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Article

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THE ROLE OF THE INFORMAL ECONOMY IN ACHIEVING THE SUSTAINABLE DEVELOPMENT GOALS IN EUROPE

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Abstract

This study investigated the relationship between the informal economy and sustainable development, focussing on how the shadow economy influenced the achievement of the 17 Sustainable Development Goals (SDGs) formulated in the 2030 Agenda in Europe. The research used data extracted from the Eurostat and Schneider (2022) and analysed sustainable development performance in 36 European countries in the years 2010 and 2022. The methodology involved applying partial least squares (PLS) regression to construct a synthetic indicator of sustainable development, considering two scenarios: one that excluded and another that included the size of the informal economy. The results highlighted that while the informal economy contributed to immediate poverty alleviation and short-term economic resilience, it created challenges for long-term sustainability in areas such as formal employment, social inclusion, and environmental regulation. The findings highlighted the need for stronger policies to integrate the informal sector into the formal framework, thus improving overall sustainability. The study made an original contribution by addressing the dual role of the informal economy in sustainable development, offering new perspectives for formulating more effective policies in the context of the 2030 Agenda.

Keywords: sustainable development, SDG, informal economy, composite indicators, PLS.

JEL Classification: O17, Q01, E26, Q56, C51.

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Introduction

Humanity today is at a crossroads, aware of the dire consequences of its actions, such as social and environmental imbalances that have thrown a question mark on its future. A key concept for this study is sustainable development, defined by the United Nations as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. Therefore, the hopes for a prosperous and sustainable world are reflected in the 2030 Development Agenda, which includes the 17 Sustainable Development Goals (SDGs).

The informal economy or, in some cases, the shadow economy, can be viewed from two perspectives. On the one hand, the concept is associated with flexibility, resilience, and entrepreneurship in the literature. Sometimes it is considered more efficient and robust than the formal economy (Gurtoo and Williams, 2009; Williams and Nadin, 2010; Popescu et al., 2018), and it leads to the creation of new markets by addressing the extension of financial resources. The informal economy also adds value to the formal one (Schneider and Enste, 2002), acting as a social barrier against unemployment because it creates jobs (Galli and Kucera, 2003; Smit and Musango, 2015), thereby sometimes reducing poverty and inequality (Wan and Wang, 2019). Through the informal economy, unprivileged citizens can afford goods and services that they could not afford in the official sector (Ruzek, 2014), and it represents a significant source of income for people, especially in less developed countries (Rupani, 2020). On the other hand, the informal economy can be associated with lower remuneration, lack of social security, and poor work conditions, representing an inverse relationship with the formal economy. The absorption of labour from the formal economy creates imbalances in official statistics and unfair competition with companies in the formal economic sector (Gerxhani, 2004; La Porta and Schleifer, 2014). Furthermore, Ozgur et al. (2021) showed that the impact of an informal sector is significantly greater in emerging countries.

In line with the 2030 Agenda, the principle of leaving no one behind (Samman et al., 2019) seeks to reduce social and economic disparities and include marginalised and discriminated groups. Empirical evidence on the integration of sustainability and digital transformation in business was provided by Pinzaru et al. (2024), finding a significant relationship between digital transformation and sustainability practices as a strategy to address the challenges generated by the just transition. Fiscal policies are quite relevant in this context. Lazar et al. (2022) highlighted the need for closer coordination of direct taxation at the European level to stimulate the convergence of fiscal policies.

The main objective is to integrate the size of the shadow economy expressed as a percentage of GDP (Schneider, 2022) into a synthetic measure built for sustainable development. The aggregate indicator emphasises the importance of this socioeconomic phenomenon in the analysis of sustainable development. Therefore, to better understand this relationship, the study addresses the following research questions: (Q1) What are the main determinants of each SDG? (Q2) To what extent does the informal economy influence the achievement of the SDGs?

The main contributions of this study are: (1) the building of a synthetic indicator of sustainable development that includes the dimension of the informal economy, and (2) the highlighting of the dual influences, both positive and negative, of the informal economy on the achievement of sustainable development goals. Therefore, the paper provides a solid

theoretical basis for understanding this complex relationship and developing inclusive policies that maximise the benefits and minimise the risks associated with the informal economy. The next section presents a review of the relevant literature, highlighting current debates about the role of the informal economy in sustainable development. The methodology section details the approach used, including PLS regression, to construct the composite indicators. The empirical results and discussion provide an analysis of the main determinants of the SDGs in the baseline and alternative scenarios, comparing the differences between them. Finally, the conclusion section outlines the theoretical and practical implications of the study and offers suggestions for future research.

1. Review of the scientific literature

The relationship between sustainability and the informal economy is multifaceted and complex and addresses economic, social, and environmental dimensions. The informal economy, often neglected in sustainability discussions, plays an important role in achieving sustainable development, especially in developing countries. According to the International Labour Organisation (ILO, 2020), the informal economy employs more than half of the world's workforce and represents more than 90% of micro and small enterprises (SMEs), representing a significant feature of global labour markets. Since the concept of an "informal economy" encompasses a wide range of circumstances and phenomena, the solution must be adapted to specific circumstances faced by different countries and categories of economic units or workers. The informal economy implies a lack of social security, workplace rights, and unacceptable working conditions for hundreds of millions of people, as well as low productivity and low access to finance for businesses. The only SDG that directly addresses the informal economy is SDG8 (Decent Work and Economic Growth), while other SDGs are indirectly related to the informal economy: poverty (SDG 1), gender equality (SDG 5), equal rights (SDG 10), organisations (SDG 16), and collaborations (SDG 17).

The literature on sustainable development has focused on changes in the formal sector without recognising the potential benefits of the informal sector for long-term sustainability. As a result, ignoring the informal sector and its consequences for long-term growth may be neglecting a key component of the economies of certain emerging countries.

Thus, on the one hand, the informal economy is associated in the literature with entrepreneurship, flexibility and resilience, being considered even more inventive, resource efficient, and resilient than the formal economy (Schneider and Enste, 2002; Gurtoo and Williams, 2009; Williams and Nadin, 2010), leading to the creation of new markets, the intensification of entrepreneurship, and the expansion of financial resources. It also adds value to the economy (Schneider and Enste, 2002), being a social buffer against unemployment, as it makes it easier for the unemployed to find jobs (Galli and Kucera, 2003; Ruzek, 2014; Smit and Musango, 2015), reducing poverty and inequality (Weaver, 2016; Chen, 2019). The study by Gurtoo and Williams (2009) points out in a very relevant way the role of the informal economy in promoting entrepreneurship and innovation, supporting the idea of creating new markets, an idea that finds its foundation more notably in the context of the 2030 Agenda and SDG1 (no poverty) and SDG8 (decent work and economic growth). This theory is supported by the studies by Williams and Nadin (2010). Although there is evidence in the direction of reducing poverty and inequalities under the

prerogative of the informal economy (Weaver, 2016; Chen, 2019), this contribution will have to be put in the context of the benefits of the informal economy which may prove limited if the informal economy is not integrated into the economy. The role of the informal economy in sustainability is not only limited to promoting economic growth and reducing poverty (Williams and Nadin, 2010), but also brings many social benefits within communities. Benjamin et al. (2014) in Sub-Saharan Africa and La Porta et al. (2014) highlighted that the informal economy promotes community cohesion and sustains social networks essential for survival in volatile economic environments. Informal safety nets are essential in communities where formal social protection systems have not been reached, and these mutual support networks provide a valuable service. This aspect is in line with the studies of Chen (2012) and Benjamin et al. (2014), who pointed out that these jobs promote social inclusion by integrating marginalised groups into economic activities, thereby reducing social divergence.

On the other hand, the informal economy is related to lower remuneration, poor working conditions, lack of social security benefits (Farzanegan and Hassan, 2017), an inverse relationship with the formal economy, absorption of capital assets and labour from the formal economy sector, limiting state resources, creating imbalances in official statistics, and unfair competition with companies in the formal sector (Schneider and Enste, 2002; Gerxhani, 2004; La Porta and Schleifer, 2014). Therefore, these results decrease the chances of reducing inequalities (SDG 10), demonstrating the ambivalent role of the informal economy.

Sustainability from an environmental perspective is another area where the informal economy plays an important role. Waste picking issues downstream of informal activities in developing countries contribute significantly to waste management and recycling efforts (Brown et al., 2017; Thulare et al., 2021). In particular, this sector helps reduce environmental pollution and promotes the circular economy, extending the life cycle of products, aligning with SDG 12, which is related to responsible consumption and production. Furthermore, informal urban transport systems provide affordable and flexible transportation options in cities with insufficient public transport infrastructure, ultimately supporting sustainable urban mobility and aligning with SDG 11 (Mitullah, 2003). Ruzek (2014) in his study supports the perspective that the informal economy can complement formal economic activities and contribute to a more balanced and sustainable economic model. Bhattacharya and Londhe (2014) suggested how informal companies adopted innovative practices to cope with resource constraints, promoting sustainable business models. Horodnik et al. (2022) explore the reasons why consumers purchase informal goods and services, highlighting that a significant proportion of consumers choose to buy informal goods and services explicitly for environmental protection and location.

However, from an environmental point of view, the informal economy leads to increased pollution (Biswass et al., 2003) and to the growth of the export market (Bacchetta, 2012); therefore, it must be addressed and controlled. Furthermore, regulation in the informal economy leads to environmental degradation and presents challenges to environmental sustainability, as stated in SDG 12 (Brown et al., 2017; Thulare et al., 2021; Alvarado et al., 2022). Furthermore, Alvarado et al. (2022) points out in their study that the negative impact of the informal economy on the ecological footprint accumulates over time, endangering the sustainability of the environment.

Although in studies in the literature, the informal economy contributes to significant economic and social imbalances, negatively affecting the functioning of the formal sector, market competitiveness, and the efficiency of economic governance (Gerxhani, 2004; Maloney, 2004; Williams, 2008; La Porta and Shleifer, 2014), Gerxhani (2004) consider that ineffective fiscal policies also explain these effects, while La Porta and Schleifer (2014) base their arguments on governance and regulatory factors. At the same time, if the study by Sultana et al. (2022) supports the idea of promoting the informal economy through inclusive policies, other studies in the specialised literature point to the role of governance policies in limiting the magnitude of this phenomenon. These differences make an analysis of fiscal policies and governance increasingly necessary in explaining the effects of the informal economy on sustainable development.

The relationship between the underground economy and sustainable development has pros and cons. Since the participants do not benefit from resources, their results are unpredictable, and it is very difficult to determine the economic sustainability in the informal sector (Briassoulis, 1992), and controlling and regulating such activities is necessary. On the other hand, there are studies in which the informal sector can ensure the necessary transition in economic paradigms, resulting in new jobs, which therefore represents a step towards a long-term future (Ruzek, 2014; Smit and Musango, 2015). It is important to mention that there are significant differences among the authors who have analysed the impact of the informal economy on sustainable development, noting that the different studies offer complementary but different perspectives on how the informal economy can support sustainable development.

Starting from the existing theories in the specialised literature according to which the informal economy has a dual effect on sustainable development, depending on the degree of regulation and integration (Gurtoo and Williams, 2009; Williams and Nadin, 2010; Sultana et al., 2022) have the following two hypotheses were tested. **Hypothesis 1 (H1):** The informal economy contributes positively to the reduction of poverty and economic growth (SDGs 1 and 8), but negatively affects climate action and the reduction of inequalities (SDGs 10 and 13) without adequate regulation. **Hypothesis 2 (H2):** Regulation and integration of the informal economy can improve the sustainability of European countries, while nonregulation maintains the negative effects on sustainable development. Thus, it becomes essential to recognise the duality of this economy from a double perspective: on the one hand, as a source of economic and social opportunities, and on the other hand, as a source of major challenges, highlighting even more the need to create a policy framework that integrates the contributions of this phenomenon present in any state of the world in a to a lesser or greater extent, in sustainable development strategies.

2. Research methodology

The article aims to estimate the annual scores for the Sustainable Development Goals (SDGs) incorporating the most important determinant of each SDG for both 2010 and 2022 (the first and last available period). The years 2010 and 2022 were selected for analysis to capture the significant changes in the progress of sustainable development over a representative period, spanning a decade that saw numerous European initiatives and policies towards the achievement of the Sustainable Development Goals. Each of the 80 indicators is the result of systematic adjustments based on publicly accessible data

provided by Eurostat. Sustainable development indicators are combined at the pillar level (SDGs) to obtain an aggregated score derived from the PLS regression (Höskuldsson, 1988). In this study, two scenarios are analysed: one that does not consider the magnitude of the informal economy (which will be called the base scenario) and the other that includes the informal economy (the alternative scenario).

The baseline scenario was constructed using 79 sustainable development indicators from Eurostat, and the alternative scenario included an 80th indicator, representing the size of the informal economy as a percentage of GDP (Schneider, 2022), to assess differences in the achievement of the SDGs in the presence of the informal economy. The size of the underground economy, taken from Schneider (2022), was estimated using the liquidity demand method, which analyses the preference for cash transactions as a proxy for undeclared economic activities, adjusted for country-specific economic and institutional factors.

The analysis covers two years, 2010 and 2022, and includes 36 European countries. The analysis also included non-EU European countries to provide a more comprehensive perspective on the informal economy and sustainable development in Europe, given the socioeconomic and regulatory diversity, which can significantly influence the variability and relevance of the results obtained. The data is divided into 17 SDG pillars, according to the standardised methodology offered by the United Nations. An indicator selection process was implemented to ensure the comparability of the Sustainable Development Index (SDI), similar to other works (Schmidt-Traub et al., 2017). Differences in geographic coverage were considered, indicating the availability of indicators for all countries in the study during the specified period (in this context, 2010 and 2022). In this way, indicators with substantial geographical differences (data missing for several countries) are considered less reliable. Bosnia and Herzegovina was excluded from the analysis due to insufficient data.

The methodology contains four main steps. The first step is data normalisation. The SDG indicators are transformed into z-scores for each country and both years, i.e. $SDI_{i,j,t}^z$ where $t=2010$ or 2022 . This makes it easier to compare the initial data regarding risk assessment and standardises all variables. The second step is to smooth the data to isolate more evident patterns or trends, giving more importance/weight to certain trends while minimising noise:

$$SDI_{i,j,t}^{smoothed} = \alpha \cdot SDI_{i,j,t}^z + (1 - \alpha) \cdot SDI_{i,j,t-1}^z \quad (1)$$

The third step is represented by two PLS models that estimate the weights of each i -th indicator (i.e. $SDI_{i,j,t}^z$) for each j -th latent construct (i.e. $S_SDI_{i,j,t}^z$). We define these estimated coefficients “intra-pillar weights”. PLS regression is particularly suited for this study because it is capable of handling multicollinearity while focussing on the prediction of the dependent variables. The PLS method assumes a linear regression model by projecting the predicted variables and the observable variables into a new vectorial space. Mathematically, the PLS regression can be represented as

$$SDI_{i,j,t} = W_j T_j + E_j \quad (2)$$

where W_j is the weight matrix for the j -th SDG, T_j is the score vector, and E_j is the error term. This equation defines the relationship between the observed variables (indicators) and their respective latent variables (SDG pillars).

$$T_j = P_j U_j + F_j \quad (3)$$

where P_i is the loadings matrix, U_i is the latent scores, and F_i is the residual term. The latest equation represents the relationship between the latent variables. Finally, the predictor matrix is deflated to remove the explained variance, iteratively refining the model.

In the fourth step, the latent scores for each j -th SDG ($S_SDI_{i,j,t}^z$) are calculated by multiplying adjusted intra-pillar weights ($w_{SDGi,j,t}^{adj}$) to the standardised indicators ($SDI_{i,j,t}^z$), according to the following formula:

$$S_SDI_{j,t}^z = w_{SDGi,j,t}^{adj} \cdot SDI_{i,j,t}^z \quad (4)$$

where the weights adjustment consists of fixing the sum of weights in each pillar to the unit, i.e. $w_{SDGi,j,t}^{adj} = w_SDI_{i,j,t}^z / \sum_{i=1}^{n_j} w_SDI_{i,j,t}^z$ with n_j that indicates the highest indicator associated to the j -th latent construct (SDG). The results derived from this approach are used to construct the synthetic for 2010 and 2022.

In order to validate the results, the PLS methodology allows the calculation of the variance explained by the dependent variable in the model, which is preferably as close as possible to 100%, but also Q^2 , a measure specific to the PLS regression that helps to evaluate the model's ability to generalise when encounters new input data by cross-validating the data. Thus, a value of Q^2 above 0.5 indicates a good prediction model. Finally, two sets of indicators were obtained for the baseline and the alternative scenario. The first scenario involves all variables specific to each SDG, while the second includes an additional variable, namely the size of the underground economy estimated by Schneider (2022).

3. Results and discussion

The Appendix no. 1 highlights the main factors, and their weights needed to achieve a target value of the various SDGs in the baseline scenarios for 2010 and the projections for 2022. The specific determinant of SDG1, "People at risk of poverty or social exclusion", has an importance of 6.84 in 2010 (rank 11) and decreases to 3.80 in 2022 (rank 14). Regarding SDG2, "Government support for agricultural research and development" was valued at 4.56 in 2010 (rank 16). In 2022, the determinant became "Agricultural real factor income", with an increased importance of 11.30 (rank 5). Under SDG3, "Standardised preventable and treatable mortality" has an importance score of 47.20 in 2010 (rank 2) and increases to 54.17 in 2022 (rank 1).

Regarding SDG4, "Participation in early childhood education" has an importance of 13.01 in 2010 (rank 8) and 10.24 in 2022 (rank 7). "Seats held by women in national parliaments" (SDG5) is important at 5.75 in the baseline scenario (rank 14) and 4.89 in the alternative scenario (rank 13). In the SDG6-specific baseline scenario, "Population connected to at least secondary wastewater treatment" has an importance of 20.9 (rank 3) and decreases in the alternative scenario to 8.70 in 2022 (rank 10). "Population unable to keep home adequately warm" (SDG7) has an importance of 11.15 in 2010 (rank 9), and in 2022 it becomes "Primary energy consumption" with an importance of 5.00 (rank 12). Considering the SDG8 baseline scenario, the "Unemployment rate" has an importance of 5.88 (rank 13), and in 2022, the determinant becomes "Young people neither in employment nor in education and training" with an importance of 3.33 (rank 15). "High-speed Internet coverage" (SDG9) has an importance of 13.30 in 2010 (rank 7) and decreases to 8.72 in 2022 (rank 9). "People at risk of poverty or social exclusion by degree of urbanisation" has an importance of 7.76 in the SDG10 baseline scenario (rank 10) and decreases to "People at

risk of monetary poverty after social transfers” with an importance of 2.52 in the alternative scenario (rank 16). “Recycling rate of municipal waste” has an importance of 14.70 in 2010 (rank 6) and decreases to 6.28 in 2022 (rank 11) under SDG11. “Circular material use rate” has an importance of 6.29 over SDG12 in the baseline scenario (rank 12) and becomes The “average CO₂ emissions per km from new passenger cars” with an importance of 18.47 in the scenario alternative (rank 3). “Average CO₂ emissions per km from new passenger cars” has an importance of 17.10 in 2010 (rank 4) and becomes the “net greenhouse gas emissions” with an importance of 10.99 in 2022 (rank 6) specific SDG13. Considering SDG15, “Share of forest area” has an importance of 5.58 in 2010 (rank 15) and increases to 9.34 in 2022 (rank 8). “General government total expenditure on law courts” has a very high importance of 48.5 in the base scenario (rank 1) and decreases to 35.44 in the alternative (rank 2) according to SDG16. Finally, under SDG17, “General Government Gross Debt” has an importance of 16.5 in 2010 (rank 5) and decreases to 14.14 in 2022 (rank 4).

The Appendixes no 2 presents the alternative scenario with the underground economy as an explanatory variable in addition to the other sustainability perspectives. In this PLS model, “People at risk of poverty or social exclusion” is a significant variable with an importance score of 6.78 in the base scenario and 6.70 in the alternative scenario. By 2022, its importance scores drop sharply to 3.82 and 3.01, respectively. The underground economy has very little influence on this figure. The baseline scenario in 2010 focusses on “government support for agricultural research and development”, while the alternative scenario includes an „obesity rate” with an importance of 4.54. In 2022, both scenarios have changes in „real agricultural factor income” as a critical determinant, while the alternative scenario includes “obesity rate” with an importance of 4.54. In 2022, the critical determinant in both scenarios becomes “real agricultural factor income”, with an increase in importance in the alternative scenario from 4.54 in 2010 to 11.31 in 2022.

The most important determinant is “standardised preventable and treatable mortality” in different scenarios and years, with very high importance scores (47.2 in 2010 and 54.16 in 2022). The significance of “participation in early childhood education” in 2010 (12.9) changes and is taken over by “tertiary educational attainment” in 2022, with a significant value of (10.24) but still giving a similar importance to the other. “Seats held by women in national parliaments” is a constant determinant for each of the simulations, although it is slightly less important in the 2022 scenario run (4.86 vs. 4.89). “Population connected to at least secondary wastewater treatment” remains an important determinant in both scenarios, but its relative importance decreases from 20.91 in 2010 to 8.78 in 2022. In the 2010 scenario, a relatively large coefficient attributes to “the population that cannot keep their homes warm enough”. In 2022 it switched back to “primary energy consumption”, but with an importance of 5.01 in the alternative scenario. An underground economy can raise the importance of those who use informal ways of accessing energy – in the form of uncontrolled electrical connections – in overall energy sustainability. The underground economy, comprising the determinant in the alternative scenario, presents its major role: 7.12 in 2010 and 4.4 in 2022 in terms of employment rates and the level of economic activity.

“High-speed Internet coverage” remains a constant determinant of great importance for both scenarios. In 2010, it was 13.17, while it was at 8.72 in 2022. The determinant changes from “people at risk of poverty or social exclusion depending on the degree of

urbanisation” in 2010 to “young people who do not have a job, nor do education and training” in 2022. The significant determinant in both scenarios, which concerns the “municipal waste recycling rate”, reflects successive efforts in sustainable urban waste management. The informal economy, particularly through the recycling sectors, plays a vital role in waste management and resource recovery, which is reflected in its importance scores: 14.58 in 2010 and 6.22 in 2022. Shifting focus from the ‘circular rate of material use’ to “average CO₂ emissions per km of new cars” shows the crucial role that transport plays in sustainability. The increase and importance of the „share of forest area” indicates an increased effort for forest conservation. Due to the way in which the underground economy has significantly affected informal logging and land use, integrated conservation approaches that should consider both formal and informal sector activities are required. „Total general government expenditure on courts” is very important and underlines the importance of investment in justice. “General government gross debt” remains one of the key factors reflecting the critical role of financial stability. Therefore, the underground economy can affect government revenue and debt levels through unregulated economic activities, affecting overall fiscal health.

Figure no. 1 shows the Sustainable Development Index (SDI) for European countries in relation to the annual percentage difference of 2022 compared to 2010 in the baseline scenario.

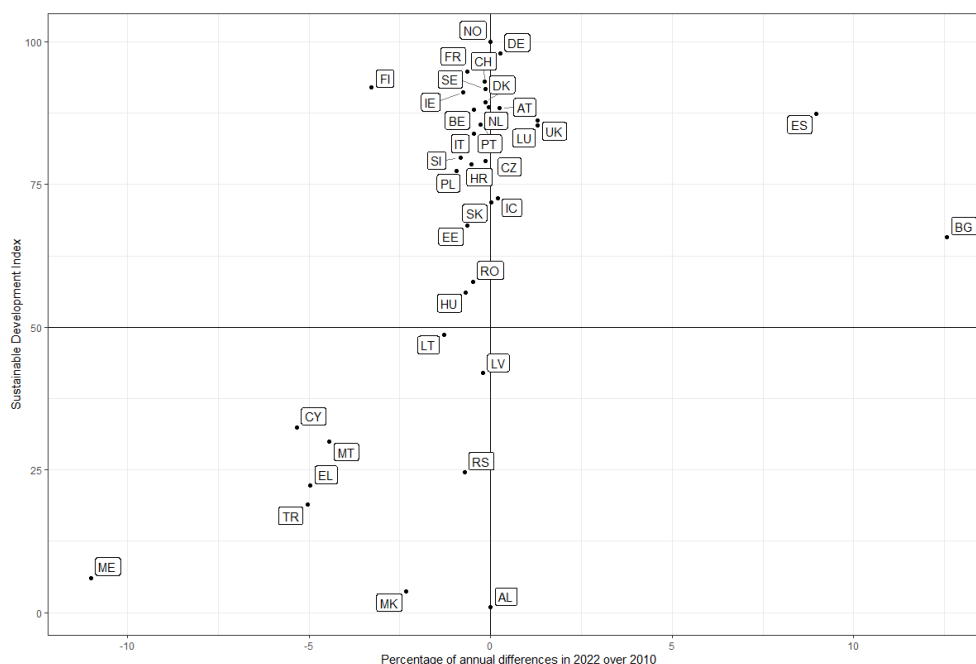


Figure no. 1. Baseline Sustainable Development Index vs. Annual Percentage Change
Source: Author's creation.

Countries in the upper right quadrant, such as Norway, Germany and Denmark, show high SDI values and a positive growth rate, indicating continued progress towards sustainable development. On the contrary, Finland and France, located in the upper left quadrant, although they have high initial SDI values, show negative growth rates, suggesting

difficulties in maintaining a steady pace of progress. Countries in the lower right quadrant, such as Bulgaria and Spain, initially had lower SDI scores but had impressive positive growth, indicating a significant improvement in sustainability practices. However, countries such as Montenegro and Northern Macedonia, in the lower left quadrant, have low SDI scores and negative growth rates, indicating significant obstacles to achieving sustainable development.

Figure 2 shows the Alternative Sustainable Development Index (SDIA) for European countries, comparing the annual percentage difference in 2022 compared to 2010 and considering the underground economy as a determinant. Countries such as Germany, Switzerland and the United Kingdom, located in the upper right quadrant of the graph, have high SDIA values and a positive percentage change, indicating a significant increase in sustainability practices even in the presence of an informal economy. In the top-left quadrant, countries such as Denmark and Finland show high SDIA scores but with slight negative growth, suggesting solid structures for sustainable development but challenges in the informal sector. On the contrary, Bulgaria and Romania, although they have lower initial SDIA scores, are in the lower right quadrant showing positive growth, reflecting important progress in integrating the informal economy into sustainable development strategies. On the other hand, countries such as Turkey and North Macedonia, located in the lower left quadrant, have low SDIA scores and negative growth rates, indicating major difficulties in achieving sustainable development goals, and underground economy activities could exacerbate these problems. Estonia also has an SDIA score well below the baseline, suggesting a considerable negative impact of the underground economy on its sustainable development.

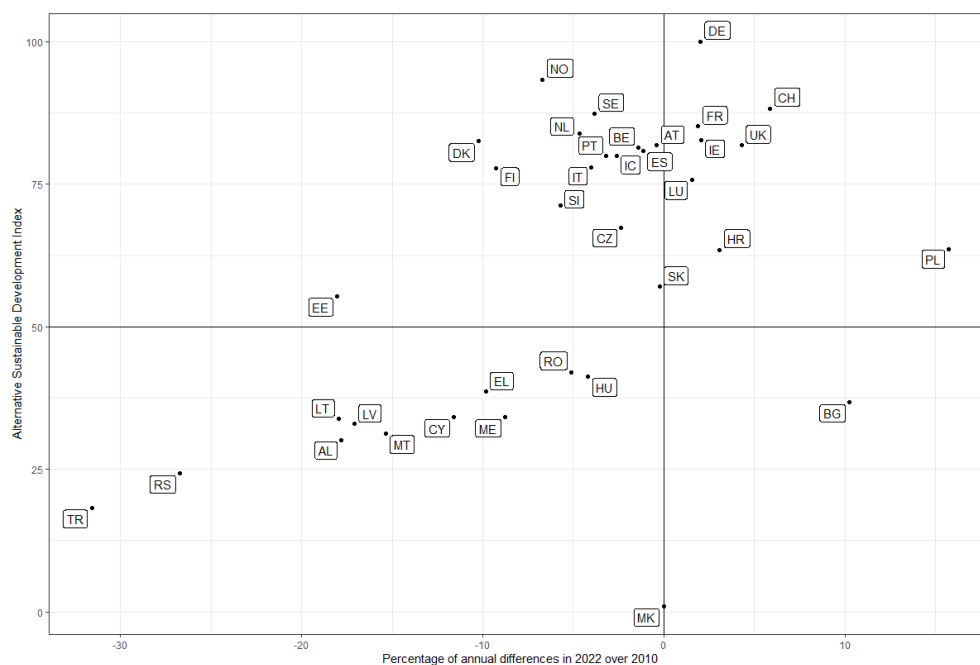


Figure no. 2. Alternative Sustainable Development vs. Annual Percentage Change

Source: Author's creation.

Table no. 3. shows the results of the accuracy metrics of the PLS models in the two scenarios. Thus, the model specific to the alternative scenario presents higher values from the perspective of explained variance (90.28%) and the Q2 metric (0.67). Therefore, it can be concluded that both models show satisfactory results and, by comparison, the model specific to the alternative scenario shows higher values.

Table no. 3. Validation of PLS regression models in the two scenarios

Model	Explained variance	Q ²
Baseline scenario	89.11%	0.64
Alternative scenario	90.28%	0.67

Source: Author's creation.

The main drivers of the SDGs in the baseline scenario show a significant shift in policy priorities, with a decrease in the importance of risk of poverty and social exclusion, while an increase in the importance of agricultural income and higher education. These changes emphasise the emphasis on food security and human capital development as essential factors for economic and social progress (Borza et al., 2017). Similarly, the high importance of preventable and treatable standardised mortality highlights the need for continuous improvement of health systems (Barna, 2020), while the increasing concern towards greenhouse gas emissions and the conservation of natural resources suggests a reorientation towards goals of environmental sustainability.

At the same time, the alternative scenario indicates a complex role for the informal economy in shaping the sustainable development trajectory of European countries. Although informal economic activities can generate short-term economic benefits, they fail to reduce long-term social exclusion, suggesting the need for more coherent policy measures to effectively integrate the underground economy into development strategies (Derlukiewicz, 2014). Furthermore, the diverse influences of the informal economy on different areas, from energy markets to informal agriculture, underscore the need for integrated approaches targeting both the formal and informal sectors to ensure comprehensive sustainable development. These results are consistent with the studies by La Porta and Shleifer (2014) which point to the importance of the integration and regulation of the informal economy, but also consistent with the study of Davidescu and Manta (2022), which emphasises the need for effective governance in addressing this phenomenon. At the same time, the analysis also pointed to an increase in the importance of ecological sustainability by increasing the importance of environmental determinants, results that subscribe to the studies of Thulare et al. (2021) and Brown et al. (2017), which highlight the role of the informal economy as both a challenge and an opportunity in the context of environmental sustainability.

The results of the sustainable development indices (SDI and SDIA) highlight significant disparities between European countries in terms of their sustainability performance and progress dynamics. Countries with high SDIA and positive growth, such as Germany, Switzerland, and the United Kingdom, demonstrate that proper integration of the informal economy does not compromise sustainable development, suggesting the need for innovative policies and appropriate regulations (Fura et al., 2017). In contrast, countries such as Estonia and North Macedonia, which show both low SDIA scores and negative growth rates, indicate that underground economy activities can significantly undermine formal development efforts. These results highlight the differences between governance approaches and emphasise the importance of a robust governance framework, in line with

the results of studies in the literature (Gerxhani, 2004; Davidescu and Manta, 2022). At the same time, the empirical results pointed out changes in the importance of the determinants for the SDGs, underlining the complexity of the interdependence between economic, social, and environmental factors, also supported by the studies of Martínez and Short (2022). Hypothesis 1 is validated by the mixed impact of the informal economy: on the one hand, it has a positive impact on poverty reduction and economic growth (SDGs 1 and 8) in the short term, and on the other hand, it has a negative impact on climate action and reducing inequalities (SDGs 10 and 13) without adequate regulations. Hypothesis 2 is validated by the results of the study, which show that regulating and integrating the informal economy into a formal framework can improve the sustainability performance of European countries. It should be noted that in the absence of adequate regulations, the negative impact on sustainable development is maintained, according to the studies of Gerxhani (2004) and Davidescu and Manta (2022). At the same time, it is relevant to mention that the regulation and integration of the informal economy in a formal framework could be the solution to maximise its benefits in sustainable development, regulating in a certain way the negative impact on the environment and social inequalities.

Conclusions

Analysis of SDI and integration of the shadow economy reveals important insinuations toward multifaceted sustainable development across European countries. The alternative scenario, which covers the informal economy, reveals light on the weight the informal economic activities carry in determining sustainability outcomes. Germany, Switzerland, and the United Kingdom are some of the high SDI countries that have shown sustainability practices significantly advanced if efforts of integrating informal economic activities are done correctly, therefore reflected in growth rates. This clearly points out the need to have an appropriate policy framework that is comprehensive and acknowledges and integrates the contributions of the informal sector to achieve sustainable development goals.

On the contrary, countries like Denmark and Finland have high SDI scores, but show a marginal decline in growth under the alternative scenario, which can be illustrative of the fact that these countries have strong sustainable development platforms, but challenges from the informal economy still stand as stumbling blocks to further growth; hence, creative policies are needed so that informal economic activities can be better integrated and regulated for sustained development gains.

In other words, although the initial scores for the SDI indexes in countries like Bulgaria and Romania were weaker than others, the growth is still positive and indicates that integrating activities in the informal economy into the strategy at the national level does work and, to a greater extent, contributes to overall sustainability as far as the formalisation of the respective sector activities is concerned. Yet, when countries like Turkey or North Macedonia are taken into consideration, with both weak SDI scores and negative growth, this points out the enormous barriers presented by the informal economy. Special interventions in these countries are needed to correct this informality and improve sustainability.

A limitation of the current study is the fact that it uses only publicly available data, and so does not capture the subtle informalities of the economies being analysed. Moreover, aggregating the informal economy into one aggregated variable may be oversimplified for

such a diversified and complex nature of informal activities in different countries and among various sectors. The study is also carried out in European countries, which makes the generalisability of the findings to other regions, more so with different socioeconomic contexts, very low.

Future research could take this one step further by providing a more disaggregated view of the informal activities and their impacts on the sector level. An analysis that included more countries from other regions, especially those characterised by significant portions of their economies as informal, would enable a more overarching perspective on the global implications of informality for sustainable development. Furthermore, with time, the study can determine the individual effect that each policy intervention has on the integration of informal economies into sustainable development frameworks and, as a result, provide guidelines regarding effective strategies to promote inclusive and equitable growth.

In conclusion, the study indicates that inclusive policies must be developed to mainstream the informal economy within formal frameworks to ensure economic resilience and social equity. Policymakers identifying the opportunities and challenges posed by the dualism of the informal economy will enable them to design strategies for the former while serving the larger 2030 Development Agenda and the attendant needs of the marginalised and vulnerable sectors of society.

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Appendix no. 1 - Main determinants of SDG in the baseline scenario

SDG	1 – No poverty	2 – No hunger	3 – Good health and well-being	4 – Quality education	5 – Gender equality
Determinant in baseline scenario for 2010	Persons at risk of poverty or social exclusion	Government support for agricultural research and development	Standardised preventable and treatable mortality	Participation in early childhood education	Seats held by women in national parliaments
Importance	6.84	4.56	47.20	13.01	5.75
Rank	11	16	2	8	14
Determinant in baseline scenario for 2022	Persons at risk of poverty or social exclusion	Agricultural real factor income	Standardised preventable and treatable mortality	Tertiary educational attainment	Seats held by women in national parliaments
Importance	3.80	11.30	54.17	10.24	4.89
Rank	14	5	1	7	13

Appendix no. 1 - continued

SDG	6 - Clean water and sanitation	7 - Affordable and clean energy	8 – Decent work and economic growth	9 - Industry, innovation, and infrastructure	10 - Reduced inequality
Determinant in baseline scenario for 2010	Population connected to at least secondary wastewater treatment	Population unable to keep home adequately warm	Unemployment rate	High-speed internet coverage	Persons at risk of poverty or social exclusion by degree of urbanisation
Importance	20.9	11.15	5.88	13.30	7.76
Rank	3	9	13	7	10
Determinant in baseline scenario for 2022	Population connected to at least secondary wastewater treatment	Primary energy consumption	Young people neither in employment nor in education and training	High-speed internet coverage	Persons at risk of monetary poverty after social transfers
Importance	8.70	5.00	3.33	8.72	2.52
Rank	10	12	15	9	16

Appendix no. 1 - continued

SDG	11 – Sustainable cities and communities	12 – Responsible consumption and production	13 – Climate action	15 – Life on land	16 - Peace, justice and strong institutions	17 - Partnership for the goals
Determinant in baseline scenario for 2010	Recycling rate of municipal waste	Circular material use rate	Average CO2 emissions per km from new passenger cars	Share of forest area	General government total expenditure on law courts	General government gross debt
Importance	14.70	6.29	17.10	5.58	48.5	16.5
Rank	6	12	4	15	1	5
Determinant in baseline scenario for 2022	Recycling rate of municipal waste	Average CO2 emissions per km from new passenger cars	Net greenhouse gas emissions	Share of forest area	General government total expenditure on law courts	General government gross debt
Importance	6.28	18.47	10.99	9.34	35.44	14.14
Rank	11	3	6	8	2	4

Source: Author's creation.

Appendix no. 2. -Main determinants of SDG in the alternative scenario

SDG	1 – No poverty	2 – No hunger	3 – Good health and well-being	4 – Quality education	5 – Gender equality
Determinant in alternative scenario for 2010	Persons at risk of poverty or social exclusion	Obesity rate	Standardised preventable and treatable mortality	Participation in early childhood education	Tertiary educational attainment
Importance	6.78	4.54	47.20	12.90	8.47
Rank	13	16	2	8	10
Determinant in alternative scenario for 2022	Persons at risk of poverty or social exclusion	Agricultural real factor income	Standardised preventable and treatable mortality	Tertiary educational attainment	Seats held by women in national parliaments
Importance	3.82	11.31	54.16	10.24	4.86
Rank	15	5	1	7	13

Appendix no. 2 - continued

SDG	6 - Clean water and sanitation	7 - Affordable and clean energy	8 – Decent work and economic growth	9 - Industry, innovation, and infrastructure	10 - Reduced inequality
Determinant in alternative scenario for 2010	Population connected to at least secondary wastewater treatment	Population unable to keep home adequately warm	Shadow economy	High-speed internet coverage	Persons at risk of poverty or social exclusion by degree of urbanisation
Importance	20.91	11.10	7.12	13.17	7.70
Rank	3	9	12	7	11
Determinant in alternative scenario for 2022	Population connected to at least secondary wastewater treatment	Primary energy consumption	Shadow economy	High-speed internet coverage	Young people neither in employment nor in education and training
Importance	8.78	5.01	4.40	8.70	3.34
Rank	9	12	14	10	16

Appendix no. 2 - continued

SDG	11 – Sustainable cities and communities	12 – Responsible consumption and production	13 – Climate action	15 – Life on land	16 - Peace, justice and strong institutions	17 - Partnership for the goals
Determinant in alternative scenario for 2010	Recycling rate of municipal waste	Circular material use rate	Average CO2 emissions per km from new passenger cars	Share of forest area	General government total expenditure on law courts	General government gross debt
Importance	14.58	6.69	17.16	5.62	48.19	16.39
Rank	6	14	4	15	1	5
Determinant in alternative scenario for 2022	Recycling rate of municipal waste	Average CO2 emissions per km from new passenger cars	Net greenhouse gas emissions	Share of forest area	General government total expenditure on law courts	General government gross debt
Importance	6.22	18.51	11.01	9.35	35.41	14.11
Rank	11	3	6	8	2	4

Source: Author's creation.