Indian Journal of Economics and Business
Vol. 20 No. 4 (December, 2021)

http://www.ashwinanokha.com/IJEB.php

# Incidence of Democracy, Quality of Life and Transparency in Scientific Production in Latin America (2012-2018)

**Carolina Henao-Rodríguez[a*], Jenny Paola Lis-Gutiérrez[b,c,d], Melissa Lis-Gutiérrez [e],&Juan Antonio Marmolejo [c]**

[a]*Universidad Externado de Colombia;* [b]*Universidad de la Costa;* [c]*Universidad de Granada;* [d] *Universidad Nacional de Colombia*[e]*Corporación Universitaria del Meta*

[*] *Corresponding author: linda.henao1@est.uexternado.edu.c o*

**Received:**03October 2021
**Revised:**25October 2021
**Accepted:**12 November 2021

---

**Abstract:** Scientific publications are taken as a measure of scientific production activity, which should be understood as a social process of knowledge construction. In this context, this paper aims to go beyond the traditional variables to explain scientific production and understand how democracy, transparency (less corruption), quality of life, population and the H index can affect scientific production in a sample of 17 Latin American countries. For this purpose, we consider the following variables: documents indexed in Scopus between 2012 and 2018 (dependent variable); the Legatum index (quality of life), the democracy index (democracy), the transparency index, population, and the H index. We made use of two traditional panel data techniques: generalized least squares estimators and Panel-Corrected Standard Errors. Since endogeneity was evidenced, we proceeded to estimate a dynamic panel model. In this model, all the lagged values of the variables (values in previous years) were significant to explicate scientific production in the following periods. The main finding of the paper is to demonstrate statistically that scientific production in Latin America is not explained exclusively by the levels of investment in research and development. It requires a favorable environment that includes conditions of democracy, transparency, and quality of life. These variables must necessarily be analyzed in the environments of research, development, and innovation ecosystems.

**Keywords:** scientific production, quality of life, Scopus, democracy index, transparency index, Latin America, dynamic panel data model.

---

## 1. Introduction

Scientific publications are taken as a measure of scientific production activity, which should be understood as a social process of knowledge construction (Handzic*et al.*, 2021; Siciliano*et al.*, 2018). In this sense, there are conditions of the social, political, economic, and cultural context that can favor this process of collective knowledge construction (Lis-Gutiérrez et al., 2018a; Csomós, 2018).

Alarcón-Quinapanta et al. (2019) found a relationship between academic production and human development, associated with the use of abilities and skills to solve problems. This increases the quality of life and the wealth of a society. The research conclude that knowledge management and intellectual capital integrate efficient processes of communication, information, and competencies. In this way, measurement systems allow higher education institutions to identify factors that create social value and contribute to human development, increasing prosperity and harmony in a sustainable world.

At the same time, countries with good quality of life,and a higher level of economic development can provide a better education for their populations.These permits build qualified human capital with greater competencies for high-quality scientific production (Macias Ruano et al., 2021).

Now, the relationship between scientific production and different democratic models is based on how each society allocates resources and defines its priorities (De Oliveira et al., 2021; Kurt Topuz, 2021). Another variable of interest is transparency, understood as the opposite of corruption. On this path, corruption can lead to a deterioration of democracy and quality of life and may affect the documents indexed in Scopus.

Recent studies, such as that of Gründler and Potrafke (2019), identified from a sample of 175 countries that the effect of corruption on gross national product implied a reduction of 17%. The authors established that the effect of corruption on economic growth is moreremarkable in autocracies and the channels of transmission were reducing foreign direct investment and increasing inflation. Similarly, Lehman & Morton (2017), considered corruption as a universal problem, which affects people's quality of life.Also, this work indicates the misuse of public power by politicians and as an obstacle to the economic development of citizens.

In this context, this article aims to examine the relationship between quality of life, transparency, democracy, and scientific productivity for Latin American countries between 2012 and 2018, taking as control variables: the population and the H index.

## 2. Method

### a. Data

This study makes an estimate using panel data (Fini*et al.*, 2021). The countries analyzed were: "Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Paraguay, Panama, Peru, and Uruguay." Additionally, the variables considered were:

- Population (The World Bank, 2021). This variable is considered a control.
- Quality of life was measured by the Legatum index (The Legatum Institute Foundation, 2021).
- The H index was provided by Scimago (SCImago, 2021). This variable is considered a control.
- Democracy index was made by The Economist Intelligence Unit (The Economist Intelligence Unit, 2021).
- The corruption perception index (transparency) was taken from Transparency International Spain (Transparency International, 2021).

## b. Model

"The models used are presented below.

**Model 1**

The model is specified as follows:

$ldjt = \beta 0 + \beta 1\ llgjt + \beta 2lcjt + \beta 3lpjt + \beta 4lhjt + \beta 5ldejt + uj + \varepsilon jt$

- j represents the country.
- t is the year.
- ldis the natural logarithm of the number of documents in Scopus.
- llgis the natural logarithm of Legatum index.
- lc refers to the natural logarithm of the transparency index.
- lpis the natural logarithm of the population.
- lhis the natural logarithm of the H index.
- ldeis the natural logarithm of the democracy index.
- uj is considered as fixed and is a random variable."

**Model 2**

The model is specified as follows:

$ld it = \propto ld i,-1 + \beta 1\ llgjt\text{-}1 + \beta 2ldejt\text{-}1 + \beta 3lpjt + \beta 4lhjt ++ \beta 5lcjt\ \varepsilon it$

$\varepsilon it = \mu i + \vartheta it$

$( ui)=( \vartheta it)=E(\mu i \vartheta it )= 0$

$\mu i$= fixed effects

$\vartheta it$= idiosyncratic shocks

The estimation was made using the homoscedastic weight matrix. Likewise, it was guaranteed that the instruments were not greater than the number of groups and the Sargan test was carried out. The results indicate that the null hypothesis is not rejected, and the over-identification restrictions are valid.

# 3. Results

## a. Descriptive results

The behavior of the academic production indexed in Scopus of the selected countries for the year 2018 is presented below. Dark red corresponds to the highest values and light yellow represents the lowest. Following the analysis of Lis-Gutiérrez et al. (2018b) on the Moran and Geary indices to measure spatial autocorrelation, it can be indicated that there is no evidence of first- or second-order spatial autocorrelation.

Figure 1 (a, b, c, d, and e) show the leading countries in the region: Brazil, Mexico, Argentina, Chile, and Colombia (in terms of documents, citable documents, citations, self-citations, and index H.). Panama leads the citations per document with a value of 1.05 for 2018, followed by Chile and Nicaragua with 0.8.

## b. Econometric results

The Lagrange multiplier test for random effects indicated that the null hypothesis needed to be rejected. Hence, it is necessary to estimate by random effects, instead of a grouped regression (Table 1).

***"Table 1: Results of regression; Fixed-effects (within) regression and Hausman test"***

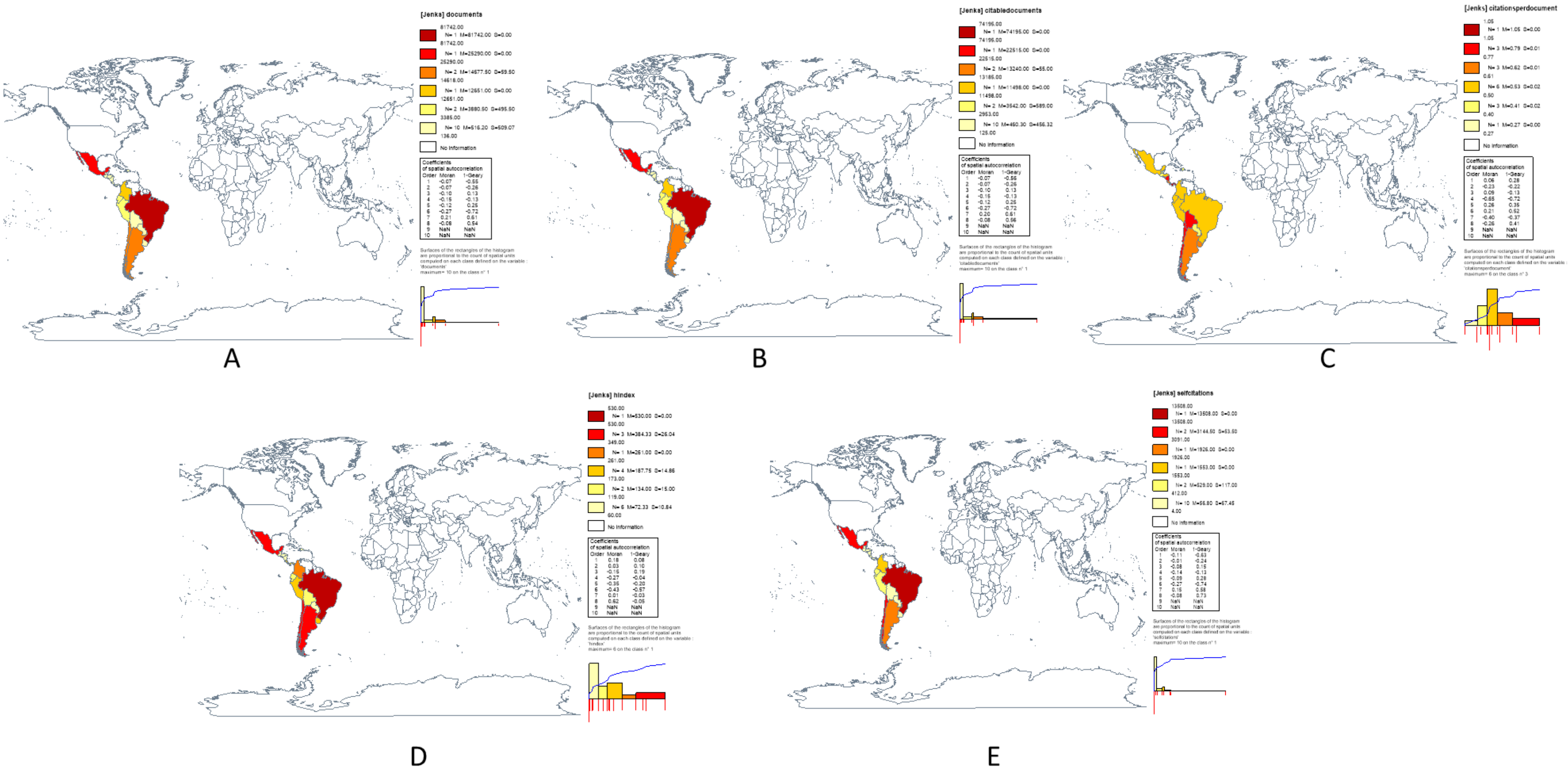
| "Random-effects GLS regression" | | | | "Fixed-effects (within) regression" | | | "Test Hausman" | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ld | Coef. | T | P>t | Coef. | T | P>t | (b) | (B) | (b-B) | Sqrt (diag(V_b-V_B)) |
| | | | | | | | **Fe** | **Re** | **Difference** | **S.E.** |
| llg | 6.074167 | 4.85 | 0 | 2.742396 | 0.113 | -0.6635204 | 2.742396 | 6.074167 | -3.331771 | 1.173547 |
| lc | 0.0943028 | 0.33 | 0.745 | 0.1905446 | 0.559 | -0.4546616 | 0.1905446 | 0.0943028 | 0.0962418 | 0.1468501 |
| lde | 0.5608441 | 1.19 | 0.235 | 0.790098 | 0.094 | -0.1380094 | 0.790098 | 0.5608441 | 0.2292539 | . |
| lp | 0.790382 | 6.59 | 0 | 3.880983 | 0 | 2.624381 | 3.880983 | 0.790382 | 3.090601 | 0.6214964 |
| lh | 1.799263 | 8.61 | 0 | 1.812937 | 0.013 | 0.3876895 | 1.812937 | 1.799263 | 0.0136741 | 0.686799 |
| _cons | -41.43902 | -7.23 | 0 | -79.69866 | 0 | -98.77161 | | | | |

"*b = consistent under Ho and Ha; obtained from xtreg; B = inconsistent under Ha, efficient under Ho; obtained from xtreg; Test: Ho: difference in coefficients not systematic; chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 47.42; Prob>chi2 = 0.0000; (V_b-V_B is not positive definite)""

***Source:*** Author's findings

Indian Journal of Economics and Business
Vol. 20 No. 4 (December, 2021)

http://www.ashwinanokha.com/IJEB.php




“Figure 1: Academic production indexed in Scopus of the selected countries for the year 2018.

A) Number of documents; B) Number of Citable Documents; C) Citation per document; D) H index and E) Self-citations

Source: own elaboration using Philcarto.”

The Breusch and Pagan Lagrangian multiplier test for random effects show a variance for the values Ld, E, and U of 4.162134; 0.033008; 0.0817724 respectively, and sd=sqrt(Var) values of 2.040131; 0.1816811; 0.2859587. The $chibar^2(01)$ was 103.59

The fixed effects estimate (Table 1), the null hypothesis about all state dichotomous variables was rejected. For its part, the restrictive F test concluded that the fixed-effects method should be used instead of a pooled regression.

Concerning the Hausman test (Table 1), the null hypothesis is rejected, and that the most appropriate estimate was the fixed effects, which allows exploring the association between the predictor and the outcome variables within a state. This means that each country has its own individual attributes and influences the predictor variables.

Now, assumptions of the fixed-effects model are:

- Invariable characteristics over time are unique to the individual
- Invariable characteristics over time are not correlated with the attributes of other individuals.
- The entity's error term and constant are not correlated among them.

On the other hand, the Wooldridge autocorrelation test proves the first-order autocorrelation, in other words, the errors within each unit are temporarily correlated"(H0: no first-order autocorrelation; F(1,16)=9.377 and Prob > F = 0.0074)."

In addition, we use the modified Wald heteroscedasticity test where the null hypothesis was $sigma(i)^2=sigma^2$ for all i. It is not sensitive to the assumption of normal errors. This showed that heteroscedasticity exists in the estimated model with $chi^2(17) = 5942.81$.

The weak cross-sectional dependence Pesaran test was conducted"with the null hypothesis H0: errors are weakly cross-sectional dependent. This test showed that errors are weakly cross-sectional with a CD = -0.556 and p-value = 0.578."

The tests identified the following problems in the models: (i) contemporary correlation, (ii) heteroscedasticity, and (iii) autocorrelation. These difficulties can be solved through the (a) "Generalized Least Squares Estimators"or (b) "Panel-Corrected Standard Errors", including dichotomous variables of time. These capture the temporal effectsand can be seen in table 2.

In the two models estimates (Table 2), the quality-of-life index, the transparency index, the population, the democracy index, and the H index show a positive and statistically significant relationship with the documents published and indexed in Scopus (p-value <1%). The democracy index is significant at 10% and retains a positive relationship (p-value ≤ 10%).

The existence of a correlation between quality of life, transparency, democracy, and the term error can be interpreted as a problem of simultaneity. Since there is no consensus in the literature regarding the existence of a single valid test to evaluate endogeneity, we use a dynamic panel data regression model to correct this problem (Model 2).

***Table 2: Results of the regression models used***

| "Prais-Winsten regression, correlated panels corrected standard errors (PCSEs) " | | | | "Cross-sectional time-series FGLS regression" | | |
|---|---|---|---|---|---|---|
| ld | Coef. | t | P>t | Coef. | P>\|z\| | [95% |
| llg | 2.92005 | 5.03 | 0 | 2.899895 | 3.78 | 0 |
| lc | 0.554688 | 3.76 | 0 | 0.5487838 | 2.89 | 0.004 |
| lp | 0.7074655 | 19.78 | 0 | 0.7052627 | 12.93 | 0 |
| lh | 1.81557 | 30.65 | 0 | 1.820177 | 18.2 | 0 |
| lde | 0.5226873 | 1.92 | 0.054 | 0.5293759 | 1.56 | 0.118 |
| 2013 | 0.0242742 | 2.74 | 0.006 | 0.0234156 | 0.5 | 0.614 |
| 2014 | 0.098504 | 13.69 | 0 | 0.0962611 | 1.67 | 0.095 |
| 2015 | 0.2075389 | 20.09 | 0,000 | 0.2026087 | 3.16 | 0.002 |
| 2016 | 0.2957902 | 20.23 | 0 | 0.2965342 | 4.33 | 0 |
| 2017 | 0.330756 | 22.54 | 0 | 0.3369183 | 4.81 | 0 |
| 2018 | 0.3245053 | 16.06 | 0 | 0.3286028 | 4.45 | 0 |
| _cons | -28.91481 | -12.46 | 0 | -28.81115 | -9.07 | 0 |

***Source:*** Author's findings

The dynamic models allow to include in the estimation the causal relations. This kind the estimation was proposed by Arellano and Bond (1991), allowed to use as instruments the differences of the delays of the index of quality of life, the index of transparency, and the index of democracy.

The Sargan test was applied to model 2. To guarantee that this test could be carried out, a non-robust estimation of heteroscedasticity was made. The null hypothesis (over identifying restrictions are valid) not be rejected, and it was possible to conclude that the over identification restrictions are valid with chi2(8) equal to 7.647153 and Prob > chi2 = 0.4687.

In search of consistency of estimation and the proper use of dynamic models, and the errors must not be serially correlated. This is tested with the Arellano and Bond tests where the null hypothesis was no autocorrelation. It can be concluded that there is no correlation of the first (z=-2.5488) or second-order(z=1.9646) errors, at 1% of significance (1% critical value).

However, given that heteroscedasticity is a frequent problem in dynamic models, the estimation is made robust, this being the definitive model (Table 3).

***Table 3: Arellano-Bond dynamic panel-data estimation***

| Ld | Coef. Robust | z | P>\|z\| |
|---|---|---|---|
| **Ld** | | | |
| L1(Ld) | 0.8710194 | 7.62 | 0.000 |
| Llg | -1.22551 | -1.36 | 0.173 |
| L1(Llg) | 2.250587 | 1.92 | 0.055 |
| **Lde** | 0.5058171 | 1.27 | 0.204 |
| L1(Lde) | -2.101887 | -2.76 | 0.006 |
| **Lc** | -0.1456749 | -0.36 | 0.718 |
| L1(Lc) | 0.7044817 | 2.67 | 0.008 |
| Lp | 0.1432934 | 0.33 | 0.744 |
| Lh | 0.9915613 | 1.87 | 0.061 |

"Std. Err. adjusted for clustering on var3; Instruments for differenced equation GMM-type: L(2/3).ld; Standard: LD.llgLD.ldeD.lhD.lp D.lc
***Source:*** Author's findings"

## 4. Discussions and Conclusions

This research includes the use the dynamic panel data regression model, one of the most robust econometric techniques. Likewise, we would like to remark the evaluation of the variables used, since they are not conventional in the analysis of scientific production.

After the estimation of dynamic panels, it was possible to conclude that the lag of democracy index is a significant variable (1% critical value) and presents a negative coefficient. On the other hand, the lag of transparency presented a positive and significant relationship with the production of documents indexed in Scopus. Furthermore, if one considers that transparency undermines democracy, this result is consistent with the estimates made (Di Pietra and Melis, 2016).

The lag of index of quality of life turned out to be a significant variable (6% critical value) and presents a positive relationship with the scientific production of high-quality. This reaffirms the findings of Siciliano*et al.* (2018), and Handzic*et al.* (2021), whereby that scientific production is a social process, and therefore, the cultural, social, economic, and political context influences the quality of research.

The positive relationship between quality of life and production of documents indexed in Scopus corroborates for Latin America that Csomós (2018) found for the cities of the world, where a growing relationship between scientific production and economic development is evident. Therefore, the quality of life is a very complex concept with several factors, which we attempt to model using the Legatum index.

The results of the model showed that population is not a significant variable in the production of documents indexed in Scopus. In contrast, the H index is a statistically significant variable (7% critical value). This makes sense considering that: (i) a higher h-index can be understood as a reflection of the reputation of publications; (ii) it evaluates the trajectory of communities, researchers, and countries; (iii) it is a measure that combines impact and productivity.

The main finding of the paper is to demonstrate statistically that scientific production in Latin America is not explained exclusively by the levels of investment in research and development. It requires a favorable environment that includes conditions of democracy, transparency, and quality of life. These variables must necessarily be analyzed in the environments of research, development and innovation systems or ecosystems.

Likewise, the results of the estimates made by Generalized Least Squares and Panel-Corrected Standard Errors are not maintained when the endogeneity problem is corrected, that is, when using the dynamic panel data regression model. Since the population turned out to be a non-significant variable and the democracy index showed a negative relationship with the number of documents published in Scopus indexed journals. This should be analyzed in further research, seeking to use another index that captures information on democracy, given the recent criticisms of the metric, among them: that it includes a subjective perception and not the citizen or institutional perception.

Another one of the extensions of this study includes the incorporation of countries from other regions to analyze whether the results are maintained. Similarly, a later field of application would be to use supervised or unsupervised learning algorithms for the classification and prediction of the behavior of countries.

## REFERENCES

Alarcón-Quinapanta, M. A., Freire-Lescano, L. R., Pérez-Barral, O., Frías-Jiménez, R. A., & Nogueira-Rivera, D. (2019). Medición del rendimiento del talento humano en instituciones de educación superior: producción científica. *Ingeniería Industrial*, 40(1), 24-36.

Arellano, M., & S. Bond. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies*, 58, 277–297.

Csomós, G. (2018). A spatial scientometric analysis of the publication output of cities worldwide. *Journal of Informetrics*, 12(2), 547-566.

De Oliveira, T. M., Marques, F. P. J., Veloso Leão, A., de Albuquerque, A., Prado, J. L. A., Grohmann, R., &Guazina, L. S. (2021). Towards an Inclusive Agenda of Open Science for Communication Research: A Latin American approach. *Journal of Communication*, 25, 1-29. https://doi.org/10.1093/joc/jqab025

Di Pietra, R., & Melis, A. (2016). Governance and corruption: is history repeating itself? Fostering a debate and inviting contributions from a multidisciplinary perspective. *Journal of Management & Governance*, 20(4), 689-701.

Fini, R., Perkmann, M., & Michael Ross, J. (2021). Attention to exploration: The effect of academic entrepreneurship on the production of scientific knowledge. *Organization Science*, 14(55), 1-28.

https://doi.org/10.1287/orsc.2021.1455https://pubsonline.informs.org/doi/pdf/10.1287/orsc.2021.1455

Gründler, K., &Potrafke, N. (2019). Corruption and economic growth: New empirical evidence. *EuropeanJournal of Political Economy*, 60 *(101810)*, 1-36.http://documents.worldbank.org/curated/en/831401468150568436/pdf/399850PUB0REPL1f0Corruption1Spanish.pdf

Handzic, M., Bratianu, C., &Bolisani, E. (2021). Scientific Associations as Communities of Practice for Fostering Collaborative Knowledge Building: Case Study of *IAKM. Electronic Journal of Knowledge Managemen*t, 19(2), 91-104.

Kurt Topuz, S. (2021). The Effect Of Countries' democracy Levels On The Global Gender Gap: A Study On OECD Countries. *Ekonomik ve Sosyal Araştırmalar Dergisi*, 17(1), 171-182. https://dergipark.org.tr/en/pub/esad/issue/62547/881569

Lehman, G., & Morton, E. (2017). Accountability, corruption, and social and environment accounting: Micro-political processes of change. *AccountingForum*, 41(4), 281-288.

Lis-Gutiérrez, J. P., Henao, C., Zerda, Á., Gaitán, M., Correa, J. C., &Viloria, A. (2018a). Determinants of the impact factor of publications: A panel model for journals indexed in scopus 2017. *Lecture Notes in Computer Science,* 10943, 491-499.

Lis-Gutiérrez, J. P., Lis-Gutiérrez, M., Gaitán-Angulo, M., Balaguera, M. I., Viloria, A., & Santander-Abril, J. E. (2018b). Use of the industrial property system for new creations in Colombia: a departmental analysis (2000–2016). *Lecture Notes in ComputerScience,* 10943, 786-796.

Macias Ruano, A. J., Milán-García, J., Marruecos Rumí, M. E., & De Pablo Valenciano, J. (2021). Scientific Production on the Social Economy: A Review of Worldwide Research. *VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations*, 2021, 1-19.

SCImago (2021). SJR — SCImago Journal & Country Rank [Portal]. http://www.scimagojr.com

Siciliano, M. D., Welch, E. W., & Feeney, M. K. (2018). Network exploration and exploitation: Professional network churn and scientific production. *Social Networks*, 52, 167-179.

The Economist Intelligence Unit (2021). Democracy Index [Database]. https://www.eiu.com/n/campaigns/democracy-index-2020/

The Legatum Institute Foundation (2021). The Legatum Index [Database]. https://www.prosperity.com/rankings

The World Bank (2021). Population [Database]. https://data.worldbank.org/indicator/SP.POP.TOTL

Transparency International (2021). Corruption perception index [Database]. https://www.transparency.org/en/cpi/2020