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Article

Empirical analysis of economic growth in Greece and the relationship between the index of democracy and corruption (2012–2022)

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Abstract: This study investigates the complex interrelationship between democracy, corruption, and economic growth in Greece over the period 2012–2022. Using data from Transparency International, the Economist Intelligence Unit, and Eurostat, appropriate methods such as Ordinary Least Squares (OLS) regression, Generalized Method of Moments (GMM) estimation, and Granger causality tests were applied. The findings reveal that increased democracy correlates positively with reported corruption, likely reflecting heightened transparency and exposure. Conversely, economic growth shows a negative association with corruption, underlining the role of structural reforms and institutional improvements. These insights emphasize the need for strengthening democratic institutions, promoting digital governance, and implementing targeted economic reforms to reduce corruption and foster sustainable development.

Keywords: democracy; corruption; economic growth; governance; funding; Greece; transparency

1. Introduction

The inter-relationship between democracy, corruption, and economic growth is an intricate one, with many countries, even those that have faced political and economic upheaval, trying to find a solution. Greece, in more ways than one, presents an interesting case. This country faced such a horrific economic crisis in 2008–2009 that it had to face not only financial instability but also issues of governance, corruption, and political accountability. While Greece has taken up numerous reforms in its institutions and fostered more openness in the ten years hence, how much this has really translated into change for corruption levels and economic development remains to be well established. This paper looks at how democracy and corruption in Greece have changed from 2012 to 2022-a decade in which the country embarked on its recovery journey. We tackle two basic questions: first, does strengthening democracy help to reduce corruption? The second part is how economic growth has influenced corruption in this period. Both questions are of particular relevance, since Greece's post-crisis reforms did not target only economic recovery but also the restoration of trust in its democratic institutions. The study of the Greek experience can illustrate a bigger global conversation. The storyline that links democracy and corruption is far from linear; some countries see a decline in corruption with

strengthening democracies, while others are subjected to corruption even in democratic settings around the world. By focusing on Greece, we aim to clarify how these dynamics play out in a country that has undergone significant political and economic challenges.

Our findings will not only contribute to the academic discussion but also offer practical insights for policymakers in Greece and beyond. As countries seek to rebuild and grow in the aftermath of crises, this research helps us understand how democracy and economic growth can, or sometimes cannot, go hand in hand with reducing corruption.

Corruption, involving the illicit pursuit of wealth through the misuse of public authority, is a pervasive issue worldwide, varying in intensity across different countries (Agbu, 2001). Its origins trace back to ancient human civilizations (Lipset and Lenz, 2000), influencing various forms of governance—from democratic to dictatorial or aristocratic—and impacting economic systems like feudalism, socialism, and capitalism. Throughout history, religious societies have grappled with this enduring challenge (Dike, 2005). A multitude of socio-economic factors, such as including poverty, unemployment, commercial restrictions, etc. significantly contribute to fostering corruption (Akçay, 2001). When demand surpasses supply, corruption often thrives (Adaman et al., 2001). Ultimately, corruption becomes a breeding ground for numerous issues within a nation, eroding its foundations and hindering economic performance.

The political situation prevailing in a country affects the economic, social and cultural sectors. Our country shows variability in shaping the political climate, but not at regular intervals. Also, the phenomenon of the dominance of one party in power for a long period of time is observed, as a result of which the views and preferences of the specific party in power are imposed each time.

In 1974 and after the prevalence of Democracy in Greece we have the establishment of two political parties that dominate for over thirty years, the New Democracy and the Panhellenic Socialist Movement. The views that prevail in the first party have a center-right air and a generally liberal character. It usually collects percentages between 40 and 45%. Panhellenic Socialist Movement (PASOK), on the other hand, combined the liberal ideas of the old Venizelics with the traditional left of the National Resistance.

It reached its peak during the leadership of Andreas Papandreou, garnering over 50% of the vote. Today, both PASOK and New Democracy (ND) are criticized for corruption and client relations, while PASOK's position after its fall to 6% was taken by the Coalition of the Radical Left.

The political parties exert influence on the life of the Greek people to a very large extent compared to other Western countries and exercise control over the public administration, which triggers phenomena of corruption and incompetence (Krueger, 1975; Tanzi and Davoodi, 1997).

International investors care most about a country's political stability, as Khan and Akbar (2013) point out. When a country is politically unstable, it can directly affect the returns on their investments, as explained by Busse and Hefeker (2007). Instability can also threaten the long-term success of economic opportunities, according to Grindle (2004). In short, when the political environment is uncertain, it discourages

investors, which in turn can slow down economic growth, as emphasized by Khan and Akbar (2013).

To begin, the study addresses the global issue of corruption, offering a historical perspective on its origins, development, and the impact it has on societies. It also examines how Greece's political landscape affects governance and shapes corruption, highlighting the critical role of political stability in driving economic growth.

This study examines the complex interrelations between democracy, corruption, and economic growth in Greece.

The following hypotheses are proposed:

1) Democracy and Corruption: Increased levels of democracy are associated with heightened transparency, which in turn leads to higher reported corruption, as latent corrupt practices are exposed through stronger democratic institutions.
2) Economic Growth and Corruption: Higher levels of economic growth are inversely correlated with corruption, as economic stability and structural reforms reduce opportunities for corrupt activities.
3) Democratic Development and Economic Growth: Democratic development and economic growth share a bidirectional relationship, where democratic reforms stimulate economic growth and, in turn, economic stability strengthens democratic institutions.

While this study identifies correlations among these variables, we acknowledge that correlation does not imply causation. Observed relationships may also be influenced by confounding factors such as political stability, historical governance patterns, and cultural norms.

These complexities are addressed in the methodology and discussion sections to provide a nuanced interpretation of the results.

1) Increased democracy levels are associated with heightened transparency and higher reported corruption.
2) Economic growth inversely correlates with corruption levels due to improved governance and institutional reforms.
3) Democratic development has a bidirectional relationship with economic growth and corruption.

Following that, the paper proceeds to do a review of the existing literature regarding linkages of corruption, economic growth, and democracy. The paper discusses theories on how corruption impacts economic development, what drives economic growth, and in what way democratic governance is relevant for prosperity. Various perspectives are also put together to see how corruption, democracy, and economic growth might relate to one another. Bibliometric Analysis describes the method followed in bibliometric analysis, which is a quantitatively based examination of research trends in a given field. This summarizes how data collection and analyses were made from scholarly publications in relation to corruption, democracy, and GDP. Major findings of bibliometric analysis are also included in this chapter, discussing greater themes and trends of research. The fourth module shows a presentation of sources and variables of data that will be considered in this study. Data that will feature in this study include the Corruption Percentage Index (CPI), democracy index (DI), and gross domestic index (GDP). This module shows the methodological approach during the examination, like Ordinary Least Squares (OLS) regression, Breuch-Pagan-

Godfrey test, Generalized Method of Moments (GMM) regression, and Granger causality test. In this chapter, it also describes any transformations applied to the original data for analysis. The findings of the empirical analysis are presented at the next module. In this regard, descriptive statistics of the variables are included in the chapter in question, comprising of CPI, DI, and GDP. It also contains statistical test results for the stationarity of the data. It describes the results of various regression analyses carried out-from OLS and GMM regressions to Granger causality test results. This paper, being the sixth module, tries to interpret and discuss the implications of its findings. It interprets the results in light of the literature available, the discrepancies or similarities observed between this study and the related ones, the theoretical significance, and practical meaning of the findings. It also makes an attempt to relate the findings to the implications for policy and directions for future research. Lastly, we sum up the key findings of this study and once again reiterates the importance of the same. It discusses the implications of findings for policy and practice, including recommendations on ways in which corruption could be handled to ensure economic growth. Additionally, areas for future research are identified to further develop the findings of the current study.

2. Literature review

2.1. Theoretical review of corruption.

Linking corruption and economic growth, various statistical methods and measures were utilized by studies of Mo (2001), Qudah (2009), and Tanzi and Davoodi (2001). Nevertheless, the obvious negative relationship between corruption and economic development is the commonly established finding of these three authors. Mo (2001), on the contrary, particularly identifies the fact that an increase in corruption by a mere percentage of 1% can lead to a 0.072% decrease in the rate of economic growth. This finding therefore indicates that countries with less corruption go on to exhibit better institutional transparency and do record more meaningful advancements regarding economic development than those in which corruption levels are a bit higher. Patton 2012 gave a related observation noting that of the highly corrupt nations, 19 out of 21 had annual GDPs less than $100 billion while the cleanest nations had annual GDPs below $100 million. From this perspective, Popova and Podolyakina (2014) cited that unequal opportunities for the development of citizens in corrupt countries may occur. Also, individuals in corrupt countries who are allied to different political factions use political and economic privileges more than unaffiliated people, making the progress of economic development slow. The debate concerning the relationship between corruption and economic growth theoretically develops along two major approaches, usually labeled “grind the wheels” and “grease the wheels.” According to the “grind the wheels” theory, corruption negatively influences economic growth. This approach maintains that corruption causes disincentives, which subsequently discourage investment, entrepreneurship, and economic performance in general. This view was supported, for example, by Rose-Ackerman (1978). On the other hand, in case corruption in some cases could have a positive influence on economic growth, here is when the “grease the wheels” theory comes in. This approach believes that corruption helps people get around bureaucratic barriers

and inspires officials to work more effectively. Summers (1977) contributed to this by suggesting that corruption is able to make bureaucracy hindrances be overcome; corruption thus was one of the factors. Some researchers hold different opinions about these theories. While some have confirmed that corruption negatively affects economic growth, such as Blackburn et al. (2006) and Ivanyna et al. (2016), hence being supportive of the "grinding the wheels" hypothesis, some other studies have shown that corruption can favor the economy under certain conditions. Therefore, it supports the alternative "greasing the wheels" hypothesis. Because this issue is very complex, differentiated factors in each country should be considered in regard to the conditions and institutional aspects when analyzing the actual impact caused by corruption in its economic development. Both theoretical and empirical research consistently highlight a strong link between corruption and economic growth. Many studies, including those by Abed and Davoodi (2002), Bardhan (1997), Ehrlich and Lui (1999), Mauro (1995, 1996), Murphy et al. (1993), and Tanzi and Davoodi (1998), emphasize the harmful effects corruption has on economic growth, showing that it hinders a country's progress and development.

2.2. Theoretical review of economic growth.

The literature on economic growth has deep historical roots, tracing back to the Industrial Revolution in 1776, spearheaded by Adam Smith. Smith, a key figure in studying the sources of wealth and how to enhance it, identified three main drivers of national prosperity: the division of labor, capital accumulation, and market size—each contributing to a nation's funding and productivity. By dividing up the work process and encouraging division of labor among workers, Smith said efficiency and output could be substantially improved. He also made the emphasis that accumulation of capital, especially in machinery, stimulated specialization and could produce more and higher value per capita. Larger markets that permitted trade allowed specialized producers to sell their products and obtain what they needed with greater ease, further reinforcing the division of labor. Beginning in the mid-20th century, economic theories began to shift, and neoclassical models stressed technical innovation and superior means of production as the keys to growth. The model of Solow was one that assumed that a country's production demonstrated diminishing returns and had constant returns to scale. He showed the relationship between capital accumulation and economic growth. Surprisingly, the model also indicated that the poorer countries could grow faster compared to the richer countries. It also showed that the changes in the labor supply coupled with technological change were exogenous factors that provided the impetus for long-term growth. Noticing, however, that one cannot rely entirely on pure technical progress, the endogenous growth theory was born. One of the very first models dealing with these issues was Romer's model back in 1986. His model stressed that the drivers of long-run growth are endogenous to the system, and that externalities are at the heart of the process. Human capital investments, public infrastructure, and institutions-a Kurum all affected by externalities-became key factors in trying to comprehend sustained economic growth.

2.3. Theoretical review of democracy

Many studies, cited by Aggarwal and Goodell (2009), Apergis and Apergis (2019), and Tavares and Wacziarg (2001) indicate that the relationship between democracy and economic growth may be related to political stability. The political uncertainty of political instability makes investment cautious and tends to retard growth because investors cannot predict future decisions with ease, thus generally reducing the attractiveness of economic opportunities. Other researchers also note that political stability is very often dependent upon the kind of political regime in question, democratic systems, for instance, are generally more stable for a few key reasons. Firstly, the democratic system is instituted with clearly outlined regulations that ensure the peaceful transfer of power between political parties. While authoritarian regimes would depend on force and coercion by leaders to retain power, democracies have relatively structured processes through which leadership succession is conducted. Democracy also allows for open debates and public participation that allow for the toning down of extremism and a reduced probability of undemocratic seizures of power. Because of this, political power in democracies is transferred in a more predictable and stable manner whereby development is always assured even after changes in political leadership. The second reason is that democratic governments are always encapsulated within institutional frameworks which temper the powers of persons making up the political decision-making team to follows laws as stipulated in the constitution. In these respects, authoritarian states often lack such checks and balances to restrain their rulers' discretion. That also means that democratic governments are more transparent and carry less risk of abrupt, unforeseen changes in policy. On the other hand, authoritarian leaders may change rules unpredictably, further creating an uncertain environment that keeps investors away. Finally, most democracies are considered more stable in the long run, especially during the transition of leadership-a factor that instills confidence in the political system. This stability therefore promotes the domestic and foreign investors to undertake projects which are long-term and facilitates the process of capital accumulation accordingly. However, as for the Greek economy, economic theories have identified a few weaknesses. These include internal market dynamics as well as global financial pressures along with macroeconomic imbalances in terms of debt and deficits that affected Greece's international competitiveness. Kouretas and Vlamis (2010) asserted that internal economic factors were the prime movers in causing the financial crisis of Greece. Argyrou and Tsoukalas opined that poor performance at the macroeconomic level and disincentive performance made it different from the rest of the Euro-zone countries, and low credibility has resulted in the nation's economic slump. From a more Marxist perspective, Mavroudeas (2013) has attributed this crisis in Greece to its position within the wider European capitalistic system and specifically to capital overaccumulation. Others, like Tsoulfidis et al. (2016), have identified that a mix of structural factors with those related to the global financial crisis of 2007–2008 contributed to low profitability, investment, production, and employment. Other contributors, Maniatis and Passas (2013), said that the crisis was caused by the modest profitability, capital accumulation, and labor exploitation. Several commentators have expressed an opinion that the crisis of Greece in the EU-as particularly compared to

Germany-became because of the structural inefficiencies and a deficiency in competitiveness. Other contributors still debate that the source of this had been caused by macroeconomic imbalances, financialization, trade imbalances, and falling profit rates. There are also those who blame successive Greek governments for failing to address declining national savings and vulnerabilities in the banking sector.

Beyond purely economic factors, some scholars focus on the social dimensions of the crisis. For example, rising inequality may have led to reduced demand, with households increasing their debt to maintain their standard of living. In Greece's case, many link the crisis to the growth of the welfare state, with Matsaganis (2011) arguing that deficits from pension and healthcare systems played a significant role.

Interestingly, in the early years of the crisis, Greece experienced an increase in its democracy index, but corruption levels were also high. After the crisis, both democracy and corruption indices declined. However, since 2019, we've seen a rise in the democracy index along with increased transparency. This could suggest that in the earlier years, democracy was somewhat distorted due to high corruption. The improvements from 2019 onward, including the parallel rise in democracy and transparency, may be partly explained by the acceleration of digital transformation, which was spurred by the COVID-19 pandemic.

A vast body of research highlights the detrimental effects of corruption on economic development. Mo (2001) observed that a 1% increase in corruption could reduce economic growth by 0.072%. Mauro (1995) emphasized that corruption undermines institutional efficiency and discourages both domestic and foreign investment. Rose-Ackerman (1978) framed corruption as a disincentive to innovation and entrepreneurship, which negatively impacts economic performance. Conversely, Summers (1977) proposed the "grease the wheels" hypothesis, suggesting that corruption could, under certain conditions, bypass bureaucratic inefficiencies and stimulate growth.

Recent studies have also examined corruption's sectoral impact, revealing its pervasive effects on public spending, infrastructure, and human capital development. These findings consistently highlight the importance of governance and anti-corruption policies in fostering sustainable economic growth.

The relationship between democracy and corruption is nuanced. While democracy is expected to reduce corruption through transparency and accountability, Jetter et al. (2015) found that democratization initially exposes latent corruption, leading to increased reports of corrupt practices. Gossel (2018) observed that in transitioning democracies, the process of strengthening institutions often brings hidden corruption to light. Popova and Podolyakina (2014) argued that this phenomenon is particularly pronounced in countries undergoing political and economic transitions, as reforms unveil existing vulnerabilities.

Stable democratic systems foster economic growth by creating predictable environments for investment. Busse and Hefeker (2007) emphasized that political stability in democracies reduces uncertainty, encouraging both domestic and foreign investments. Kouretas and Vlamis (2010) highlighted that Greece's historical political volatility has often undermined its economic potential. Moreover, studies by Ivanyna et al. (2016) and Mauro (1996) underscored the importance of robust democratic

institutions in ensuring the effective allocation of resources and enhancing economic performance.

While significant progress has been made in understanding the relationships between corruption, democracy, and economic growth, gaps remain. Few studies have explored these dynamics in the context of countries recovering from financial crises, such as Greece. Additionally, the bidirectional relationships among these variables—particularly the feedback loops between democracy and economic growth—remain underexplored. This study seeks to address these gaps by examining Greece's unique trajectory from 2012 to 2022.

3. Bibliometric analysis

Bibliometric analysis is a popular research technique worldwide that highlights the research trends in the specific field (Long et al., 2022; Lucey et al., 2023; Singh et al., 2023). Bibliometric analysis is carried out with the Biblioshiny R tool from the R package. In the first step, we collect the data from the Scopus database using the keywords ("Corruption") AND ("Democracy" OR "Democracy rate") AND ("GDP"). Regarding publications from the years 2002 to 2023, 63 papers are used. The available data from these papers are the following: (i) the title of the paper, (ii) the journal, (ii) the date of the publication, (iii) the names and affiliations of the authors, (iv) the abstract, (v) authors' keywords, and (vi) the citations.

To contextualize the research within the broader academic discourse, a bibliometric analysis was conducted to identify prevailing themes and trends in studies of corruption, democracy, and economic growth. Publications from 2010 to 2022 were analyzed for keyword frequency and co-occurrence.

Studies predominantly focused on corruption's impact on governance, economic development, and institutional quality. A growing emphasis on the role of democratic institutions in mitigating corruption was evident. While most studies emphasized global patterns, there is limited literature addressing the specific dynamics in Mediterranean economies, including Greece. Few studies integrate corruption, democracy, and economic growth into a cohesive framework. This underscores the need for holistic analyses like the one presented in this study.

Figure 1 depicts the words are mostly used in the papers. The shape of the word shows the frequency of the words' appearance. The words "democracy", "corruption" and "gross domestic product" are the most popular words. Researchers, also, investigate themes relative to "public policy", "carbon emission", "transparency" and "conflict of interest". Similarly to the WordCloud, **Figure 2** depicts the TreeMap. According to the TreeMap, the words "democracy" and "gross domestic product" appear in a frequency of 9%, while the percentage of the word "corruption" is 8%. The words "economic growth" and "public policy" are following with the percentage of 3%.

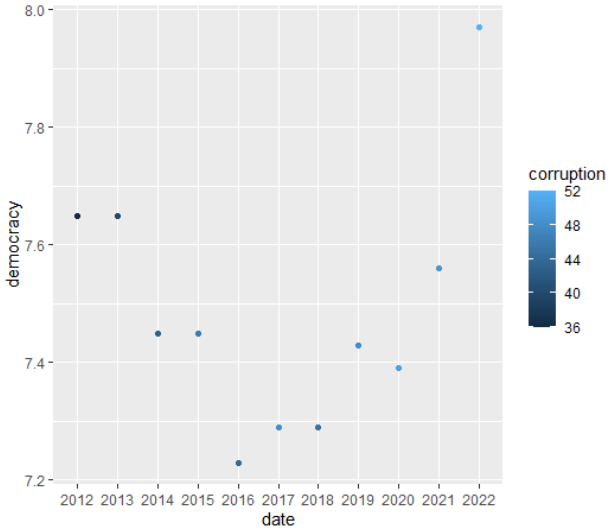

Figure 1. Democracy vs corruption (2012–2022).

Figure 2. WordCloud.

Source: Biblioshiny, 2024(Own elaboration).

Table 1 presents the 10 most cited countries worldwide. Denmark is the frontier of the countries with 346 citations, following USA with 199 citations and Korea with 62 citations.

Table 1. 10 most cited countries.

Country	N. of Citations
Denmark	346
USA	199
Korea	62
Norway	59
Australia	35
Malaysia	29
Ireland	26
China	13
France	7
Germany	7

Source: Biblioshiny, 2024 (Own elaboration).

Using the Biblioshiny from the Bibliometrix-R tool, the thematic map is constructed as shown in **Figure 3**. The horizontal axis and the vertical axis divide the thematic map into four quadrants. The first quadrant includes themes very important to the scientific committee, which have been investigated for a long time. In the second quadrant, there are themes that are important but irrelevant to the researchers' keywords, while in the third quadrants, there are themes that have no research interest and have not been investigating yet. In this quadrant, the existing themes either emerged or disappeared. The fourth quadrant is the most important, as the themes are presented are the most important and less developed themes, revealing a new path in the scholars' research. According to **Figure 4**, democracy, gross domestic product and corruption are between the first and fourth quadrant, revealing that these themes are very important to the scientific committee and further investigation is recommended.

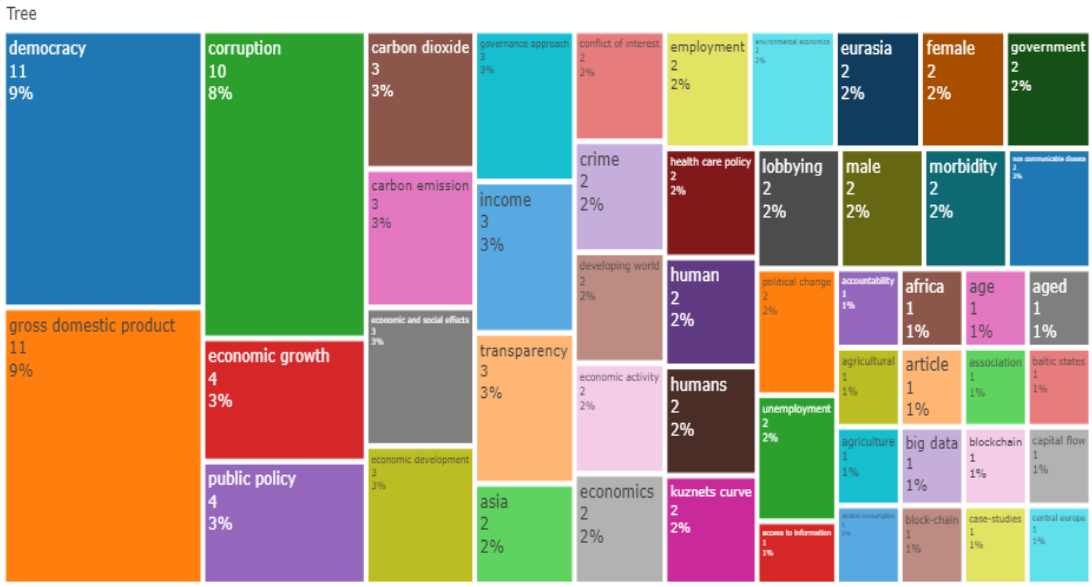

Figure 3. TreeMap.

Source: Biblioshiny, 2024(Own elaboration).

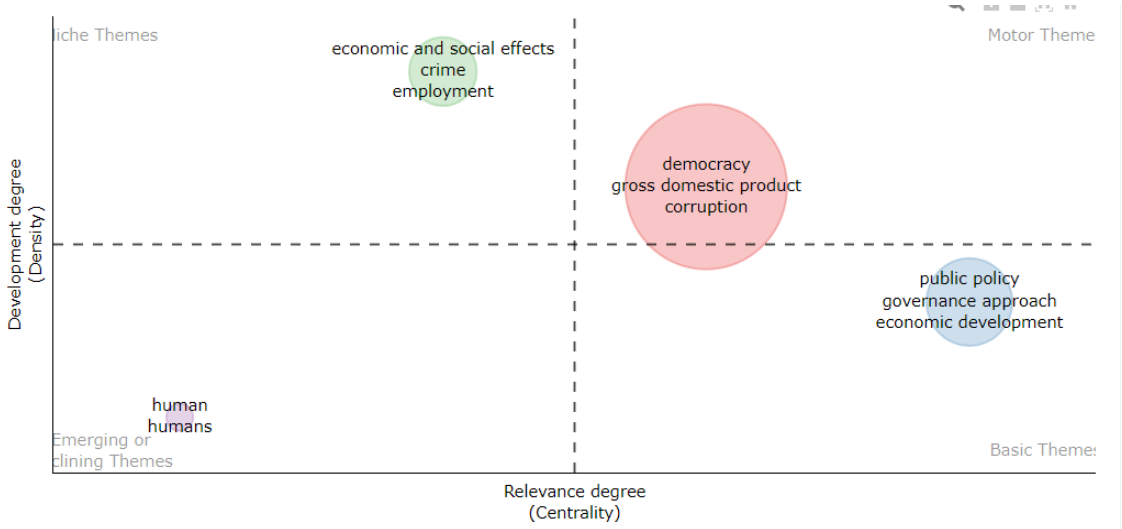

Figure 4. The thematic map.

VOSviewer software is also used to demonstrate the collaboration among the countries in the specific field and the co-occurrence of the authors' keywords. **Figure 4** shows the country-based bibliographic couple. The greater the cycle, the greater the influence of this country on the subject. United States has significant impact on the field relative to corruption and democracy, following by United Kingdom and Australia. **Figure 5** shows a cluster analysis with VOSviewer, presenting the co-occurrence of the authors' keywords. Keywords are presented by circles. The size of the label and the circle is determined by the importance of its keyword (van Eck and Waltman, 2013). Keywords are grouped into clusters. Every cluster has a different color. The relationships among clusters are shown by the lines. According to **Figure 6**, the interest of the scholars focus on corruption. The cluster in blue depicts the core issue, including keywords such as transparency, crime, public policy. Moreover, the cluster in red shows the most important indicators related to corruption. This cluster includes keywords such as government, foreign direct investment, health care policy, income, developing and developed countries.

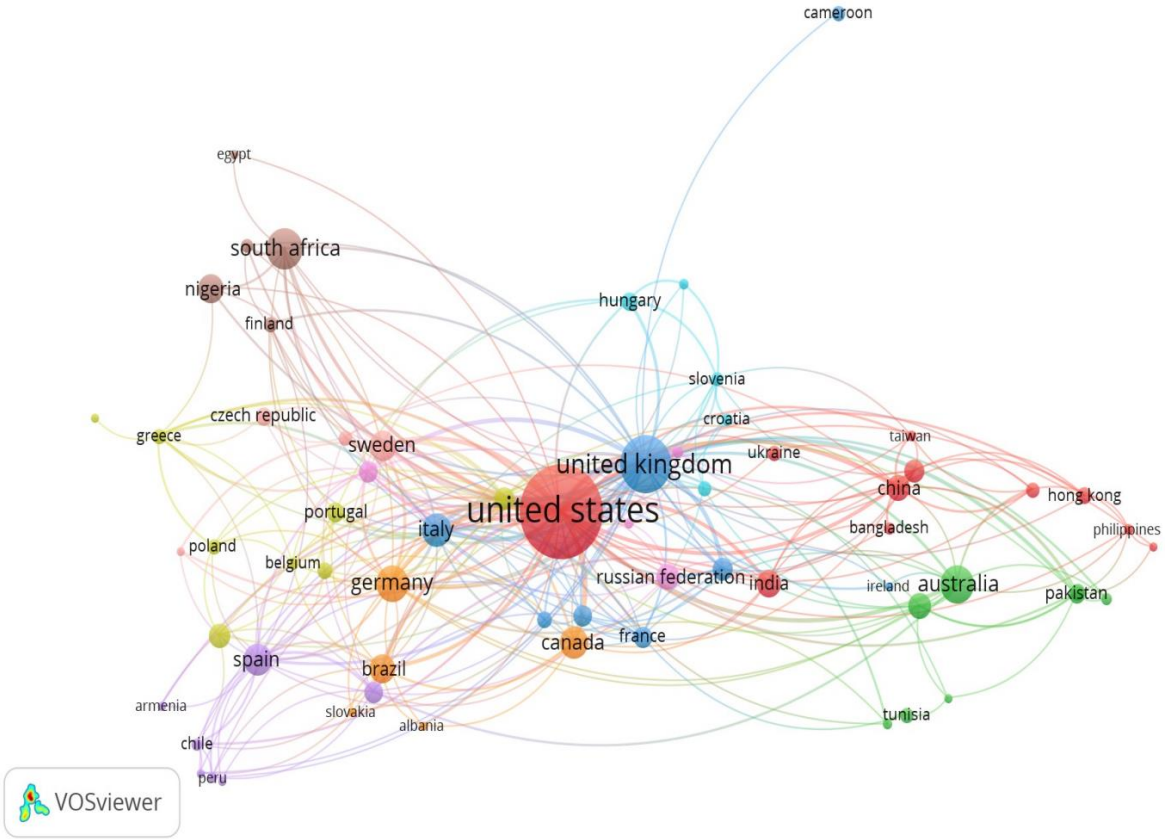

Figure 5. The country-based bibliographic coupling.
Source: Scopus/VOSviewer, 2024(Own elaboration).

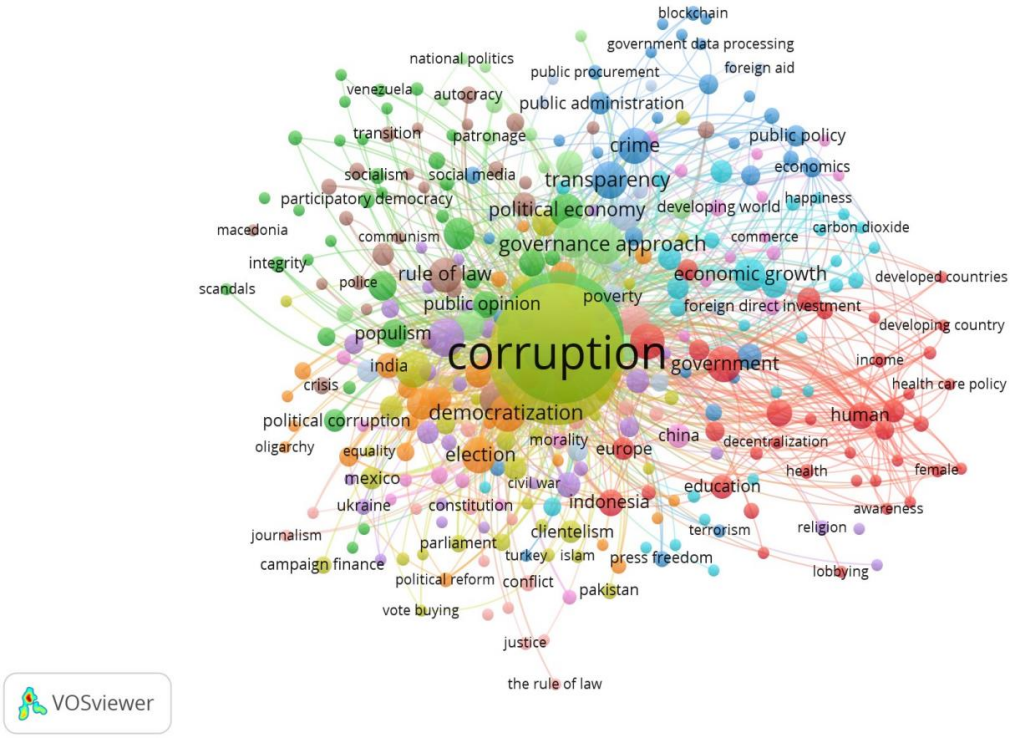

Figure 6. Co-occurrence of the authors' keywords.
Source: Scopus/VOSviewer, 2024 (Own elaboration).

4. Data and methodology

4.1. Data

The data we used in this study comes from reliable, well-established sources. Corruption data are presented by using the Corruption Presentage Index (CPI) is provided by Transparency International, the Democracy Index (DI) comes from the Economist Intelligence Unit, and GDP figures were sourced from Eurostat. These data points span the period from 2012 to 2022, a critical time for Greece as it navigated its post-crisis recovery.

We applied logarithmic transformations to the CPI, DI, and GDP values. This step helps ensure that the relationships between variables are more linear and makes it easier to interpret the results. Specifically, after transforming the data, the coefficients can be understood as elasticities, which show the percentage change in corruption for a given percentage change in democracy or economic growth.

Time-series data can often be tricky because the statistical properties of variables can change over time, leading to unreliable results. To evade this, we applied the Augmented Dickey-Fuller test to ensure that the data we were working with had stationarity, meaning they are stable over time. The test showed that at their raw levels, the variables were not stationary but would be after taking first-order differences, and thus our regression analysis would be valid. Selection of methods and data preparation with care means that we worked out the relations of democracy, corruption, and economic growth in Greece using appropriate tools and techniques. This paper investigates the relationship between corruption, democracy and gross domestic product in Greece during the period of 2012–2022. Based on previous studies, such as

Gossel (2018), Jetter et al. (2015), Kotera et al. (2012), Corruption Percentage Index, CPI, is chosen to be the dependent variable. CPI is carried out by the Transparency International and varies from 0 - high corruption - to 100 - no corruption. The independent variables are the Gross Domestic Product and the Democracy Index. The Democracy Index conducted by the Economist Intelligence Unit ranges from 0, which indicates a lack of democracy, to 10, indicating full democracy. The original data are transformed into logarithmic form to capture the corruption elasticity of the independent variables.

We use:

- Corruption data from Transparency International's CPI.
- Democracy Index (DI) from the Economist Intelligence Unit.
- GDP data from Eurostat.

Logarithmic transformations of CPI, DI, and GDP values ensure linear relationships and interpretability as elasticities.

4.2. Methodology

Statistical Techniques

1) OLS Regression: Provides initial insights into relationships between variables but may suffer from endogeneity.
2) GMM Estimation: Addresses endogeneity by using instrumental variables to yield reliable estimates.
3) Granger Causality Test: Explores directional relationships among variables over time.

Limitations of Granger Causality: While the Granger causality test identifies temporal associations, it does not confirm true causation. The test assumes stationarity of data and excludes the influence of latent variables that may affect both series. Consequently, results derived from Granger causality should be interpreted cautiously, recognizing the potential for confounding factors and spurious relationships.

To ensure robustness, we apply the Augmented Dickey-Fuller test to verify stationarity of variables and transform them when necessary.

The CPI was chosen as a corruption measure due to its broad acceptance as a reliable proxy for capturing public sector corruption. The DI serves as a comprehensive indicator of democracy, encompassing multiple dimensions relevant to governance. GDP was selected as the measure for economic growth, reflecting overall economic performance.

Logarithmic transformations of CPI, DI, and GDP values were applied to normalize the data and ensure linear relationships among variables. This approach allows for interpreting coefficients as elasticities, making results more intuitive. For instance, a 1% increase in GDP would correspond to a proportional change in corruption or democracy, based on the model outputs. This transformation also reduces the influence of outliers, improving the robustness of the analysis.

The findings of this study reveal important insights for policymakers seeking to enhance governance, reduce corruption, and sustain economic growth in Greece. The following policy recommendations are proposed:

1) Strengthen Democratic Institutions:

- Enhance transparency and accountability mechanisms within government institutions. Initiatives such as regular public audits, independent anti-corruption agencies, and freedom of information laws can help strengthen public trust and reduce corruption.
- Support civic education programs that promote democratic participation and accountability, ensuring citizens are informed and empowered to demand transparent governance.

2) Promote Economic Reforms:
   - Focus on reducing bureaucratic inefficiencies by implementing streamlined regulatory frameworks for businesses. For instance, digitalizing public services and business registration processes can minimize opportunities for corruption.
   - Invest in infrastructure, education, and technology to boost economic stability, creating an environment where corruption is less likely to thrive.
3) Leverage Digital Governance:
   - Expand e-governance initiatives, such as electronic procurement systems, to limit discretionary powers and increase transparency in government contracts and resource allocation.
   - Utilize digital platforms to monitor and report corruption cases, providing a user-friendly mechanism for whistleblowers and citizens to report misconduct safely and efficiently.
4) Strengthen Anti-Corruption Enforcement:
   - Allocate greater resources to anti-corruption agencies to ensure they have the capacity to investigate and prosecute corruption cases effectively.
   - Develop international partnerships with organizations such as the EU and OECD to adopt best practices and technical support for anti-corruption measures.
5) Encourage Public-Private Partnerships (PPPs):
   - Foster collaboration between the public and private sectors to improve service delivery and infrastructure development. Well-regulated PPPs can reduce inefficiencies and corruption risks while stimulating economic growth.
6) Monitor and Evaluate Progress:
   - Establish metrics to assess the impact of anti-corruption initiatives and economic reforms. Regular monitoring and evaluation ensure that policies remain adaptive to changing circumstances and effectively address governance challenges.

By implementing these recommendations, Greece can leverage its recent democratic reforms and economic stabilization to create a sustainable and transparent governance framework. These strategies are crucial for fostering long-term economic resilience and public trust in institutions.

1) Strengthen Democratic Institutions: Enhance transparency and accountability mechanisms to sustain democratic development.
2) Promote Economic Reforms: Focus on infrastructural, educational, and technological investments to reduce corruption opportunities.

3) Leverage Digital Governance: Expand e-governance initiatives to reduce bureaucratic inefficiencies and foster transparency.

4.3. Methodological framework

Step 1: Data Collection

- Gather data from Transparency International, Economist Intelligence Unit, and Eurostat.

Step 2: Preprocessing

- Log-transform variables for normalization.
- Conduct stationarity tests using the Augmented Dickey-Fuller test.

Step 3: Statistical Analysis

- Perform OLS regression for initial insights.
- Apply GMM estimation to address endogeneity concerns.
- Conduct Granger causality tests to explore temporal relationships.

Step 4: Interpretation

- Analyze results within the socio-economic context of Greece.

Step 5: Policy Implications

- Derive actionable recommendations based on findings.

We investigate the nexus of corruption, democracy, and economic growth in Greece during the period 2012–2022, utilizing a multi-faceted approach of statistical analysis, including OLS, GMM, and Granger Causality tests. The methodological approach has been chosen because it allows one to alleviate the well-known problems of a reverse causality problem and the endogeneity of regressors, which complicates the analytical efforts when examining governance and economic variables. OLS is a starting point for our analysis because it is the most straightforward way to investigate the relationship that exists between variables. In this case, we applied OLS to assess how corruption CPI, democracy index DI, and gross domestic product GDP are interlinked. It proves very helpful as an initial snapshot of relationships among variables because OLS is so easily interpretable and applicable. However, OLS tends to have its own drawbacks, especially when there are problems concerning heteroskedasticity-unequal error variances-or serial correlation-errors correlated over time. An even more important problem, though, is that of endogeneity, where one of the explanatory variables, such as DI or GDP, is thought to be determined by some variable that also determines the error term in this equation. For example, democracy might reduce corruption, and high levels of corruption might weaken democratic institutions. To deal with such complexities, we turn to a more advanced method in this chapter: GMM. In this respect, GMM is an advanced method that helps sort out the problems created by OLS and, more generally, endogeneity. In such an example, where democracy and corruption may well affect one another both ways, GMM provides cleaner, more reliable estimates by way of the application of instrumental variables. These are variables which relate to the potentially problematic explanatory variable but are not affected by the same error term, thereby allowing us to control for bias.

In simpler terms, GMM helps us handle situations where the relationships between our variables might be two-way streets—like when not only can democracy

impact corruption, but corruption can also affect the quality of democracy. By accounting for this, GMM gives us a more accurate understanding of how democracy and economic growth really interact with corruption.

While OLS and GMM help us understand the relationships between variables, they don't tell us about the direction of those relationships. That's where the Granger Causality test comes in—it helps us figure out whether changes in one variable (like democracy) can predict changes in another (like corruption), or if the influence runs in the opposite direction.

In this study, the Granger Causality test helps us answer a key question: Does more democracy lead to less corruption, or does less corruption lead to stronger democratic institutions? Or could it be both? This test is ideal for understanding how these variables influence each other over time, giving us more insight into the direction of these effects.

In order to explore the linkages among corruption, democracy and GDP, we will estimate the following equation:

$$CPI_{it} = a_0 + a_1 DI_{it} + a_2 GDP_{it} + u_{it} \quad (1)$$

Estimating the regression using Ordinary Least Squares (OLS) method, we must overcome some potential problems of OLS regressions such as heteroskedasticity, serial correlation and endogeneity. The problem of the heteroskedasticity will be examined by the Breuch-Pagan-Godfrey test. The existence of the serial correlation will be checked by the LM test. The reverse causality of the variables may leads to endogeneity problem. In order to capture the endogeneity, we will use the Generalized Method of Moments (GMM). According to Gossel (2018), GMM has the advantage of taking into consideration the possibility of endogeneneity between explanatory variables, which is applicable to the persistence of corruption (Bissessar, 2009; Goel and Nelson, 2010). Moreover, this study will explore the causal relationship among the variables by employing the Granger causality test. If variable *x* Granger causes variable *y*, there is a unidirectional causality. At the same time, if variable *y* Granger causes variable *x*, then there is a bidirectional causality.

5. Results

Table 2 presents the descriptive statistics of the variables. The Democracy Index has the lowest mean (2.012845), while the highest price appeared in GDP (5.358874). Regarding the standard deviation, the lowest price appeared in DI (0.028015), while CPI has the highest price (0.106660). The GDP and DI have positive asymmetry (0.246726 and 0.903401 respectively), while regarding the kurtosis DI and CPI are leptokurtic and GDP is platykurtic.

Table 2. Descriptive statistics.

Variables	CPI	DI	GDP
Mean	3.813689	2.012845	5.358874
Median	3.828641	2.008214	5.357294
Maximum	3.951244	2.075684	5.489681
Minimum	3.583519	1.978239	5.240529

Table 2. (*Continued*).

Variables	CPI	DI	GDP
Std. Dev.	0.106660	0.028015	0.088029
Skewness	−0.855232	0.903401	0.246726
Kurtosis	3.032877	3.301206	1.715303

It is essential to check the stationary of the variables. **Table 3** depicts the results of the Augmented Dickey Fuller Test. According to the **Table 3**, none of the variables are stable at the levels, while all the variables became stable at the first differences.

Table 3. Augmented dickey fuller test.

Variables	Levels		First Differences	
	***t*-Statistic**	**Prob.**	***t*-Statistic**	**Prob.**
CPI	1.916867	0.9777	−2.218918**	0.0335
DI	0.885591	0.9982	−4.034709***	0.0055
GDP	−0.401976	0.5124	−2.854916***	0.0099

Notes: critical *t*-values were taken as −2.847250 and −1.988198 for the significance level of 1% and 5% respectively. ** indicate 5% significance level and *** indicate 1% significance level.

The results of the OLS estimation are presented by the **Table 4**. Employing Breusch-Pagan-Godfrey Test (Appendix **Table A1**) and LM Test (Appendix Table A2), we conclude that the equation does not suffer from the problem of heteroskedasticity or serial correlation. The results reveal there is a positive relationship between the corruption and the democracy index (2.070085) at a significance level of 10%, while a negative relationship is detected between the corruption and the GDP (−1.158333) at a significance level of 1%.

Table 4. The results of the OLS regression (dependent variable: Corruption).

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
C	5.854290***	1.776706	3.295024	0.0109
DI	2.070085*	1.022002	2.025520	0.0774
GDP	−1.158333***	0.325252	−3.561340	0.0074

Note: * indicates 10% significance level and *** indicate 1% significance level.

Regression Analysis

1) OLS Results:

Democracy positively correlates with corruption (Coefficient = 2.07, $p < 0.10$).

Economic growth negatively correlates with corruption (Coefficient = −1.16, $p < 0.01$).

2) GMM Results:

Findings align with OLS, confirming the robustness of relationships.

The positive association between democracy and corruption highlights the transparency effects of democratic systems. Increased democracy often exposes latent corrupt practices, particularly in transitioning economies such as Greece.

The negative correlation between GDP and corruption emphasizes how economic growth, accompanied by structural reforms and governance improvements, can reduce opportunities for rent-seeking behaviors and increase regulatory efficiency.

Implications of GMM Results:

The GMM findings underscore the dynamic interplay between governance, economic performance, and transparency. These results suggest that reforms fostering economic stability and institutional efficiency can diminish corruption over time.

However, the bidirectional nature of democracy and corruption, as suggested by the GMM model, implies that efforts to improve democratic institutions may initially lead to increased reported corruption due to heightened transparency. Long-term strategies must balance these dynamics to achieve sustainable governance improvements.

According to the theory, the reverse causality of the variables may leads to endogeneity problem. In this case, the OLS estimators may be biased, so we construct the Generalized Method of Moments (GMM) in order to capture the endogeneity problem. **Table 5** presents the results of the GMM. The results of GMM are in line with the results of the OLS regression. The positive relationship between the CPI and DI (2.566179) reveals that the high level of democracy is relative to transparency. Similarly, Jetter et al. (Jetter et al., 2015) conclude that Democracy reduces corruption in the developed countries, while in poorer nations, democratization increase the corruption. Gossel (2018) uses the GMM analysis to explore the relationship among FDI, democracy and corruption in Sub-Saharan Africa. The results show that FDI is attracted by both democracy and corruption. According to the GMM regression, the GDP is negatively correlated to the corruption index (−0.681528) at a 10% significance level, revealing that an increase in GDP is associated with the increase of the corruption of the country.

Table 5. The results of the GMM regression (dependent variable: Corruption).

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
C	2.341307	2.771789	0.844692	0.4458
DI	2.566179***	0.484423	5.297396	0.0061
GDP	−0.681528*	0.405204	−1.681938	0.1079

Note: * indicates 10% significance level and *** indicate 1% significance level.

The causal relationships among the variables (CPI, DI and GDP) will be explored by employing the Granger causality test. **Table 6** shows the results of the Granger causality test. According to the **Table 6**, there is a unidirectional causal relationship from corruption to democracy index at a 10% significance level, Furthermore, the null hypothesis that GDP does not Granger Cause DI is rejected at a 10% significance level, so a unidirectional causal relationship is detected from GDP to democracy index.

Table 6. The results of the pairwise granger causality test.

Null Hypothesis:	***F*-Statistic**	**Prob.**
DI does not Granger Cause CPI	0.77059	0.5211
CPI does not Granger Cause DI	5.10760*	0.0792
GDP does not Granger Cause CPI	1.12313	0.4101
CPI does not Granger Cause GDP	0.36829	0.7132
GDP does not Granger Cause DI	6.14507*	0.0603
DI does not Granger Cause GDP	1.00058	0.4443

Note: * indicates 10% significance level.

The test reveals:

- Democracy Granger-causes corruption ($p < 0.10$).
- GDP Granger-causes democracy ($p < 0.10$).

6. Discussion and conclusions

This study sheds light on how democracy, corruption, and economic growth have interacted in Greece during a crucial period of recovery from the 2008–2009 financial crisis. Our findings help connect the dots between the political and economic changes in the country and what's been discussed in previous research, revealing both patterns and some surprising nuances. One of the key takeaways from our study is the positive correlation between democracy and corruption. While at first this might seem counterintuitive—after all, isn't democracy supposed to reduce corruption? It actually aligns with what researchers like Gossel (2018) and Jetter et al. (2015) have found. These scholars suggest that as democratic institutions become stronger, they often bring more transparency, which in turn exposes more corruption. In other words, the increase in reported corruption might not mean more corrupt activity, but rather that democratic reforms have brought issues to light that were previously hidden. This is like the idea put forward by Popova and Podolyakina (2014), who argue that in transitioning economies like Greece, increased transparency often leads to more visibility of corruption rather than a real increase in corrupt practices.

On the other hand, our finding that higher economic growth is linked to lower corruption levels is in line with what many studies have already shown. For instance, Mauro (1995) and Mo (2001) both concluded that as economies grow, they tend to become less corrupt. This would be because economic stability often comes hand in hand with better governance and reduces opportunities for illicit activities. Our findings thus hint that as Greece began its path of economic recovery, it also started seeing some reduction in corruption-a hypothesis further cemented by the fact that economic health improves the quality of institutions. This also goes in line with the work of Busse and Hefeker (2007), who assert that in countries where economic growth and stability are witnessed, there is a tendency for corrupt practices to be less attractive. However, it does not imply that the relationship is simple. In this paper, we also look into the debate between the "grind the wheels" and "grease the wheels" theories of corruption. The "grind the wheels" theory of Blackburn et al. (2006) and Rose-Ackerman (1978) states that corruption is one of the major deterrents to economic development. Our results indicate such. On the other side, the "grease the

wheels" hypothesis postulates that at times corruption might get around red tape and actually inspire economic development. But in the case of Greece, it can be seen that corruption has actually been a hindrance rather than a help to economic growth, further backing up the "grind the wheels" perspective. First, the fact that democracy and corruption are positively correlated should be seen in a positive light-it's a sign that efforts to promote transparency are working. As Greece strengthens its democratic processes, it's shining a light on corruption that might have previously gone unnoticed. Second, while more corruption cases seem to appear, policymakers should not be discouraged but rather redouble efforts toward transparency reforms and make sure the legal frameworks that deal with such revelations are in place. As the relationship between corruption and economic growth is complementary, there is a higher need for policies that contribute to sustainable growth. These infrastructural, educational, and technological investments contribute to making the economy less vulnerable to corruption by building stronger institutions. As Khan and Akbar (2013) mentioned, "Political stability is more important for attracting foreign investment, which is needed for higher levels of economic growth and further reduction in corruption opportunities.". Yet, the fact that corruption has remained in place, even with economic growth, would argue that economic growth itself is not a panacea. Instead, what would be required are deep structural changes in institutions and especially in the field of public administration. In this respect, recent moves to digitize government services have already begun to bear some fruit by way of reducing corruption, as it is more transparent and difficult to manipulate. Expanding these efforts could help further diminish the opportunities for corruption to take hold. The final result from the Granger Causality test is a good reminder that improvements in one area, say democracy or economic growth, tend to spill over into other areas. So long as Greece continues its efforts at fostering economic development and democratic reforms, the overall governance environment should improve.

The positive relationship between democracy and corruption reflects increased transparency in democratic systems, exposing previously hidden corrupt activities. This finding aligns with the notion that democratic reforms often shed light on entrenched corruption, particularly in transitioning economies like Greece. The democratization process introduces stronger institutional frameworks and public accountability measures, which can initially lead to an increase in reported corruption as these systems reveal previously obscured malpractices. This phenomenon is consistent with the findings of Jetter et al. (2015) and Popova and Podolyakina (2014), who argue that transparency and accountability mechanisms can inadvertently amplify corruption visibility during early stages of democratic reform.

Conversely, the negative association between economic growth and corruption underscores the role of structural reforms and governance improvements in reducing corruption. Economic growth in Greece during the post-crisis recovery period was accompanied by targeted government efforts to streamline bureaucratic processes, increase regulatory efficiency, and reduce opportunities for rent-seeking behaviors. For instance, reforms aimed at reducing bureaucratic barriers in business permits and inspections helped alleviate corruption pressures on private sector activities. Additionally, the adoption of digital governance tools and e-government initiatives

minimized opportunities for discretionary decision-making by public officials, curbing corruption.

Moreover, the observed relationship between economic growth and reduced corruption can be interpreted through the lens of resource allocation. As Greece stabilized economically, increased fiscal capacity allowed for the strengthening of anti-corruption agencies and legal frameworks. This created an environment where corrupt practices faced greater scrutiny and enforcement, further deterring illicit activities.

However, causality remains a complex issue. While Granger causality tests indicate temporal relationships—such as democracy Granger-causing corruption and GDP Granger-causing democracy—these results do not confirm true causation. Unobserved factors, including cultural norms, historical governance patterns, and geopolitical influences, may also play significant roles. For example, Greece's integration into the European Union and compliance with EU transparency standards likely contributed to the observed trends.

To fully understand these dynamics, it is essential to consider the broader socio-economic processes at play. The interplay between democratic development and economic growth reflects a feedback loop: as democratic institutions strengthen, they facilitate economic stability, which in turn reinforces the capacity for governance reforms. However, the extent to which these processes are sustainable depends on continued policy innovation and societal commitment to transparency and accountability.

These elements should be related by policymakers, who should approach them in a holistic reform because efforts toward the reduction of corruption must go hand in hand with economic and democratic improvement. Though this study provides valuable insight, it also raises new questions that need further exploration. Other contributing factors in corruption in Greece, like political stability and the rule of law, may also be studied in further research as a means of providing a more holistic analysis. It would also be very useful to draw some lessons from Greece in comparison with other countries that have passed similarly through such crises. Finally, a more qualitative approach might detect the exact type of institutional reforms that have contributed to lower corruption-noticeably, how technology and digitization improved transparency. A set of important conclusions is drawn from the analysis regarding the triangle of democracy, corruption, and economic growth-GDP-in Greece. First, from the results, one can notice a positive effect of democracy on corruption in Greece. This could, therefore, suggest that the more democracy strengthens, the more strengthened is transparency and accountability, which may lead to an increase in the detection and reporting of corrupt practices. It should, however, be underlined that this relationship does not necessarily involve a question of causality, as there might be other factors running in tandem and influencing democracy and corruption. The study shows the negative relation of GDP with corruption, which implies that a higher economic growth is accompanied by lower corruption cases. It is what indicates the role of economic development in combating corruption. With greater economic growth and prosperity, there is also more incentive by institutions and individuals to maintain integrity and transparency. Analysis also points out the possibility of endogeneity: the possible two-way relationship between democracy, corruption, and GDP-the

possibility that good democratic institutions and economic growth could result in less corruption and that corruption could thwart democratic processes and hinder economic development. Such endogeneity concerns might be investigated in more detail in future research to elucidate the causal mechanisms at work. These findings have significant policy implications for governance and economic policies that might be implemented in Greece. The strengthening of democratic institutions, enhancing transparency and accountability, and the stimulation of economic growth are some of the principal policy preoccupations that ought to be pursued. Comprehensive reforms targeting the uprooting of corruption, while encouraging a favorable environment for economic development, may also have their long-term impacts on the socio-economic setting of Greece. Further research will be required to see in detail how democracy, corruption, and GDP are related in Greece. Longitudinal studies may also yield useful results on how these relationships change over time, considering external factors such as international economic trends and political changes. Qualitative research methods might provide further insight into contextual factors that shape corruption and democratic processes in Greece.

This study contributes to the existing body of literature by offering a nuanced understanding of the relationships among democracy, corruption, and economic growth in Greece. It extends previous research by highlighting how democratic transitions can initially increase reported corruption through transparency effects, a phenomenon that has been underexplored in Mediterranean economies. Additionally, the study illustrates how structural reforms and economic stability create an environment that curbs corruption over time, offering empirical validation for governance theories in a post-crisis context.

The findings provide actionable insights for policymakers aiming to enhance governance and economic performance. Strengthening democratic institutions, implementing digital governance solutions, and focusing on long-term economic reforms are essential strategies for reducing corruption and fostering sustainable development. The study also underscores the importance of balancing short-term increases in reported corruption with long-term gains in transparency and institutional accountability.

Compared to existing literature, this study uniquely examines the interplay of these variables in Greece during a critical decade of economic recovery and reform. By incorporating dynamic statistical techniques like GMM estimation and Granger causality, the research sheds light on temporal relationships and provides a methodological framework applicable to similar economies in transition.

Limitations and Future Research:

Despite its contributions, this study has certain limitations:

1) Causality Interpretation: While Granger causality indicates temporal associations, it does not confirm true causation, and unobserved factors may influence the observed dynamics.
2) Context-Specific Findings: The results are specific to Greece's unique socio-political and economic conditions, which may limit their generalizability to other contexts.
3) Data Constraints: The study relies on secondary data sources, which may include inherent biases or inaccuracies.

Future research should address these limitations by:

- Conducting comparative analyses with other Mediterranean or transitioning economies to validate the findings.
- Exploring additional latent variables, such as cultural norms and international influences, to enhance the robustness of causality interpretations.
- Employing longitudinal data collection methods to capture changes over extended periods and assess the sustainability of reforms.

In general, this study contributes to the understanding of the complex interplay between democracy, corruption, and economic growth in Greece and hence provides an additional contribution to valuable insight into policy makers, researchers, and practitioners in addressing challenges with governance and sustainable development.

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Abbreviations

CPI	Corruption Percentage Index
GDP	Gross Domestic Index
DI	Democracy Index
OLS	Ordinary Least Squares
GMM	Generalized Method of Moments
PASOK	Panhellenic Socialist Movement
ND	New Democracy

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Appendix

Table A1. Breusch-Pagan-Godfrey test.

***F*-statistic**	**1.406389**	**Prob. *F* (2,8)**	**0.2996**
Obs**R*-squared	2.861481	Prob. Chi-Square (2)	0.2391

Table A2. Breusch-Godfrey serial correlation LM test.

***F*-statistic**	**0.775558**	**Prob. *F* (2,6)**	**0.5017**
Obs**R*-squared	2.259571	Prob. Chi-Square (2)	0.3231