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RENEWABLE ENERGY POLICIES: THE CASE OF FEED-IN TARIFFS ON RENEWABLE ENERGY DEPLOYMENT

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Abstract

In recent years, renewable energy support policies such as Feed-in Tariffs have gained momentum worldwide. This study uses panel data analysis to evaluate the effectiveness of Feed-in Tariff policies on renewable energy deployment, utilizing a comprehensive global sample of 181 countries spanning from 2002 to 2019. The findings reveal that the policy positively affects high-income countries but negatively impacts low-income countries. A distinctive feature of this study is the examination of the role of governance in determining the policy's divergent effectiveness. The results indicate that good governance enhances the policy's effect while poor governance diminishes it.

Keywords: Renewable Energy Support Policies, Feed-in Tariffs, Renewable Energy, Governance, Developing Countries, Panel Data

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1. The context

Over the past two decades, the energy landscape has witnessed a remarkable shift towards renewable sources, with 80 percent of all newly added electricity capacity worldwide being powered by renewables. Despite this positive shift in the energy landscape, renewables still represent only 12.6 percent of global energy consumption (REN21, 2023). Investments in the energy sector are essential to the global shift towards renewable energy. However, this transformation calls for substantial financial commitments, with global investments in renewable energy technologies estimated at a significant USD 8.3 trillion from 2023 to 2050, essential for achieving the goal of net-zero emissions by 2050 (BloombergNEF 2023).

Despite climate change being a global issue and sustainable transformation requiring collective efforts and actions, investments in developing countries are essential (UNCTAD 2023). To achieve their climate and development objectives, developing countries require estimated annual investments of USD 1 trillion in renewable energy. However, they currently attract only about half of this necessary amount (UNCTAD 2023).

Investments in renewable energy are fundamental to addressing the climate crisis globally, but it is not without its challenges. The capital-intensive nature of renewable energy investments presents an essential barrier, especially when coupled with the costs associated with replacing existing infrastructure. These factors contribute to significant affordability challenges, as the upfront financial requirements are substantial (REN21 2023). Moreover, in emerging markets and developing countries, investors' concerns about the perceived risks of investing, which can stem from various factors including political instability, regulatory uncertainties, and market volatility, pose another significant barrier (IEA, IRENA, UNSD, World Bank, and WHO 2022).

1.2 Renewable energy support policies

Recognizing the critical role of renewable energy and acknowledging the barriers to its adoption, government policy instruments emerge as strategic efforts to facilitate and support the investment and deployment of renewable electricity generation. These instruments are known as renewable energy support policies (RESP), encompassing a range of forms, including fiscal incentives and public financing, regulatory measures, and clearly defined targets (REN21 2023). As of today, renewable energy support policies have been adopted by 166 countries around the world (REN21 2023). This positive progress reflects the prioritization by government authorities in promoting the generation and adoption of renewable energy.

By now, the most prominent fiscal instrument to promote renewable energy technologies has been Feed-in Tariffs (FIT) (Menanteau, Finon and Lamy 2003). FITs work by offering long-term contracts to renewable energy producers, with compensation typically aligned with the cost of generating for each technology. Under a FIT, electricity producers receive a certain amount of money per kilowatt-hour produced and fed into the electricity grid at a guaranteed rate. The FITs aim at encouraging the adoption of renewable energy by providing a stable and predictable investment climate, thereby mitigating the cost barriers for renewable energy investments (Menanteau et al. 2003).

The United States pioneered the use of FITs as early as 1978, with countries such as Germany, Spain, and Denmark following in the 1990s (Azuela and Barroso 2012). Since then, the policy has experienced widespread adoption, with countries from every geographic region and income level implementing it. As of today, the number of countries that have implemented FITs has risen to 83, a significant increase from 45 in 2005 (REN21 2023). Recognizing the potential of FITs to reduce investment risks and stimulate growth in the renewable energy sector, it is notable that half of the countries that have implemented the policy today are developing countries. Therefore, as the number of countries implementing the FIT policy is growing and the policy expands across diverse economic, social, and political landscapes, it becomes crucial to assess its performance and effectiveness in these varying contexts. With the FIT policy being the most widespread and prominent among the RESP, the following study aims to assess its worldwide effectiveness.

2. Literature review

The following section presents the existing literature that has investigated the effectiveness of RESP and its distinct driving factors. Table 1 and 2 in Appendix A summaries the literature.

2.1 Diverging effect of feed-in tariffs

The literature researching the effectiveness of FIT primarily has been concentrated on the experience in Europe, the United States, and the OECD countries. In particular, the ongoing debate in the literature has focused on RESP policies and their effectiveness in promoting investments in, and deployment of, renewable energy sources.

In the context of Europe, Marques and Fuinhas (2012) analyzed the effectiveness of various RESPs in promoting renewable energy development. Overall, the research highlights the positive and significant impact of well-designed public policies on the advancement of renewable energy in Europe, especially incentives and subsidies, such as FIT. Additionally, within OECD countries, policies supporting renewable energy have been observed to significantly attract investment. Eyraud, Clements and Wane (2013) delve into various RESPs, affirming their overall effectiveness, by investigating two primary sets of drivers influencing green investments: macroeconomic factors, like GDP and interest rates, and policy drivers, including FIT, Renewable Portfolio Standards (RPS), carbon pricing schemes, and mandates. Notably, they found that FIT played a crucial role, significantly boosting green investments by two to three times. A general consensus has emerged in the literature regarding FITs as an effective policy tool having successful implementation in these countries.

As more developing countries have adopted RESP in more recent years, the research in this area is growing. However, the findings on RESP appear to be more diverging in a developing context. Romano, Scandurra, Carfora, and Fodor (2017) analyzed the impact of various RESPs on a sample of developed and developing countries and found a diverging effect of the policies in promoting investments in renewable sources. Their findings suggest that the efficacy of such policies is dependent on the country's level of development, indicating a nuanced relationship between these policy mechanisms and the economic contexts which they are implemented. Aguirre and Ibikunle (2014) find further diverging effects as they expand their previous study of European and the OECD countries by also including the BRICS countries. In this extended sample, they found that some policies intended to support renewable energy actually had a reverse effect. Additionally, in a geographic comparison of Europe and Latin America, Bersalli, Menanteau, and El-Methni (2020) find that in general, RESPs have a positive and significant effect on renewable energy investments in both regions. Specifically, while both areas show positive impacts from general RESP, financial incentives alone are not sufficient to ensure the deployment of renewable energy. The study emphasizes that the effectiveness of RESP in driving renewable energy investment is different across these two regions and highlights the importance of adapting these policies to specific economic and energy contexts.

2.2 Factors contributing to the effectiveness of feed-in tariffs

In determining the drivers of the policy's effectiveness, some empirical studies particularly emphasize its design features and the technologies it specifically targets as key factors. Other research concentrates on the external environment where the policy is implemented, underscoring the influence of political and institutional factors.

Jenner, Groba, and Indvik (2013) highlight the effectiveness of FIT in fostering renewable energy development, particularly by delving into the policy design features of FIT in 26 European countries. The study emphasizes that policy design features are more important drivers of renewable development than the enactment of the policy alone. Besides the design features itself, the consideration of the market and technology it is tailored for also matter for its success. Focusing on the OECD countries, Polzin, Migendt, Taübe, and Von Flotow (2015) explored various policy measures impacting renewable energy, reinforcing the consensus on FITs as effective fiscal incentives for attracting investments. Their findings underscore the significance of market-based instruments, like GHG trading systems, and the role of regulatory measures and long-term strategic planning, in creating a conducive environment for renewable energy investments. This indicate that FITs' effectiveness is enhanced when combined with a mix of regulatory, fiscal, and market-based instruments, and that these should be tailored to specific market conditions and the technological maturity stage.

The effectiveness of RESP policies are also significantly influenced by the institutional and political context in which they are implemented. According to Fredriksson and Svensson (2003), political instability and corruption can negatively impact the stringency of environmental regulations, but their effects are contingent upon each other. Their findings indicate that in environments with low corruption, political instability undermines the stringency of environmental policies. However, in highly unstable political environments, corruption can paradoxically strengthen environmental policies, as businesses may use bribery to navigate weak institutions, inadvertently leading to stricter regulations. Building on this, Bélaïd, El-Sayed, and Omri (2021) also delve into the influence of political stability, alongside factors such as government quality and financial development, within the realm of renewable energy. Their research focuses on the Middle East and North Africa (MENA) region and reveals that governance quality has a positive impact in renewable energy development. Their findings indicate that a well-functioning institutional framework, characterized by strong governance institutions, can create a supportive environment for renewable energy investments.

2.3 The role of governance

While research on the relationship between governance and FIT is lacking, the impact of governance on investments in renewable energy has been more extensively documented. Considering that the primary goal of FIT is to stimulate investments in renewable energy, understanding the drivers of investments and financial flows is crucial.

Sy and Sow (2019) studied the relationship between good governance and energy investment in Sub-Saharan Africa and found that good governance is positively associated with private investments and official development finance to the energy sector. In another approach to studying the relationship between investments and renewable energy, Dossou, Kambaye, Asongu, Alinsato and Berhe (2023) examine the moderating effect of governance. Focusing their study on Sub-Saharan Africa, they find that countries with higher levels of governance quality are more likely to attract foreign direct investment (FDI) to renewable energy projects. The paper also finds that the interaction between FDI and governance quality is positive and significant, meaning that the positive impact of FDI on renewable energy development is amplified in countries with higher levels of governance quality. Adopting an alternative method to investigate governance, Asongu and Nwachukwu (2015) are distinguishing between bundled and unbundled governance indicators in their studies of its impact on FDI. In their studies of BRICS and MINT countries, they observed varied impacts of the individual governance indicators on FDI, but pronounced effect for the bundled indicator. This approach evaluates the overall governance environment on stimulating FDI, which recognizes the interconnectedness and collective impact of different governance dimensions.

2.4 Aim, scope, and contribution

The contribution of this study is twofold. First, the study aims to assess the effectiveness of the FIT policy on renewable energy deployment across various economic contexts by examining the relationship on a global scale. This is done to test whether the diverging impact of FIT observed in the literature, reveals any patterns when examined globally. Thus, the study contributes by expanding the scope with an extensive sample of 181 countries. The countries included in the study is listed in Table 3 Appendix B. Existing studies have divided the samples into regions (Bersalli et al. 2020; Aguirre and Ibikunle (2014) or split the sample into two groups representing developed and developing countries (Romano et al. 2017). In the study by Romano et al. (2017), the split between developed and developing countries is based on the income group classification by the World Bank (2023a), focusing alone on upper-middle income and high-income countries. This study will use the same classification and extend the scope to also include the lower-middle and low-income country groups, covering most of the world. Furthermore, the study contributes by covering more recent years up to 2019. This is essential because many countries in the developing parts of the world have implemented the policy in more recent years.

Second, his study aims to contribute to the existing literature by examining the role of governance in the relationship between the FIT policy and renewable energy deployment, which, to the best of my knowledge, has not been done previously. The primary objective of this feature of the study is to explore the underlying causes for the diverging effectiveness of the FIT policy generally observed in the literature. The role of governance has been studied and identified as a significant determinant for investments in developing countries (Bélaïd et al. 2021; Dossou et al. 2023; Asongu and Nwachukwu 2015; Sy and Sow 2019) and this analysis, encompassing a global sample, aim to determinate the role of governance as a factor for the efficacy of the FIT policy for renewable deployment. This comprehensive approach is designed to shed light on the reasons behind the policy's varying degrees of success in different economic and governmental contexts.

3. Methodology

The study aims to understand the drivers of FIT policy effectiveness through a twofold approach: First, the study assesses the impact of the FIT policy across different economic contexts, examining whether its varied effects correspond with existing literature when applied globally. The second objective is dedicated to investigating the drivers behind the effectiveness of FIT policies, with a specific emphasis on governance. This includes exploring the interaction of governance with FIT policies for renewable energy deployment.

3.1 Measuring governance

An extensive part of the existing literature investigating governance quality is using the six governance indicators from the World Governance Indicators (WGIs), by either using some (Fredriksson and Svensson 2003) or all the indicators (Asongu and Nwachukwu 2015, Dossou et al. 2023; Sy and Sow 2019). Following these studies, the WGIs are used as governance measures as they cover various dimensions of governance related to political, economic, and institutional governance. The WGIs encompass Rule of Law, Control of Corruption, Governance Effectiveness, Voice and Accountability, Regulatory Quality, and Political Stability and are listed in Table 4 with an associated description of each. The data on the indicators are retrieved from the World Bank (2023b) which annually publishes scores on the indicators for more than 200 countries, with the scores ranging from -2.5 (worst) to 2.5 (best). Hence, the WGI database offers comprehensive coverage, providing data on a wide range of countries worldwide. This extensive coverage ensures that the indicators are standardized across different nations, facilitating consistent comparisons across countries and over time. Additionally, the WGIs encompass multiple dimensions of governance and are constructed from aggregated data from various sources, which allows a holistic analysis of governance.

Table 4 - Overview of governance variables

Abbr.	WGI	Description
RL	Rule of Law	Adherence to societal rules and the quality of legal structures.
CC	Control of Corruption	Prevalence of public power used for private benefits.
GE	Government Effectiveness	Quality and independence of public and civil services.
VA	Voice and Accountability	Citizens' participation in government and freedom of expression.
RQ	Regulatory Quality	Government's ability to promote private sector development through sound regulations.
PS	Political Stability	Likelihood of political instability or politically motivated violence.

As the WGIs cover various dimensions of governance, there is a potential issue of multicollinearity among the variables. To investigate this, a correlation matrix was utilized to examine the correlation coefficients between pairs of the governance variables. As displayed in Table 5 in Appendix C, the matrix indicates a significant degree of correlation among these variables, with several pairs showing coefficients near -1 or 1, suggesting the presence of multicollinearity. To address this issue, Principal Component Analysis (PCA) is used, as this technique can consolidates highly correlated variables into a smaller set of principal components. This technique is also used in the literature by Asongu and Nwachukwu (2015) when measuring the effect of governance by bundling the indicators. PCA is utilized to generate a new variable, the Governance Index, which encapsulates the six governance variables from the WGIs. This index is created to range from 0 to 1, where values closer to 1 indicate a higher quality of governance.

3.2 Empirical models

The first regression model is designed to investigate the relationship between the FIT policy and different levels of economic development represented by four distinct income groups - low, lower-middle, upper-middle, and high. The country classification by income group is based on the assignment from the World Bank (2023a), which is determined based on the country's gross national income per capita. The country classification is displayed in Table 3 in Appendix B. The following equation is used to estimate this relationship:

$$Renew_{i,t} = \beta_0 + \beta_1(FIT_{i,t} * IG_i) + \sum_{k=1}^{K} \beta_k X_{i,t} + \eta_i + \upsilon_t + \varepsilon_{i,t}$$

where $Renew_{i,t}$ is the renewable deployment presented by the share of renewable capacity out of total installed capacity for country i in year t, $FIT_{i,t} * IG_i$ represent the interaction effect of income group IG_i and the binary policy variable for whether a country i has the FIT policy at time t and $X_{i,t}$ indicates the vector of relevant control variables, namely total capacity, per capita electricity consumption, electricity imports, and GDP per capita. β_0 is a constant, and

β_1 and β_k are coefficients of each variable. η_i denotes the country fixed effect capturing time-invariant country heterogeneity, υ_t is the time fixed effect capturing time-variant factors, and $\varepsilon_{i,t}$ is the error term. Entities i corresponds to $i = 1, \dots, N$ and time t is $t = 1, \dots, T$.

Building on this relationship, this study aims to explore the determinants of the effectiveness of FIT policies, with a specific focus on governance. To examine the interplay between governance and the FIT policy on renewable energy development, their interaction term is included in the model controlling for the direct effect of governance. The following equation is used to explore the role of governance:

$$Renew_{i,t} = \beta_0 + \beta_1 FIT_{i,t} + \beta_2 Gov_{i,t} + \beta_3 (FIT_{i,t} * Gov_{i,t}) + \sum_{k=1}^{K} \beta_k X_{,i,t} + \eta_i + \upsilon_t + \varepsilon_{i,t}$$

where $FIT_{i,t}$ denotes the binary policy variable for whether a country i has the FIT policy at time t, $Gov_{i,t}$ is the Governance Index constructed through PCA, $FIT_{i,t} * Gov_{i,t}$ represents the interaction effect of the FIT policy and the Governance Index.

4. Data

For this research, a dataset encompassing 12 different variables has been constructed, covering 18 years from 2002 to 2019 across a global sample of 181 countries, leading to a total of 39,880 observations. This study encompasses a global scope, with the inclusion of countries in the sample being contingent on data availability. Although the data for the different variables vary in their respective years of coverage, all variables consistently provide data up to 2019. The starting point of 2002 was chosen due to the lack of data in the WGIs for the year 2001. Consequently, this study focuses on data available from 2002 onwards.

The analysis uses panel data, which includes a cross-sectional dimension by including several countries and a time-series dimension as these countries are observed at several point in time. A panel data analysis allows for the examination of dynamics of change, as they track the same countries over time. One of the primary benefits of using panel data methodology to analyze the impact of the FIT policy is its ability to accommodate unobserved heterogeneity by incorporating individual-specific effects. This study incorporates country-fixed effects to account for unmeasured country-specific characteristics that might impact the deployment of renewables as well as year-fixed effects to control for common time-specific influences. This dual control allows the analysis to focus more accurately on the impact of the FIT policy on renewable deployment, minimizing the potential bias arising from omitted variables that vary either across countries or over time.

The 12 variables included in this analysis are summarized in Table 6 in Appendix D. The following section provides a detailed description of these variables, along with the rationale for their inclusion and the anticipated relationships they hold.

4.1 The dependent variable

The literature on renewable energy development employs various dependent variables, differing in whether they measure capacity or generation, and in whether they measure renewables as a cumulative total, an annual change, or as a proportion or percentage of total energy output. Following Aguirre & Ibikunle (2014), the dependent variable of this study is the ratio of renewable electricity capacity in total installed capacity. The renewable capacity includes energy sources like hydroelectricity, geothermal, solar, tide/wave, wind, biomass, and waste. Nuclear energy is not included in this study following the notation by Eyraud et al. (2013) that note significant differences in investment decisions between nuclear and other renewable energy sources. Furthermore, this study focuses on capacity rather than generation as it is less vulnerable to external fluctuations like weather conditions, technical issues, or changes in demand (Jenner et al. 2023). In contrast, electricity capacity represents the maximum amount a country can generate, offering a fixed benchmark for potential energy production. The data on electricity capacity is retrieved from the U.S. Energy Information Administration (EIA), a database also used by Jenner et al. (2013) for energy data.

4.2 The policy variable

The policy variable represents the FIT policy, constructed as a dummy variable taking the value 1 when a country has implemented at least one FIT policy for any type of renewable energy source in a given year, and 0 otherwise. The dummy variable is assigned a value of 1 for all years during which the policy is in effect, continuing until the policy eventually concludes. The variable is constructed as a dummy to ensure comparability across countries, as data on the policy is derived from different sources, including the OECD database and the International Energy Agency's Policies and Measures Database (IEA).

4.3 The Governance Index variable

It has been documented that investments in the renewable energy sector depend on the quality of governance or instructions of a country (Bélaïd et al. 2021). Countries with higher levels of governance quality are more likely to attract FDI in renewable energy projects (Dossou et al. 2023). The role of governance quality in the effectiveness of FIT is still to be determined. Given the close link between FIT and investments, it is expected that these policies, when coupled with good governance, will have a positive effect on investments, thereby facilitating the deployment of renewable energy sources. The construction of the Governance Index variable, along with a detailed description of the included variables and the source of the data, has been previously outlined in section 3.1.

4.4 Control variables

Beyond the policy, there might be context-specific variables that can have a significant effect on renewable deployment. To account for energy market dynamics and economic development in the analysis, variables such as total capacity, per capita electricity consumption, electricity imports, and GDP per capita are included.

Total capacity

The study controls for the size of the energy market by using the total installed capacity for electricity generation. According to Jenner et al. (2023), there is a positive correlation between the overall electricity market size and the growth of renewable energy capacity. This suggests that larger national electricity markets are better positioned to facilitate the installation of renewable energy infrastructure. The total capacity encompasses all the various renewable energy sources as listed in the description of the dependent variable in section 4.1 as well as coal, petroleum, natural gas, nuclear, and hydroelectric pumped storage. The installed capacity is measured in megawatts (MW) and retrieved from the EIA.

Consumption per capita

Consumption is included as a control variable to reflect the demand for electricity and subsequent energy investments. As a country's demand for electricity grows, there is a corresponding need to invest in additional power generation capacity, including fossil fuels and renewable energy sources. (Romano et al. 2017). Additionally, when fossil fuel power plants reach the end of their operational lifespan, they must be replaced with an equivalent new capacity, which could also encourage further investments in renewable capacity (Bersalli et al. 2020) In this study, the consumption variable is expressed in per capita terms, calculated by dividing the total annual consumption by the population size for that year. The data on annual electricity consumption is measured in megawatt hours (MWh) and retrieved from EIA.

Import

The import of electricity is included as a control variable to reflect the energy dependence. This is based on the assumption that countries with high dependence on external energy supply have a more pressing need to develop their production sources, including renewable energy (Bersalli et al. 2020). Reducing energy dependence is an energy policy objective and one of the main arguments for increasing renewable energy in both developed and developing countries (Aguirre and Ibikunle 2014; Marques and Fuinhas 2023). Following Marques and Fuinhas (2012) the expected relationship is positive, indicating as the higher the country's dependence on external supply, the greater will the incentive be to deploy renewable sources. The variable takes the value of the total amount of energy imported annually measured in megawatts hours (MWh) and 0 otherwise. The data is retrieved from EIA.

GDP per capita

Existing studies commonly control for GDP per capita, utilizing it as a proxy for economic development (Bersalli et al. 2020; Marques and Fuinhas 2012; Aguirre and Ibikunle; Romano et al. 2017). The underlying assumption is that high-income countries are better capable of bearing the cost of developing renewable technologies and encourage them through economic incentives and therefore more likely to deploy renewables. The study utilizes the percentage annual growth rate of GDP per capita as a control variable, as GDP per capita was highly correlated with consumption per capita. The data is from the World Development Indicators (WDI) by the World Bank (World Bank 2023c)

4.5 Data limitation

The OECD database covers the 37 OECD countries as well as 36 non-OECD countries. This database provides detailed data on FITs, including characteristics such as the length of the purchase agreement and the tariff rate for the various renewable sources. Jenner et al. (2013) emphasize the importance of including policy design features in analyzing the effectiveness of FIT policies. Their research reveals that the features of the policy design are important determinants of renewable development. Hence, it would be desirable to include the policy design features in this study. However, as the policy data is supplemented by the IEA database, the policy variable has been constructed as a binary indicator to ensure consistency across different countries. Consequently, employing a dummy variable to assess the policy eliminates the nuances of its quantity and design, which, as demonstrated by Jenner et al. (2013) play a significant role in influencing renewable energy investments and deployment. This simplification may overlook critical aspects of policy design features that are crucial for understanding the true impact of the FIT policy initiative.

5. Empirical results

In the following part, the findings from the regression models of this study will be presented and discussed. For both regression tables, the first column displays the results from a regression model without controls. The second column presents the results from a regression model, which includes the additional control variables, namely total capacity, electricity consumption per capita, electricity import, and GDP per capita annual growth. Presenting these two sets of results enables to assess whether the initial findings remain robust upon the inclusion of these variables and to what extent they contribute to the observed relationship.

6.1 Income group results

In Table 7, the results for the interaction between the FIT policy on the four different income groups are presented, showing the varying effect of the FIT policy on the share of renewables in the country's total electricity capacity. The baseline for the interaction is the scenario when the FIT variable is 0, indicating when the policy is not in place. In this setup, the coefficients for the interaction terms represent the difference in the effect of the FIT policy on the renewable share for each income group compared to when there is no FIT policy.

Table 7 - Regression results for the income groups

	(1)	(2)
High income group * FIT policy	0.0232*	0.0208*
	(0.0133)	(0.0124)
Upper-middle income group * FIT policy	0.000914	0.000616
	(0.0128)	(0.0127)
Lower-middle income group * FIT policy	-0.0504**	-0.0489**
	(0.024)	(0.0242)
Low income group * FIT policy	-0.0745	-0.0731
	(0.0611)	(0.0612)
Total capacity		8.16e-08***
		(2.84E-08)
Consumption per capita		-0.000585
		(0.00198)
Import		0.0015
		(0.00156)
GDP per capita		3.07E-05
		(0.000428)
Constant	0.0781***	0.0810***
	(0.013)	(0.0151)
Observations	3,148	3,090
R-squared	0.949	0.949
Country FE	YES	YES
Year FE	YES	YES

Notes: Standard errors are clustered at the country level to account for within-cluster correlation. ***, **, * denotes significance at the 1, 5, and 10 percent level, respectively.

For high-income countries, the effect of the FIT policy on the renewable share is positive and significant, indicating that the FIT policy has a favorable effect on the share of renewable electricity in the countries where it has been implemented. Similarly, a positive yet not significant effect is observed for upper-middle-income countries. This corresponds with the general consensus that FIT policies are effective in contexts characterized by higher levels of development (Romano et al. 2017; Eyraud et al. 2013).

Upon examining the two lower income groups, the findings indicate that the FIT policy starts to exert a degrading effect on the share of renewables in countries that have adopted the policy. For lower-middle-income countries, the analysis reveals that the implementation of FIT has a significant and negative effect on renewable deployment. This negative impact of the FIT policy seems to be even more pronounced for lower-middle-income group, yet not significant. These findings suggest a continued downward trend in the coefficients, demonstrating that as the level of economic development decreases, the policy's diminishing effect on renewable deployment becomes more pronounced. These findings demonstrate consistency across both regression analyses and remain robust after incorporating the control variables.

The negative effect of the policy, also observed by Aguirre and Ibikunle (2014), appear counterintuitive, contradicting the intended objectives of the FIT policy of promoting renewable energy development. Fredriksson and Svensson (2003) and Romano et al. (2017) suggest that the negative impact of FITs in developing countries can be attributed to policy instability and the broader energy policy context. The unpredictability and frequent changes of FITs, particularly in countries with already unstable policy environments, hinder long-term investment and impede the growth of renewable energy sectors. We will explore this consideration of the policy impact from the literature in greater detail in the next section.

6.2 Governance results

To examine whether governance can explain the diverging findings of FIT across different levels of economic development, the Governance Index variable is added to the regression analysis. Table 8 presents the outcomes when incorporating the Governance Index into the relationship between FIT policy and the share of renewable in the total installed capacity.

Table 8 - Regression results on governance for the global sample

	(1)	(2)
FIT policy	-0.0770**	-0.0713**
	(0.0306)	(0.0298)
Governance Index	0.0262	0.0131
	(0.105)	(0.107)
Governance Index * FIT policy	0.120***	0.110**
	(0.0451)	(0.0428)
Total capacity		7.94e-08**
		(3.05E-08)
Consumption per capita		-0.00037
		(0.00162)
Import		-0.00157
		(0.0478)
GDP per capita		0.000014
		(0.000428)
Constant	0.0627	0.0351
	(0.0867)	(0.0883)
Observations	3,165	3,109
R-squared	0.949	0.949
Country FE	YES	YES
Year FE	YES	YES

Notes: Standard errors are clustered at the country level to account for within-cluster correlation. ***, **, * denotes significance at the 1, 5, and 10 percent level, respectively.

The coefficient for FIT policy represents the effect when the Governance Index is equal to 0, indicating very poor governance. On a global scale, the coefficients for the FIT policy are negative and statistically significant at the 5% level, which suggests that the policy has a negative effect in countries with poor governance.

The interaction term between the Governance Index and FIT policy shows how the effect of FIT policies on the renewable deployment changes with the quality of governance. The positive coefficient suggests that as countries with good governance, the FIT policy helps enhance the share of renewable capacity. This suggests that as governance improves, the effect of FIT policy's impact on renewable capacity becomes more positive. These coefficients are statistically significant at the 1% level in regression (1) and at the 5% level in regression (2) including the control variables. Beside this difference in significance, the results obtained are not substantial different, indicating that the observed effects are attributed to the variables included.

The findings of this interaction term can be compared with the one analyzed by Dossou et al. (2023), which primarily examined the interplay between FDI and governance quality, rather than focusing on FIT. Their research also yielded positive and significant results, highlighting that FDI fosters renewable energy development in Sub-Saharan African countries with higher governance quality. Our findings not only corroborate this relationship within the context of Sub-Saharan Africa but also extend its validity on a global scale. Dossou et al. (2023) suggest that poor governance creates an environment fraught with risks for foreign investors, characterized by corruption, policy instability, and weak enforcement of contracts. In contrast, strong governance can foster a stable and predictable environment conducive to investing in renewable energy projects, ensuring the enforcement of contracts, protection of property rights, and shielding investments from arbitrary policy changes.

The significance of the interaction term underscores the vital role that governance plays in the success of the FIT policy implementation. The quality of governance in a country likely explains the negative impact observed for lower-income groups in Table 7. In countries with poor governance, the FIT policy tends to have a negative impact on renewable energy deployment, contrary to the positive effect it was initially intended to have when implemented. These findings further confirm the essential impact of governance on environmental policy formulation (Fredriksson and Svensson 2003) and that governance quality is essential to attract investments to renewable projects (Dossou et al. 2023).

7. Policy implications and further research

The findings indicate that the effectiveness of FIT is highly contingent upon the governance quality in the country in which it is implemented. These insights indicate that while FIT can be successful in countries with good governance, its implementation in countries with poor governance may lead to adverse effects. This disparity between countries with good and poor governance also relates to a broader issue of the financing gap experienced in developing countries. Notably, 80% of all financial commitments are concentrated in just 30 countries (World Bank et al. 2022). This gap is not just a reflection of economic disparity but also the consequence of perceived risk associated with poor governance. The financing gap reflects not only economic disparities but also the perceived risks associated with poor governance. In countries plagued by issues like corruption, regulatory uncertainty, and political instability, investors are often reluctant to finance renewable energy projects (Bélaïd et al. 2021), even when incentivized by policies like FIT as these findings reveal. This reluctance stems from the unattractiveness of these investment environments. Conversely, countries with good governance structures benefit from a stable and predictable regulatory environment, making renewable energy projects more appealing to investors, which is thoroughly documented in the literature (Dossou et al. 2023; Asongu and Nwachukwu 2015; Sy and Sow 2019)

This disparity presents a significant challenge in ensuring equitable resource distribution and support for renewable energy development across developing countries. The limited success of the FIT policy in settings of poor governance and lower economic development highlights its ineffectiveness in bridging the financing gap and attracting investments. However, whether other RESP are more effective in these contexts could serve as a basis for further research. Therefore, further research is suggested to explore the dependence on governance quality as a common factor affecting RESP. In order to address the financing gap experienced in developing countries, it is further suggested to examine the effectiveness of other RESP in developing countries to identify more effective strategies in attracting investments and promoting renewable energy.

8. Conclusion

As FIT policies have been proven effective in many developed countries, a growing number of developing countries have recognized their potential to stimulate investment in renewables and have started implementing the policy. Given the worldwide expansion of the policy in recent years, there is a need to assess whether it succeeds with its intended effect. The current literature generally agrees that the FIT policy is highly effective in attracting investments and expanding the use and adoption of renewable sources. However, studies find more divergent impacts of the policy when applied in the context of developing economies. This study confirms the general consensus in the current literature that the policy has diverging impacts in different economic settings. Particularly, while the FIT policy appears to exert a positive impact in high and upper-middle-income countries, this trend does not hold for lower-middle and low-income groups. In fact, the analysis identifies a downward trend for the policy's impact as the level of economic development decreases. Whereas existing literature highlights a distinction in its impact between developed and developing countries and specific regional contexts, these findings reveal a more nuanced dynamic, showing the divergent impact in a global scale.

To investigate the observed diverging effects of the policy, this study assessed how the role of governance on the relationship between the policy and renewable energy deployment. The findings indicate that the efficacy of the FIT policy is contingent upon a country's governance quality. In cases where a positive impact of the policy has been observed, it can be attributed to the presence of good governance systems. In contract, countries with poor governance, the implementation of the policy yields the opposite effect. Therefore, governance can be identified as a key factor contributing to the observed divergence in the policy's effects on a global scale. These contexts of poor governance exacerbate the challenge of attracting investments, further contributing to the recognized financing gap prevalent in developing countries.

This study highlights the need to consider the governance environment when designing and implementing policies like FITs. The study emphasizes that the effectiveness of the policy can depend on factors beyond the specific mechanisms of the policy itself, but is also contingent upon the broader economic and governance context in which it is implemented.

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Appendix A

Table 1 - Overview of RESP specific literature

Author(s)	Period of study	Sample(s)	Type of RESP	Findings
Marques and Fuinhas (2012)	1990 to 2007	23 European countries	FIT, grants, loans, standards, tax incentives, strategic planning, institutional creation.	Public policies, particularly incentives and subsidies (incl. FIT) are significant driver in enhancing the use of renewable energy in Europe.
Eyraud et al. (2013)	2000 to 2010	32 OECD countries + Brazil, China, and India	FIT, RPS, carbon pricing schemes, biofuel mandates	FIT and carbon pricing schemes had a significant effect on green investments, with FIT increasing investments two to three folded for countries adopting the policy.
Polzin et al. (2015)	2000 to 2011	The OECD countries	FIT, grants, subsidies, GHG trading system, RPS, codes and standards.	Technology-specific policies, which consider market conditions and the technology life cycle stage, are most effective.
Jenner et al. (2013)	1992 to 2008	26 European countries	FIT	The policy design features are more important determinants for renewable energy development than the policy enactment itself.
Aguirre and Ibikunle (2014)	1990 to 2010	170 covering EU, the OECD and BRICS countries	FIT, fossil fuel subsidies	Both fossil fuel subsidies and FIT can have significant effects on renewable energy growth. However, the direction of the effect depends on the specific policy design and the context in which the policy is implemented.
Romano et al. (2017)	2004 to 2013	50 developed and developing countries	FIT, quota, RPS, tradeable REC, subsidy, tax credits, taxes, bidding, loans, and grants.	The effectiveness of RESP depends on the developmental stage of the country.
Bersalli et al. (2020)	1995 to 2014	20 countries from Latin America and 30 European countries	FIT, auction, quota obligations with negotiable green certificates, RPS	In Europe, FIT, RPS and auctions are central instruments in RE development, while FIT not show to have the same effect in Latin America.

Table 2 - Overview of governance specific literature

Author(s)	Period of study	Sample(s)	Governance elements studied	Findings
Dossou et al. (2023)	1996 to 2020	37 Sub-Saharan African countries	Governance quality covering all the WGI	Governance quality is positively associated with renewable energy.
Sy and Sow (2019)	1996 to 2014	48 Sub-Saharan Africa Countries	WGI and RISE	Good governance is associated with increased private investment and ODA in the energy sector but varies with country characteristics for FDI.
Fredriksson and Svensson (2003)	1981 to 1990	63 countries, both developed and developing countries.	Political stability and control of corruption.	Political instability and corruption interact in complex ways to influence environmental policy, with instability reducing policy stringency in low-corruption contexts but increasing it in high-corruption scenarios.
Asongu and Nwachukwu (2015)	2001 to 2011	BRICS and MINT countries	Bundled and unbundled WGI.	The impact of governance on FDI varies depending on whether governance variables are considered separately (unbundled) and in combination (bundled).
Bélaïd et al. (2021)	1984 to 2014	9 MENA countries	Political stability and governance quality.	Political stability is important investments in the renewable energy sector.

Appendix B

Table 3 - List of countries divided by income group

High income	Upper-middle income	Lower-middle income	Low income
Antigua and Barbuda	Albania	Angola	Afghanistan
Australia	Algeria	Armenia	Bangladesh
Austria	Argentina	Bhutan	Benin
Bahrain	Azerbaijan	Bolivia	Burkina Faso
Barbados	Belarus	Cabo Verde	Burundi
Belgium	Belize	Cameroon	Cambodia
Brunei	Bosnia and Herzegovina	China	Central African Republic
Canada	Botswana	Congo	Chad
Croatia	Brazil	Cote d'Ivoire	Comoros
Cyprus	Bulgaria	Djibouti	Congo, Dem. Rep.
Czechia	Chile	Egypt	Eritrea
Denmark	Costa Rica	El Salvador	Ethiopia
Estonia	Cuba	Eswatini	Gambia
Finland	Dominica	Georgia	Guinea
France	Dominican Republic	Ghana	Guinea-Bissau
Germany	Ecuador	Guatemala	Haiti
Greece	Equatorial Guinea	Guyana	Kenya
Hungary	Fiji	Honduras	Kyrgyzstan
Iceland	Gabon	India	Liberia
Ireland	Grenada	Indonesia	Madagascar
Israel	Iran	Kiribati	Malawi
Italy	Iraq	Kosovo	Mali
Japan	Jamaica	Laos	Mozambique
Kuwait	Jordan	Lesotho	Nepal
Luxembourg	Kazakhstan	Mauritania	Niger
Malta	Latvia	Moldova	North Korea
Netherlands	Libya	Morocco	Rwanda
New Zealand	Lithuania	Nicaragua	Senegal
Norway	Malaysia	Nigeria	Sierra Leone
Oman	Maldives	Pakistan	Somalia
Poland	Mauritius	Papua New Guinea	Tajikistan
Portugal	Mexico	Paraguay	Tanzania
Qatar	Montenegro	Philippines	Togo
Saudi Arabia	Namibia	Samoa	Uganda
Singapore	North Macedonia	Sao Tome and Principe	Yemen
Slovakia	Panama	Solomon Islands	Zimbabwe
Slovenia	Peru	Sri Lanka	

South Korea	Romania	Sudan	
Spain	Russia	Syria	
Sweden	Saint Kitts and Nevis	Tonga	
Switzerland	Saint Lucia	Tunisia	
The Bahamas	Saint Vincent	Turkmenistan	
Trinidad and Tobago	Serbia	Ukraine	
United Arab Emirates	Seychelles	Uzbekistan	
United Kingdom	South Africa	Vanuatu	
United States	Suriname	Vietnam	
Uruguay	Thailand	Zambia	
	Turkiye		
	Turkmenistan		
	Uruguay		
	Venezuela		
Total 47 countries	Total 51 countries	Total 47 countries	Total 36 countries

Appendix C

Table 5 - Correlation matrix of the governance variables

	RL	CC	GE	PS	VA	RQ
RL: Rule of Law	1.0000					
CC: Control of Corruption	0.9431	1.0000				
GE: Government Effectivness	0.9466	0.9248	1.0000			
PS: Political Stability	0.7686	0.7489	0.7107	1.0000		
VA: Voice and Accountability	0.8156	0.7721	0.7693	0.6413	1.0000	
RQ: Regulatory Quality	0.9158	0.8656	0.9303	0.6607	0.8029	1.0000

Appendix D

Table 6 - Data overview

Variable	Name	Definition	Measurement	Source
Dependent variable	Renew	Share of renewable capacity in total electricity capacity	Ratio	EIA
Policy variable	FIT policy	Takes value 1 if a country at certain year implemented a FIT policy for any renewable source and 0 otherwise	Binary	OECD.Stat and IEA Policies and Measures Database
Governance Index	Rule of Law	Adherence to societal rules and the quality of legal structures	Score from -2.5 to 2.5	WGI by the World Bank
	Control of Corruption	Prevalence of public power used for private benefits	Score from -2.5 to 2.5	WGI by the World Bank
	Government Effectiveness	Quality and independence of public and civil services	Score from -2.5 to 2.5	WGI by the World Bank
	Voice and Accountability	Citizens' participation in government and freedom of expression	Score from -2.5 to 2.5	WGI by the World Bank
	Regulatory Quality	Government's ability to promote private sector development through sound regulations	Score from -2.5 to 2.5	WGI by the World Bank
	Political Stability	Likelihood of political instability or politically motivated violence	Score from -2.5 to 2.5	WGI by the World Bank
Control variables	Total capacity	Total installed electricity-generating capacity	MW	EIA
	Consumption	Electricity consumption per capita	MWh	EIA
	Import	Amount of electricity imported annually, and 0 otherwise	MWh	EIA
	GDP	Annual percentage growth rate of GDP per capita	%	WDI by the World Bank