Estimating Bulgaria's 2023 Bright Economy Composite Index: Insights Into the Size of Hidden Economy

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Abstract

This study estimates Bulgaria's Bright Economy Composite Index (BECI) value, a crucial tool for assessing the country's transparency and formalization of economic activities. By analyzing both the statistical and sociological indicators that BECI comprises, the paper examines the trends in Bulgaria's bright economy and infers about the scope and size of the country's hidden economy. This research paper employs four methods of statistical estimation in order to predict BECI for 2023 based on past data and trends, as well as multiple scenarios that could have caused the composite index to deviate from its natural progression. By utilizing different variations and extracts from the complete dataset to ensure robustness and accuracy, this study forecasts that the estimated BECI 2023 value will be in the 78.19-80.50 range, implying the hidden economy accounts for about 20% of economic activity. The paper's findings suggest that while Bulgaria has made progress in brightening its economy, significant challenges remain, particularly in sectors prone to informal activities, highlighting the need for continued governmental efforts to reduce the hidden economy through targeted policies and increased transparency. The paper concludes by outlining potential avenues for future research, such as expanding the application of BECI to other sectors, exploring cross-country comparisons, and examining the impact of digital transformation on the hidden economy.

1. Introduction

Economies have conventionally been divided into the “bright” and the “hidden” economy. The bright economy comprises all activities that are officially declared and which, therefore, contribute to forming a part of the GDP. On the other hand, the hidden economy comprises undeclared activities ranging from home production and illegal businesses to legal activities concealed from authorities. A more significant share of GDP by the bright sector suggests that the economy is less dependent on illegal or government-concealed activities and, therefore, creates a more transparent and law-abiding economic setting that fosters trust and economic stabilization. In contrast, a higher value of the proportion of the hidden economy could indicate higher levels of tax evasion, informal labor, and unreported economic transactions. Monitoring the distribution of GDP between the bright and the hidden sectors is significant to countries as it affects policymaking and helps derive inferences about economic growth. More accurate data on the hidden economy can contribute to designing strategies for shifting activities from the hidden to the bright economic sectors, also known as “brightening” the economy. Improved transparency will likely result in more tax revenues and increase overall economic stability. In this light, national policymakers can design interventions to encourage formalization and ensure sustainable development. In this paper, I analyze the case of Bulgaria, which has been measuring the size of its bright economy since 2010 using an index-based measure.

The Bright Economy Composite Index (BECI), created by the Bulgarian Industrial Capital Association (BICA), evaluates the dynamics of Bulgaria’s formal economy’s spread. The index was crafted to monitor the bright economy’s patterns and trends, and its annual values help economists infer relative economic growth, expansions, or shrinkages in this sector of the economy. The foundations of BECI lay upon the perception that certain economic activities occur “below the surface” and are unreported by government agencies, and so allow official and informal (unreported or “hidden”) economies to coexist [1]. In its essence, the so-called hidden economy includes economic activity that is not reported in official statistics; the broadest definition of the hidden economy encompasses home production, illegal economic activities, and legal economic activity that is purposefully kept hidden from measurement, which has consistently been making assessing the actual size of this economy a challenging task [2].

While every modern economy has an “underground” or “hidden” sector, this phenomenon occurs to varying extents, and although challenging, evaluating the scope and dynamics of “informality” as an economic issue is crucial for developing sound economic policies. Throughout recent decades, numerous studies have placed Bulgaria among the EU countries with the most significant proportion of GDP sourced from the hidden sector. In 2022, according to *ResearchGate*, Bulgaria ranked highest in Europe, with an estimated 33.1% of the overall annual GDP sourced from activities within the said sector, almost double the European average of 17.3% [3].

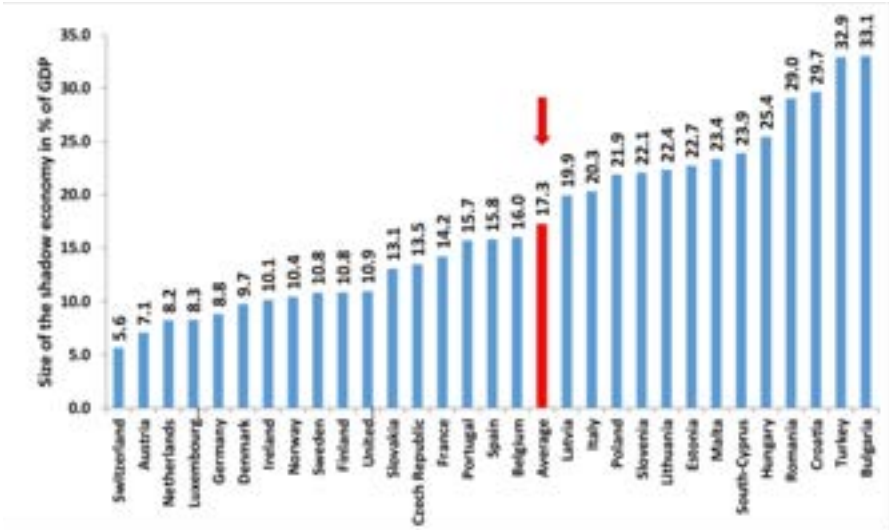


Fig. 1: Size of the hidden economy of 31 European countries in 2022 (in % of GDP) [3]

Over the years, the Bulgarian government has attempted to implement numerous policies that would incentivize people to “brighten” their business activities with the long-term aim of decreasing the relative size of the hidden economy. Since its creation, BECI has been essential in dealing with the high rate of Bulgaria’s shadow economy. BECI values range from 0-100%, making inferences about the hidden economy simple. Using BECI, in simple terms, informs the public about the potential size and consequences of the shadow economy and develops businesses through regulation, thereby rendering government involvement in policing more efficient. BECI has become a means through which formal pathways to policy work are opened, ensuring enhanced transparency through rigorous information gathering and policy intervention awareness.

In calculating the final annual BECI value, two categories of indicators are considered: statistical and sociological. The statistical category comprises seven indicators, the raw data sourced indirectly from official statistical databases such as the National Statistical Institute and the Bulgarian Ministry of Finance. The sociological category of indicators branches into two subcategories, one related to employers (eleven indicators) and the other - to employees (seven indicators).

In this research paper, I employ four methods of statistical estimation in order to predict BECI for 2023 based on past data and trends, as well as consider multiple scenarios that could have caused the composite index to deviate from its natural progression. By utilizing different variations and extracts from the complete dataset to ensure robustness and accuracy, this study forecasts that the estimated BECI 2023 value will be in the 78.19-80.50 range, implying the hidden economy accounts for about 20% of economic activity.

2. Background

Established in 2010, the National Center for Bright Economy aims to decrease and avert all forms and implications of the informal economy, including undeclared employment, by implementing methodical measures for sustainable national development. Since 2014, The National Center for Bright Economy has been calculating annual BECI values using "the innovative EU-level tool to measure the bright side of the economy and the trends and challenges to mitigate and prevent the informal economy" [4].

The data attributed to the sociological category of BECI is sourced directly, primarily through surveying the two social groups that form the subcategories: employers and employees. According to a spokesperson from the Bulgarian Industrial Capital Association, a constant panel of the same respondents is used to source data annually. These panel respondents include representatives of at least 600 enterprises of all sizes and a minimum of 1280 employed individuals. All cumulative values are measured in percent [%]. Some of the indicators include measures that aim at estimating the extent to which businesses and individuals in Bulgaria adhere to formal labor contracts, receive full remuneration, and comply with tax regulations. Additionally, the indicators assess the frequency and accuracy of financial transactions, such as payments and VAT declarations, and the presence of formal systems, like quality control and proper receipt issuance for goods and services. These measures collectively offer a comprehensive overview of economic transparency, compliance, and the formalization of economic activities in the country.[1]

After the creation of BECI in 2014, using data sourced by the National Statistical Institute and the Ministry of Finance, scientists from BICA performed the calculations for every year from 2010 to 2014. The creation of the composite index took a rigorous three-year discussion, and the components were possibly incorporated by referencing other countries that have been measuring the size of the hidden economy and the tax-evading policies they have issued.[2] In assessing the size and dynamics of this sector, researchers have outlined each component with the intention of minimizing the GDP leakage margins that are not included in the calculations. For example, if not all cash payments are reported by an enterprise, there could potentially be a leakage in the GDP measure. Similar is the scenario where, if one does not report all the labor contracted, expenditure remains underreported, and so does the employee's income, which will eventually remain outside the GDP measurement. The "Declared VAT" indicator, likewise, is taken into consideration because it assesses the declared invoices by the economy. Anecdotally, we know that some businesses may be generating fictitious invoices that never get reported in their sales, and therefore, the company never pays VAT to the government. A 100% value of declared VAT would mean that every economic sale is invoiced. However, surveys conducted in 2001 show that "almost 17% of corporate tax is evaded by purchasing fictitious invoices" [6]. In their annual reports on BECI and its implications, BICA outlines that each indicator's measure is directly related to the GDP and could lead to a gap in the overall GDP measure if not considered, analyzing each indicator separately in a similar manner.

In Bulgaria, BECI has aided in economic expansion and improved transparency. In simple terms, BECI assesses the condition of the national economy in conjunction with sector-specific transparency, making it easier to identify trends and shape policies that would

[1] Complete list of indicators available in section 3.1
[2] Due to the limited information available on the historical factors behind BECI, this section primarily uses authorial assumptions based on articles officially published by BICA.

boost economic stability. The energy industry is one of the leading industries using BECI for purposes such as keeping tabs on investments and changes in laws to ensure the sustainability and overall competitiveness of the sector. As such, BECI acts as a tool for developing manufacturing and industry based on the trend of investment and productivity. The ICT sector also gains from BECI by looking at ICT applications and innovative skills development, both of which are core to establishing the digital economy in Bulgaria. In the financial services industry, BECI analyzes the regulatory framework and increases stability in customer trust through the transparency of the instruments. The tourism industry uses the index to evaluate how the offered services perform and ensure that business activities are eco-friendly. This branch is also considered among the ones with the highest proportion of undeclared labor, along with the construction branch. Holistically, BECI stimulates sales, increases sectoral efficiency, promotes transparency and sustainability, and helps policy-making through reliable research and investment ideas.

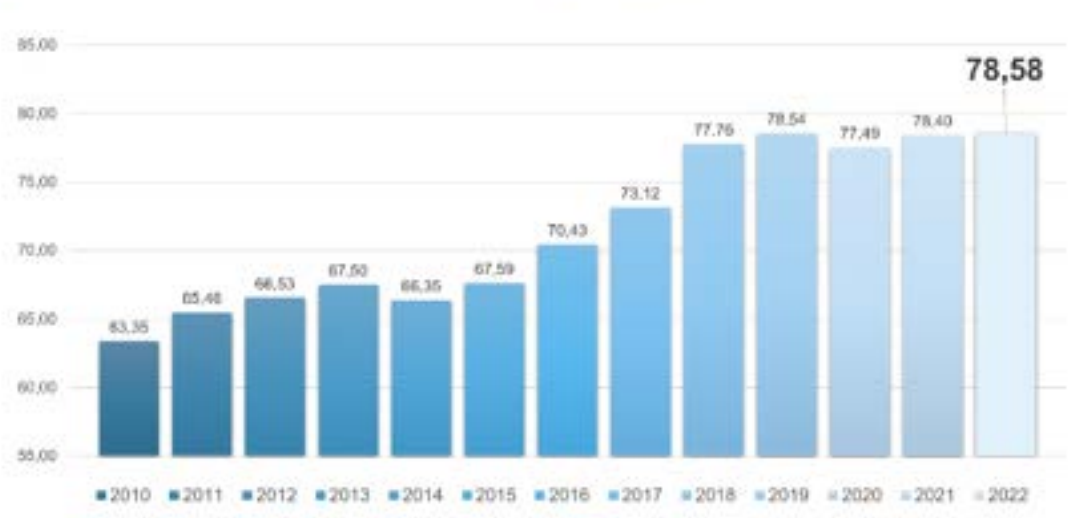
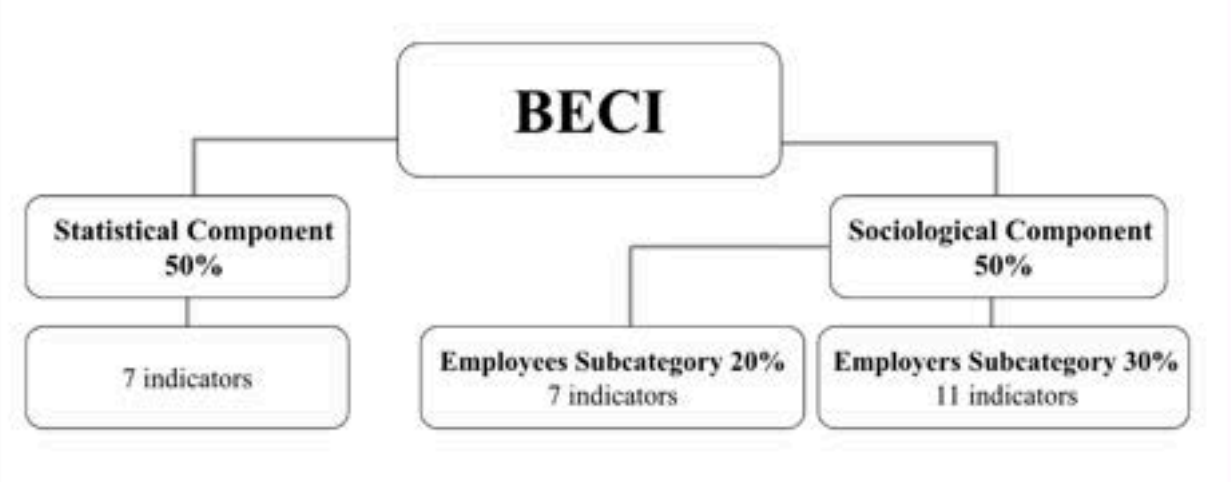


Fig. 2: BECI Dynamics [5]

The bar chart in Fig. 2 exhibits the growth of the BECI values since 2010. Since 2015, there has been a steady annual increase of about 3% up until 2018, when there was a larger increase of 4.6% in the BECI value compared to 2017. Since 2018, BECI values have been progressing relatively proportionally once again with a 0.1% margin, except for 2020, where the economic situation took a turn due to COVID-19 in Bulgaria and throughout the world.

The latest officially published value of BECI is 78.58, measured in 2022. As the hidden economy is identified as the complement of the BECI value each year, it could be concluded that it accounts for (100-78.58)% = 21.42% of Bulgaria's GDP for 2022 [5]. Although Bulgaria has been demonstrating adequate progress in brightening the economy and decreasing the proportion of GDP coming from "underground" activities, Bulgaria has to continue investing efforts and implementing tailor-made policies to be evaluated as closely to the 17.3% European average as possible.

3. Methodology & Data



Flowchart 1: BECI Indicator Breakdown by Components

3.1 Indicator Meaning, Measurement, and Weight

The table below explains each indicator that is utilized in the calculation of the index. The statistical indicators primarily look into the overall nature of transactions in the economy. For example, we can see the proportion of declared VAT (Value Added Tax) has a 13.5% weight in the index. One could imagine that this measure indicates how close the reported VAT is to the actual expected VAT in the economy; a higher proportion would thus represent that the economy is "brighter." In other words, it would mean that the extent of hidden transactions or unreported transactions on which VAT would be evaded is lower.

Description of each indicator, specifying that the units are proportions, in the 0-100 range, and explanation of the proportion they measure:

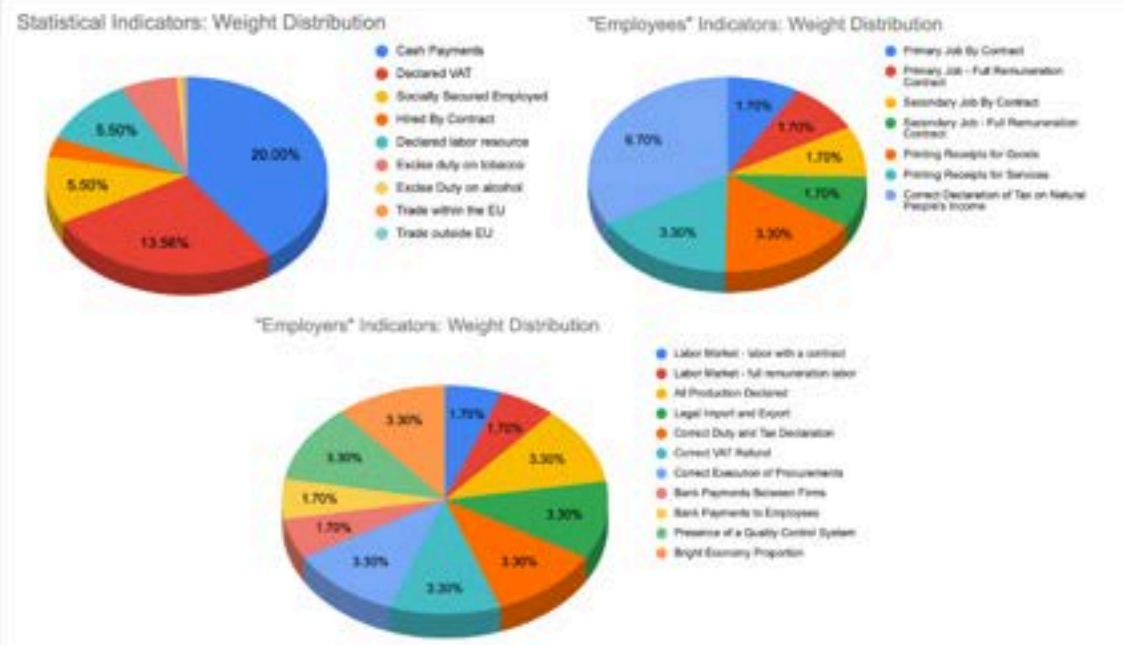
Statistical Components	Weight	Description
Cash Payments	20.00%	The proportion of total transactions made in cash out of all transactions.
Declared VAT	13.56%	The proportion of the total Value Added Tax (VAT) declared by businesses out of the expected VAT.
Socially Secured Employed	5.50%	The proportion of employees with social security coverage out of the total workforce.
Informally Employed	N/A[3]	The proportion of workers engaged in economic activities without official contracts, social security registration, or legal recognition.
Hired By Contract	1.58%	The proportion of employees hired under formal contracts out of the total workforce.
Declared labor resource	5.50%	The proportion of the total labor force declared by businesses out of the total potential labor force.
Excise duty		
Excise duty on tobacco	3.28%	The proportion of excise tax revenue from tobacco products out of the total expected excise tax revenue from tobacco.
Excise Duty on alcohol	0.28%	The proportion of excise tax revenue from alcoholic beverages out of the total expected excise tax revenue from alcohol.
International Trade		
Trade within the EU	0.20%	The proportion of trade transactions within European Union countries out of the total possible trade transactions within the EU.
Trade outside EU	0.10%	The proportion of trade transactions outside European Union countries out of the total possible trade transactions outside the EU.
Subtotal:	**50%**	
Sociological Components	**Weight**	
Employers	30.00%	
Labor Market - labor with a contract	1.70%	The proportion of the labor force with formal employment contracts out of the total labor force.
Labor Market - full remuneration labor	1.70%	The proportion of the labor force receiving full remuneration out of the total labor force.
All Production Declared	3.30%	The proportion of the total production output declared by businesses out of the total expected production output.
Legal Import and Export	3.30%	The proportion of import and export activities that are legally compliant out of the total import and export activities.

[3] This indicator is no longer recognized as of 2018.

Correct Duty and Tax Declaration	3.30%	The proportion of businesses accurately declaring duties and taxes out of the total number of businesses.
Correct VAT Refund	3.30%	The proportion of VAT refunds processed accurately and timely out of the total VAT refunds.
Correct Execution of Procurements	3.30%	The proportion of procurement processes executed correctly out of the total procurement processes.
Bank Payments Between Firms	1.70%	The proportion of bank transactions between firms out of the total expected bank transactions between firms.
Bank Payments to Employees	1.70%	The proportion of bank transactions to employees out of the total expected bank transactions to employees.
Presence of a Quality Control System	3.30%	The proportion of businesses or entities with a quality control system in place out of the total number of businesses or entities.
Bright Economy Proportion	3.30%	
Subtotal:	**30%**	
Employees	20.00%	
Primary Job By Contract	1.70%	The proportion of the labor force with a primary job secured by a formal employment contract out of the total labor force.
Primary Job - Full Remuneration Contract	1.70%	The proportion of the labor force with a primary job that receives full remuneration under a formal contract out of the total labor force.
Secondary Job By Contract	1.70%	The proportion of the labor force with a secondary job secured by a formal employment contract out of the total labor force.
Secondary Job - Full Remuneration Contract	1.70%	The proportion of the labor force with a secondary job that receives full remuneration under a formal contract out of the total labor force.
Printing Receipts for Goods	3.30%	The proportion of transactions for goods where receipts are printed out of the total transactions for goods.
Printing Receipts for Services	3.30%	The proportion of transactions for services where receipts are printed out of the total transactions for services.
Correct Declaration of Tax on Natural People's Income	6.70%	The proportion of individuals correctly declaring their income taxes out of the total number of individuals required to do so.
Subtotal:	**20%**	
TOTAL:	**100%**	

Table 1: Indicator Weights[4] & Descriptions [10]

[4] Weights are sourced from the latest, 2022 BICA report on BECI. Explanations of indicators are based on the author's understanding.



Charts 1, 2, 3 (from left to right): Indicator Weight Distribution By Category[5]

3.2 Assumptions

As the 2023 data will be available in late 2024 in the newest BECI report of BICA, this research paper, therefore, assumes that:

1. The indicators will remain the same and will not undergo any expansion or shrinkage (7 statistical and 11+7 sociological indicators).
2. The weighting distribution between indicators will remain the same, as evident in the 2018-2022 data sample (Shown in Table 1 and Charts 1-3 above).

Data analysis in the following section will utilize statistical theory, including calculating average growth rates, moving averages, and working with regression models and trendlines. To ensure a higher estimation accuracy for the 2023 BECI value, this paper will showcase different scenarios that will collectively contribute to creating an accurate data range. In the different scenarios presented in the following sections, we will expand our dataset back to 2015 and analyze the hypothetical situation where the global economic disturbances of 2020 due to the COVID outbreak are omitted. Having a range and using different fragments of the 2015-2022 dataset will allow us to construct multiple hypotheses about the estimated 2023 BECI value, considering the current and most recent global socioeconomic events.

[5] Percentages show contribution to the final weight of 100% that is broken down into both the statistical and sociological component.

3.3 Observations

In our study, it is important to acknowledge the reasons behind the annual change in BECI values. Several regulatory adjustments and steps were taken in 2015 and 2016 to improve control and streamline the operations of the National Revenue Agency (NRA) and the Customs Agency and to electronize their services. These actions increased the amount of public debt that was collected. Joint inspections conducted in 2018 by the NRA, the GIT, and the police served as the impetus for initiatives to curb unethical labor practices and expose financial infractions. However, labor relations were still improving among those with the lowest wages [7]. The Bulgarian economy faced two mutually opposing forces in 2020, 2021, and 2022 that had entirely different effects on the incentives and behaviors of economic agents. One aspect of the situation was the inclination to utilize fraudulent techniques to endure. 2020 saw a 4% decline in real GDP and a loss of jobs, with 2,212 thousand fewer persons employed in 2020 than there were in 2019. Many businesses faced severe financial difficulties due to the severe crisis, which caused certain economic activities to cease operations temporarily or permanently and resulted in staff layoffs. Labor market difficulties persisted in 2021 and 2022. Many detrimental factors have displaced the pandemic crisis's implications, which are especially pertinent in 2020. These factors include populism, the administrative minimum wage setting process, the ongoing uncertainty surrounding pension relationships, the ongoing disproportionate increase in the minimum wage in line with labor productivity and the average wage, etc. [8].

Since 2018, the "Informally Employed" indicator has no longer been considered when performing calculations belonging to the statistical component of BECI. Instead, in its place, BICA introduced two new indicators ("Hired By Contract" and "Declared Labor Resource") with the aim of more precisely measuring the true economic impact of activities associated with labor and employment and avoiding a leakage in annual GDP measurements. The "Socially Secured Employed" indicator was also put into practice with a similar purpose.

Consolidated tables with 2015-2022 values and weighted values are available for reference in the paper's appendix.[6]

[6] Indicator values have been growing relatively proportionally and the weight distribution has remained constant, so calculations in the next section will involve either values or weighted values as necessary, because the final BECI value calculations will remain unaffected either way.

4. Data Analysis & 2023 Prediction

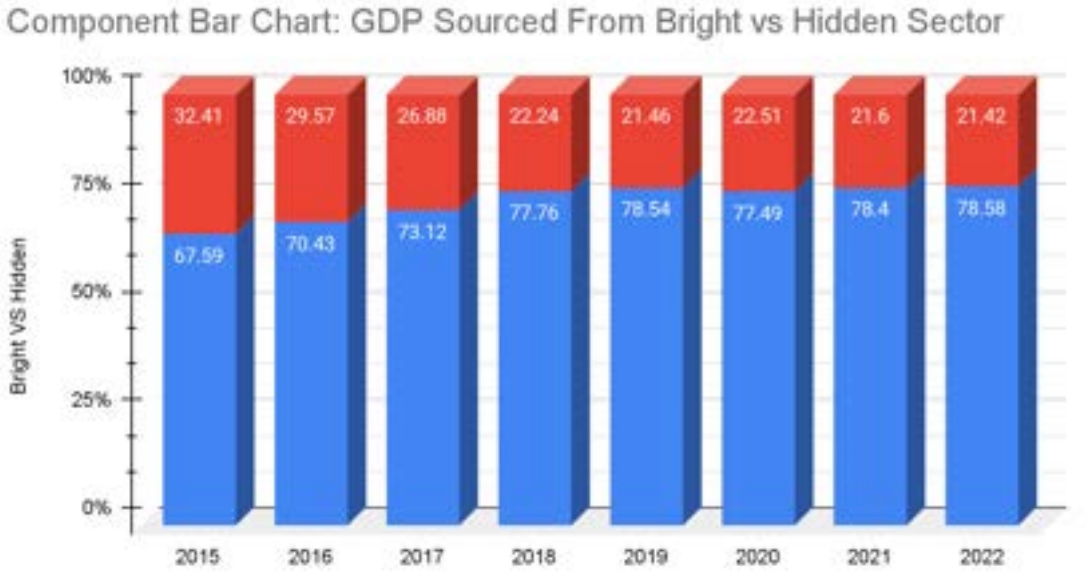


Fig. 3: GDP Sourced from Bright (blue) vs Hidden (red) sector

In the figure above, I have plotted the index over the last seven years, which shows the complementarity between the bright and hidden sectors. It can be seen that the bright economic contribution has been increasing over the years as the blue section of the graph has progressively risen. The red section of each bar, on the other hand, has been conversely experiencing reduction. Holistically, Fig. 3 showcases the process of “brightening” of the Bulgarian economy.

4.1 Introduction to Estimation Methods

In order to estimate the value of the Bright Economy Composite Index (BECI) in Bulgaria for 2023, this paper employs four distinct methods of estimation. Each method provides a unique approach to projecting the BECI value, offering a comprehensive range of possible outcomes. The goal is to create plausible upper and lower boundaries, representing ambitious and conservative calculations, respectively.

Each of these methods will be applied to the BECI data from 2015 to 2022. The analysis will include scenarios that account for global economic disturbances, such as the COVID-19 pandemic, by omitting data from 2020. This approach ensures a robust estimation process, allowing for multiple hypotheses about the 2023 BECI value.

By leveraging these diverse estimation methods, the paper aims to present a comprehensive and accurate forecast of Bulgaria’s 2023 BECI value. This multifaceted approach provides a detailed understanding of the potential future trajectory of Bulgaria’s bright economy, aiding policymakers and stakeholders in making informed decisions.

The methods outlined provide a solid framework for estimating the 2023 BECI value, considering various historical trends and economic factors. By applying these techniques, this

paper aims to offer a reliable forecast that captures the complexities of Bulgaria's bright economy.

4.2 Calculations

Method 1: Average Annual Growth Rate (AAGR)

The first method involves calculating the average annual growth of the BECI from historical data in the 2015-2022 time frame. By analyzing the trend of indicator values[7] over previous years, this method projects the 2023 value based on the average increase observed annually in the value. This approach assumes that past growth patterns will continue into the future, providing a straightforward yet effective means of estimation. The following formula is applied: $Average\ Annual\ Growth\ Rate\ = \frac{latest\ value\ in\ dataset - first\ value\ in\ dataset}{number\ of\ years\ apart}$.

After an estimated value of annual growth is calculated for each indicator, it is added to the latest value in the dataset, resulting in an estimated 2023 indicator value. $2023\ Estimated\ Value\ = \frac{latest\ value\ in\ dataset - first\ value\ in\ dataset}{number\ of\ years\ apart} + latest\ value\ in\ dataset.$

Then, each projected indicator value is multiplied by its weight, resulting in a weighted value. All weighted values are then added and the total value represents the 2023 BECI estimate of 80.19[8]

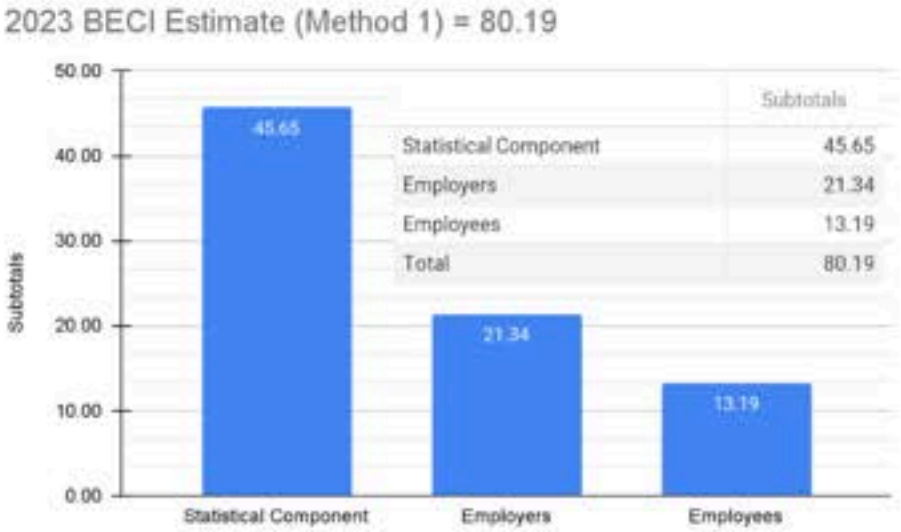


Fig. 4: 2023 BECI Estimate, Average Annual Growth, Whole Dataset

[7] Working with the values instead of weighted values will not result in major changes to the final estimation because each indicator estimated value is then multiplied by the proportion that it contributes to the final weight.
[8] For a detailed justification and explanation of calculations, please contact authors.

Method 2: Year-to-Year Average Growth Rate (YoY AGR)

The second method focuses on the year-to-year growth rates, and then results in an average annual growth rate from the beginning to the end of the dataset. Instead of a simple average over the entire period, this method examines the growth rate between each consecutive year.

$Average\ Growth\ Rate = \frac{Ending\ value}{Beginning\ value} - 1$. By taking the average of these year-to-year changes, the method accounts for potential volatility and provides a nuanced projection that considers short-term fluctuations. After an AGR is calculated, the following formula is applied: $2023\ Estimated\ Indicator\ Value = (2022\ value) \times (1 + AGR)$. Each indicator value is then multiplied by its weight, which presumably remains constant, rendering a 2023 estimated weighted average. Similarly to other methods, the 2023 estimated weighted average for each indicator is combined, resulting in a cumulative 2023 BECI estimate. Using the whole dataset, the 2023 BECI estimate stands at 80.50, while in the scenario where only the most recent three years are taken into consideration, the 2023 BECI estimate stands at 79.41[9].

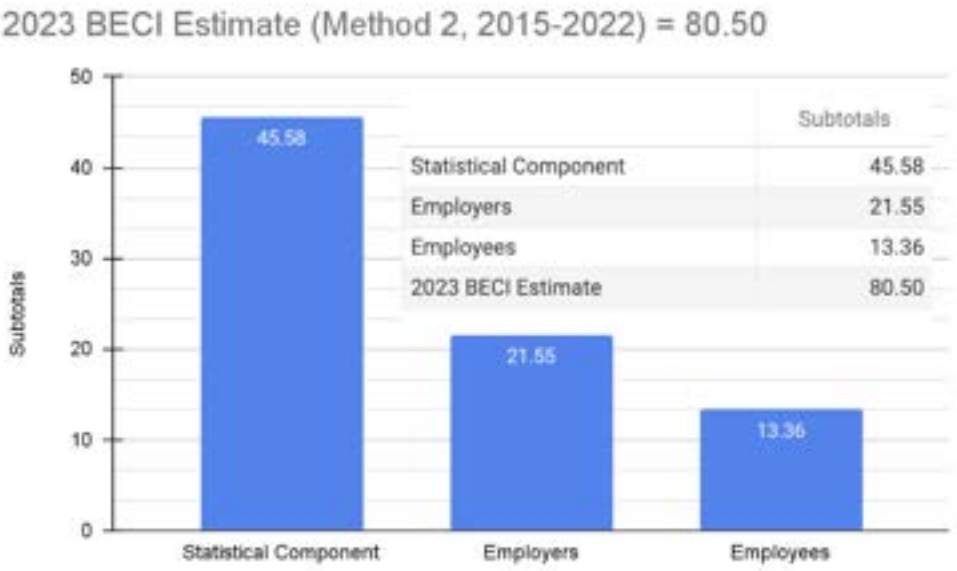


Fig. 5: 2023 BECI Estimate, Year-to-Year Average Growth Rate, Whole Dataset

[9] For a detailed justification and explanation of calculations, please contact authors.

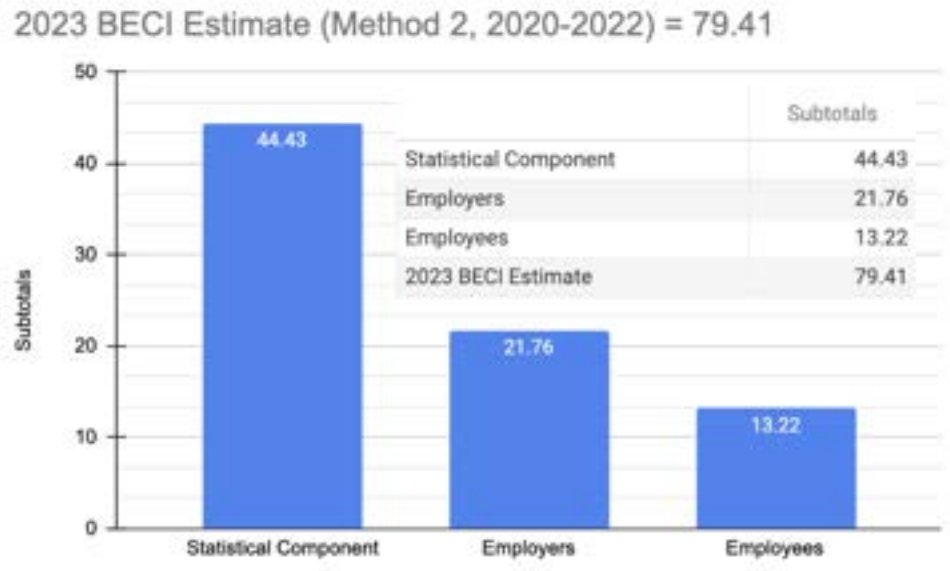


Fig. 6: 2023 BECI Estimate, Year-to-Year Average Growth Rate, 2020-2022 Data

Because using the whole dataset in this method renders a potentially overambitious BECI estimate of 80.50 as it incorporates a high growth rate from earlier years which inflates the average growth rate, our preferred estimate using this method is 79.41, which is the result of only considering the latest three years (2020-2022) in the dataset. In view of the mostly steady and consistent growth from the last five years (2018-2022), the second estimate showcased above appears to be more plausible. Nevertheless, the first estimate using this method, including data from the complete 2015-2022 time frame, will not remain disregarded in outlining the 2023 BECI range.

Method 3: Simple Moving Averages (SMA)

The third method employs moving averages to smooth out short-term variations and highlight longer-term trends. This technique calculates the average of the BECI values over a specified number of years, continuously updating as new data points are added. In this scenario, for calculating each average titled A_n, where "n" represents the number of averages considered in the final moving average calculation, an average of three years is computed. By using moving averages, the method mitigates the impact of anomalous years and emphasizes the underlying trend in BECI values. Using this method absorbs extreme shocks that might have happened in the past, which in turn allows for variation and reduces extremities, while also involving simple regressions and nonlinear estimations. Because one indicator has no longer been in use after 2018, and two new ones have been introduced in its place, calculations using this method will only take into account values after 2018, where indicators remain unchanged. Averages are titled as follows:

$$A_1 = \frac{2018\ value + 2019\ value + 2020\ value}{3}$$

$$A_2 = \frac{2019\ value + 2020\ value + 2021\ value}{3}$$

$$A_3 = \frac{2020\ value + 2021\ value + 2022\ value}{3}$$

A_1 corresponds to an estimated 2021 BECI value, and similarly, A_2 coincides with the estimated 2022 BECI value, which means that A_3 stands for the predicted 2023 BECI value of 78.19.[10]

Year	Actual Value	Moving Average	% difference
2020	77.50		
2021	78.39	77.79	0.77%
2022	78.56	78.17	0.50%
2023		78.19	

Fig 7: 2023 BECI Estimate, Simple Moving Averages, 2018-2022 Data

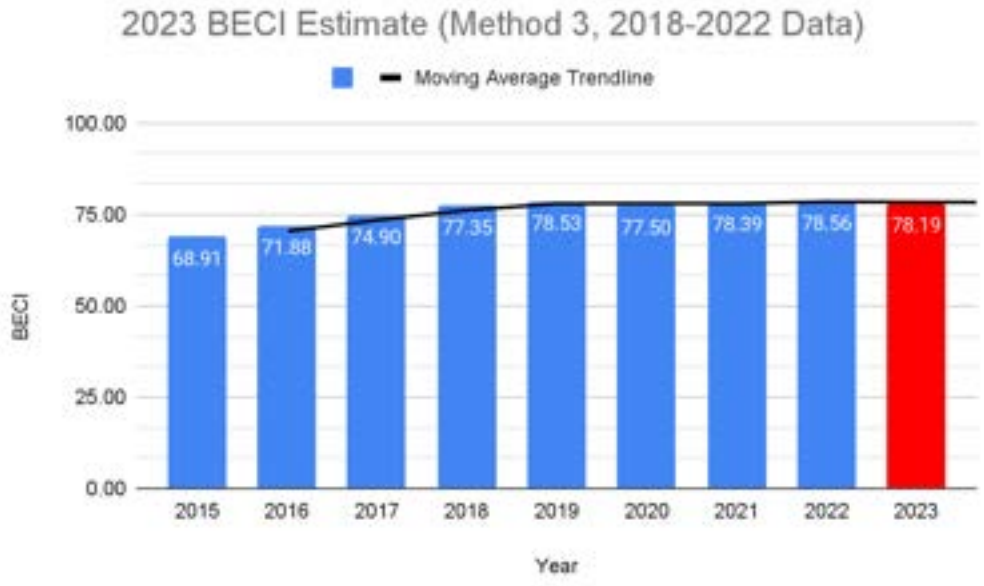


Fig. 8: 2023 BECI Estimate, Simple Moving Averages, 2018-2022 Data

Method 4: Regression Models and Trendlines (LR)

The fourth method utilizes regression models and trendlines to estimate the future BECI value. By fitting a statistical model to the historical BECI data, this approach identifies the relationship between time and BECI values. The model then projects the 2023 BECI value based on this identified trend. Regression analysis provides a rigorous framework for estimation, incorporating both linear and non-linear trends to capture the data's underlying dynamics.

[10] Detailed justification and explanation of calculations could be provided upon request.

Year	Time Period (x)	BECI (y)	Linear Regression Equation $y = mx + b + error$
2015	1	68.91	
2016	2	71.88	
2017	3	74.90	
2018	4	77.35	
2019	5	78.53	
2020	6	77.50	
2021	7	78.39	
2022	8	78.56	
2023	9	**ŷ = 81.60**	$y = 1.30x + 69.91 + error$ (based on the complete dataset)
		ŷ = 78.75	$y = 0.23x + 76.70 + error$ (based on last 5 years)

Table 4: Linear Regression Equations

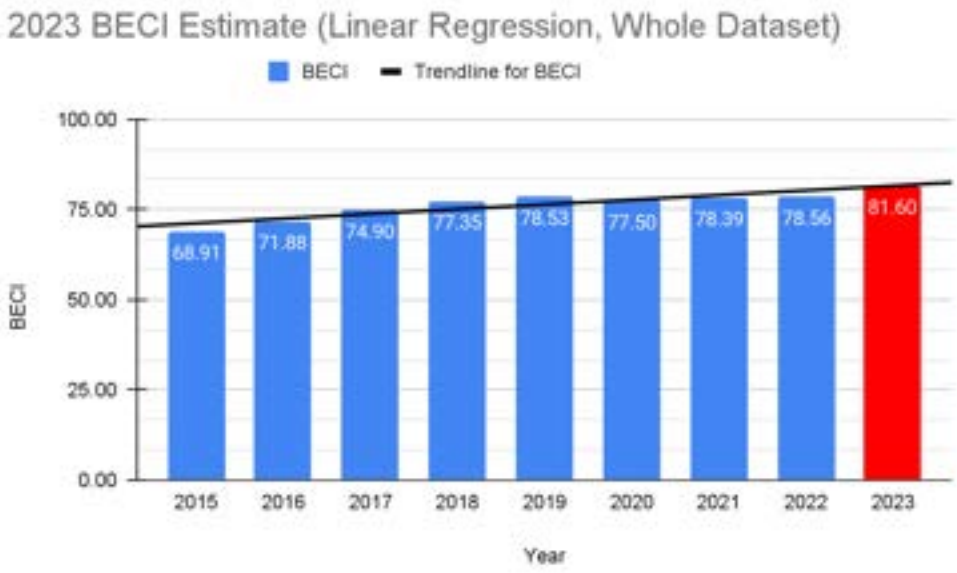


Fig. 9: Regression Trendline (2015-2023)

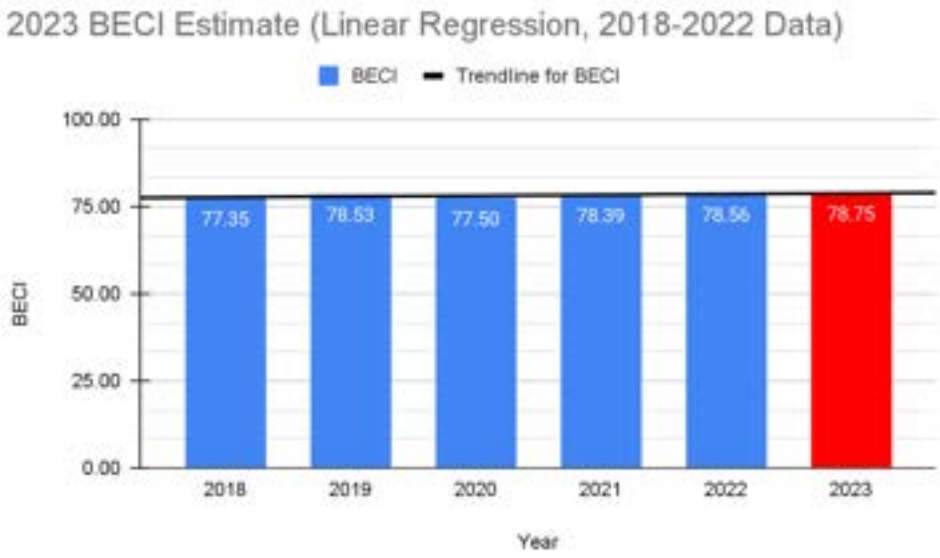


Fig. 10: Regression Trendline (2018-2023)

When taking into account data from the whole data set, the predicted value for the 2023 BECI is 81.60, but when taking into account data from just the last five most recent years, the predicted value for the 2023 BECI is 78.75. Our preferred estimate from this method is 78.75, using the equation $y = 0.23x + 76.70 + error$, because it more accurately observes the stickier and cohesive BECI growth as of 2018, as opposed to the fact that employing the whole dataset might inflate growth rates and lead to an overambitious 2023 BECI estimate. The predicted value of 81.60 seems unrealistic in view of BECI values over the last few years, consistently around 77-78, thus it will therefore not be considered in outlining the range in which BECI is predicted to fall.

5. Data Inference & Discussion

M1	M2	M3	M4
AAGR	YoY AGR	SMA	LR

Fig. 11: Intra Method Comparison

In the figure above, I decompose the BECI by subcategories for each of the methods employed. In this section, I will discuss different scenarios and look at how they compare across methods.

5.1 Sensitivity Analysis

Based on the comprehensive data analysis conducted for estimating the 2023 BECI value for Bulgaria, several inferences can be drawn regarding the effectiveness and implications of the different estimation methods. The estimated range for the 2023 BECI is between 78.19 and 80.50, reflecting the variability in outcomes depending on the methodology applied.

Method 3 (Simple Moving Averages), analyzing data from 2018 to 2022, yields the most conservative estimate at 78.19. By smoothing out short-term fluctuations, this method highlights the underlying stability but also tends to be more reserved in its projections, possibly due to the lack of major recent improvements in economic transparency. This estimate is significant because it suggests a cautious approach, acknowledging the slower, steadier progress in formalizing the economy. Due to changes in indicators in 2018, using data from only the last five years minimizes the risk of "losing" data values in converting averages between components.

The most optimistic estimate comes from Method 2 (Year-to-Year Average Growth Rate), which predicts the 2023 BECI at 80.50 after evaluating the complete 2015-2022 dataset. This figure represents the upper boundary of the estimated range and suggests a rather rapid improvement in economic transparency in the context of the 2022 BECI value. However, this method might potentially be slightly overly optimistic as it assumes that the strong growth seen in certain years will continue unabated without accounting for potential economic setbacks or stagnation that might appear as unforeseen. On the other hand, YoY AGR, which uses data from just the last three years, renders an estimate of 79.41. This figure is likely to be more closely aligned with what the actual BECI might be in 2023. The reason this method might be more accurate than working with AGR using values from the whole dataset is that it captures more recent trends while excluding older, more volatile data that may have been influenced by past economic policies, no longer causing any effects or changes in how indicators were measured. As a result, this method offers a balanced view, potentially reflecting the current state of the Bulgarian economy more accurately.

Method 1 (AAGR) produces a more ambitious estimate of 80.19. While this is still plausible, it is on the higher end of the spectrum. A potential issue with this method is that it includes years like 2015 and 2016, which had substantially lower bright economic proportions than the rest of the years in the dataset. This inclusion skews the annual growth rate upwards, giving the impression of higher growth than what might realistically be expected if considering only recent years. Since 2019, the growth has been more modest, suggesting that this method might potentially overestimate the 2023 BECI.

Focusing on Method 4, the linear regression models offer a nuanced perspective on estimating Bulgaria's 2023 Bright Economy Composite Index (BECI). By analyzing the entire dataset from 2015 to 2022, the regression model projects a relatively high BECI value of 81.60, which is also the most ambitious form of calculation in this research. This estimate reflects an assumption of long-term growth in economic transparency, suggesting that the bright economy in Bulgaria has improved abruptly compared to 2022, which raises questions about its plausibility. However, when the regression model is applied to a more recent timeframe, specifically the last five years, the projected value drops to 78.75. This lower estimate indicates

that recent trends might not be as robust as the longer-term data suggests, possibly due to recent economic challenges or slower-than-expected improvements in transparency lately, potentially influenced by events such as the ongoing political conflicts worldwide or the COVID pandemic from a few years ago. This contrast highlights the regression method's sensitivity to the selected timeframe and underscores the importance of considering both long-term and short-term trends when making economic projections. While the overall regression approach is reliable for identifying general trends, it may overestimate the BECI when relying on older data or underestimate it if recent data reflects temporary slowdowns. Thus, while the regression models provide valuable insights, they should be viewed within the broader context of other estimation methods to avoid overly optimistic or conservative conclusions. In either case, it undoubtedly confirms the robustness of the different calculation methods and verifies the range of possible 2023 BECI values.

In all of the methods employed in the data analysis, based on the predictive power of the values for previous years, it could be concluded that all predictions are robust with a margin of error of about 5%, rendering a roughly 95% confidence interval.

5.2 Range Overview

The estimated BECI range of 78.19 to 80.50 implies that Bulgaria's hidden economy proportions would fall within the range of approximately 19.50 to 21.81. This indicates that while significant progress has been made, a considerable portion of economic activities remains outside the formal economy. When compared to European and global averages, Bulgaria still has a higher proportion of its economy in the shadows, signaling the need for continued efforts to reduce this hidden sector.

In conclusion, while the range of BECI estimates provides a comprehensive view of where Bulgaria stands, the YoY AGR method using 2020-2022 data appears to offer the most realistic projection for 2023 at an estimated 79.41. Continued efforts are necessary to decrease the hidden economy further, bringing Bulgaria closer to European and global standards.

5.3 Inferences About the Hidden Economy Sector

The estimated 2023 BECI range, projected to be between approximately 78% and 80.5%, provides critical insights into the state of Bulgaria's hidden economy. A higher BECI indicates a larger proportion of the economy operating within the formal, regulated sector, implying that the hidden economy -- comprising unreported income, informal employment, and other forms of economic activity that escape taxation and regulation-- is shrinking. Given this estimated range, the hidden economy will likely constitute roughly 19.5% to 22% of the total economy.

This level is significant as it suggests that while progress has been made in formalizing economic activities, a substantial portion of economic activity remains outside the official economy. Unlike European and global averages, where hidden economies typically range between 10% to 20% of GDP (with a European average of 17.3% [3]), Bulgaria's estimated hidden economy is on the higher end, though not exceptionally so. The persistence of a relatively large hidden economy could indicate challenges in enforcing regulations, gaps in tax collection, or cultural factors that sustain informal economic practices.

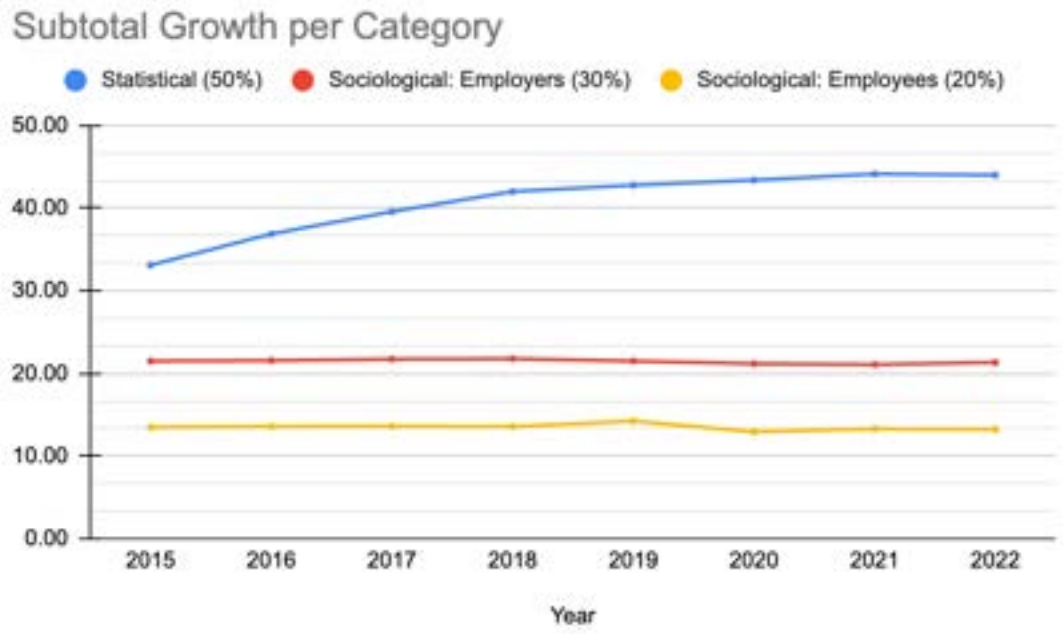


Fig. 12: Subtotal Growth, 2015-2022

I further deepdive into the analysis by looking into the subtotal trends by categories, as shown in Fig. 12. Based on the subtotal analysis using the trendlines, no notable variation within the subtotals could be observed. Hence, a slower and consistent BECI growth indicates that the statistical and sociological components are changing sluggishly. For example, because the regression method is only based on data from 2015-2022, while the estimate in aggregate shows that the bright economy proportion has gone up if we look at the subtotals more closely, we do observe that due to the COVID outbreak in 2020, the sociological component based on the employee responses actually reduced formal economic activities. We can observe a dip of approximately 1.5 units in the Employees subcategory, yet the change in the final value adds up to approximately 1 unit, which means that other indicators and subcategories can compensate for occasional or incidental dips in any of the categories, or in other words – that bigger changes in final BECI values might be set off across indicators. Nevertheless, 1 percent in the scale of GDP is indubitably a large number, which ends up being very costly to any government as it is not receiving tax for this said percent of the hidden economy. Therefore, we should really think of the subtotal values as crucial because they are directly tied to the scope of government expenditure.

It could be the case that the final BECI value is exactly the same over two different years, but the composition may have changed. This means that psychologically, people might have shifted towards adopting a brighter economy more than what is based on the actual activity measured by the statistical component. In this case, it could be inferred that people generally start accepting a bright economy, and therefore, they are reporting higher employer satisfaction, for example, but when it comes to payment of VAT, for instance, we still see a reduction in contribution. Based on those observations, it may also be inferred that the sociological component greatly affects the acceptance of the indicators. In Bulgaria, however, there is a

general lack of awareness among the public about the existence of BECI, which means many people miss out on the valuable insights it offers regarding the overall economy and specific sector activities. Among many potential reasons behind that, it is critical for us to acknowledge that when COVID occurred, the “Employees” sociological subcategory was reduced, possibly leading to people’s perception of the stability and security of formal employment being adversely affected. This could have contributed to a shift towards more informal or hidden economic activities as individuals and businesses sought to mitigate the uncertainties brought on by the pandemic.

That being said, to further reduce the size of the hidden economy, the government may need to implement policies focused on improving tax compliance, enhancing the effectiveness of regulatory bodies, and incentivizing businesses to operate transparently. Measures such as reducing the tax burden on small businesses, increasing digitalization in transactions, and enhancing public trust in government institutions could be effective in maintaining and potentially accelerating the decline in the hidden economy’s size. Additionally, incentivizing businesses to operate transparently, perhaps through tax breaks or subsidies for compliant enterprises, might encourage greater adherence to formal economic practices.

Holistically, although the BECI provides critical data on the distribution between the formal and informal sectors, helping to identify trends and inform policy decisions that could enhance economic transparency and stability, due to limited public knowledge, these insights remain underutilized, hindering their potential impact. Spreading more awareness about how BECI can be useful would empower businesses, policymakers, and citizens to make more informed decisions, ultimately contributing to a brighter and more sustainable economic future for Bulgaria.

6. Limitations

There were several notable limitations in the research:

6.1 Low Public Data Availability

A significant limitation in the research process was the low public accessibility of raw data used in the annual BECI calculations, sourced from governmental institutions. Information regarding the formulas used by BICA to develop the values for each indicator was unavailable to the mass public and non-disclosable to the organization, which did not allow us to execute calculations with true data, and we had to work with estimations accordingly. The preliminary sources for all data used in BECI calculations were also unavailable. In assembling the consolidated sheets with a complete list of values and weighted values in our data set, the values in annual BECI reports by BICA did not always correspond to different BECI reports with data on the same period published on the same website. While BICA analysts go in retrospect and perform new calculations on BECI in previous years based on the emergence of new, more precise ways of measurement, yet older reports are still stored on the BICA webpage. Combined with the generally low data availability on this topic, the data collection component of this research, in turn, was significantly elongated.

6.2 Public Disengagement and Policy Efficacy

Over the recent decades, the Bulgarian government has tried to implement numerous policies to tackle the issue of a large proportion of GDP coming from hidden economic activity. Some of those include increasing the number of checks for indirect tax for businesses, which would lead to more effective monitoring; posing VAT restrictions on sellers; attempting to tackle this issue on an administrative level, which, in the best case scenario, would reduce corrupt practices. Throughout the years, one of the most crucial objectives for the government and other federal institutions has been to monitor whether businesses operate in accordance with the way they have documented their activity, as many employees are forced to work overtime, and their contracted labor does not coincide with the true amount of work they invest. The implementation of the majority of the policies has been relatively unsuccessful, and specialists claim that this is accounted for by the mass unawareness and disinterest in getting to know the depths and dimensions of normative practices within business sectors. With mass citizen disinterest in engaging, institutional efforts could never be truly effective in mitigating this issue and decreasing the share of GDP coming from the hidden sector. All of this being said, it is extremely difficult to pinpoint changes in the GDP distribution between the bright and the hidden sectors to any specific policy that the government may have implemented, which in turn makes it harder for professionals to back up claims on which types of policies are effective and should be continually put into practice.

6.3 Bias Introduced by Learning Over Time

Given that BICA uses a constant panel of respondents every year in an attempt to supply data belonging to the sociological component of the BECI, it is plausible to assume that respondents might exhibit learning over time. Potentially, this could lead to an overinflated bright economy proportion, which may not accurately represent and assess the true economic status quo in Bulgaria. Respondents may choose to underreport or overreport their activity belonging to any of the indicators that BECI is composed of, which means that a practical risk of data fabrication and manipulation exists. Since data availability was low and the sociological component of the BECI is primarily reliant on questionnaires and surveys, we were compelled to exclude consideration of the potential risk of data fabrication.

6.4 Lack of Transparency In Data Collection

In the scope of this research, we could not find the questions that the fixed panel of respondents in the sociological component is asked. Hence, it is important to acknowledge that there could be framing effects that might influence the value of the index year over year.

6.5 Scope of chosen methods

Potential limitations of the four methods of estimating the 2023 BECI value have been discussed in detail in section 5. The primary limitation that significantly impacted the research process remains low data availability, as discussed in section 6.1.

7. Conclusion

In this paper, we have conducted a thorough analysis to estimate Bulgaria's BECI value for 2023. By utilizing a combination of statistical estimation, scenario analysis, and trend extrapolation, we aimed to provide an accurate forecast of BECI, a key indicator of the size of the formal economy relative to the total economy. Our analysis was grounded in a detailed review of existing data, supplemented by projections and scenarios to address the inherent uncertainties in measuring the hidden economy.

The results indicate that the BECI for Bulgaria is likely to fall within the range of 78.19 to 80.50, suggesting that the hidden economy still constitutes approximately 20% of the country's GDP. This finding is consistent with previous years' trends, signaling both progress and the need for ongoing vigilance. The methodological approach adopted here was chosen over more complex econometric models due to its ability to handle data limitations and its applicability in scenarios where precise data is scarce. The combination of these methods provides a reliable and practical estimation, which is crucial for informing policy decisions.

If more comprehensive and granular data were available, the analysis could have been enhanced by estimating the BECI using actual figures rather than relying on projections and scenario-based estimates. This would have allowed for a more precise and potentially more accurate understanding of the hidden economy's dynamics. However, the current approach offers a solid foundation for policymakers, even as it acknowledges the limitations posed by data availability.

That being said, there is still a great scope for future research related to the present findings. Further studies might consider BECI in other economic sectors beyond those mentioned in the current paper, which might include healthcare, education, or the agricultural sector. Additionally, cross-country comparisons of BECI could be valuable in shedding more light on how national policies against the hidden economy work in practice. Future research in this area may be oriented to constructing prediction models that include BECI, among other macroeconomic indicators, for establishing and assessing the trend of economic activity and hence improving policymakers' preparedness to respond to emerging challenges in this field or unforeseen economic circumstances. Given the fast development pace of digital technology, future research could also investigate how and to what extent digital transformation influences the size and nature of the shadow economy, especially concerning potential implications for the accuracy and relevance of the applied BECI measurements.

8. Acknowledgements

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9. Appendix

9.1 Consolidated 2015-2022 Indicator Values

Statistical Components	Value							
	2015	2016	2017	2018	2019	2020	2021	2022
Cash Payments	48.10	56.10	72.08	74.40	76.77	79.00	79.27	80.21
Declared VAT	85.80	90.80	90.87	92.00	92.50	94.92	98.22	94.71
Socially Secured Employed				90.53	88.35	88.17	91.05	90.41
Informally Employed	63.80	71.30	59.29					
Hired By Contract				97.76	97.69	98.20	98.39	98.12
Declared labor resource				91.13	89.79	87.25	88.77	89.65
Excise duty								
Excise duty on tobacco	73.59	81.21	78.68	91.86	92.42	92.25	92.20	95.97
Excise Duty on alcohol	96.62	97.49	98.14	97.36	86.67	76.84	83.04	85.84
International Trade								
Trade within the EU	82.37	86.97	91.38	86.41	95.27	96.00	92.78	95.64
Trade outside EU	83.5	66.95	67.25	58.77	73.02	75.00	81.63	83.73
Sociological Components								
Employers								
Labor Market - labor with a contract	73.00	73.20	73.00	73.40	69.70	69.58	76.32	80.73
Labor Market - full remuneration labor	60.80	59.30	58.80	59.40	56.70	78.62	83.24	70.26
All Production Declared	70.10	71.30	71.50	71.60	81.20	63.01	68.66	61.87
Legal Import and Export	75.30	76.10	76.40	76.30	80.00	71.02	77.32	76.16
Correct Duty and Tax Declaration	75.70	75.80	76.20	76.70	73.40	70.16	75.17	74.98
Correct VAT Refund	78.60	78.90	79.80	80.10	81.30	71.44	75.99	73.84
Correct Execution of Procurements	58.30	58.10	57.90	56.80	65.20	63.12	65.77	73.34
Bank Payments Between Firms	82.40	82.50	83.20	83.80	75.40	85.64	88.23	83.56
Bank Payments to	86.00	86.60	86.90	87.90	78.80	85.28	85.35	84.63

Employees								
Presence of a Quality Control System	61.80	62.00	62.80	63.30	54.50	64.03	26.39	49.79
Bright Economy Proportion	72.10	72.50	74.80	76.60	71.70	65.45	74.47	72.48
Employees								
Primary Job By Contract	76.20	77.40	77.10	77.50	85.60	73.4	82.47	79.63
Primary Job - Full Remuneration Contract	38.80	37.40	36.80	37.20	45.10	63.53	78.97	78.75
Secondary Job By Contract	93.10	94.00	93.30	92.80	89.20	75.22	40.8	61.17
Secondary Job - Full Remuneration Contract	83.50	83.90	82.80	81.70	76.20	52.5	50.98	50.72
Printing Receipts for Goods	84.30	85.20	85.80	86.20	85.50	79.7	79.01	78.66
Printing Receipts for Services	42.10	42.40	42.60	43.10	48.30	46.06	59.64	51.14
Correct Declaration of Tax on Natural People's Income	65.10	65.40	66.10	66.50	71.40	63.9	65.82	64.92

Table 2: Consolidated 2015-2022 Indicator Values [7] [8] [9] [10]

9.2 Consolidated 2015-2022 Indicator Weighted Values

Statistical Components	Weighted Value							
	2015	2016	2017	2018	2019	2020	2021	2022
Cash Payments	9.62	11.22	14.42	14.48	15.35	15.80	15.85	16.04
Declared VAT	12.87	13.62	13.63	12.48	12.54	12.87	13.32	12.84
Socially Secured Employed				4.98	4.86	4.85	5.01	4.97
Informally Employed	3.19	3.57	2.96					
Hired By Contract				1.54	1.54	1.55	1.55	1.55
Declared labor resource				5.01	4.94	4.80	4.88	4.93
Excise duty	3.29	4.47	4.42	3.29	3.28	3.25	3.25	3.39
Excise duty on tobacco	1.84	2.03	1.97	3.01	3.03	3.03	3.02	3.15
Excise Duty on alcohol	2.42	2.44	2.45	0.27	0.25	0.22	0.23	0.24
International Trade	4.14	4.00	4.15	0.23	0.26	0.27	0.27	0.28
Trade within the EU	2.68	2.83	2.97	0.17	0.19	0.19	0.19	0.19
Trade outside EU	1.46	1.17	1.18	0.06	0.07	0.08	0.08	0.08
Sociological Components								
Employers								
Labor Market - labor with a contract	1.22	1.22	1.22	1.23	1.18	1.18	1.40	1.37
Labor Market - full remuneration labor	1.02	0.99	0.98	0.99	0.96	1.15	1.42	1.19
All Production Declared	2.34	2.38	2.39	2.38	2.68	2.41	2.27	2.04
Legal Import and Export	2.52	2.54	2.55	2.54	2.64	2.34	2.55	2.51
Correct Duty and Tax Declaration	2.53	2.53	2.55	2.55	2.42	2.32	2.48	2.47
Correct VAT Refund	2.63	2.64	2.67	2.67	2.68	2.52	2.51	2.44
Correct Execution of Procurements	1.95	1.94	1.93	1.89	2.15	2.08	2.17	2.42
Bank Payments Between Firms	1.38	1.38	1.39	1.40	1.28	1.46	1.50	1.42
Bank Payments to	1.44	1.45	1.45	1.47	1.34	1.45	1.45	1.44

Employees								
Presence of a Quality Control System	2.06	2.07	2.10	2.11	1.80	2.11	0.87	1.64
Bright Economy Proportion	2.41	2.42	2.50	2.55	2.37	2.16	2.46	2.39
Employees								
Primary Job By Contract	1.30	1.32	1.31	1.29	1.46	1.25	1.40	1.35
Primary Job - Full Remuneration Contract	0.66	0.64	0.63	0.62	0.77	1.08	1.34	1.34
Secondary Job By Contract	1.58	1.60	1.59	1.55	1.52	1.28	0.69	1.04
Secondary Job - Full Remuneration Contract	1.42	1.43	1.41	1.36	1.30	0.89	0.87	0.86
Printing Receipts for Goods	2.78	2.81	2.83	2.87	2.82	2.63	2.61	2.60
Printing Receipts for Services	1.39	1.40	1.41	1.44	1.59	1.52	1.97	1.69
Correct Declaration of Tax on Natural People's Income	4.36	4.38	4.43	4.43	4.78	4.28	4.41	4.35

Table 3: Consolidated 2015-2022 Indicator Weighted Values [7] [8] [9] [10]

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