

DOES ENERGY DEMOCRACY AFFECT ECONOMIC GROWTH? EARLY EVIDENCE FROM HIGH INCOME COUNTRIES DURING 1997–2020

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Abstract. In accordance with UN sustainable development policies, this study examines the impact of energy democracy, energy equality, exports, globalization, financial development, and natural resources on economic growth patterns of high-income countries from 1997 to 2020. The study finds evidence of a long-run relationship among variables. Empirical estimations from FMOLS and DOLS models reveal that energy democracy, exports, globalization, and financial resources enhance economic progress, while natural resource consumption provides an opposite effect. This study suggests that high-income countries should promote community-based renewable energy projects and energy-efficient practices as well as implementing an adequate harmonisation of energy democracy policies and processes.

Keywords: energy democracy, globalization, financial development, economic growth, high income countries.

JEL Classification: E02, F6, F43, P18.

Introduction

Some of the most urgent problems harming the planet's sustainability are the degradation of ecosystems, declining biodiversity, global warming, air and water pollution. In this regard, the United Nations Development Programme (UNDP) plays a pivotal role. The 17 sustainable development goals introduced in 2015 offer a yardstick for long-term progress towards a better world by tackling most challenging social, economic, and environmental issues (Danish et al., 2020). The transition to the green economy and the pursuit of energy independence are contributing to the above goals, although much should be done in the short as well as long run (Vazquez-Brust & Plaza-Úbeda, 2021). Energy independence generally describes a situation in which a country or region is self-sufficient in terms of energy production. According to the Treaty on the Functioning of the European Union (EUR-Lex, n.d.), the production and use of renewable energy should sharply increase in the near future to help reducing traditional fossil fuels use and contributing to global pollution mitigation. Gaining independence from renewable energy sources favours energy security as well as economic growth and job creation (Burke & Stephens, 2017; Connolly et al., 2016). In addition, locally owned renewable energy infrastructures

may provide community involvement to enhance local sustainable growth (Zafar et al., 2019; Wang & Dong, 2019; Wang et al., 2022).

In order to encourage economic growth and reduce greenhouse gas emissions, the latest COP 27 provides a platform for governments to join together and establish realistic climate goals. Incentives for green sources, energy efficiency, and low-carbon infrastructure investments are examples to accomplish this goal. Similarly, globalization is playing a significant role in the expansion of the global energy system, as well as the growth of renewable energy markets.

Many countries and organizations have pledged to set a net zero 2050 target as part of their climate action plans (Erdoğan et al., 2020). It is necessary for governments and policy makers to take action, by providing investments in green energy projects and raise community awareness for renewable energy use.

An energy democracy process may therefore be the key for the upcoming generation towards a fair energy system and economic growth.

To deepen the knowledge of the above issues, the main aim of the present study is to investigate the impact of energy democracy, energy equality, exports,

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globalization, financial development, and natural resources, on economic growth in high income countries from 1997 to 2020.

The remainder of the paper is structured as follows: Section 1 highlights a brief literature review; Section 2 sets out the methodology: first, it introduces data sources and variables description; then, it considers second generation panel unit root tests, cointegration tests and long-run estimations tests; Section 3 applies pool mean group auto regressive distributed lag models, after which discusses results; Section 4 provides relevant policy implications; and finally, the last section concludes.

1. The concept of energy democracy

1.1. Literature review

Energy democracy refers to the shift from centralized, fossil fuel-based energy systems to more decentralized, renewable energy systems that are owned and controlled by communities and individuals. The impact of energy democracy on economic development is complex and depends on several factors (Hess, 2018; van Veelen & van der Horst, 2018; Sweidan, 2021). Energy is a global policy issue. 1.5 billion individuals in the world have access to electricity (Becker & Naumann, 2017). With its “Sustainable Energy for Everyone” campaign, the United Nations establishes the “universal right to access clean energy” (Zhang et al., 2021).

Exports have been widely acknowledged as one of the main drivers of economic growth for many countries. The positive impact of exports on economic growth is attributed to various factors, such as it increases foreign exchange earnings (Ahmad, 2017), access to new markets (Millia et al., 2021), and improved competitiveness (Wen et al., 2023). However, exports generate foreign exchange earnings that are used to finance imports of goods and services (Saleem et al., 2023), pay off foreign debts (Rahman, 2017), and accumulate foreign reserves (Chhabra et al., 2023). This inflow of foreign currency into a country’s economy helps to stabilizing the value of the local currency, promote international trade, and provide resources for investments in infrastructure, education, and healthcare (Kalaitzi & Cleeve, 2018). Exports are widely acknowledged to have a favourable impact on GDP growth (Ahmad, 2017; Bakari & Mabrouki, 2017) while some other works address an opposite effects (Bakari, 2017).

Also, globalization promotes economic growth by providing access to markets, new technologies, and cheaper inputs. Globalization increases competition, leading to greater efficiency and innovation, and stimulating foreign investments, creating jobs and boosting economic activity (Jahanger et al., 2022). In recent years the process of globalization has mainly affected Asian economies. The study by Hasan (2019) applied pooled mean group (PMG) model and the main findings revealed that globalization help boosting economic

growth. Some scholars argue that globalization increases economic volatility, as countries become more interconnected and vulnerable to external shocks, which ultimately negatively affect economic growth patterns (Khan et al., 2019; Zaidi et al., 2019).

The literature also widely recognises the effects of financial development on the growth process. According to recent studies of Erdoğan et al. (2020), Wang et al. (2021) and Ehigiamusoe (2021) by improving access to credit, financial institutions help businesses and individuals to invest in new projects and technologies, thus increasing productivity and creating new jobs. Financial markets also improve the allocation of capital by directing or re-directing savings into productive investments.

Natural resources also have a significant impact on economic growth. Natural resources such as oil, gas, minerals, timber, and agricultural land, provide raw materials to many industries and contribute to increase gross domestic product (GDP) (Zhang et al., 2021; Nathaniel, 2021; Khan et al., 2021). Vice-versa, the reliance on natural resources as a primary source of income also pose risks to economic stability. The volatility of global commodity prices leads to fluctuations of revenues and instability of the economy. Therefore, a balanced and sustainable approach is necessary to manage and use natural resources to ensure economic stability and long-term prosperity.

In terms of energy democracy processes, several studies highlight the importance of establishing a collaborative network acting as a bridge between public institutions (state and local), the private sector and citizens (Burke & Stephens, 2017; Campos et al., 2020; Jahanger et al., 2022). This process, on the other hand, may be seen as a chimera, if placed beyond an institutional body of international vigilance and supervision (James, 2016; Zaidi et al., 2019; Acheampong et al., 2022). In this regard, the study by Rogge et al. (2017) underlines the difficulties to comply with the Paris Agreement (2015) if it had not been ratified under the auspices of the UN, due to an excessive dis-homogeneity of national regulations and criteria set by each single signatory country.

1.2. Literature gap

While a significant body of research focused the attention on the factors described above, there is still little acknowledged by the international debate regarding the potential effects of an energy democracy process on economic growth.

In light of the lack of empirical research on this topic, further investigation is required to establish a causal relationship between energy democracy and economic growth. Most studies on energy democracy are either theoretical or qualitative in nature (Sweidan, 2021), although several works have made use of panel data analyses to investigate the links between democracy and economic growth (Usman et al., 2020; Murshed, 2022).

The literature also presents several gaps regarding the strategies and economic policies that would allow for an

effective implementation of an energy democracy process. As observed by Ansell and Gash (2008), the issue of collaboration between formally independent organizations across different sectors should be investigated, as limited studies are present on this subject. Generally, major international organizations establish consensus-oriented collaborations, and hence the production of collective outputs (e.g. decisions, projects, services). Emerson et al. (2012) strongly contrasts this view, although Berthod et al. (2022) suggest the need for further scientific debate on democratization processes (Droubi et al., 2022; Wang et al., 2022). In particular, the need to establish a multi-level leadership to make this process effective is strongly desirable (Fliervoet et al., 2016; Nolden et al., 2020; Berthod et al., 2022).

2. Methodology

2.1. Variables description and data sources

The present section provides information on data sources and a brief description of the variables used for high income countries during the period 1997–2020. Data are retrieved from World Development Indicators (World Bank, n.d.), Dheher (Eidgenössische Technische Hochschule Zürich, n.d.), International Monetary Fund (n.d.), and Varieties of Democracy databases (n.d.). The energy democracy variable is an interaction term between energy equality and democracy. Economic growth is expressed in terms of per capita GDP measured in 2015 constant US\$. Exports are measured in current US\$. Globalization refers to the interdependence of nations and economies around the world, facilitated by advances in transportation, communication, and technology. The current study uses a globalization index with value ranges from 1(= minimum level of globalization) to 100(= maximum level of globalization). Similarly, financial development is also measured as an index expressed in a range from 1 to 100. Total natural resources (NR) is used as a proportion of GDP.

2.2. Models

The following equations explain the influence of our explanatory variables on economic growth.

$$GDP_{it} = f_{1it} + f_2(EE \times DEMO)_{it} + f_3EXP_{it} + f_4GLO_{it} + f_5FD_{it} + f_6NR_{it} + m_{it}, \quad (1)$$

where *EE* stands for energy equality and *DEMO* for democracy. *ED* is the energy democracy variable; whereas, *EXP* is the level of exports; *GLOI* is the globalization index; *FD* and *NR* indicate financial development and natural resource use, respectively; f_1 is the intercept term, while $f_2 \dots f_6$ are the parameters to be estimated, while *m* indicates the error term. The suffixes, *I* and *t* indicate countries and time units. In Eq. (2) below, data are considered in terms of their natural log to avoid or reduce estimation biases and data sharpness. Therefore, Eq. (2) can be seen as a percentage change in the dependent

variable for every unit change in the explanatory variable:

$$\ln GDP_{it} = f_{1it} + f_2ED_{it} + f_3\ln EXP_{it} + f_4\ln GLO_{it} + f_5\ln FD_{it} + f_6\ln NR_{it} + m_{it}, \quad (2)$$

where $f_2 \dots f_6$ denote elasticity parameters.

2.3. Panel unit root tests

The presence of a unit root in a panel dataset indicates non-stationarity and time-varying trends, that could be tested in advance of relevant statistical analyses. The most commonly used panel unit root tests are the Levin-Lin-Chu (LLC) test, Augmented Dickey-Fuller (ADF) test and Im-Pesaran-Shin (IPS) test. Findings from panel unit root tests guide researchers towards the most suitable econometric model for their analysis.

2.4. Panel cointegration tests

Once the stationarity shocks have been checked, the next stage in panel data analysis involves the examination of the existence of a long-term cointegration relationship among the series. This study will use Kao and Pedroni cointegration tests. On the basis of probability values, we are able to accept or reject the null hypothesis.

2.5. Long run estimations: FMOLS and DOLS approaches for robustness check

Fully Modified Ordinary Least Squares (FMOLS) cointegration regression is a statistical technique used to estimate the long run relationship among variables that are integrated of different orders. FMOLS accounts for residual autocorrelation and endogeneity biases, which can lead to inefficient and biased parameter estimates in standard cointegration regression.

Dynamic Ordinary Least Squares (DOLS) cointegration regression is also a statistical technique investigating the long run relationship among variables. It uses both levels and the first difference of the variables to estimate the parameters. It estimates a dynamic error correction model, which includes lagged dependent variables and lagged errors as regressors, to examine both short-term and long-term relationships among variables over time.

3. Results and discussion

Table 1 and Figure 1 exhibit the descriptive statistics and correlation matrix, respectively. Data highlight that the economic growth (*lnGDP*) in high income countries has an average per-capita value of 10.2%, with a minimum of 8.4% and a maximum of 12.5%. This indicates the existence of significant disparities in terms of economic growth across countries. Similarly, the energy democracy (*lnED*) value ranges from 0.5 to 0.9; while the average value of globalization (*lnGLO*) is 4.2 (min = 3.2 max = 5.3). Natural resource use (*lnNR*) is on average 0.7%. Both the latter and the globalization index deviate from the sample mean by 0.2%, respectively.

Table 1. Descriptive statistics

	lnGDP	ED	lnEXP	lnGLO	lnFD	lnNR
Mean	10.2	0.6	25.0	4.2	4.3	0.7
Min.	8.4	0.5	15.7	3.2	2.1	0.0
Max.	12.5	0.9	29.7	5.3	4.4	4.3
S.D.	0.5	0.3	1.7	0.2	0.9	0.2

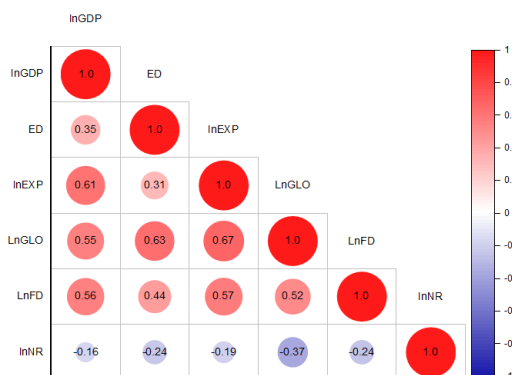


Figure 1. Correlation matrix (source: author’s elaborations)

According to the bivariate correlation matrix in Figure 1, a positive link exists between economic growth and energy democracy (0.35). Similar results can be found between economic growth and globalization (0.55), economic growth and financial development (0.56) and globalization and financial development (0.52). Energy democracy appears positively correlated to globalization (0.63) and financial development (0.44). In contrast, a negative correlation coefficient (−0.24) exists between financial development and natural resources, and also between natural resources (−0.16) and energy democracy.

In addition, no multicollinearity is detected among variables and the estimated correlation coefficients are below the threshold value of 0.85 (Balsalobre-Lorente et al., 2022).

Table 2 shows the outcomes of Pedroni and Kao tests. At a first glance, it provides evidence for the existence of a long-term relationship among energy democracy, exports, globalization, financial development, and economic growth. We therefore reject the null hypothesis of no association among the series at 1%, 5% and 10% level of confidence.

Table 2. Kao and Padroni-Johnson tests (source: authors’ own elaborations)

	Statistics	Prob	Statistics	Prob
Pedroni-test				
Panel v statistics	−0.57	0.35	0.47	0.57
Panel rho statistics	7.80	0.00	3.58	0.24
Panel PP statistics	−3.09	0.00	−2.74	0.02
Panel ADF statistics	−5.67	0.00	−4.57	0.00
Group rho statistic	3.90	0.12	n.a.	n.a.
Group PP statistics	−4.73	0.00	n.a.	n.a.
Group ADF statistics	−5.26	0.00	n.a.	n.a.
Kao test	−4.35	0.00		

Note: n.a.: not available.

3.1. Results of panel unit root tests

The results of the panel unit root tests are presented in Table 3. LCC, IPS, Fisher ADF and Fisher PP tests assess the stationarity of the variables at both level with trend and intercept, and their first difference with intercept. Main findings suggest the existence of a mixed outcome: while some variables become stationary at their level; all show stationary properties at their first difference with the intercept.

Table 3. Panel unit root tests

Intercept and Level				
Series	LLC	IPS	Fisher ADF	Fisher PP
LnGDP	−7.66*	−4.12	124.45	20.13
ED	−2.89	−2.40*	13.35**	52.15*
LnEXP	−6.77	−2.35	107.76	2.435
LnGLO	−7.00*	−4.48	234.90	41.23
LnFD	−3.673	−5.23	234.5*	23.8*
LnNR	−12.90	−8.5*	35.45*	21.8*
Intercept and 1 st difference				
LnGDP	−2.35**	−7.274*	29.9*	−23.72*
ED	−11.56**	−10.82**	30.2*	−771.87*
LnEXP	13.89***	13.81**	34.9*	443.91*
LnGLO	−11.35***	−14.40*	40.4**	108.76*
LnFD	−9.21**	13.66**	4146**	99.19**
LnNR	−5.46**	−2.47**	81.80**	21.87**

Note: *, **, and *** 10%, 5% and 1% level of significance.

3.2. Long run estimations

The study uses both FMOLS and DOLS methodologies to construct long-term forecasts, and the outcomes are summarized in Table 4.

Table 4. Robustness check: FMOLS and DOLS statistics (source: authors’ own elaborations)

FMOLS statistics		
Series	Statistics	Prob
ED	0.58	0.00
LnEXP	0.60	0.00
LnGLO	0.33	0.08
LnFD	0.10	0.01
LnTNR	−0.03	0.13
DOLS statistics		
Series	Statistics	Prob
ED	0.47	0.00
LnEXP	0.54	0.00
LnGLO	−0.30	0.19
LnFD	0.38	0.06
LnTNR	−0.09	0.03

In high-income countries, the FMOLS model indicates that energy democracy, exports, globalization, and financial development provide positive effects on economic growth, while natural resource consumption does not appear to play a major role in driving economic expansion. Surprisingly, a 1% increase in energy democracy leads to an increase of economic growth by only 0.58%. Similarly, a 1% increase in export leads the GDP growth to increase by 0.60%. These figures are in line with current literature (Tang & Abosedra, 2019). Exports generally stimulate economic growth by providing new markets for domestic goods and services, generating foreign exchange earnings, and creating job opportunities, thus enhancing economic growth patterns. Also, a significant impact on economic growth is due to globalization: according to our findings a 1% rise in the above variable affects economic growth by 32%. The work of Santiago et al. (2020) also supports this finding. The positive elasticity of financial development shows that a 1% increase contributes to increase the GDP growth by 0.2% (An et al., 2021). In contrast, a negative elasticity of natural resources shows that a 1% increase in natural resources use negatively affects the GDP growth by 0.03%. This finding is also supported by the recent literature of Yang et al. (2021).

4. Policy implications

Based on the empirical evidence highlighted in the previous sections, this study puts forward several implications for policymakers, stakeholders, and governments, particularly those focused on promoting economic and environmental sustainability. Energy democracy is beneficial to economy growth because it protects individual freedom and property rights (Vanegas Cantarero, 2020). Economies flourish when property rights are well defined and protected because it encourages production and trade while simultaneously reducing transaction costs (Peev & Mueller, 2012).

However, high-income countries are still striving on harmonising the available policy options for green energy production and use. Unknown issues may delay the development of energy policy implementation. Reducing uncertainties and asymmetric information at an early stage of the green energy transition would be beneficial to increase community awareness for implementing actual strategies and energy production and use options.

The present study provides several policy insights to the policy maker. First, promoting for widespread use of energy-savings habits and tools in domestic and commercial settings. Energy-efficient buildings require less energy for heating, cooling, and operating devices and electronics. Ultimately, efficient energy use reduces production costs, and enhances patterns of economic growth. Among the investigated countries, Denmark, the Netherlands, Belgium, Germany, Austria, Italy, USA, Sweden, the United Kingdom, and France (Alarcón-Ferrari & Chartier, 2017) offer some best practices of energy

democracy processes. In these countries, heterogeneous ways for energy production and use are actually being considered from policy makers at all level of governance. In addition, globalization also accelerates these processes. Internet of Things (IoT) allows new electronic devices and appliances to provide real-time data, facilitating the understanding of energy consumption behaviours. Second, the development of community-based renewable energy projects (i.e. from wind, solar, biomass) generates local economic benefits and enhances local economic growth. Finally, an adequate governmental framework, which would reduce the mis-match between central and regional agencies and support businesses and SMEs, can help the effective implementation of an energy democracy process across countries (Osabohien et al., 2019).

The EU has set an agenda that is consistent across all member states and conforms to UN rules. This supports several studies highlighting the need to place the energy democratization process under the supervision of an international body to account for national or private interests (Četković & Buzogány, 2016; Campos et al., 2020; Jahanger, 2022). To help the economic recovery and reach the goals set out in the European Green Deal, the European Commission has prioritized the production of clean, accessible, and safe energy. This effort puts in place the promotion of decarbonized energy products within the EU area (Haas et al., 2015; Connolly et al., 2016; Lowitzsch et al., 2020). To do so, the establishment of a functioning and secure internal energy market, which is suitable for decarbonization, is necessary. The progress of the internal energy market is monitored by the governance of the Energy Union – which envisages an energy transition towards the binomial of “Fairness and Sustainability”.

On the other hand, the international debate moves its discussion in an opposite direction (Burke & Stephens, 2017; James, 2016; Mendonça et al., 2009) which is particularly relevant for the US. That is, the difficulty of achieving energy policy objectives and/or providing an effective participation of local communities and individuals without adequate financial support. Another example is the British Commonwealth, which, despite presenting a structured agenda, does not provide participating countries with institutional bodies capable of binding national policies to favour the democratization of resource process, as it is in place in the EU. Similarly, the above issue applies to other international intergovernmental organizations, such as the Trans-Pacific Partnership (CPTPP) or the North American UMSCA, as well as autocratic regimes and intergovernmental organizations such as the Community of Independent States (CIS) and the Shanghai Cooperation (SCO).

Conclusions

The purpose of this study is to contribute to current UN strategies of sustainable development in high income countries by posing particular attention to energy

democracy, among the studied socio-economic and environmental variables, on economic growth. In particular, the research considered a large time span from 1997 to 2020. We employed a multivariate approaches such as FMOLS and DOLS models to check for robustness of our finding. In doing so, the current research study considered a first generation econometrics test because of the existence of a cross sectional problem in high income countries. The outcome of the panel unit root tests revealed that all studied variables were not stationary at level, but they became stationary at integrated order of one. In addition, the use of Kao and Pedroni-Johnson cointegration tests revealed the presence of a long run association among variables. Furthermore, the estimated outcomes of FMOLS and DMOL showed that energy democracy, exports, globalization, and financial development enhance economic growth in high income countries instead of natural resources use. Drawing on empirical evidence, this study puts forward several policy implications for policymakers, stakeholders, and governments, particularly those focused on promoting economic and environmental sustainability. Firstly, encouraging the adoption of energy-efficient practices and technologies in homes, buildings, and industries. This can reduce energy consumption and costs. Secondly, the development of community-based renewable energy projects to generate local economic benefits. Lastly, investments in renewable energy projects through financial incentives, as well as the provision of adequate governance frameworks, to help removing the actual barriers to renewable energy deployment, are advisable.

In conclusion, the present study is not without limitations. First, it deals with high income countries in which some energy democracy processes are already in place; and second, it does not fully capture the endogenous differences in the energy democracy process across the EU and other countries. Further research is needed. This can focus on considering and testing for endogeneity processes between economic growth and energy democracy. In addition, the inclusion of low-income countries in the sample should provide further insights and highlight differences in the production and use of renewable energy across countries in view of testing the effectiveness of energy democracy processes for economic growth purposes.

Further research is also needed to deepen the understanding of the relationships between energy democracy processes and economic growth and to identify policies and strategies that can promote sustainable economic growth through energy efficiency improvements.

The debated insights suggest the importance of further studies (also across low income countries), since these may counterbalance the skepticism towards a real implementation of energy democracy processes.

Author contributions

MS designed the study, data collection, data analysis, obtained results and discussion, conclusion and policy

implication. GB contributed to introduction and literature review and policy implications. PP and CDL provided critical feedback, editing and revisions to the manuscript.

Disclosure statement

The authors declare to have no competing financial, professional, or personal interests from other parties.

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