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Good Governance and Innovation: a Renewed Global Framework for National and Supranational Policy Advancement

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Abstract
There exists ample literature on the effect of democracy on innovation, with mix results. The present study includes the variable good governance, to study its potential effect on innovation. The research main goal consists in building upon and going beyond existing research dedicated to fostering innovation by identifying key good governance indicators at a country and supranational level, and their potential synergies and interactions with variables that complete the new model. The methodology used for the statistical analysis is based on Partial Least Square Structural Equation Modelling (PLS-SEM), due to the exploratory nature of the study. The research analyzes interactions between good governance indicators, innovation, education, and democracy, along with gross domestic product per capita as a mediating variable. The findings reveal that good governance, education, and gross domestic product indicators have a positive effect on innovation within EU countries and supranational government-controlled institutions. Furthermore, the research identifies the mediation role of gross domestic product between good governance and innovation as well as between education and innovation and the critical role of management to promote good governance and innovation. Based on these findings and the study limitations, the research proposes specific policies to promote innovation.

Keywords Education · Good governance · Innovation · Management · Policy · Strategy

JEL Classification E02 · G38 · H11 · I25 · L38 · 038

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Introduction

While the research on the relationship between democracy and innovation has a strong literature background, governance has been studied more in depth from a corporate standpoint. The present research aims at studying on a country level, as well as government-controlled institutions, the potential relation between good governance (GG) and innovation, while taking into consideration within the model the variable democracy. The study applies to the European Union members as of June 2020. Furthermore, we will study the potential relations of education and GDP per capita on innovation, along with the implications of effective management to foster governance and thus innovation.

The main contributions of this paper reside in the development of a research framework for examining the relations among the variables that have been studied previously, but never to the best of our understanding within the same framework. The research analyzes the interactions between GG indicators, innovation, education, and democracy, along with GDP per capita as a mediating variable, and develops policy recommendations, based on best management practices, to foster country and supranational public institution innovation output. A second contribution resides in the methodology used for the statistical analysis, which is based on Partial Least Square Structural Equation Modelling (PLS-SEM), due to the exploratory nature of the study (Hair et al. 2011, 2017, 2018), to address the nature of the proposed research questions and the complexity of the potential relations among the variables. The third contribution of the research focuses on applying the GG framework outside the corporate world, and within the country and supranational level institutions.

The following research questions (RQs) address the potential contributions of the present research:

RQ1. What is the potential effect of country GG on innovation in EU countries?
RQ2. What are the potential relations among country GG indicators, democracy, education, GDP per capita, and innovation within EU countries?
RQ3. What is the potential mediation effect of GDP per capita on innovation within EU countries?

The study is organized as follows: the "Literature Review" section reviews the literature that addresses the key relevant studies on democracy, good governance, and innovation. The "Methodology" and "Model Results" sections outline the conceptual framework and the research hypotheses, along with methodology and the proposed model to answer the research questions. The "Discussion" section addresses the discussion and policy implications of the findings. Finally, the "Conclusion and Limitations" section summarizes the research findings and policy implications, along with its limitations, policy recommendations, and future lines of research.

Literature Review

There exists a generous literature on the impact of democracy on innovation. For the purpose of this study, the term innovation is based on Porter's (1990) definition: "…the process that uses new knowledge, technologies, and the processes to

generate new products as well as new or improved products themselves." Fung and Wright (2003) state that as the duties of democratic states become more complex, they face more difficulties fostering growth and innovation. According to Carayannis and Campbell (2014), democracy is not necessary to produce knowledge and innovation, while Smith and Stirling (2018), as well as Carayannis and Campbell (2021) and Carayannis et al. (2021), argue that innovation represents a key element for democracy. Furthermore, Arrona et al. (2018) propose democratic policy processes will foster innovation.

Kuhn and Quandt (1962) related innovation to disruptive forces that compel societies to find new ways to cope with the new unpredictable contexts, while Popper (2005, 2012), as well as Ghardallou and Sridi (2020), argued that democracy plays a key role fomenting innovation. Gao et al. (2017) tested Popper's hypothesis. Their research results were not able to identify a positive effect of democracy on innovation, while Bischoff and Christiansen (2017) reported a significant degree of correlation between the two variables.

Based on these findings, we propose to include within the present study the variable good governance (GG), to analyze how it might affect innovation at country and supranational government-controlled institutions. This will allow studying governance and democracy within the same model to understand how they interact, as well as their potential relation with innovation management. Based on Gao et al., we include the variables GDP per capita and education since they might play a more important role fostering innovation than "…the nature of the political system" (2017, p. 6).

According to Gao et al. (2017), countries with a democratic system possess a higher level of innovation when measured by patent count, but the authors propose the research question whether democracy by itself fosters innovation. This research tries to provide value by testing if democratization by itself foments innovation and analyzes other variables that might affect more directly innovation such as good governance, education, and the mediating effect of GDP per capita. Furthermore, based on the most recent findings of Varma et al. (2020) on the combined effects of management controls and management risk, we explore the role of management to foster innovation, via good governance.

There exists abundant research on the relationship between democracy and innovation. Despite this, there is no empirical data to support an explicit cause and effect relation. Harrison and Huntington (2000) and Almond and Verba (2015) suggest that factors such as country and state culture might play a significant role in determining the correlation between democracy and innovation, while Cinnirella and Streb (2017) focused their research on the effect of human capital on innovation. A highly qualified population will have a positive impact on innovation. The present research will seek to measure this effect including the variable education within the present model as proposed by Gao et al. (2017).

Gao et al. tested Popper´s hypothesis in their 2017 research. Popper (2005, 2012) proposed democratic countries nurtured and better support innovation than non-democratic ones. Gao et al. (2017) tested this hypothesis using worldwide panel data. Their results do not support a causality relation between democracy and innovation. Among Gao et al. (2017) findings, we highlight the following "Thus,

education and the GDP per capita are more important determinants of national innovation than the nature of the political system" (p. 6). In the cited research, education and GDP per capita are control variables, assuming they have a certain impact on innovation that cannot be overlooked, while on the present research, based on the literature review for the proposed model, they are considered independent variables required within the model to evaluate their interactions with democracy, good governance, and innovation. Furthermore, the present study relies on the Demand Following Hypothesis (DFH) framework (Cetin 2013; Pradhan et al. 2016), which suggests unidirectional causality from GDP per capita to innovation.

In terms of measuring innovation, there exists a wide consensus in the literature to use patent count as a proxy. According to Griliches (1998), the use of patents as a proxy to innovation represents a relevant resource for research purposes. Nevertheless, as Boldrin et al. (2011) state that not all innovations might be content within patents and not all patents might provide innovation value. Despite this, data related to patents represent a key source for innovation research (Griliches, 1998). Due to this fact and to the abundant research that supports the use of this data as a valuable measurement for innovative ideas (Griffith et al., 2006; Acharya and Subramanian, 2009; Hsu et al., 2014), we relate to it in the present study. To account for part of these constrains, the present research does not include the data on patent applications but rather focus on patents granted. The data set encompasses the years 1996 to 2019 for every European Union country except Cyprus, Latvia, and Malta, for whom there were missing data for several years. The present research uses data from the World Intellectual Property Office (WIPO, 2021), since all the data points are available for the EU member states under study, except the three countries previously mentioned. The reason to select the data on innovation provided by (WIPO) resides in the fact that it was established as an agency of the United Nations in 1967. Since then, it has been widely used in the literature by researchers such as Crosby (2000), Veugelers et al. (2010), Boix et al. (2016), and Dutta and Lanvin (2016) among others, as a source for intellectual property services to promote innovation policies. As Gao et al. (2017) propose, there exist numerous innovation indexes, but patents provide a large enough time frame, as well as a consistent path to relate to innovation.

According to Bartel and Lichtenberg (1987), the higher the level of education of a population, the more prone they will be to adopt and implement new technology. Baumol (2005) stresses the importance of a high degree of education as a prerequisite to innovation. There exists a consensus in the literature about the positive impact of education as a source of national growth (Breton 2013; Hanushek and Woessmann 2015; among others). Delgado et al. (2014) also confirm this relation but point out that the mean scores as a measure of academic achievement have a more significant positive impact on growth than the number of schooling years. Ideas represent a key element for growth and innovation, and these ideas emerge from intellectual capital. This might lead to assume that the higher the degree of education of country human capital, the higher its effect on growth. However, do all types of education foster innovation? According to Toivanen and Väänänen (2016), engineering education fosters innovation (measured in patent count) and has a higher positive effect on innovation than any other

academic field. This view, while methodologically sound and data based driven, might not take into consideration the fact that not all patents represent a real innovation. Furthermore, this view on engineering as the center of innovation progress, would lead to neglect the positive effect on innovation coming from social sciences, and formal sciences.

To address the effect of education on innovation, the present research establishes the following six economic- as well as academic education-related indicators retrieved from the World Bank Group (2020).

1. Gross enrollment ratios.
2. Graduates from tertiary education.
3. Government expenditure on tertiary education as percentage of GDP.
4. Total government expenditure on education as percentage of GDP.
5. Gross enrolment ratio primary, gender parity index (GPI).
6. Primary completion rate.

These indicators retrieved from the World Bank Education will allow to better assess the relation between country level investments in education, educational-specific indicators, and innovation.

The interaction between GDP per capita and innovation has been addressed in both directions along the literature. While Cheung (2014) focused on how innovation fosters GDP per capita, Maradana et al. (2017) explored the unidirectional as well as bidirectional causality between both variables using the Granger causality test. Kacprzyk and Doryń (2017) studied the relation between patent activities, as a measure of innovation, and economic growth in European Union countries. The research did not find a significant positive relation between the two variables. According to Ibanez and Sisodia, each country-specific endowment will influence innovation since investment requires sources of financing (2020), along with the country absorptive capacity (Castro et al. 2022). Countries with stable and robust financial institutions might promote innovation based on their ability to provide financial resources to enterprises and entrepreneurs. According to Durusu-Ciftci (2017), countries with high level of financial development have a positive long-run effect on GDP per capita. Considering GDP per capita as an indicator of economic country development, the present study analyzes its effect on patent development. The data source for this variable is the International Monetary Fund World Economic Outlook (I.M.F. 2020).

Based on these findings, we propose to include in the present model education as an independent variable and GDP per capita as a mediator between the independent variables good governance and education and the dependent variable innovation to assess their effects and relations within the model. This approach builds upon and goes beyond the method used by Gerring et al. (2005); Papaioannou and Siourounis (2008); and Acemoglu et al. (2014), as well as Gao et al. (2017), emphasizing the role of GDP and education on innovation, while identifying the potential of good governance indicators that might foster innovation at country and supranational level. As Fernandez et al. state, each country-specific

context and distinctive competency might affect its performance as a whole and shape country competitive advantage (2018).

As Gao et al. (2017) state in their research, "Democratic countries (or countries in a democratic period) enjoy higher patent counts, patent citations and patent originality, more years of average education, a higher GDP per capita, a larger population density and a higher level of urbanization…" (p. 3). Furthermore, Bischoff and Christiansen (2017) detected that a high degree of internal democratic participation might promote innovation. However, research so far has not been able to conclude a direct causation effect between democracy and innovation. In order to follow and expand this line of research, we propose to add into the model indicators to quantify country governance. One of the reasons to explore this path resides in Gackstatter et al.'s (2014) findings related to the fact that innovation management might rely on "the efficient allocation of investments and the rigorous implementation of innovation strategy" (p. 14). This will allow expanding the search for specific frameworks that might foster country innovation such as the democratic governance of innovation proposed by Owen et al. (2012).

Roach et al. (2016), as well as Barasa et al. (2019), established as one of the key factors that hinders innovation the lack of effective country and corporate governance. There exists a generous literature on indicators to measure country governance. Among them, we can highlight the World Bank Institute's Worldwide Governance Indicators, the Legatum Prosperity Index, the Revenue Watch, the World Economic Forum's Competitiveness indexes, and the Bertelsmann's BTI among others. As Stanig et al. (2013) expose, there are several limitations to the existing indicators. The two main ones reside in the fact that these indicators might fail to capture critical supranational dynamics such as belonging to global trade blocks, as well as the intraregional forces within a country.

According to Esser (2007), "Among all these indicators, a group deserves to be singled out: the governance indicators of World Bank from all the rest. This is because the authors compiled the indicators based on the aggregation of six indicators emancipating from 15 different sources among the indicators listed above" (p. 8). Apart from over 150 world countries, the World Bank Governance Indicators include all EU countries related to the present study.

The Worldwide Governance Indicators (WGI) captures the data from the World Bank research project on country governance since 1996. The World Bank Group (2018) defines governance as "the traditions and institutions by which authority in a country is exercised." Furthermore, Wahlén (2018) specifies the WGI include "the process by which governments are selected, monitored and replaced, government capacity to formulate and implement sound policies and respect of citizens and the state for the institutions that govern economic and social interactions" (p. 1). The WGI provide annual data for each country on the following six governance dimensions. The definition and indicator's indexes are retrieved from the World Bank Group (2019) Worldwide Governance Indicators and are the following: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption. Following below, we find a brief explanation to each of the WGI variables used in the study based on the World Bank Group (2019) and Worldwide Governance Indicators definition:

1. **Voice and accountability** includes indicators measuring aspects such as the political process, civil liberties, political and human rights, and the extent to which citizens can and might engage in electing their representatives.
2. **Political stability and absence of violence** establishes the potential for a government in power to be destabilized or overthrown by possibly unconstitutional and/or violent means, including domestic violence or terrorism.
3. **Government effectiveness** defines the quality of public service provision and its bureaucracy, the competence of public officials, the independence of the public officials from political pressures, and the credibility of the government's commitment to policies.
4. **Regulatory quality** focuses on the policies as well as potential excessive regulation in areas such as foreign trade and business development.
5. **Rule of law** refers to the confidence level and respect of the society's stakeholders on the rules by which the country stands for. These include the incidence of crime, the effectiveness and predictability of the judiciary, and the enforceability of contracts. If we consider that this also includes protection of intellectual property rights by law, it is not a surprise to see high association between rule of law and summary innovation index.
6. **Control of corruption** is a measure of the extent of corruption, conventionally defined as the exercise of public power for private gain.

   Some of the critics on the World Government Indicators arise from their lack of compatibility over time and its calculation complexity. Hamilton and Hammer (2018) concluded in their study that governance indicators provide, despite being imperfect, a measurement of government effectiveness.

Methodology

To address the research questions, the present study proposes the following hypotheses:

H1: There exists a positive relation between GG and innovation for EU countries.
H2: There exists a positive relation between GDP per capita and innovation for EU countries.
H3: There exists a positive relation between education and innovation for EU countries.
H4: There exists a positive relation between democracy and innovation for EU countries.
H5: As the value of GDP increases, the relationship between GG and innovation increases.
H6: As the value of GDP per capita increases, the relationship between education and innovation increases.

These hypotheses seek to respond to the proposed research questions on the interactions among the variables under study.

Researchers use the smart PLS-SEM technique for creating hypothesis in insightful research. Path analysis, regression models, and confirmatory factor analysis represent applications of the smart PLS-SEM. The SEM method simplifies the linear relationship analysis between the independent variables and the latent variables. Moreover, the PLS-SEM method is widely used to evaluate the relationship between the indicators and the constructs to identify relationships among the constructs (Chin 1998).

The present analysis implements Partial Least Square Structural Equation Modelling (PLS-SEM). SEM provides a direct and sound evaluation of the path model and the factor model. Moreover, PLS grants the advantage of allowing the whole research model to be verified (Fornell and Larcker 1981). The research focused on PLS- SEM path modeling with a precise goal: to establish hypothetical constructs based on the literature review to explain the significance of relationships among the variables. For the present model, each indicator has been measured and incorporated into each construct based on Ringle et al.'s (2015) methodology. The following paragraphs expose the data collection process and model evaluation.

The data used in the present research was collected for 25 European countries during the period 1996 to 2019. Good governance as well as education are represented each by six observed variables. The repeated indicators approach, also referred as the hierarchical model approach, represents one of the most favored methods when estimating higher order constructs with PLS. Each second-order construct is measured by the observed variables for all the first-order constructs. This procedure is supported by the research of Wold (1982) and Lohmöller (1989). A potential drawback of this method might rely on the fact that the exogenous variables might become the endogenous ones. Applying a Monte Carlo modeling approach provides further insight into this effect. Following Sarstedt et al.'s (2016) guidelines, this methodology approach includes mediation effects that will further enhance the selected technique and model results.

Because the present model represents a hierarchical component model, at the starting point of the analyses we performed a large number of evaluations for PLS and SEM. This is a two-step process based on the Hair et al. (2014) methodology. Each reflective model essentially needs to overcome the measurement model assessment by the quality measures before going on to the assessment of a structural model. As per our reflective model, the quality criteria defined the first step to evaluate our measurement model.

Model Results

Relationships between the latent variables and the measured variables for all constructs are illustrated within the model. Upon the first analysis of the model, we identified two variables related to GG with a high correlation. In order to eliminate multicollinearity from the present model, two items were removed from GG: control of corruption and rule of law. This allowed our model to be stabilized and to become less sensitive to minor changes, by decreasing the variance of the coefficient

estimates. The four remaining GG items under study are the following: voice and accountability (VA), political stability (PS), government effectiveness (GE), and regulatory quality (RQ). Also, two variables related to education presented high correlation and were removed from the model (gross enrollment ratio primary and primary completion rate). The four remaining items under study for education are gross enrollment ratio (GER), graduates from tertiary education (GTE), government expenditure on tertiary education (GET), and total government expenditure on education (TGE).

The construct reliability (Table 1) shows that the measures are strong regarding the internal consistency reliability. Hair et al. (2014) recommends that the composite reliability (CR) should be equal or greater than 0.7. For the present model, CRs are 0.799 for the education, 0.903 for governance, and 0.861 for innovation. In all cases, they are over the recommended 0.7 threshold.

The degrees to a particular latent construct can be calculated using discriminant validity, which is unique in relation to another latent variable (Esposito Vinzi et al. 2010). The study of the magnitude of the correlation represents a methodology that allows to gauge the discriminant validity by applying the smart PLS-SEM technique. Henseler et al. (2015) proposed this new technique to discover discriminant legitimacy. As per Henseler et al. (2016), the heterotrait-monotrait proportion of relationships (HTMT) means that the estimation for the factor correlation, and the HTMT edge esteem should be lesser than one altogether. Consequently, this proposed examination applied the HTMT rule to gauge validity of discriminant (Cohen 2013). From the HTMT values in Table 2, we can infer that there are no discriminant validity problems according to the HTMT 0.85 criterions. This implied that the HTMT criterion did not detect any collinearity problems among the latent constructs.

The latent variable correlation provides perspective on how much average variances are common among the latent variables. For this purpose, the value of the correlation must be greater than 0.5. For the present model, Table 3 shows that all our validity measures are higher than 0.5, which supports the discriminant validity (Cohen 2013).

Our study aims to explore the direct relations between good governance, education, and democracy to innovation and their indirect effects with the mediation of GDP per capita. The following table and figure will present a comprehensive estimation for the suggested model with statistical evidence. The coefficient of determination (R^2) is a critical measure for SEM. Several authors such as Cohen (2013)

Table 1 Construct reliability and validity

	Cronbach's alpha	rho_A	Composite reliability	AVE
Democracy index		1.000		
Education	0.671	0.873	0.799	0.522
GDP per capita		1.000		
Governance	0.857	0.862	0.903	0.700
Innovation	0.821	0.897	0.861	0.411

Source: Authors' elaboration

Table 2 Discriminant validity assessment (HTMT criterion).

	Democracy index_	Education	GDP per capita_	Governance	Innovation_
Democracy index_					
Education	0.629	0.720			
GDP per capita_	0.759	0.488			
Governance	0.800	0.634	0.710	0.836	
Innovation_	0.829	0.828	0.759	0.850	0.641

Source: Authors' elaboration

clarified that the R^2 presents proportional variation of the predicting variables and the independent variables and can explain it properly.

R^2 indicates the variation among the latent variable in the Path model coefficients. Table 4 shows that the explained variance for the democracy index, GDP per capita, and the innovation R^2 is above the 0.50 threshold. This implies that the relationships among these constructs in the path coefficients are high enough to provide a good fit for the present model Moreover, all the endogenous latent variables were significant as shown in Fig. 1.

Figure 1 shows the PLS model, the path coefficients, and the R^2 for dependent constructs. All the β coefficients (explained on each path in the figure) are positive and are statistically significant at α less than 0.05. Moreover, to test whether the path model coefficients are statistically significant, we conducted a bootstrapping (10,000 resamples) and as Table 5 shows, the standard errors and the T-test show that all the path coefficients are statistically significant.

Table 3 Latent variable correlations

	Democracy index_	Education	GDP per capita_	Governance
Democracy index_				
Education	0.629			
GDP per capita_	0.759	0.488		
Governance	0.800	0.634	0.710	
Innovation_	0.829	0.828	0.759	0.850

Source: Authors' elaboration

Table 4 R Square and R square adjusted

	R square	R square adjusted
GDP per capita_	0.507	0.505
Governance	0.641	0.640
Innovation_	0.998	0.998

Source: Authors' elaboration

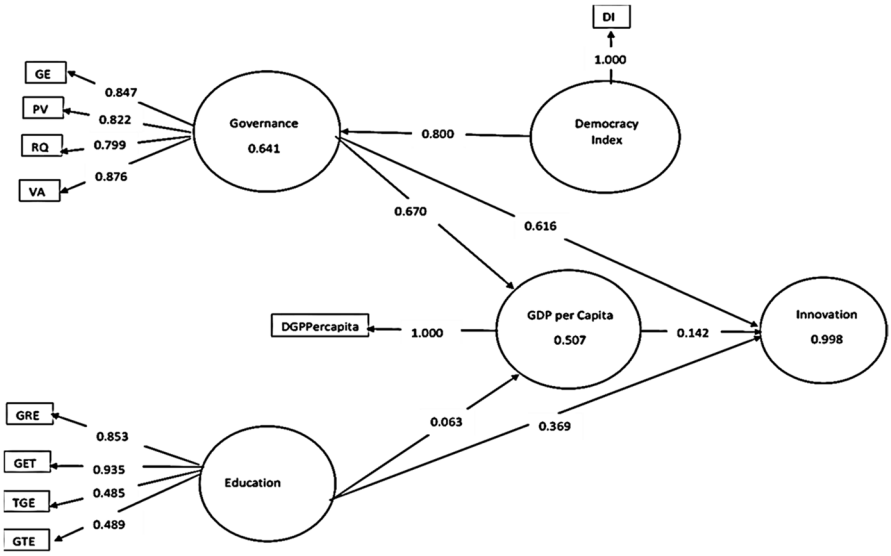

Fig. 1 Structural model (PLS-SEM bootstrapping analysis). **Source:** Authors' elaboration

Figure 1 presents the structural model results, where the β values of path coefficient and the p-values specify the direct effects of predictors on the latent constructs. According to these results, there exists a substantial positive relation between GG and innovation for EU countries. Also there exists a positive relation between GDP per capita and innovation, as well as between education and innovation for EU countries. Furthermore, GDP per capita positively mediates between education and innovation, as well as between GG and innovation.

By using the reflective model, we can be certain that the variable which is not directly measured is independent from the observed variables (Borsboom et al., 2004). Within SEM frameworks, when we measure the characters by attitudes and especially in business and social science, such reflective models, it helps to ensure the independency between the latent and the observed variables (Netemeyer et al. 2003). The present framework utilizes the reflective model for good governance and education, since the indicators are considered to be caused by the construct.

Table 5 illustrates the mean, STDEV, T-values, p-values, and coefficients of the estimated model. First, we discuss the total effect of each predictor on the perception of the overall quality. Then, we analyze each total effect in terms of sum of direct effects and indirect effects, via mediation in the case of GDP per capita. We further discuss the results in terms of effect sizes. This is important for implications, as not all the statistically significant predictors are suitable for interventions, but only those with effect sizes beyond a certain threshold.

The PLS analysis provides significant t-values and high R^2. Therefore, we can reject the null hypothesis of no effect. Table 5 shows that all t-values are significant since p-values are below α (0.05), which supports the proposed hypothesis on direct and indirect effects. Moreover, all the β coefficients for the direct and indirect effects

Table 5 The coefficients of the estimated model, mean, STDEV, *T*-values, and *p*-values

	Original sample	Sample mean	Standard deviation	*T* statistics (|O/STDEV|)	*p*-values
Path coefficients					
Democracy index_ -> governance	0.800	0.801	0.012	68.216	**0.000**
Education -> GDP per capita_	0.063	0.068	0.028	2.242	**0.025**
Education -> innovation_	0.369	0.368	0.011	34.919	**0.000**
GDP per capita_ -> innovation_	0.142	0.142	0.008	17.857	**0.000**
Governance -> GDP per capita_	0.670	0.669	0.021	31.387	**0.000**
Governance -> innovation_	0.616	0.615	0.015	41.694	**0.000**
Total indirect effects					
Democracy index_ -> GDP per capita_	0.536	0.536	0.021	25.829	**0.000**
Democracy index_ -> Innovation_	0.569	0.569	0.012	47.734	**0.000**
Education -> innovation_	0.009	0.010	0.004	2.095	**0.036**
Specific indirect effects					
Democracy index_ -> governance -> GDP per capita_	0.536	0.536	0.021	25.829	**0.000**
Education -> GDP per capita_ -> innovation_	0.009	0.010	0.004	2.095	**0.036**
Governance -> GDP per capita_ -> innovation_	0.095	0.095	0.006	14.789	**0.000**
Democracy index_ -> Governance -> GDP per capita_ -> innovation_	0.076	0.076	0.005	14.086	**0.000**
Democracy index_ -> governance -> innovation_	0.493	0.493	0.013	37.600	**0.000**
Total effects					
Democracy index_ -> GDP per capita_	0.536	0.536	0.021	25.829	**0.000**
Democracy index_ -> governance	0.800	0.801	0.012	68.216	**0.000**
Democracy index_ -> innovation_	0.569	0.569	0.012	47.734	**0.000**
Education -> GDP per capita_	0.063	0.068	0.028	2.242	**0.025**
Education -> innovation_	0.378	0.378	0.011	34.926	**0.000**
GDP per capita_ -> innovation_	0.142	0.142	0.008	17.857	**0.000**

Table 5 (continued)

	Original sample	Sample mean	Standard deviation	*T* statistics (|O/STDEV|)	*p*-values
Governance -> GDP per capita_	0.670	0.669	0.021	31.387	**0.000**
Governance -> innovation_	0.711	0.710	0.012	61.430	**0.000**

Source: Authors' elaboration

are positive, which provides an indication that the variables under study might have a positive influence on innovation (e.g., the dependent variable innovation and education ($\beta = 0.369$ with p-value $= 0.000$), also as per GG and the innovation index ($\beta = 0.616$ with p-value $= 0.000$)). This research follows the guidelines established by Hair et al. (2017) in order to analyze the mediation model. Based on the t-values analysis and the positive correlation, GDP per capita represents a complementary (partial) mediator for the present model.

Discussion

Based on the analysis, the relation between GG and innovation is positive and significant. Within the components of GG, voice and accountability, government effectiveness, political stability, and regulatory quality represent the main drivers to foster GG and promote country and supranational innovation. GG provides the highest positive effect on innovation within the model under study. This might imply that fostering EU common policies that promote GG might have a robust direct positive effect on innovation output within EU countries. This result is aligned with hypothesis 1 and is consistent with studies for different geographical regions such as the one developed by Setayesh and Daryaei (2017).

In the future line of research, we propose to desegregate the components of GG to identify the ones who have a higher effect on innovation for EU countries.

These results, along with the previous findings, might imply that GG represents a prerequisite for economic advance and innovation development. Based on the present results of the positive relation between GG and innovation, further research on the relation of citizens involvement, such as periodic consultations on key issues, might provide new information on its potential effect over citizens' voice and government accountability. Strategies that promote state and local governments might increase government effectiveness, while contributing to political stability. These strategies are aligned with the guidelines established by Arrona et al. (2018) to promote effective and more democratic policy processes to foster innovation, by strengthening the relation between central and local governments, and as Mendoza et al. report, might help to close the gap between private and public innovation investment (2022). Furthermore, government effectiveness is aligned with the fundamentals of management such as defining functions and roles, as well as clearly stating the responsibilities for the governing bodies. Applying effective management principals, such as consistency and adaptive leadership, as well as benchmarking management best practices will foster government effectiveness, which will positively affect innovation. In terms of regulatory quality, identifying regulatory gaps as well as reducing regulatory burdens, especially publicly held institutions and government-controlled organizations, will further promote government effectiveness. These results are consistent with Kok and Creemers's (2008), as well as Spender et al.'s (2017), findings on the relationship between governance structural characteristics and governance effectiveness, to promote innovation. The third component of GG is related to regulatory quality. Further research into the relation between GG and innovation might provide new information on countries as well as supranational

government-controlled institutions, engaging in burden-reduction programs to manage more efficiently, and reduce growing layers of rules and regulations that hinder innovation. Political stability represents the fourth component of GG to foster innovation. Once again, effective management at country and supranational government-controlled institutions results critical to promote innovation. Economic policies to ensure growth might provide a stable environment, as well as implementing management by consensus for all stakeholders to adhere to the existing and new rules and regulations. These strategies related to management and the GG components under study might provide synergies that will further foster innovation.

The relation between GDP per capita and innovation is positive and significant, which allows to confirm hypothesis 2. This result is consistent with the Demand Following Hypothesis (DFH) framework (Cetin 2013; Pradhan et al. 2016), which suggests unidirectional causality from economic growth to innovation. Nevertheless, the effect is weak; therefore, it cannot be considered a critical variable within the model or as a leverage factor to foster innovation within EU countries. This result is aligned with Kacprzyk and Doryń (2017). In future lines of research, the feedback hypothesis stated by Cetin (2013) and Pradhan et al. (2016) among other researchers will be pursued in order to study the potential bidirectional effects between both variables. Country-specific endowments within EU members might also play a critical role in the direction of the relations between GDP per capita and innovation and call for further research. This might include the study of EU policies that might play a relevant role promoting innovation within EU members with a lower investment capacity. EU funding for public and private sectors, as well as tax incentives for innovation development, might be further assessed to understand their potential to foster innovation and GDP per capita growth. Furthermore, fostering synergies between education, research, and the corporate sector might further promote innovation and GDP per capita growth. This is consistent with Rossi's (2010) and Abbott et al.'s (2015) findings, on the need of increasing university-industry knowledge transfer and the positive effect of governance along this process.

The relation between education and innovation is positive and significant. This result allows confirming hypothesis 3 and is aligned with previous findings such as Hanshek and Woessmann (2015). Because education represents a long-term investment, we encourage EU countries to perform a benefit and cost analysis to provide context for the contribution of investing in education as a mean to remain competitive within a global context, and foster innovation in the end. Policies such as increasing teaching quality, incentivizing knowledge outcomes, and intensifying educational exchanges at the student and professor level might foster education quality within the EU and have a positive effect on innovation output. These policies will require an adequate financing framework to foment education and research and ensure long-term sustainability both at the financing level and the development of innovation output. As Marshall reports, policies to foster education must be based on solid data and economic analysis, as well as on the study of the socio-economical context where these investments will take place (1997). It is as critical for policy development and implementation to rely on data analysis, as well as understanding the social drivers that hinder education, and therefore the innovation process.

As Wright proposes, to strengthen the relation between education and innovation, we must work beyond policies that just repurpose educational institutions as knowledge clusters (2016). These clusters are usually focused on already established economic models which, while being still useful, might hinder new frameworks and innovation processes. To address this situation, policies that will not just connect, but that will embed the academic research with the social and economic context, might provide a competitive advantage for the countries who implement it. It might be noteworthy to start the learning through direct engagement with the social and economic context, from the early stages of education. This way, when students proceed to higher education, they will possess a greater domain of the creativity and innovation processes. Furthermore, establishing early on within the academic curricula the development of the competencies on creativity, problem identification and idea generation will further enhance the learning as well as the innovation process as students progress in their personal and professional development.

Regarding the relation between democracy and innovation expressed in hypothesis 4, the results are not significant. Therefore, we are unable to infer any relation between both variables.

The results also allow for the analysis of the following relations.

The relationship between education and GDP per capita is positive and significant. A higher level of education might foster country economic growth. The literature supports this positive effect of education on GDP per capita (Fernandez et al. 2022; Solaki, 2013; Kakar et al. 2011), as well as the bidirectional causality between education and growth (Islam et al. 2007). The present study addresses the unidirectional relation and confirms the positive relation between education and GDP per capita for EU members. Countries with higher education indicators might be more successful at increasing productivity, fostering creativity, and promoting entrepreneurship.

The relationship between democracy and GG is positive and significant. According to Charron and Lapuente (2010), leaders from democratic states have strong motivations to improve GG once the country reaches a certain level of wealth. One of the goals of the external policy for the EU consists in promoting democracy and GG in third countries, such as potential new members (Kotzian et al. 2011). This policy is aligned with the USAID's report to globally promote democratic governance to foster growth and mitigate conflict (2020). The present results reinforce the positive effect of democracy on GG and supports EU policies to endorse democratic transitions in third countries to foster GG.

The present results also confirm a positive and significant relation between GG and GDP per capita. This would imply that policies implemented to increase the level of GG such as compliance, accountability, transparency, equitability, and inclusive policies would have a direct positive effect on GDP per capita. This is supported by the World Bank report "Governance and Development" (1992). This report is challenged by the study results of Kurtz and Schrank (2007), who report that economic growth provides a higher positive impact on GG than vice versa. Understanding the dynamics between GG and growth results critical since the policy implications would be profound.

As per the analysis of indirect effects, GDP per capita mediates between GG and innovation and between education and innovation. The total effects are calculated by multiplying the indirect effects and adding the direct effect. Based on the statistical results, GDP per capita represents a complementary (partial) mediator in the present model.

The total result of the direct and indirect effects for GG and GDP per capita on innovation is 0.711. This result is aligned with hypothesis five. The public sector plays a crucial role in GG management. As policy recommendations, EU countries could establish supranational structures that will supervise the transparency and accountability of each country public sector, as well as the EU institutions. One of the key elements consists in recognizing that GG relies on compliance, but it is a much broader concept. GG policies should guaranty the rule of law and improve public sector efficiency. EU countries could benefit by promoting the collaboration with international institutions such as the World Bank to share best practices. Benchmarking among countries and supranational institutions could be an effective policy to understand what practices provide the highest positive effect on GG. The adaptation and implementation of these best GG policies in EU institutions and countries might provide a significant positive effect on innovation. Furthermore, the proposed policies could complement and enhance the ones established in the White Paper on European Governance (European Commission Communities, 2001), whose goals were to promote democracy, transparency, and subsidiarity within its member states and the EU institutions. Fostering GG will positively affect innovation as well as GDP per capita within EU countries, while GDP per capita will further increase the level of country innovation.

The total result of the direct and indirect effects for education and GDP per capita on innovation is 0.378. This result is aligned with hypothesis 6. This would imply that the total direct and indirect effects of education and GDP could provide a significant potential to foster innovation within EU countries. As discussed earlier, education might promote growth via increases in productivity, creativity, entrepreneurship, and technological development among other means. Furthermore, GDP per capita fosters innovation by providing a greater capacity to invest in potential developments.

Conclusion and Limitations

The goals of the present study have been accomplished by revealing the relations between GG, democracy, and education with innovation, and the potential mediation effect of GDP per capita The model results indicate that the effect of democracy upon innovation is not statistically significant for EU countries. These results differ from Popper's hypothesis and are aligned with recent studies on the effect of democracy on innovation. GG as well as education does provide a positive effect on innovation. Furthermore, GDP per capita mediates between GG, education, and innovation. Since GDP per capita represents a variable quite elusive for countries and supranational government-controlled institutions to act upon, the

present research focuses on policies related to promoting GG, education, and the implementation of best management practices in order to foment innovation.

One of the key findings is the fact that democracy fosters GG. GG represents the variable with the highest positive effect on innovation within the present model. This calls for further research on the potential mediation role of GG on innovation. GDP per capita, as well as education, positively affects innovation. The results highlight the mediation role of GDP per capita between GG and innovation and education and innovation. Due to the fact that countries and supranational government-controlled institutions might have a more direct effect on education and GG through policy implementation, rather than on GDP per capita, we propose country as well as EU level policies to center around GG and education in order to foster innovation. These results also suggest the potential benefits of supranational institutions such as the EU and the World Bank, in order to promote the implementation of best practices to foster GG, education, and innovation, as well as the critical role of best management practices to promote GG and foster innovation.

Based on the positive effect of GG on innovation, we propose as a future line of research to desegregate the components of GG to study their individual effects on innovation for EU countries. Furthermore, GDP per capita will be studied within the new model as a control variable to account for its potential bidirectional relation with innovation.

Among the limitations of the present study, when measuring innovation based on patent count, we are neglecting all innovation related to social sciences. This implies a need to develop scales that will encompass all types of innovation. Furthermore, as Nagaoka, et al. (2010) indicate, the differences among countries when applying for patents generate an additional limitation on the use of them as a proxy for innovation.

Furthermore, future lines of research might be able to differentiate the level of innovation specifically by country. Finally, while the present research did not establish a relation between democracy and innovation, this might be due to the different momentums both variables require for their development. The future line of research will attempt to address both limitations.

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Author contributions All authors made substantial contributions to the conception and design of the work, revised it critically, and approved the version to be published.

Data Availability The authors confirm that the data supporting the findings of this study are available upon request.

Code Availability Software used is SmartPLS 3 Version 3.3.2.

Declarations

Ethics Approval Not applicable due to the absence of animal and human studies.

Conflict of Interest The authors declare no competing interests.

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