In 2019, 43 countries in the world used tax credits as a stimulus of some sort, and 101 countries used public financing (Raturi, 2019). By doing a cross-country analysis of 27 countries in the EU and the United States for a span of 18 years from 1990 to 2018, Kilinc-Ata (2016) finds that feed-in-tariffs and tax policies help the deployment of renewable energy production. In the same vein, Liu et al. (2019) do a cross-country analysis with 29 countries over the years 2000 to 2015 and conclude that fiscal and financial incentives, market-based instruments, policy and support, and RD&D improves the renewable energy deployment. Finally, Shrimali and Jenner (2013) do a cross-state analysis for the United States over the years 1998-2009, finding that tax credits, among other policies, increase the production of solar photovoltaic power by reducing its costs. Net metering is another important regulatory policy; it incentivizes households and firms to produce renewable energy at a small scale for their own consumption. If the agent suffers a shortage or excess of energy, they can take or overturn that energy to the grid. 67 countries had applied net metering to increase their production of renewable energy, at a national or subnational level by 2019 (Raturi, 2019). In Figure 5, we can see the evolution of such a policy in the same sub-sample of high-income countries.

4 Data and Descriptive statistics

I have panel data for a sub-sample of high-income countries for the years 1990 and 1997 to 2015. Table 11 in the Appendix shows the list of all the countries in my sample. I focus on high-income countries as categorized by the World Bank. These countries account for 56.19% of the total production of renewable energy without hydropower (Ritchie, 2017). Adding Brazil, China, and India accounts for 91.26% of the total production of renewable energy (Ritchie, 2017). Thus, I will add these countries as an extra robustness check.

My variable of interest is renewable electricity production without hydropower. The World Bank (WBI.b, 2020) defines this variable as the proportion of electricity generated by renewable plants over the total production of electricity. Renewable plants include geothermal, solar, tidal, wind, and biomass power and biofuels. I exclude hydropower following Verdolini et al. (2018) and Popp et al. (2011), as they argue it is a mature source of renewable energy, in which most deployment has already occurred. Nevertheless, I will do my main specification with hydropower as a robustness check.

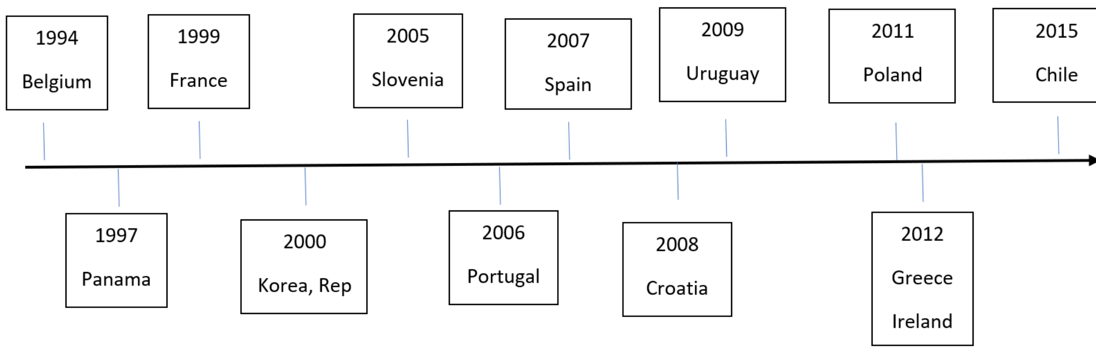
In addition, I use as a dependent variable a proxy for investment in renewable energy: the change in the net electrical capacity installed by renewable sources over total net capacity installed, as defined by Verdolini et al. (2018) (also without hydropower). The data was obtained from the United Nations Statistics Division (UN, 2020).

My main independent variable is the proportion of women in parliament. The World Bank defines this variable as "the percentage of parliamentary seats in a single or lower chamber held by women" (WBI.a, 2020).[7] The proportion of women in national parliaments in the world in 1997, considering the single or lower chambers, was 11.69%. In 2019 that number rose to 24.64% (WBI.a, 2020). In high-income countries, for the same period, the proportion of women in the single or lower chamber increased by 83.25%. Despite having been gaining more seats over time, women's total participation is still fairly low. Consequently, several countries have decided to implement a gender quota law to reduce the gap. In my sample, a total of 13 countries have passed a gender quota law (see Table 9 in the Appendix for further details). I use a dummy equal one once a quota law was passed in the lower or single house as my instrument (IDEA, 2020; ECLAC, 2020). I consider only the quotas that specify a percentage of seats for females. Therefore, Italy was ruled out because its quota law does not specify a number of seats for women, only that "male/females should have equal opportunities" (IDEA, 2020). In diagram 6, I present a timeline that shows when a quota law was

[7]This variable considers presidential and parliamentary government systems.

adopted.

Figure 6: Quota Law timeline.



This figure shows the timeline when high-income countries adopted a quota law. Source: (IDEA, 2020; ECLAC, 2020).

I also use the (logarithm of the) GDP *per capita* at constant 2010 dollars as another control (WB.c, 2020). In addition, I use Freedom House's Civil Liberties Index. This index goes from 1 to 7, where 7 represents the lowest level of freedom, and 1, the highest. Thus, an increase in the index number reflects a decrease in civil liberties (House, 2020).

Furthermore, I add the political orientation (right- or left-wing or centrist) of the party that wins the election (Cruz et al., 2016). The authors categorize the election winning party as right-wing if the party is self-defined as conservative, Christian democratic, or right-wing.[8] A left-wing party is designated as such if it considers itself socialist, social-democratic, communist, or left-wing. Finally, a party is considered centrist if it is self-defined as such. Parties that do not conform with the previous categories are ruled out. I transform the categorical variable in dummies. Therefore, if the government is centrist, right-wing, or left-wing, the variable is equal to one or, otherwise, zero. Lastly, I add another specification on whether having a parliamentary system differs from having a presidential one (CIA, 2020) (see Appendix Table 13 for more details). Specifically, I create a variable that equals one if the system is parliamentary (i.e., parliamentary republic, federal parliamentary democracy under a consti-

[8]More precisely, Cruz et al. (2016) use "chief executive's party's."

Table 1: Descriptive Statistics

	Mean	Standard Deviation	Min.	Max
Pct. renewable energy prod. (No hydropower)	5.54	7.78	0	65.44
Pct. renewable energy production	26.88	29.66	0	99.88
Δ pct. net electrical capacity	0.0062	0.0144	-0.1025	0.1121
Quota law	0.16	0.37	0	1
Pct. women legislature	21.4	10.8	1.4	47.3
GDP *per capita*	33962.2	20086.8	4061.6	111968.4
Right-wing	0.49	0.5	0	1
Center	0.14	0.35	0	1
Left-wing	0.37	0.48	0	1
Civil liberties	1.32	0.54	1	4
Parliamentary	0.8	0.40	0	1
Years since women's suffrage	70.82	20.04	14	122

tutional monarchy, federal parliamentary republic, parliamentary constitutional monarchy, parliamentary democracy, or parliamentary democracy under a constitutional monarchy). Table 1 presents the descriptive statistics of the data used in the regression analysis.

5 Methodology

My econometric specification is the following[9]:

$$y_{it} = \alpha + \rho W_{it} + \beta X_{it} + \delta_i + \gamma_t + \epsilon_{it} \quad (1)$$

where y_{it} is the proportion of renewable electricity output over the total production of electricity of country i at time t without hydropower. The proportion of seats held by women in the national parliament of country i at time t is represented by the variable W_{it}. X_{it} is a set of time-variant variables linked to both female participation and the use of renewable energy: logarithm of GDP *per capita* of country i at time t, the government of country i at time t is right-wing, centrist, or left-wing, and finally the civil rights index. Time invariant country fixed effects and time dummies for the years 1990 and 1997 to 2015 are represented by δ_i and γ_t, respectively. Finally, ϵ_{it} is the error term.

Identifying the effect that more women in parliament have on the level of renewable energy production worldwide is not straightforward. Do women prefer more renewable energy or are countries that prefer more renewable energy also more likely to elect women to the legislature because these countries are intrinsically more progressive?. This is hard to handle without doing an experiment. The optimal identification strategy would be to randomly select some countries to assign them a certain number of women in their parliaments and then analyze their differences in renewable production outcomes. Chattopadhyay and Duflo (2004) exploit a natural experiment that does exactly that. A plausible alternative is using instrumental variables, like Clots-Figueras (2011) did.[10] She was able to get robust results, aligned with the ones found by Chattopadhyay and Duflo (2004).

Specifically, there could be some omitted-variable bias, for example, some cultural or histori-

[9] I use the Stata command from Schaffer (2020).

[10] The author uses "the fraction of seats in the state won by a female politician in a close election against a man" as an instrument.

cal persistence. Hence, in order to try to mitigate this problem, I apply an IV- approach and add year and country fixed effects. Furthermore, I control for variables that would impact both the number of women in the Parliament and the production of renewable energy, simultaneously (X_{it}). The instrumental variable is "countries with legislated candidate quotas in the lower or single house," which I obtain from IDEA (2020); ECLAC (2020) websites. The instrument is equal to one if the law requires that a certain number of seats are reserved for women (Z_{it}). Table 9 in the Appendix describes the quota law for each country.

Thus, the first stage of my estimation is:

$$W_{it} = \alpha^{'} + \phi Z_{it} + \beta^{'} X_{it} + \delta_i^{'} + \gamma_t^{'} + \eta_{it} \tag{2}$$

And the second stage:

$$y_{it} = \alpha + \rho \hat{W}_{it} + \beta X_{it} + \delta_i + \gamma_t + \epsilon_{it} \tag{3}$$

For the instrument to work, firstly, it has to be relevant. In my case, gender quota law must have a positive and significant effect on the proportion of women in parliament. Secondly, the instrument has to comply with the exclusion restriction. That means that the instrument must be as good as randomly assigned and the instrument can only affect the percentage of renewable electricity output by the variable we want to instrument, proportion of women in the parliament.

The exclusion restriction may not hold if countries that pursue diversity strongly enough to pass a quota law also care more about the environment. Nevertheless, quota laws are passed to increase diversity, which is different from progressiveness. More progressive countries want both: to increase the number of females in policy-making positions and to increase the production of renewable energy. A quota law increases the former, but not necessarily the latter. For example, Haiti passed a quota law in 2012, granting 30% of its seats to women

(ECLAC, 2020). Nevertheless, their Freedom House's Civil Liberties Index score for the same year was 5, which means it was considered only partially free (House, 2020). Secondly, I only consider countries in which the law requires at least a percentage of their seats to be held by females. Thirdly, women in legislative bodies have been underrepresented for decades, so, passing a quota law has, in principle, the sole effect of reducing gender inequality. The channel I am exploiting is the following: passing a quota law increases the number of females in parliament, who push for different policies than men.[11].

I cluster my sample at country level to allow residuals to have an unrestricted correlation within countries (Angrist & Pischke, 2008). Particularly, this allows the residuals to have a time series correlation. My sample has 41 clusters that are categorized as high-income by the World Bank. Nevertheless, they have disparities among them. For example, Table 1 illustrates that Iceland and Norway have more than 65.4% of their energy produced by renewable sources (without considering hydropower), while the average of the whole sample is 5.5%. Finally, 11 out of 41 countries in the treatment have passed a quota law, hence, the number of clusters is less than 42 (Angrist & Pischke, 2008); they are not homogeneous; and I might have a small number of treated clusters. Roodman et al. (2019) recommend finding p-values via bootstrap if either of those conditions holds because they lead to over-rejection. I follow Cameron et al. (2008) and use a wild-bootstrap. I present the bootstrap p-values in my main estimation results.[12]

[11] It could be the case that I have a reverse causality and/or a measurement error problem. However, I do not think this is the case. For the latter, the data is obtained from official and external sources. For the former, I cannot think of a reason why an increase in the production of renewable energy increases female participation in parliament.

[12] I use the boottest Stata command with 9999 draws (Roodman et al., 2019).

6 Results

In this section, I present my estimation results. I start by presenting the first and second stage estimates of my main specification in Tables 2 and 4, respectively. Then I present the same specification using "investment in renewable energy" as a dependent variable.

I started my analysis with 96 countries; the results of the regression (3) can be seen in the Appendix Table 8.[13] I obtained positive and (almost) significant results.[14] Since these countries have a high level of heterogeneity, from this point onward I only focus on high-income countries as categorized by the World Bank.

OLS estimation results can be seen in the first column of Table 4. In such regression, the coefficient for the variable "proportion of women in parliament", including all the controls, is 0.035 (0.136). As already mentioned, there could be some omitted variable bias that is negatively correlated with the variable of interest. Therefore, I apply an IV approach.

Analyzing the first stage, I conclude that the instrument is quite robust and has the correct positive sign. My preferred specification is the fourth column, which includes all the controls. In said specification, the introduction of a gender quota law increases the proportion of women in parliament by 2.4 percentage points, in comparison with high-income countries that do not have a quota law. The coefficient is significant at 5%.

For my second stage, my preferred specification (column 5) says that, within countries, a 1 percentage point increase in the proportion of women in parliament increases the percentage of renewable energy production by 1.64 percentage points. The coefficient is significant at 5%, after controlling for the type of government, the degree of civil liberty, and the log of GDP *per capita* in 2010 constant dollars. Analyzing the magnitude of my effect, a 1 standard deviation change in the proportion of women in parliament generates a 2.2 standard deviation

[13] I used GDP *per capita* instead of log GDP *per capita*.

[14] The actual p-value is 0.108.

Table 2: First Stage Estimation

Pct. Of Women in parliament

Quota Law	2.696***	2.658***	2.704**	2.443**
	(1.003)	(1.03)	(1.059)	(1.113)
Log GDP *per capita*		0.933	1.172	0.885
		(3.444)	(3.489)	(3.77)
Right-wing			-0.268	-0.17
			(0.471)	(0.444)
Centrist			-0.757	-0.738
			(0.692)	(0.7)
Civil liberties				-1.525
				(0.648)
Country fixed effects	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y
N	704	704	704	704

This table shows the impact of adopting a quota law on the percentage of women in the parliament. Standards errors are cluster at country level, in parentheses. Significance levels: ***0.01 **0.05 *0.1.

change in the proportion of renewable energy without hydropower.

Most of my controls are not statistically significant. The coefficients for type of party and civil liberties have an unexpected sign. Specially considering that an increase in the former happens when the Government moves further to the "left". Since I have fixed effects, this means that having a right-wing government or a centrist government has a positive (yet not significant) impact on the production of renewable energy in comparison to that of having a left-wing government. In addition, for the civil liberties variable, 1 is the highest level of freedom. Thus, increasing a unit in the civil Liberties Index (i.e., a decay in the Civil Liberties Index) implies a higher effect on renewable energy. Lastly, the fact that the logarithm of GDP *per capita* is negative is also counter-intuitive. However, the fact that I am only focusing on countries that are already high-income may explain this result. For

Table 4: IV Estimation of Renewable Energy

Percentage of renewable energy production (no hydropower)	OLS	IV estimation			
Pct. women parliament	0.0353	1.329***	1.462**	1.463**	1.644**
	(0.136)	(0.748)	(0.739)	(0.761)	(0.875)
	[0.815]	[0.0002]	[0.039]	[0.041]	[0.031]
Log GDP *per capita*	-6.27		-8.81	-8.949	-8.621*
	(5.76)		(6.516)	(6.764)	(7.518)
	[0.331]		[0.109]	[0.119]	[0.081]
Right-wing	-0.031			0.427	0.29
	(0.703)			(0.905)	(0.951)
	[0.964]			[0.535]	[0.682]
Centrist	-0.240			0.548	0.65
	(1.126)			(1.516)	(1.628)
	[0.837]			[0.708]	[0.641]
Civil liberties	0.03				2.868**
	(0.856)				(2.009)
	[0.971]				[0.025]
Country fixed effects	Y	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y	Y
N	704	704	704	704	704

Column 1 shows the OLS results of the effect of women in Parliament on renewable energy production. From columns 2 through 5 the IV results of the effect of women in Parliament on renewable energy production are presented. Standards errors are cluster at country level, in parentheses. Wild bootstrap p-values, in square brackets. Significance levels: ***0.01 **0.05 *0.1.

example, the level of renewable energy depends upon large-scale projects which might need external funds. Furthermore, despite being counter-intuitive, it has already appeared in the literature; see Dong (2012), and Yin and Powers (2010).

In Table 12 of the Appendix I present the results from the reduced form estimation, as specified in equation (4):

$$y_{it} = \dot{\alpha} + \dot{\delta}_i + \dot{\gamma}_t + \dot{\beta} X_{it} + \dot{\phi} Z_{it} + \dot{\epsilon}_{it} \quad (4)$$

The reduced form estimation indicates that the quota law has a positive and significant effect on the production of renewable energy, consistent with my previous analysis. Thus, this is further evidence that my instrument is valid. Nevertheless, I am not interested in the effect the quota law has on the production of renewable energy *per se*. Instead, I am interested in how passing a quota law increases the number of females in the legislature and how that increases the production of and investment in renewable energy. I also test whether having more women in the legislature has a more pronounced effect for parliamentary rather than presidential systems (see the Appendix Table 13 for more details). Legislators under a parliamentary system may have more active and decisive participation than under a presidential system. I present the point estimates in Table 5. Specifically, I create a variable equals one if the government is parliamentary (i.e., parliamentary republic, federal parliamentary democracy under a constitutional monarchy, federal parliamentary republic, parliamentary constitutional monarchy, parliamentary democracy, parliamentary democracy under a constitutional monarchy (CIA, 2020)). Then, I create an interaction term ("$Parliamentary * Prop.\ women\ parliament$") that considers the proportion of seats represented by women and parliamentary government. The point estimate for such interaction is negative and not significant, so the effect of being in a parliamentary system is inconclusive.

I also estimate equation (3) using the proportion of renewable energy production with hydropower as dependent variable. The coefficient of the proportion of women in parliament is 1.1, after controlling for the type of government, the degree of civil liberty, and the log of GDP *per capita* in 2010 constant dollars. The effect is smaller but significant at 10%, which is consistent with the idea that hydropower is considered a mature energy source where most of the deployment has already happened (Verdolini et al., 2018; Popp et al., 2011). The results can be seen in the Appendix in Table 14.

To understand mechanisms I interact the Proportion of women in parliament with the Civil Liberties Index. In the appendix table 15, the estimation results are presented. This shows

Table 5: IV estimation of Renewable Energy production

	Pct. renewable energy production (no hydropower)
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) [0.383]
Right-wing	0.423 (0.812) [0.581]
Centrist	0.522 (1.40) [0.766]
Civil liberties	2.2 (1.865) [0.176]
Country fixed effects	Y
Year fixed effects	Y
N	704

The IV results of the effect of women in parliament on renewable energy production are presented. The type of government is included as another control. "$Parliamentary * prop.womenparliament$" equals one if the government is parliamentary, zero if it's non-parliamentary, e.g., a presidential republic. Standards errors cluster at country level, in parentheses. Wild bootstrap p-values, in square brackets. Significance levels: ***0.01 **0.05 *0.1.

how having more females in the legislature varies by the civil Liberties Index. Given how this variable is constructed, a decrease in the Civil Liberties Index actually represents an improvement. The coefficient is negative and significant at 5%. Thus, having more women in the parliament has a more pronounced effect in countries with a lower index of civil liberties, i.e., a higher level of civil liberties.

6.1 Investment in renewable energy production

The annual budget on research, development, and demonstration (R&D), from the International Energy Agency (IEA, 2020), makes it possible to examine the annual budget each government allocated over time to renewable energy, fossil fuels, and more. In figures 7 and 8, I graph the evolution of the (average) expenditure on RD&D in renewable energy in 2015 US PPP dollars (WB.d, 2020; OECD, 2020), in absolute terms or as a proportion of the total budget, respectively.

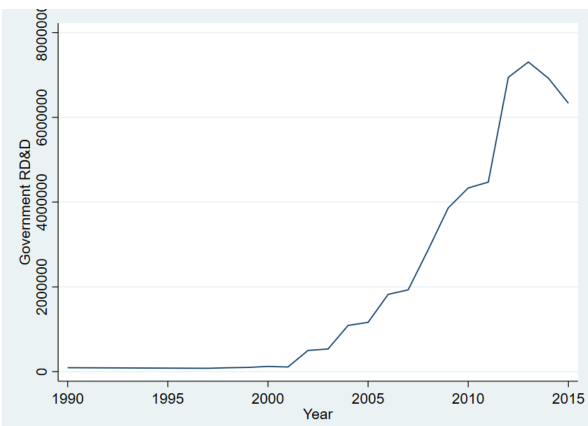


Figure 7: Gov. RD&D in Ren. Energy. Source (IEA, 2020)

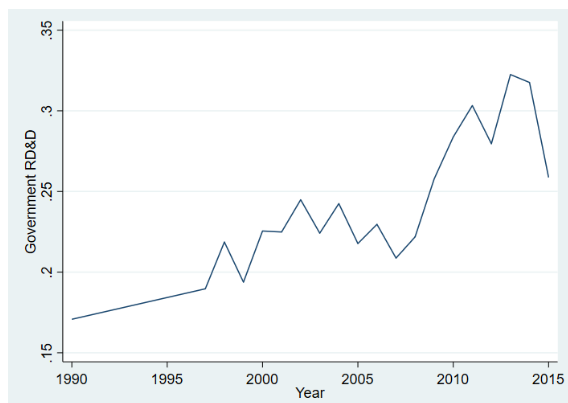


Figure 8: Gov. RD&D in Ren. Energy (% Total Budget). Source (IEA, 2020)

In the first graph, we can observe that after 2002 the budget for RD&D on renewable energy increases greatly. Nevertheless, Figure 8 shows that the share of RD&D in renewables over the total budget is less pronounced. Although governments have increased their budgets for research on renewable energy, they have also increased the money spent on RD&D in other areas, such as energy efficiency or fossil fuels.[15] Given the fact that I only have RD&D information from 27 countries in my samples, I use a proxy for investment.

I follow Verdolini et al. (2018) and use as a proxy for investment in renewable energy the "net installed electrical capacity" from UN (2020) data without hydropower. I am considering the following renewable sources: wind, solar, nuclear, marine, and geothermal. The authors discuss this is a good proxy for investment because net capacity reflects the expected return of investment and shows the direct and indirect cost of producing electricity.

I slightly change Verdolini et al. (2018) approach and use, as a dependent variable, the net installed capacity by renewable sources over total net installed capacity, instead of the net installed capacity *per capita* as a proxy for investment in renewable energy. [16]. Since it is a ratio, it could be the case that the denominator is driving my results if it is decreasing over time. However, as it can be seen in Figure 11 in the Appendix, after a slight decline in 1997 relative to 1990, it increases continuously. My dependent variable is the following:

$$\Delta net\ capacity_{it} = \left(\frac{renewables\ net\ capacity_{it}}{total\ net\ capacity_{it}}\right) - \left(\frac{renewables\ net\ capacity_{it-1}}{total\ net\ capacity_{it-1}}\right) \tag{5}$$

Where $capacity_{it}$ is the net electrical capacity installed by renewable sources over total net electrical capacity installed in country i at time t.

Therefore, I estimate the following equation with this new dependent variable:

$$y_{it} = \alpha + \delta_i + \gamma_t + \beta X_{it} + \rho \hat{W}_{it} + \epsilon_{it} \tag{6}$$

My preferred specification (column 4) in Table 6 says that, within countries, a 1 percentage point increase in the proportion of women in parliament increases the investment (renewable

[15]The IEA has eight categories in total: energy efficiency, fossil fuels, renewable energy, nuclear, hydrogen and fuel cells, other power and storage technologies, other cross-cutting technologies and research, and unallocated.

[16]The authors normalize all their variables by population

Table 6: IV estimation of Net renewable capacity

	Renewable Δ net capacity			
Prop. women parliament	0.0019* (0.0014) [0.073]	0.0018* (0.0014) [0.085]	0.0017* (0.0013) [0.099]	0.0019* (0.0014) [0.088]
Log GDP *per capita*		0.0067 (0.0165) [0.130]	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]
Centrist			-0.0005 (0.0025) [0.816]	-0.0003 (0.0027) [0.711]
Civil liberties				0.0047* (0.0034) [0.053]
Country fixed effects	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y
N	673	673	673	673

The IV results of the effect of women in Parliament on the net capacity of renewable energy are presented. Standards errors cluster at country level, in parentheses. Wild bootstrap p-values, in square brackets. Significance levels: ***0.01 **0.05 *0.1.

delta net capacity) on renewable energy production by 0.0019 percentage points. The coefficient is significant at 10%, after controlling for the type of government, the degree of civil liberties, and the log of GDP *per capita* in 2010 constant dollars. I present the first stage analysis in the Appendix Table 16.

Analyzing the magnitude of my effect, a 1 standard deviation change in the proportion of women in parliament changes 1.43 standard deviation in the delta net capacity installed of renewables.

7 Robustness Checks

I conduct a set of placebo tests by changing the quota law adoption by 2 and 4 years, respectively (Angrist & Pischke, 2008). I also randomly assign a new quota law to the treated countries.[17] This"anticipatory" and "random" effects should have no impact on the production of renewable energy. Lastly, I do my preferred specification but dropping the year 1990. These results can be seen in Table 7.

The first 3 placebo tests work as expected: there is no significant effect of the proportion of women in parliament on the production of renewable energy if I use the "fake" gender quota laws as an instrument. This gives validity to my causal interpretation.

Given the lack of continuity of my data, I have observations for the year 1990 and then from the years 1997 to 2015. It could be that the year 1990 is different from the rest and that is driving my causal effect. Column 4 of Table 7 shows my preferred specification without the year 1990. The coefficient is higher and significant, so I can conclude that my causal effect is not driven by the year 1990.

In addition, I will drop each treated country at a time and run the main specification (3), at a 95% confidence level. The results can be seen in Table 18 in the Appendix. None of my countries are driving the results; the point estimations are close to each other and are always significant at 5% or 10%.

Finally, 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 (Ritchie, 2017)). The coefficient of the percentage of women in parliament decreases slightly; it goes from 1.64 to 1.46, and is significant at 5%. Lastly, I add nine more countries; Brazil, China, India, Indonesia, Mexico, the Philippines, South Africa, Thailand, and Turkey, to my sample. These countries account for 96.11% of all the renewable energy production without hydropower worldwide (Ritchie, 2017). The coefficient of the percentage of women in parlia-

[17] See Table 17 in the Appendix to check the exact quota law dates.

Table 7: Robustness checks

Percentage of renewable energy production (no hydropower)				
	$\text{Quota}_{(2yrs\ lag)}$	$\text{Quota}_{(4yrs\ lag)}$	Quota_{Random}	$\text{Quota}_{(wo/1990)}$
Prop. women parliament	2.951	4.105	0.743	1.883*
	(2.296)	(4.756)	(0.632)	(1.088)
	[0.130]	[0.192]	[0.157]	[0.063]
Log GDP *per capita*	-10.536	-12.225	-7.303	-13.736
	(11.585)	(16.572)	(5.954)	(10.08)
	[0.116]	[0.162]	[0.436]	[0.109]
Right-wing	0.550	0.781	0.11	0.601
	(1.435)	(1.978)	(0.760)	(1.022)
	[0.618]	[0.606]	[0.815]	[0.462]
Centrist	1.374	2.013	0.152	1.224
	(2.513)	(3.7)	(1.341)	(1.683)
	[0.409]	[0.353]	[0.923]	[0.446]
Civil liberties	5.175*	7.212	1.28	3.343**
	(4.846)	(9.2)	(1.357)	(2.975)
	[0.061]	[0.145]	[0.126]	[0.049]
Country fixed effects	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y
N	704	704	704	674

The IV results of the effect of women in parliament on the percentage of renewable energy are presented. Column 1 uses fake quota as an instrument; it takes the value equal one, two years before the actual implementation. Column 2 uses a fake quota as an instrument; it takes the value equal one, four years before the actual implementation. Column 3 uses a fake random quota law as an instrument. Column 4 drops the data from the year 1990. Standards errors cluster at country level, in parentheses. Wild bootstrap p-values, in square brackets. Significance levels: ***0.01 **0.05 *0.1.

ment increases from 1.64 to 2.17 and is still significant at 5%. The estimations can be seen in Table 19, column 1 and column 2, respectively.

Another robustness check I conduct is changing the instrument variable to "years since women's suffrage" (Grier & Maldonado, 2015; Hicks et al., 2016; Mavisakalyan & Tarverdi, 2019). The data was collected from Historic (2020). Hicks et al. (2016), and Mavisakalyan and Tarverdi (2019)) show that women's suffrage is correlated with having more women in parliament, which causes an increase in aid spending and stricter climate change policies, respectively. Furthermore, suffrage expansion should not have any effect on the contemporary production of renewable energy. Having more fair countries does not necessarily mean having more progressive countries. Progressive countries are fairer, but being fair does not imply being progressive, especially considering that women's suffrage was approved, on a global average, in the year 1933. The mechanism exploited is the following: an expansion in the rights to vote for women implies women can choose according to their belief, shaping policy outcomes and increasing their participation. However, "years since women's suffrage" should have a highly diluted impact on current outcomes. The instrument was constructed as follows. Firstly, I obtained the year where suffrage was expanded to women for each country of my sample (Table 20 in the Appendix shows this in detail). Secondly, I compute the difference between the years of my data (1990, 1997-2015) minus the year suffrage was expanded to women. I estimate my favorite specification, equation (3), with this new instrument. The IV results and the first stage can be seen in the Appendix Table 22 and Table 21, respectively. The first stage has a positive and significant effect, so I can conclude that the instrument is quite robust. For my second stage, the coefficient is 0.74 after controlling for the type of government, the degree of civil liberties, and the log of GDP *per capita* in 2010 constant dollars. Thus, a one percentage point increase in the percentage of women in parliament increases the production of renewable energy without hydropower by 0.74 percentage point. The coefficient is significant at 1%. Using a completely different instrument yields a slightly lower but positive and significant result, aligned with my previous results.

I perform the Sargan-Hansen test of overidentification and I am not able to reject the null hypothesis (the p-value is equal to 0.334). Therefore, I have evidence that at least one of my instruments is exogenous and not correlated with the error term.

This section ratifies the relevance of my instrument for my main causal finding. The introduction of a quota law increases the number of women in parliament, which potentially, through an increase in the number of policies and laws adopted (as discussed in section 3), could be one of the mechanisms behind the increases in the production of renewable energy. However, these results can only be extrapolated to other high-income countries. Middle-income and low-income countries have several dissimilarities. Although, having more women in policy-making positions would certainly be positive, it won't necessarily translate into an increase in renewable energy production.

8 Summary and Concluding Remarks

I show that more women in policy-making positions increase the production and the investment in renewable energy without hydropower, after controlling for several factors. My results add to the previous literature of cross-countries analyses that link women in parliament with several outcomes. By using an IV panel with fixed effects and by considering 41 high-income countries for the years 1990, 1997 to 2015, I reinforce the argument that women in policy-making positions support the environment, increasing the renewable energy production and investment.

By using two different data sets and two different instruments, to control for possible omitted variable bias, I found qualitatively similar results. Women in parliament increase the production of renewable energy production between 0.74 and 1.64 percentage points. Similarly, they also increase the delta net renewable electricity capacity, a proxy for renewable energy investment, by 0.0019 percentage points, after controlling for log of GDP, type of government, and the Civil Liberties Index.

The literature has shown that female legislators support different policies. Thus, increasing women's participation is essential by itself: it increases diversity and reduces the gender gap. Furthermore, my research shows that having more women has a positive and significant effect on the investment in and production of renewable energy, for which a possible mechanism could be an increase in the number of policies and laws, as discussed in section 3. Consequentially, having more females representatives has an important effect towards the decarbonization of the economy, a positive externality to the rest of the world. One way to increase representation is by passing or increasing quota laws. Nevertheless, my results cannot be extrapolated to other types of countries. Middle-income or low-income countries are intrinsically different from high-income countries. Therefore, having more women in policy-making positions would certainly be positive, it will not necessarily increase the production of renewable energy.

An interesting topic for future analysis could be to explore the heterogeneity among countries; why high-income countries develop this way; what other mechanisms are present; how these mechanisms differ for middle-income countries and for low-income countries; and, finally why middle-income countries were leading in the deployment of renewable energy and then slowed down.

9 Competing interest

Declarations of interest: none.

10 Appendix

Table 8: OLS Results for the Effect of Female Participation in the Production of Renewable Energy - All Countries

Pct. Renewable energy production (no hydropower)				
Prop. women parliament	0.631	0.691	0.698	0.702
	(0.416)	(0.429)	(0.438)	(0.437)
GDP *per capita*		0.0003	0.0003	0.0003
		(0.0001)	(0.0001)	(0.0001)
Right-wing			0.66	0.664
			(0.782)	(0.78)
Centrist			0.231	0.233
			(0.951)	(0.958)
Civil liberties				0.197
				(0.564)
Country fixed effects	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y
N	1524	1524	1524	1524

The OLS results of the effect of females in parliament on the production of renewable energy are presented. Standards errors cluster at country level, in parentheses. Significance levels: ***0.01 **0.05 *0.1.

Summary of the quota laws.

Table 9: Quota Law Description

Country	Year	Description
Belgium	1994	Political parties should not have more than 2/3 candidates of the same gender in their lists - first gender quota
Chile	2015	Neither the male candidates nor the female candidates may exceed 60% of - Constitutional reform
Croatia	2008	If a gender (male or female) has less than 40% of representatives in the political arena, it is considered "under-represented" - Gender Equality Law
France	1999	Gender parity was obtain - Constitutional amendment
Greece	2012	One third of parties' candidate list must have candidates of each gender - Presidential Decree 26/2012
Ireland	2012	30% of the the candidates have to be women, and 30% have to be men - Electoral Act amended
Republic of Korea	2000	Women candidates in political parties must have at least 30% of representation in their lists - Political party law reform
Panama	1996	The law requires that at least 30% of seats are reserved for women - Law 22, Art.182-A
Poland	2011	At least 35% of the the candidates have to be women, and at least 35% have to be men - Election Code
Portugal	2006	Each gender has to have a minimum representation of 33% - Equality Law 3/2006
Slovenia	2005	A gender quota of 20% was introduced before the 2006 Election - Local Elections Act 2005 - art. 70
Spain	2007	Each gender has to have a inimum representation of 40% in the parties' candidate lists - Organic Law 3/2007
Uruguay	2009	If the first candidate in the party list is a man,then the second candidate has to be a women, and vice-versa

Sources: International Institute for Democracy and Electoral Assistance (IDEA, 2020) and/or Gender Equality America and the Caribbean (ECLAC, 2020).

Summary of the cross-country analysis of the effect of women in power positions on several outcomes.

Table 10: Summary of Cross-country and Gender Analysis

Authors	Outcome variable	Years	Countries	Paper
Shea and Christian	Humanitarian military intervention	1946-2003	59	The Impact of Women Legislators on Humanitarian Military Interventions
Ergas and York	CO_2 emission *per capita*	2004	103	Women's Status and Carbon Dioxide Emissions:A quantitative Cross-national Analysis
Pearl-Martinez	Protected land areas	2004	90	Women at the Forefront of the Clean Energy Future
Norgaard and York	Environmental treaty ratification	1999	130	Gender Equality and State Environmentalism
Clayton and Zetterberg	Government spending	1995-2012	139	Quota Shocks: Electoral Gender Quotas and Government Spending Priorities Worldwide
Weeks	Government spending on family policies	1980-2011	22	Quotas Matter: The Impact of gender Quota Laws on Work-Family Policies
Swamy, Knack Lee, and Azfar	Corruption level and bribe acceptance	1981, 1990	93	Gender and corruption
Dollar, Fisman and Gatti	Corruption level	1985, 1990 and 1995	100	Are Women Really the "Fairer" Sex? Corruption and Women in Government
McElhaney and Mobasseri	Environmental, governance and social	2012	1500 firms	Women Create A Sustainable Future
Mavisakalyan and Tarverdi	Environmental policies and CO_2 emissions	2005 - 2010	91	Gender and climate change: Do female parliamentarians make difference?

Table 11: Countries in My Sample

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

The Bahamas and Barbados were added to the database with no hydropower. In the database with hydropower they have production equal zero, however in the database with no hydropower they appear as NA. Thus, I add their production as equal zero in the database with no hydropower.

Table 12: Reduced Form Estimation

Prop. Renewable energy production (no hydropower)				
Quota Law	3.583*	3.887**	3.955**	4.017**
	(2.021)	(1.880)	(1.883)	(1.866)
Log GDP *per capita*		-7.446	-7.235	-7.167
		(4.930)	(5.129)	(5.115)
Right-wing			0.034	0.011
			(0.635)	(0.657)
Centrist			-0.559	-0.563
			(1.006)	(1.02)
Civil liberties				0.361
				(0.838)
Country fixed effects	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y
N	704	704	704	704

The OLS results of the effects of passing a quota law on the production of renewable energy are presented. Standards errors cluster at country level, in parentheses. Significance levels: ***0.01 **0.05 *0.1.

Table 13: Government type

Government type	Countries
Constitutional federal republic	United States
Constitutional monarchy	Luxembourg
Federal parliamentary democracy under a constitutional monarchy	Australia Belgium Canada
Federal parliamentary republic	Austria Germany
Parliamentary constitutional monarchy	Denmark - Japan Netherlands - Norway Spain - Sweden - UK
Parliamentary democracy	Israel
Parliamentary democracy under a constitutional monarchy	The Bahamas - Barbados New Zealand
Presidential republic	Chile - Cyprus - Republic of Korea Panama - Uruguay
Semi - presidential republic	France Lithuania - Portugal
Parliamentary republic	Croatia - Czech Republic - Estonia Finland - Greece - Hungary Iceland - Ireland - Italy Latvia - Malta - Poland Slovakia - Slovenia - Trinidad and Tobago

This table shows the type of government each country has, as defined by the CIA (2020).

In the following table, I present the point estimation results using the percentage of renewable energy with hydropower as a dependent variable.

Table 14: IV Estimation of Renewable Energy with Hydropower

Prop. Renewable energy production with hydropower				
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*		-17.171 (4.764) [0.638]	-17.3 (4.781) [0.655]	-17.198 (4.857) [0.959]
Right-wing			1.858 (0.974) [0.166]	1.815 (0.989) [0.225]
Centrist			0.93 (1.625) [0.758]	0.961 (1.635) [0.659]
Civil liberties				0.886* (1.890) [0.053]
Country fixed effects	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y
N	704	704	704	704

The IV results of the effect of women in parliament on renewable energy production with hydropower are presented. Standards errors cluster at country level, in parentheses. Wild bootstrap p-values, in square brackets. Significance levels: ***0.01 **0.05 *0.1.

Table 15: IV Estimation of Renewable Energy Production

	Pct. Renewable energy production (no hydropower)
Prop. women parliament	0.968**
	(0.538)
	[0.038]
Log GDP *per capita*	-2.574
	(4.654)
	[0.637]
Right-wing	0.158
	(0.708)
	[0.823]
Centrist	-0.637
	(1.055)
	[0.49]
Civil liberties	7.69**
	(3.784)
	[0.027]
(Prop. women parliament* Civil liberties)	-0.55**
	(0.248)
	[0.025]
Country fixed effects	Y
Year fixed effects	Y
N	704

The IV results of the effect of women in parliament on renewable energy production are presented. I add as a new control, the interaction between the proportion of women in parliament and the Civil Liberties Index. Standards errors cluster at country level, in parentheses. Wild bootstrap p-values, in square brackets. Significance levels: ***0.01 **0.05 *0.1.

In the following table, I present the first stage of the equation (6), using the delta net installed electrical capacity by renewable sources as a dependent variable.

Table 16: First Stage Estimation

Proportion of women in parliament				
Quota law	2.66**	2.539**	2.573**	2.347*
	(1.066)	(1.146)	(1.181)	(1.244)
Log GDP *per capita*		3.484	3.708	3.058
		(4.536)	(4.534)	(4.685)
Right-wing			-0.364	-0.280
			(0.472)	(0.436)
Centrist			-0.858	-0.858
			(0.655)	(0.655)
Civil liberties				-1.641*
				(0.906)
Country fixed effects	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y
N	673	673	673	673

This table shows the effects of adopting a quota law on the percentage of women in parliament. Standards errors cluster at country level, in parentheses. Significance levels: ***0.01 **0.05 *0.1.

The first stage of my instrument is quite robust and has the correct positive sign. My preferred specification is the fourth column, which includes all the controls. In this specification, the introduction of a gender quota law increases the proportion of women in parliament by 2.35 percentage points, in comparison with high-income countries that do not have a quota law.

This table shows the random draws that I treat as the new quotas laws. These new fake quota laws are used as instruments to test whether this random effect has any impact.

Table 17: Random quota law

Country	Quota Law
Belgium	1998
Chile	1995
Croatia	2015
France	2013
Greece	2012
Ireland	1998
Rep. of Korea	1993
Panama	2002
Poland	2015
Portugal	2004
Slovenia	2014
Spain	1997
Uruguay	2000

Source: own creation.

Table 18: IV Estimation of Renewable Energy production: Dropping each country at a time

	Prop. of renewable energy production (no hydropower)
Main specification	1.644** [0.031]
Belgium	1.746** [0.038]
Croatia	1.665** [0.018]
France	1.555** [0.024]
Greece	1.744* [0.057]
Ireland	1.287* [0.084]
Rep. of Korea	1.888** [0.03]
Panama	1.604** [0.026]
Poland	1.662** [0.038]
Portugal	1.563* [0.08]
Slovenia	2.114** [0.035]
Spain	1.476* [0.075]
Uruguay	1.203* [0.094]
Country fixed effects	Y
Year fixed effects	Y

The IV results of the effect of women in parliament on renewable energy production without hydropower are presented. In each line, the respective country is dropped. Significance level is set at 95%. Wild bootstrap p-values, in square brackets. Significance levels: ***0.01 **0.05 *0.1.

Table 19: IV Estimation of Renewable Energy Production without Hydropower - Extended Sample

Prop. of renewable energy production (no hydropower)

	Column 1	Column 2
Prop. women parliament	1.459**	2.171**
	(0.768)	(1.382)
	[0.025]	[0.041]
Log GDP *per capit*a	-2.301**	1.332*
	(5.573)	(9.127)
	[0.05]	[0.077]
Right-wing	0.096	0.826
	(0.801)	(1.262)
	[0.89]	[0.506]
Centrist	0.096	0.04
	(1.473)	(1.876)
	[0.93]	[0.911]
Civil liberties	2.052	3.182
	(1.486)	(2.715)
	[0.111]	[0.124]
Country fixed effects	Y	Y
Year fixed effects	Y	Y
N	763	831

The IV results of the effect of women in parliament on renewable energy production without hydropower are presented. In column 1, I added three more countries: Brazil, China, and India, which along with my sample accounts for 91.26% of all the renewable energy production done worldwide. In column 2, I am also including Brazil, China, India, Indonesia, Mexico, the Philippines, South Africa, Thailand, and Turkey. This extended sample accounts for 96.11% of all the renewable energy production done worldwide. Standard errors cluster at country level, in parentheses. Wild bootstrap p-values, in square brackets. Significance levels: ***0.01 **0.05 *0.1.

Table 20 shows the year where suffrage was extended to women.

Table 20: Women's Suffrage in My Sample

Australia	1962	Japan	1946
Austria	1918	Republic of Korea	1948
Bahamas, The	1962	Latvia	1917
Barbados	1950	Lithuania	1917
Belgium	1948	Luxembourg	1919
Canada	1960	Malta	1947
Chile	1949	Netherlands	1919
Croatia	1945	New Zealand	1893
Cyprus	1960	Norway	1913
Czech Republic	1920	Panama	1946
Denmark	1915	Poland	1918
Estonia	1917	Portugal	1976
Finland	1906	Slovakia	1920
France	1945	Slovenia	1945
Germany	1918	Spain	1931
Greece	1952	Sweden	1919
Hungary	1918	Trinidad and Tobago	1946
Iceland	1915	United Kingdom	1928
Ireland	1922	United States	1920
Israel	1948	Uruguay	1932
Italy	1945		

Source: Historic (2020)

First stage using the new instrument "Years since women's suffrage."

Table 21: First Stage Estimation

	Pct. of women in parliament			
years since women's suffrage	0.622***	0.582***	0.577***	0.564***
	(0.061)	(0.114)	(0.116)	(0.119)
Log GDP *per capita*		1.714	1.875	1.464
		(3.387)	(3.467)	(3.777)
Right-wing			-0.319	-0.199
			(0.473)	(0.438)
Centrist			-0.552	-0.554
			(0.578)	(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

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This table shows the effects of the years since women's suffrage was allowed on the percentage of women in parliament. Standards errors cluster at country level, in parentheses. Significance levels: ***0.01 **0.05 *0.1.

The first stage of my instrument is quite robust and has the correct positive sign. My preferred specification is the fourth column, which includes all the controls. In such specification, allowing women to vote a year earlier increases the proportion of women in the parliament by 0.56 percentage points, in comparison with high-income countries that allowed women suffrage a year later.

IV estimation using the new instrument "Years since women's suffrage."

Table 22: First Stage of Years since women's suffrage on the Proportion of Women in Parliament

Percentage of renewable energy production (no hydropower)				
Prop. women parliament	0.44 (0.094) [0.001]	0.725*** (0.278) [0.0]	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]
Centrist			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

The IV results of the effect of women in parliament on renewable energy production are presented. Standards errors cluster at country level, in parentheses. Wild bootstrap p-values, in square brackets. Significance levels: ***0.01 **0.05 *0.1.

Evolution of tax credits and public investment, over time, for the countries in my sample.

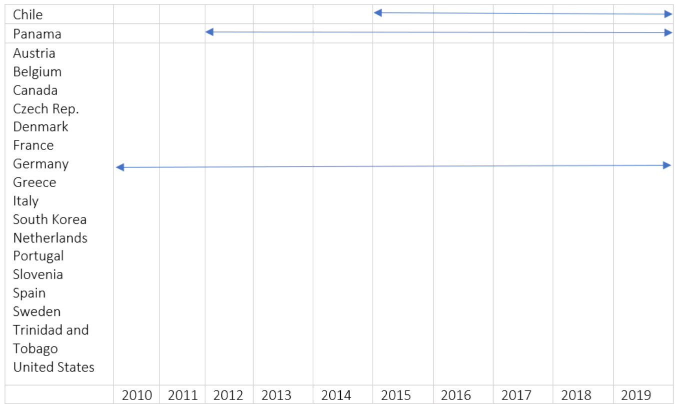

Figure 9: Tax credits

This figure shows the time span over which each country has implemented a tax credit scheme. National policies are represented with solid lines, while subnational policies are represented with dashed lines. For example, Chile implemented a tax credit policy in 2015 that is still in force, at a national level. Source: Raturi (2019)

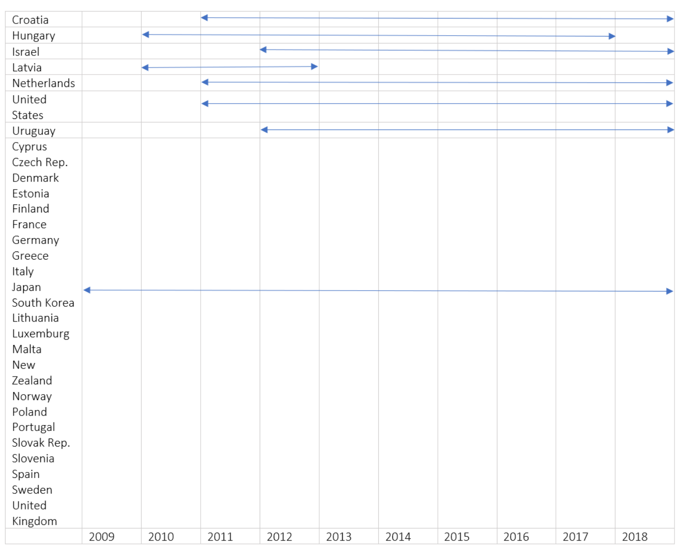

Figure 10: Public investment

This figure shows the time span over which each country has implemented a public investment scheme. National policies are represented with solid lines, while subnational policies are represented with dashed lines. For example, Latvia implemented a public investment policy from 2010 to 2013, at a national level. Source: Raturi (2019)

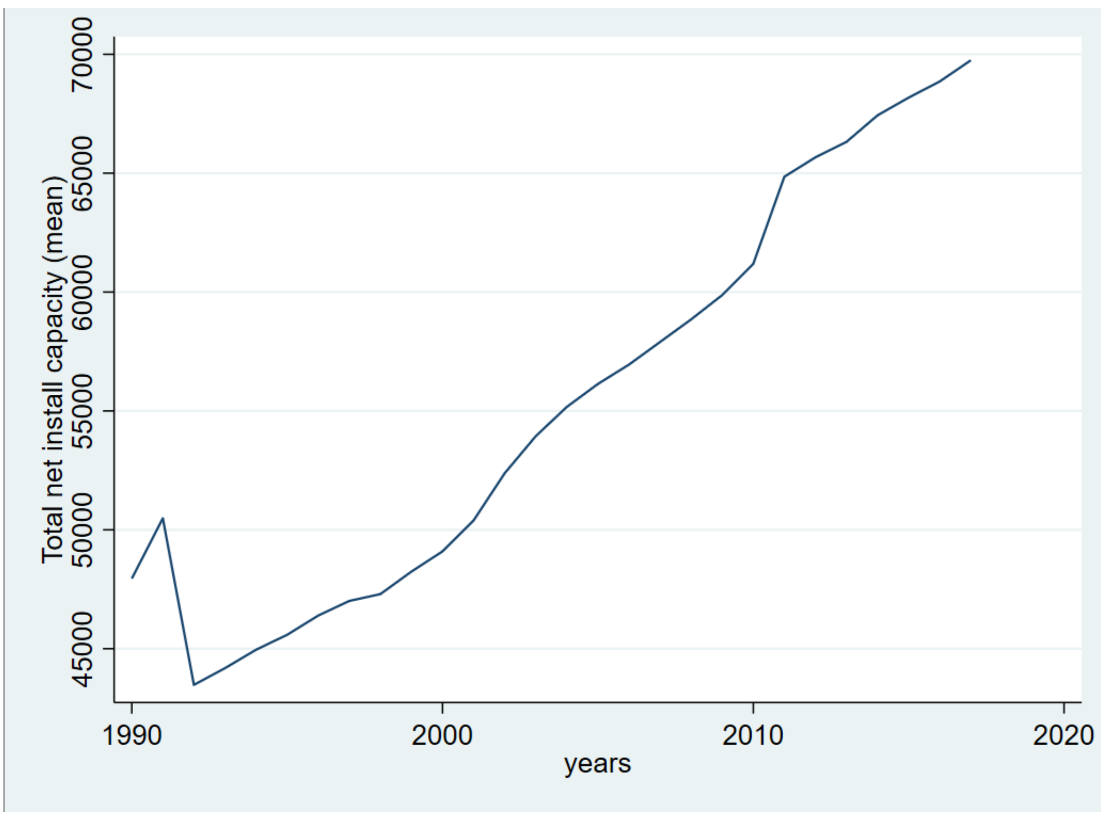

Figure 11: Evolution of total net capacity installed through time. Source (UN, 2020)

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