

ECONOMIC SCIENCES

DETERMINANTS OF THE SHADOW ECONOMY IN SELECTED NORTHERN EUROPEAN COUNTRIES: A MIMIC MODEL APPROACH

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Abstract

The shadow economy remains an important challenge for both developed and developing economies, affecting tax revenues, labor market efficiency, and the effectiveness of public policies. This study investigates the determinants of the shadow economy in selected Northern European countries during the period 2013–2023. The analysis covers Denmark, Estonia, Finland, Ireland, Latvia, Lithuania, and Sweden and employs the Multiple Indicators Multiple Causes (MIMIC) model to estimate a latent shadow economy index. Using annual panel data obtained from international databases, the study examines the effects of unemployment, tax revenue, population growth, and economic growth on shadow economic activity. The results indicate that unemployment and population growth have a positive and statistically significant effect on the shadow economy, while tax revenue is negatively associated with informal economic activity. Economic growth does not exhibit a statistically significant impact. The estimated shadow economy index further reveals substantial cross-country differences. Ireland records the highest index values throughout most of the study period, whereas Denmark consistently exhibits the lowest levels. The findings suggest that labor market conditions, demographic dynamics, and institutional effectiveness play a crucial role in shaping shadow economic activity even in highly developed economies. The study contributes to the existing literature by providing a comparative analysis of Northern European countries and extending previous regional research on the determinants of the shadow economy in Europe.

Keywords: National economy, Shadow economy, investment, MIMIC model, Northern Europe, Economic determinants

Introduction

The shadow economy remains one of the most persistent and policy-relevant challenges facing contemporary economies. Broadly defined, it encompasses economic activities that take place outside the scope of official statistics, taxation systems, and government regulation, while nonetheless generating economic value. The prevalence of shadow economic activity has important implications for public revenue collection, the effectiveness of economic policy, labor market performance, and long-term economic development. High levels of informality may reduce tax revenues, distort competitive market conditions, and erode public trust in state institutions. Consequently, identifying the determinants of the shadow economy remains a critical objective for both policymakers and academic researchers.

Although scholarly interest in the shadow economy has expanded substantially over recent decades, the existing literature has predominantly focused on developing economies, large-scale cross-country analyses, or individual country case studies. Evidence from Europe suggests that both the magnitude and determinants of the shadow economy vary considerably across regions [2]. Factors such as taxation, unemployment, institutional quality, economic growth, and demographic change may exert different effects depending on the economic and institutional context. As a result, region-specific analyses are essential for developing a

more comprehensive understanding of the mechanisms underlying shadow economic activity [1].

The Nordic countries constitute a particularly valuable setting for such an investigation. Denmark, Finland, Sweden, Ireland, and the Baltic states are characterized by high income levels, strong institutional frameworks, transparent governance structures, and comprehensive social protection systems. Nevertheless, high institutional quality does not guarantee the complete elimination of informal economic activity. Previous research demonstrates that shadow economic activities persist even in highly developed economies, suggesting that informality is influenced not only by economic development but also by labor market conditions, fiscal institutions, and demographic processes.

In the authors' previous study, the determinants of the shadow economy in selected Southern European countries were examined using the MIMIC model. The findings indicated that unemployment contributed positively to shadow economic activity, whereas population growth exerted a negative effect. Significant cross-country differences were also identified. These results highlighted the importance of examining whether similar relationships hold in other European regions. The present study extends this research agenda by focusing on the Nordic countries and providing a comparative regional perspective [4].

The primary objective of this study is to identify the determinants of the shadow economy in selected

Nordic countries over the period 2013–2023 and to assess cross-country differences in the intensity of shadow economic activity. The analysis includes Denmark, Estonia, Finland, Ireland, Latvia, Lithuania, and Sweden. The shadow economy is conceptualized as an unobservable latent variable and estimated using the Multiple Indicators Multiple Causes (MIMIC) model. Within this framework, unemployment, tax revenues, population growth, and economic growth are incorporated as the principal determinants of shadow economic activity.

This study contributes to the existing literature in several important respects. First, it provides a systematic assessment of shadow economy determinants across the Nordic region within a unified methodological framework. Second, it extends the findings of the author's previous Southern European study, thereby creating a foundation for comparative regional analysis within Europe. Third, it offers empirical evidence on the factors associated with shadow economic activity in countries characterized by high institutional quality and advanced socioeconomic development [5].

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature and identifies the research gap. Section 3 presents the data and methodological framework. Section 4 reports the empirical results. Section 5 discusses the findings and their policy implications. Finally, Section 6 summarizes the main conclusions, acknowledges the limitations of the study, and outlines directions for future research.

Literature review

Conceptual background of the shadow economy

The shadow economy is widely regarded as one of the most complex and pervasive phenomena in contemporary economies. It generally encompasses economic activities that generate value while remaining outside the scope of official statistics, taxation systems, and governmental regulation. Although no universally accepted definition exists, one of the most influential formulations was proposed by Schneider and Enste, who defined the shadow economy as the aggregate of legal value-generating activities that are not recorded within the national accounts system [20].

The literature identifies two principal theoretical perspectives on the emergence of the shadow economy. The first is grounded in rational choice theory, which posits that high tax burdens, administrative constraints, and regulatory compliance costs incentivize economic actors to engage in informal activities [3]. The second stems from institutional theory and emphasizes that the shadow economy is shaped not only by economic incentives but also by broader institutional factors, including trust in public institutions, the quality of governance, and the effectiveness of the legal system [16]. Baylarov et al., in their study, noted that applying the MIMIC model enables a detailed investigation of the current state of the shadow economy in selected Southern European countries [4].

Labor market conditions likewise play a significant role in shaping the shadow economy [17]. High unemployment rates and limited opportunities for for-

mal employment may drive individuals toward informal economic activities [18]. This tendency is particularly evident during periods of economic recession. Moreover, elevated levels of self-employment are frequently regarded as an indirect indicator of informal economic activity [7].

In recent years, increasing scholarly attention has been devoted to the relationship between demographic factors and the shadow economy. Population growth, migration flows, and age structure may affect the balance between formal and informal economic activities [8]. Nevertheless, research in this area remains limited, and the available evidence has yet to produce consistent conclusions. The Nordic countries offer a particularly valuable setting for investigating these dynamics [10]. Despite being characterized by strong institutional quality, efficient tax administration, and comprehensive social protection systems, the shadow economy has not been entirely eradicated within the region. Accordingly, examining the determinants of the shadow economy in the Nordic context is of substantial theoretical and practical relevance [11].

Empirical evidence from previous studies

The empirical literature on the shadow economy has expanded considerably over the past several decades. Early studies primarily concentrated on the effects of taxation and government regulation on informal economic activity. In his seminal analysis of the United States, Tanzi demonstrated that higher tax burdens contribute significantly to the growth of the shadow economy [21]. Subsequent research has provided broader international evidence. In a comprehensive study encompassing 162 countries, Schneider, Buehn, and Montenegro found that the size of the shadow economy is closely linked to tax burdens, unemployment levels, and institutional quality [20]. Similar conclusions were reached by Medina and Schneider in their extensive cross-country investigation [15]. Within the European context, empirical evidence highlights the critical role of institutional differences. Herwartz, Schneider, and Tafenau showed that regional disparities across European countries significantly affect the prevalence of shadow economic activity [9]. Likewise, Buehn and Schneider, applying the MIMIC model to Germany, identified labor market conditions and fiscal factors as the principal determinants of the shadow economy [6]. Research focusing on the Nordic countries indicates that the shadow economy persists despite high levels of institutional quality. Williams and Horodnic argued that tax morale, trust in public institutions, and social norms constitute key determinants of informal economic activity [22]. In the authors' previous study, the MIMIC model was employed to examine selected Southern European countries. The results indicated that unemployment exerted a positive effect on the shadow economy, whereas population growth had a negative effect. Furthermore, Greece and Italy exhibited relatively high latent shadow economy indices, while Cyprus and Malta recorded comparatively lower levels [4].

These findings emphasize the importance of cross-regional comparisons. Whereas labor market vulnerabilities and fiscal challenges appear to be the primary

determinants of the shadow economy in Southern Europe, the magnitude and direction of these effects may differ in the Nordic region. Therefore, a dedicated investigation of the Nordic countries has the potential to make a meaningful contribution to the existing literature.

Research gap and contribution

Although the existing literature offers substantial insights into the determinants of the shadow economy, several important gaps remain unresolved [19]. The first gap concerns regional specificity. The majority of existing studies are based either on large-scale cross-country analyses or on individual country case studies. Consequently, regions characterized by distinctive institutional environments, such as the Nordic countries, have received relatively limited scholarly attention in dedicated empirical investigations.

The second gap relates to the scarcity of comparative regional research. While previous studies have examined Southern European as well as Central and Eastern European countries, only a limited number of studies have analyzed the Nordic countries within a unified analytical framework using the MIMIC model. The third gap concerns the selection of determinants. Although the literature has traditionally focused on variables such as taxation and unemployment, the effects of energy consumption, economic growth, and demographic dynamics on the shadow economy remain underexplored. This study seeks to address these research gaps. Specifically, it presents a comparative regional analysis of Denmark, Estonia, Finland, Ireland, Latvia, Lithuania, and Sweden and employs the MIMIC model to estimate the shadow economy as a latent variable. Moreover, by extending the findings of the author's previous research on Southern Europe, the study provides an opportunity to conduct a systematic comparison between the Nordic and Southern European regions. Such a comparison contributes to a more nuanced understanding of how the determinants of the shadow economy may vary across distinct institutional and socioeconomic contexts [24].

Data and methodology

Data description and sample selection

This study investigates the determinants of the shadow economy in selected Nordic countries over the period 2013–2023. The analysis covers Denmark, Estonia, Finland, Ireland, Latvia, Lithuania, and Sweden. These countries were selected due to their high institutional quality, well-developed social protection systems, and stable economic structures. However, previous research indicates that, despite their advanced levels of economic and institutional development, informal economic activities have not been entirely eradicated.

The empirical analysis is based on a balanced panel dataset covering the period from 2013 to 2023 and comprising 77 observations. The data were obtained from reputable international sources, including the World Bank, Eurostat, the Organisation for Economic Co-operation and Development (OECD), and the International Energy Agency (IEA).

The selected time frame is particularly suitable for analyzing the dynamics of the shadow economy, as it

encompasses both the post-global financial crisis recovery period and the substantial economic disruptions associated with the COVID-19 pandemic. Consequently, the dataset captures significant variations in economic conditions that may influence the scale and determinants of informal economic activity. To address the inherently unobservable nature of the shadow economy, this study employs the MIMIC (Multiple Indicators Multiple Causes) model. The MIMIC framework allows the shadow economy to be estimated as a latent variable through the simultaneous incorporation of multiple causal factors and observable indicators, making it one of the most widely applied approaches in the empirical shadow economy literature.

Variable definitions

In the present study, the shadow economy is modeled as a latent variable that cannot be observed directly and must therefore be inferred from a set of observable causes and indicators within the MIMIC framework.

The causal variables included in the model are defined as follows:

- UNE (Unemployment Rate) – measured as the proportion of unemployed individuals within the working-age population. Higher levels of unemployment are expected to increase participation in informal economic activities, thereby contributing positively to the expansion of the shadow economy.

- TAX (Tax Revenue as a Percentage of GDP) – used as a proxy for the effective tax burden faced by economic agents. A higher tax burden may encourage individuals and businesses to shift economic activities from the formal to the informal sector in order to avoid taxation and regulatory compliance costs.

- POP (Population Growth Rate) – represents the annual rate of population growth. Changes in demographic conditions may affect labor market outcomes and alter the scale of informal economic activity.

- GDP_GROWTH (Annual GDP Growth Rate) – captures the overall performance of the economy. Stronger economic growth is generally expected to reduce the incentives for participation in shadow economic activities by improving employment opportunities and income prospects.

The model includes the following indicator variable:

- SELF (Self-Employment Rate) – measured as the proportion of self-employed individuals within total employment. The self-employment rate is widely recognized in the shadow economy literature as one of the most frequently employed indirect indicators of informal economic activity. Although self-employment does not necessarily imply participation in the shadow economy, elevated levels of self-employment are often associated with a greater likelihood of unreported or partially reported economic activities.

- ENERGY (Energy Consumption) – represents energy consumption and is used as an indicator variable within the MIMIC framework. Previous studies have suggested that energy consumption may capture economic activities that are not fully reflected in official statistics, making it a useful proxy indicator for latent shadow economic activity.

The MIMIC model specification

The MIMIC (Multiple Indicators Multiple Causes) model consists of two complementary components: a structural model and a measurement model. The structural model describes the relationship between the latent shadow economy variable and its underlying causal determinants, whereas the measurement model links the latent construct to observable indicators, thereby enabling its empirical estimation.

The structural component of the model is specified as follows:

$$\eta = \gamma_1 \text{UNE} + \gamma_2 \text{TAX} + \gamma_3 \text{POP} + \gamma_4 \text{GDP_GROWTH} + \zeta$$

where η denotes the latent variable representing the shadow economy; γ_1 , γ_2 , γ_3 , and γ_4 are the structural coefficients to be estimated; and ζ is the disturbance term capturing unexplained variation in the latent construct.

The measurement component is expressed as:

$$y = \lambda \eta + \varepsilon$$

where y represents the observable indicators associated with the shadow economy, λ denotes the factor loadings linking the latent variable to the observed indicators, and ε represents the measurement error terms.

Accordingly, the empirical MIMIC specification employed in this study is given by:

$$\begin{aligned} \text{SHADOW} &\sim \text{SELF} + \text{ENERGY} \\ \text{SHADOW} &\sim \text{UNE} + \text{TAX} + \text{POP} + \text{GDP_GROWTH} \end{aligned}$$

Under this framework, the shadow economy is treated as an unobservable latent variable determined by unemployment, tax revenue, population growth, and economic growth. The latent construct is measured through self-employment and energy consumption indicators. Self-employment is frequently used in the shadow economy literature as a manifestation of informal economic activity, while energy consumption serves as an additional indicator reflecting the intensity of economic activity that may not be fully captured by official statistics. This specification enables the simultaneous

estimation of both the determinants and manifestations of the shadow economy, representing one of the principal methodological advantages of the MIMIC approach in empirical shadow economy research [6].

Estimation procedure

The empirical analysis was conducted using the R statistical computing environment. Prior to model estimation, all variables were standardized to eliminate differences arising from measurement scales and to enhance the comparability of the estimated coefficients and model outputs.

The research was carried out in several sequential stages. First, descriptive statistical analyses were performed to summarize the distributional characteristics of the variables included in the study. Second, correlation analysis was undertaken to examine the strength and direction of the relationships among the variables and to identify potential multicollinearity issues. Third, the MIMIC model was estimated using the lavaan package in R through the Maximum Likelihood (ML) estimation procedure. Finally, the estimated latent shadow economy index was extracted and employed for comparative cross-country analysis across the selected Nordic economies.

The adequacy of the model was evaluated using a range of standard goodness-of-fit statistics. These included the Chi-square (χ^2) statistic, Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). Collectively, these indicators assess the extent to which the theoretical model reproduces the observed covariance matrix and therefore provide evidence regarding the overall validity and reliability of the specified model. Consistent with the structural equation modeling literature, acceptable model fit is generally indicated by higher CFI and TLI values and lower RMSEA and SRMR values.

Empirical findings Descriptive statistics

Table 1.

Descriptive statistics of the variables used in the analysis					
VARIABLE	N	MEAN	SD	MIN	MAX
UNE	77	7.34	1.87	4.24	13.73
SELF	77	12.22	2.06	8.14	17.02
TAX	77	35.26	7.95	19.90	48.10
POP	77	0.26	0.51	-1.21	1.24
GDP_GROWTH	77	3.03	4.06	-5.04	25.18
ENERGY	77	19.74	4.58	12.80	31.18

Note: UNE denotes the unemployment rate (% of the labor force), SELF represents the self-employment rate (% of total employment), TAX refers to tax revenue (% of GDP), POP indicates annual population growth (%), GDP_GROWTH measures annual GDP growth (%), and ENERGY represents energy consumption. SD denotes the standard deviation.

Source: Authors' calculations based on World Bank, Eurostat, and OECD data for the period 2013–2023 [23].

Table 1 presents descriptive statistics on the variables used in the study. The results show that the average unemployment rate was 7.34%, with a minimum of 4.24% and a maximum of 13.73%. The average self-employment rate was determined to be 12.22%, indicating that a certain part of the labor market in the selected Northern European countries operates outside of traditional wage employment.

The average tax revenue indicator was 35.26%, with significant variability observed between observations. The average population growth rate was 0.26%, with negative demographic dynamics also recorded in some countries. The average value for the economic growth indicator was 3.03%. At the same time, the dif-

ference between the minimum and maximum values reflects the cyclical nature of economic activity and, in particular, the effects of the pandemic period.

The average energy consumption was 19.74 units. The relatively high standard deviation indicates that energy use varies across countries. Overall, the observed

variation across variables suggests that there is sufficient statistical diversity to evaluate the MIMIC model.

Correlation analysis

Table 2.

Correlation matrix						
VARIABLE	UNE	SELF	TAX	POP	GDP_GROWTH	ENERGY
UNE	1.000	0.457	-0.163	-0.324	0.121	-0.347
SELF	0.457	1.000	-0.694	0.032	0.366	-0.424
TAX	-0.163	-0.694	1.000	0.133	-0.439	0.535
POP	-0.324	0.032	0.133	1.000	0.225	0.016
GDP_GROWTH	0.121	0.366	-0.439	0.225	1.000	-0.310
ENERGY	-0.347	-0.424	0.535	0.016	-0.310	1.000

Note: UNE denotes unemployment, SELF refers to self-employment, TAX represents tax revenue, POP indicates population growth, GDP_GROWTH denotes annual GDP growth, and ENERGY represents energy consumption. Correlation coefficients are reported using Pearson's correlation measure.

Source: Authors' calculations based on World Bank, Eurostat, and OECD data (2013–2023) [23].

Table 2 presents the correlations between the variables. The results show that there is a positive relationship between the unemployment rate (UNE) and self-employment (SELF) ($r = 0.457$). This result can be explained by the fact that individuals seek alternative sources of income during periods of limited employment opportunities in the labor market. On the other hand, there is a negative correlation between unemployment and population growth ($r = -0.324$), which suggests that higher demographic dynamics may be associated with relatively more favorable labor market performance.

A strong negative correlation was found between self-employment and tax revenues ($r = -0.694$). This result supports the possibility that a certain proportion of

economic activity remains outside the formal sector in conditions of high self-employment. In addition, a moderate positive correlation was observed between tax revenues and energy consumption ($r = 0.535$), indicating that higher economic activity is accompanied by an increase in both fiscal revenues and energy use.

Although the correlation coefficients generally confirm the existence of some relationships between the variables, none of them reach a very high level. This indicates that there is no serious multicollinearity problem and that the simultaneous use of the variables in the MIMIC model is statistically acceptable.

MIMIC estimation results

Table 3.

MIMIC model estimation results			
PATH	STANDARDIZED COEFFICIENT	Z-VALUE	P-VALUE
SHADOW $\leftarrow$ UNE	0.442	6.204	<0.001
SHADOW $\leftarrow$ TAX	-0.681	-8.950	<0.001
SHADOW $\leftarrow$ POP	0.277	3.707	<0.001
SHADOW $\leftarrow$ GDP_GROWTH	-0.049	-0.625	0.532
SELF $\leftarrow$ SHADOW	1.000	—	—

Model fit statistics

INDICATOR	VALUE
CFI	1.000
TLI	1.000
RMSEA	0.000
SRMR	0.000
AIC	143.116
BIC	154.835
R ² (SHADOW)	0.666

Note: Standardized coefficients are reported. SHADOW denotes the latent shadow economy index.

Source: Authors' calculations based on World Bank, Eurostat, and OECD data (2013–2023) [23].

Table 3 presents the MIMIC model estimation results for Northern European countries. The findings reveal a positive and statistically significant association

between the unemployment rate and the shadow economy indicator ($\beta = 0.442$, $p < 0.001$). This result suggests that increasing labor market instability may foster the expansion of informal economic activities.

A negative and highly statistically significant relationship is observed between the tax burden and the shadow economy ($\beta = -0.681$, $p < 0.001$). This finding is particularly noteworthy given the institutional characteristics of Northern European countries. Higher tax revenues are likely accompanied by more effective public institutions, robust regulatory and monitoring mechanisms, and stronger tax compliance, all of which contribute to curbing informal economic activity.

Population growth is found to have a positive effect on the shadow economy ($\beta = 0.277$, $p < 0.001$). This result may be explained by demographic dynamics

that increase the number of new entrants to the labor market and, in certain circumstances, encourage the expansion of informal employment. By contrast, the impact of economic growth is not statistically significant ($\beta = -0.049$, $p = 0.532$), suggesting that economic growth per se is not a primary determinant of changes in the shadow economy across the selected countries.

The model's coefficient of determination ($R^2 = 0.666$) indicates that approximately 66.6% of the variation in the latent shadow economy indicator is explained by the determinants incorporated into the model. Taken together, the findings suggest that the shadow economy in Northern European countries is predominantly influenced by labor market conditions, fiscal institutions, and demographic developments.

Country-level shadow economy index results

Table 4.

RANK	COUNTRY	MEAN SHADOW INDEX
1	Ireland	1.490
2	Finland	0.576
3	Latvia	0.564
4	Estonia	-0.019
5	Lithuania	-0.146
6	Sweden	-0.701
7	Denmark	-1.760

Note: Higher index values indicate a relatively greater estimated propensity toward shadow economic activity within the sample. The index is a relative measure derived from the MIMIC model and should not be interpreted as a direct percentage of GDP.

Source: Authors' calculations based on World Bank, Eurostat, and OECD data (2013–2023) [23].

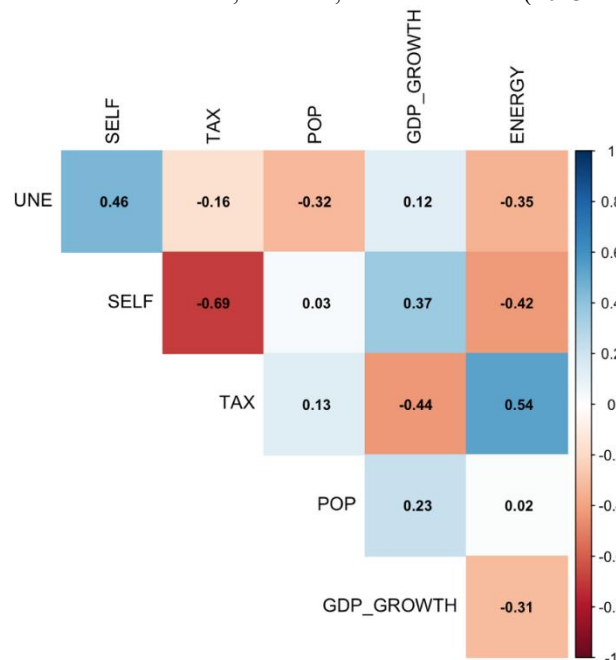


Figure 1. Estimated Shadow Economy Index Trends in Northern European Countries (2013–2023)

Note: The figure presents annual shadow economy index scores derived from the MIMIC model. Higher values indicate a relatively greater propensity toward shadow economic activity within the sample, while lower values indicate a relatively smaller propensity. The index represents a relative measure and should not be interpreted as a direct percentage of GDP.

Source: Authors' calculations based on World Bank, Eurostat, and OECD data (2013–2023) [23].

Table 4 and Figure 1 present the average levels and temporal dynamics of the shadow economy index estimated using the MIMIC model across Northern European countries. The results indicate that Ireland exhibited the highest average index value (1.490) among the countries included in the sample. Finland (0.576) and Latvia (0.564) also recorded relatively high index levels. In contrast, Denmark (-1.760) and Sweden (-0.701) displayed the lowest values. When interpreting these findings, it is important to recognize that the MIMIC approach does not provide a direct measure of the absolute size of the shadow economy. Rather, it generates a latent index that captures the relative position of each country within the sample. Consequently, a higher index value implies that a country is more strongly affected by the determinants associated with shadow economic activity.

The temporal dynamics reveal several notable trends. In Ireland, the index declined gradually from 2.326 in 2013 to 0.905 in 2023. This downward trajectory may reflect improvements in labor market perfor-

mance, enhanced fiscal stability, and strengthened institutional oversight mechanisms. Although Finland maintained positive index values throughout the study period, some fluctuations were observed over time.

By contrast, the index remained in negative territory throughout the entire observation period in both Denmark and Sweden. In Denmark, the persistently low index values may be attributed to the country's high institutional quality, effective tax administration, and extensive social protection system, all of which help to constrain informal economic activity. Similar patterns are evident in Sweden.

Taken together, the results demonstrate that the relative prevalence of the shadow economy differs considerably across Northern European countries. These variations are largely associated with the effectiveness of fiscal institutions, labor market characteristics, and demographic developments. The findings are also consistent with the existing literature, which highlights the pivotal role of institutional factors in shaping the evolution of the shadow economy across the region.

Table 5.

Annual Shadow Economy Index by Country (2013–2023)

YEAR	DENMARK	ESTONIA	FINLAND	IRELAND	LATVIA	LITHUANIA	SWEDEN
2013	-1.495	0.131	0.663	2.326	0.668	-0.214	-0.399
2014	-1.571	0.086	0.399	2.223	0.692	-0.054	-0.522
2015	-1.622	0.060	1.000	2.058	0.779	0.027	-0.559
2016	-1.660	0.041	0.764	1.944	0.825	0.058	-0.689
2017	-1.877	0.071	0.386	1.562	0.485	-0.101	-0.753
2018	-1.975	-0.004	0.317	1.356	0.476	-0.266	-0.821
2019	-1.877	-0.075	0.466	1.057	0.383	-0.270	-0.758
2020	-1.789	-0.033	0.592	1.117	0.619	-0.221	-0.722
2021	-1.641	-0.105	0.826	0.944	0.437	-0.285	-0.761
2022	-1.915	-0.237	0.604	0.875	0.374	-0.137	-0.854
2023	-1.966	-0.141	0.319	0.905	0.471	-0.142	-0.877

Note: Values represent annual shadow economy index scores estimated using the MIMIC model. Higher values indicate a relatively greater propensity toward shadow economic activity within the sample. The index is a relative latent measure and should not be interpreted as a direct percentage of GDP.

Source: Authors' calculations based on World Bank, Eurostat, and OECD data (2013–2023).

Discussion

Interpretation of determinant effects

The results of the MIMIC model indicate that unemployment, tax revenues, and population growth are statistically significant determinants of the shadow economy in the selected Nordic countries. These findings suggest that, despite the region's high institutional quality and advanced socioeconomic development, shadow economic activity remains responsive to a number of underlying structural factors.

Unemployment exerts a positive and statistically significant effect on the shadow economy ($\beta = 0.442$, $p < 0.001$). This finding implies that reduced opportunities within the formal labor market encourage individuals to seek alternative sources of income, thereby increasing participation in informal economic activities. The result is consistent with the theoretical expectations of the shadow economy literature and aligns with the findings of Schneider and Enste (2000) and Medina and Schneider (2019). Even in highly developed economies, labor market uncertainty may incentivize participation in informal economic arrangements as a means of income generation and risk mitigation.

Tax revenues were found to have a negative and highly statistically significant effect on the shadow economy ($\beta = -0.681$, $p < 0.001$). At first glance, this result appears counterintuitive, as higher taxation is often expected to encourage informal economic activity. However, within the Nordic institutional context, higher tax revenues may serve as an indicator of effective public administration, strong tax enforcement mechanisms, and high levels of tax compliance. Consequently, greater tax revenue collection is likely to reflect stronger institutional capacity and a reduced prevalence of shadow economic activity. This finding provides empirical support for institutional theory, highlighting the importance of effective governance and state capacity in constraining the shadow economy.

Population growth also exhibits a positive and statistically significant relationship with the shadow economy ($\beta = 0.277$, $p < 0.001$). This result suggests that demographic expansion may increase the number of individuals entering the labor market, thereby creating conditions under which informal employment opportunities can emerge or expand. In particular, migration inflows and the incomplete integration of newly arrived

populations into the formal economy may contribute to higher levels of informal economic activity. Nevertheless, the empirical evidence regarding this relationship remains inconclusive, and its magnitude and direction may vary across countries depending on institutional and labor market conditions.

In contrast, economic growth does not exert a statistically significant effect on the shadow economy ($\beta = -0.049$, $p = 0.532$). This finding indicates that variations in economic growth alone do not adequately explain changes in shadow economic activity within the selected Nordic countries. Rather, the results suggest that institutional quality, labor market conditions, and demographic dynamics play a more influential role in shaping the shadow economy than short-term fluctuations in economic performance.

The model demonstrates substantial explanatory power. The estimated coefficient of determination (R^2) equals 0.666, indicating that approximately 66.6% of the variation in the latent shadow economy variable is

explained by the determinants included in the model. Moreover, the goodness-of-fit statistics indicate an excellent model fit (CFI = 1.000, TLI = 1.000, RMSEA = 0.000, and SRMR = 0.000), suggesting a very high degree of consistency between the theoretical specification and the observed data.

The findings identify labor market conditions, the effectiveness of fiscal institutions, and demographic processes as the principal determinants of the shadow economy in the Nordic region. More importantly, they reinforce the argument that the shadow economy should be understood not merely as an economic phenomenon but as a multidimensional process shaped by the interaction of economic, institutional, and social factors. These results contribute to the growing body of evidence emphasizing the central role of institutional effectiveness in limiting informal economic activity, even in highly developed economies.

Cross-country comparative discussion

Shadow Economy Index Trends in Northern Europe (2013–2023)

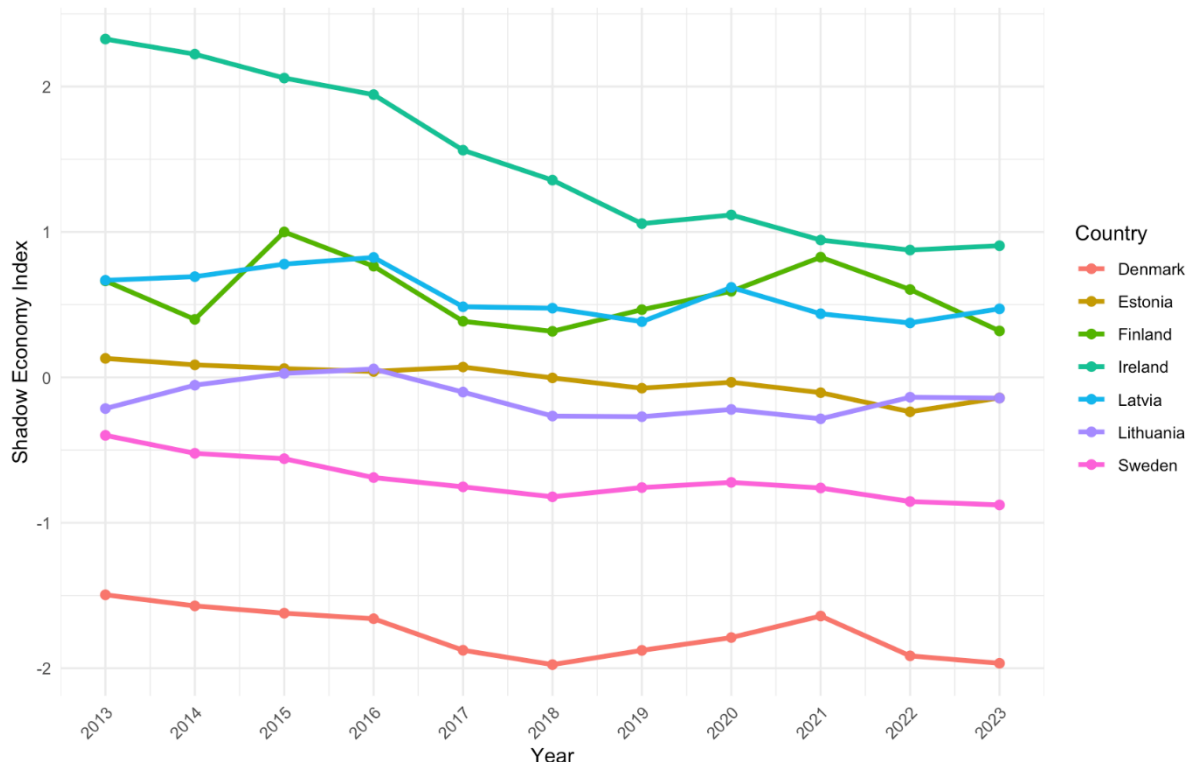


Figure 2. Shadow Economy Index Trends in Northern European Countries (2013–2023)

Note: The figure illustrates annual shadow economy index values estimated through the MIMIC model. Positive values indicate a relatively higher propensity toward shadow economic activity within the sample, whereas negative values indicate a relatively lower propensity.

Source: Authors' calculations based on World Bank, Eurostat, and OECD data (2013–2023) [23].

The results reveal considerable heterogeneity in the estimated latent shadow economy index across the selected Nordic countries. Finland also exhibited positive index values over the study period. The index reached its peak at approximately 1.0 in 2015 and subsequently followed a general downward trajectory, declining to around 0.3 by 2023. This pattern suggests that the influence of the underlying determinants associated with shadow economic activity weakened over time, resulting in a gradual reduction in the estimated latent index. Latvia displayed relatively stable positive index

values throughout the observation period. Although its trajectory occasionally mirrored that of Finland, the index generally fluctuated within a relatively narrow range of 0.4 to 0.8. Such stability may indicate that the structural determinants of shadow economic activity remained broadly unchanged during the study period. Estonia and Lithuania were characterized by index values clustered around zero. Both countries experienced only limited fluctuations, with the estimated indices remaining close to a neutral level for most of the period. This

similarity may reflect the comparable institutional environments, economic structures, and historical development paths shared by the Baltic economies. In contrast, Sweden and Denmark consistently recorded negative index values. Denmark exhibited the lowest estimated index among all countries in the sample, reaching approximately -2.0 in 2023. This finding suggests that Denmark had the lowest relative intensity of shadow economic activity during the study period. Sweden displayed a similar pattern, although its index values remained consistently higher than those observed for Denmark.

Ireland's relatively high latent index values may be attributable to the country's comparatively elevated levels of unemployment and self-employment, both of which are theoretically associated with greater participation in informal economic activities. Nevertheless, the latent nature of the MIMIC methodology must be carefully considered when interpreting these findings. The estimated index should not be understood as a direct measure of the size of the shadow economy. Rather, it reflects a relative latent position derived from the relationships between the selected causal determinants and observable indicators included in the model. Consequently, the index is more appropriately interpreted as a comparative measure of shadow economy intensity across countries rather than as an estimate of its absolute magnitude. Ireland consistently recorded

the highest shadow economy index throughout the study period. The index declined steadily from approximately 2.3 in 2013 to around 0.9 in 2023, indicating a gradual reduction in the relative intensity of shadow economic activity. This downward trend may reflect improvements in institutional effectiveness, regulatory enforcement, and overall economic conditions. Nevertheless, Ireland maintained the highest relative position among all countries in the sample throughout the entire observation period. Given the latent nature of the MIMIC index, this finding should be interpreted as a relative ranking rather than as evidence of the largest absolute shadow economy.

Overall, the figure demonstrates a broad decline in the estimated latent shadow economy index across most countries between 2013 and 2023. This trend may be associated with continued improvements in institutional quality, enhanced tax administration, and more efficient labor market performance across the region. At the same time, the persistence of cross-country differences indicates that national institutional arrangements, labor market structures, and demographic conditions continue to influence the development of shadow economic activity. These findings further support the argument that the shadow economy is shaped by a combination of economic, institutional, and social factors rather than by economic conditions alone.

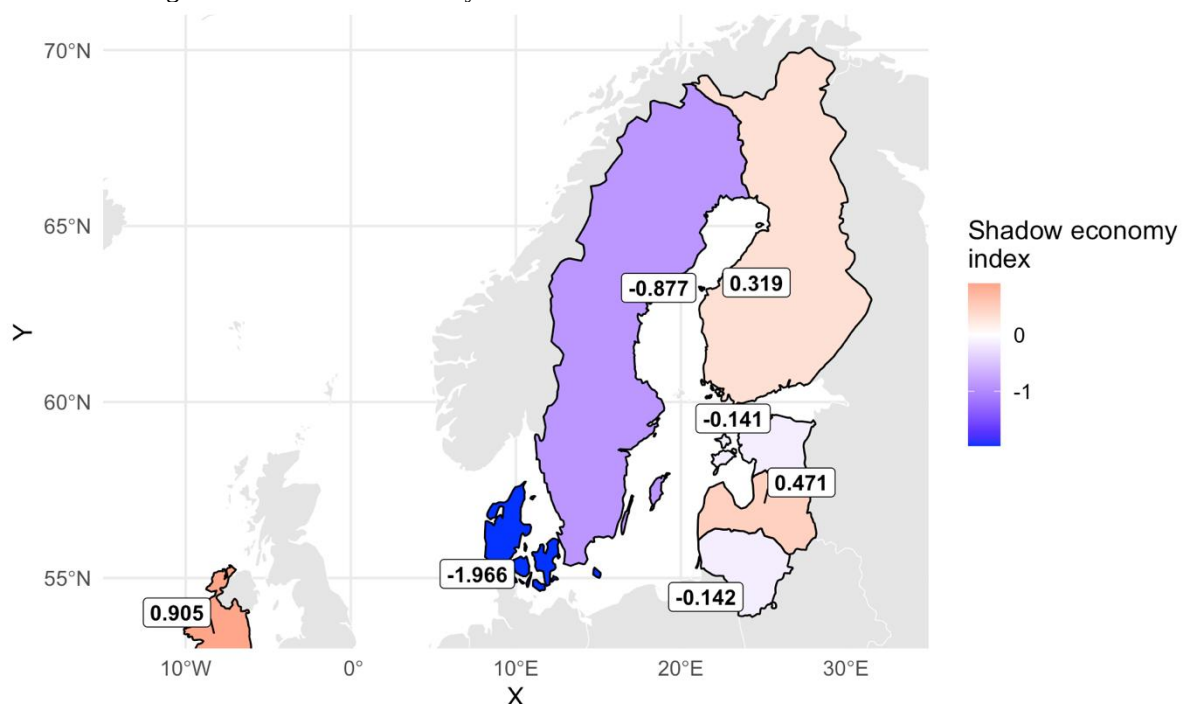


Figure 3. Estimated Shadow Economy in Northern Europe (2023)

Source: Authors' calculations based on World Bank, Eurostat, OECD, and International Energy Agency (IEA) databases (2013–2023).

Note: The map presents estimated shadow economy index values for selected Northern European countries in 2023 derived from the MIMIC model. Positive values indicate a relatively higher propensity toward shadow economic activity within the sample, whereas negative values indicate comparatively lower levels. The shadow economy index is a latent measure and should not be interpreted as the actual share of the shadow economy in GDP. Among the selected countries, Ireland exhibited the highest estimated shadow economy index (0.905), while Denmark recorded the lowest value (-1.966) in 2023.

Figure 3 presents the geographical distribution of the estimated latent shadow economy index across the selected Northern European countries in 2023. The spatial pattern reveals substantial cross-country variation in the relative intensity of shadow economic activity, highlighting the continued importance of national institutional and economic characteristics in shaping informal economic behavior. Ireland (0.905) recorded the highest latent shadow economy index among the countries included in the analysis. This finding is consistent with the temporal trends discussed earlier and indicates that Ireland maintained the highest relative position throughout most of the study period. Latvia (0.471) and Finland (0.319) also exhibited positive index values, suggesting that the determinants associated with shadow economic activity exert a comparatively stronger influence in these countries.

In contrast, Estonia (-0.141) and Lithuania (-0.142) reported index values close to zero, positioning them near the midpoint of the regional distribution. The similarity of these outcomes may reflect the comparable institutional environments and economic structures shared by the Baltic states. Sweden (-0.877) displayed a lower index value, indicating a comparatively weaker latent propensity toward shadow economic activity.

The lowest index value was observed in Denmark (-1.966). This result is consistent with Denmark's reputation for strong institutional quality, highly effective

tax administration, extensive digitalization of public services, and a well-developed social welfare system. These characteristics may contribute to reducing incentives for participation in informal economic activities and strengthening compliance within the formal economy. The map demonstrates that although the shadow economy appears to be relatively limited across Northern Europe, meaningful differences persist among countries. These differences suggest that institutional effectiveness, fiscal capacity, labor market conditions, and demographic factors continue to influence the relative intensity of shadow economic activity within the region.

Furthermore, the spatial distribution shown in Figure 3 corroborates the patterns identified in the preceding trend analysis. Countries such as Ireland and Finland remain associated with relatively higher latent index values, whereas Denmark and Sweden continue to occupy the lower end of the distribution. Importantly, these findings reinforce the argument that the shadow economy is not a homogeneous phenomenon within Northern Europe. Rather, its manifestation varies according to country-specific economic structures, institutional arrangements, and policy environments. As with all MIMIC-based estimates, the reported values should be interpreted as relative latent indices rather than direct measures of the actual size of the shadow economy.

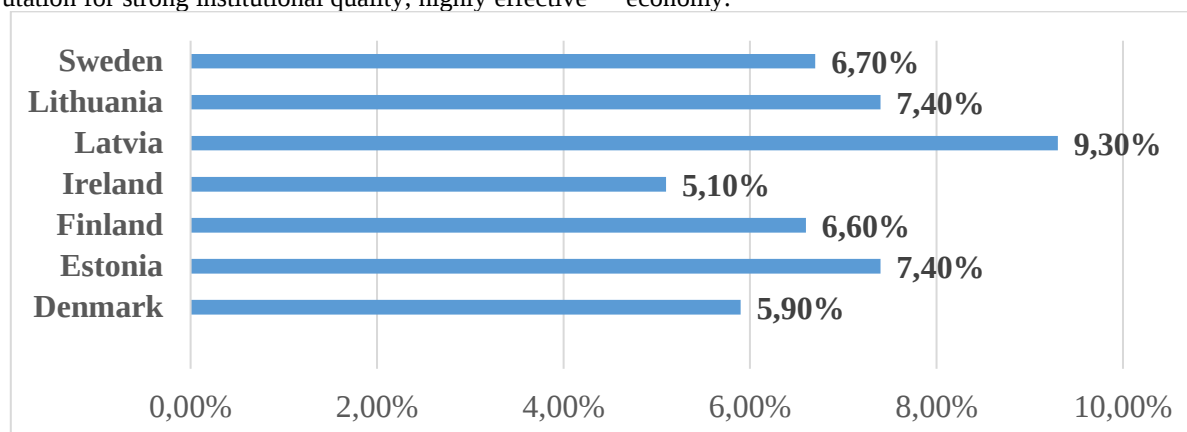


Figure 4. Shadow economy size (% of GDP) in selected Northern European countries (2023)

The conducted analysis shows that the share of the shadow economy in GDP is increasing in some Northern European countries. For example, this figure was 9.3% in Latvia, 7.4% in Lithuania, and 6.7% in Sweden. Furthermore, the share of the shadow economy accounted for 6.6% in Finland and 5.1% in Ireland. In general, it is essential to implement continuous measures at the state level to eliminate the shadow economy (Figure 4).

Source: <https://www.ey.com/content/dam/ey-unified-site/ey-com/en-gl/insights/tax/documents/ey-gl-shadow-economy-report-02-2025.pdf>

Policy implications

The findings of this study generate several important policy implications for efforts aimed at reducing the shadow economy in the Nordic countries. First, the positive and statistically significant effect of unemployment on the shadow economy highlights the central role of labor market policies. Measures designed to expand formal employment opportunities, facilitate the integration of young people into the labor market, and reduce long-term unemployment are likely to contribute to a reduction in informal economic activity. By mitigating labor market uncertainty and improving em-

ployment prospects, such policies can reduce the incentives that drive individuals toward participation in the shadow economy [12].

Second, the negative relationship between tax revenues and the shadow economy underscores the importance of effective tax administration and institutional trust [13]. This finding suggests that the prevalence of informal economic activity depends less on the nominal level of taxation and more on the transparency, fairness, and efficiency of the tax system. Consequently, policies aimed at strengthening digital tax administration, expanding electronic reporting systems, improving taxpayer services, and enhancing regulatory

transparency may play a critical role in reducing the shadow economy. More broadly, the results reinforce the view that institutional effectiveness constitutes one of the most powerful mechanisms for limiting informality.

The positive effect of population growth further indicates that demographic dynamics should be incorporated into policy design [14]. Migration flows and the successful integration of new labor market entrants into the formal economy represent important policy challenges. In particular, improving access to legal employment opportunities, vocational training programs, and labor market integration initiatives may help reduce the likelihood that newly arrived or economically vulnerable groups engage in informal activities.

The findings also demonstrate that economic growth alone does not automatically lead to a reduction in the shadow economy. As a result, policy strategies that rely exclusively on economic expansion are unlikely to be sufficient. Sustainable reductions in shadow economic activity require economic growth to be accompanied by institutional reforms, active labor market policies, and continued improvements in tax administration and regulatory enforcement.

Overall, the results suggest that the most effective strategy for reducing the shadow economy in the Nordic region involves the simultaneous strengthening of labor market performance, institutional capacity, and tax compliance. Such an integrated policy approach can contribute not only to the containment of informal economic activity but also to greater economic transparency, improved fiscal sustainability, and enhanced public trust in state institutions. These findings support the broader institutional perspective that long-term reductions in the shadow economy are achieved not solely through economic development, but through the creation of effective, transparent, and trusted public institutions.

Conclusion

This study investigated the determinants of the shadow economy in selected Nordic countries over the period 2013–2023 using the MIMIC (Multiple Indicators Multiple Causes) model. The analysis covered Denmark, Estonia, Finland, Ireland, Latvia, Lithuania, and Sweden, with the shadow economy conceptualized and estimated as a latent variable.

The empirical findings indicate that unemployment and population growth exert positive and statistically significant effects on the shadow economy. These results suggest that labor market vulnerabilities and demographic dynamics may create conditions conducive to the expansion of informal economic activity. By contrast, tax revenues were found to have a negative and statistically significant association with the shadow economy. This finding highlights the importance of effective tax administration, institutional capacity, and public trust in limiting informality. Economic growth, however, did not exhibit a statistically significant effect, suggesting that economic performance alone is insufficient to explain variations in shadow economic activity within the Nordic context.

The cross-country analysis revealed substantial heterogeneity among the selected countries. Ireland

consistently recorded the highest latent shadow economy index throughout most of the study period, whereas Denmark and Sweden exhibited comparatively low index values. The Baltic countries—Estonia, Latvia, and Lithuania—displayed relatively stable and moderate index levels. More broadly, the declining trend observed in the latent shadow economy index across most countries between 2013 and 2023 may reflect improvements in institutional quality, enhanced tax administration, and stronger labor market performance.

This study contributes to the existing literature in several important respects. First, it provides a systematic analysis of the determinants of the shadow economy in the Nordic region within a unified methodological framework. Second, it complements and extends the author's previous research on Southern Europe, thereby facilitating a comparative assessment of the factors shaping the shadow economy across different European regions. Third, it demonstrates that unemployment, fiscal variables, and demographic dynamics remain important determinants of shadow economic activity even in highly developed economies characterized by strong institutional environments.

Several limitations of the study should be acknowledged. The analysis is limited to seven Nordic countries, and the range of explanatory variables was constrained by data availability. Furthermore, because the MIMIC approach estimates the shadow economy as a latent index rather than as a direct measure, the results should be interpreted as relative indicators of shadow economy intensity and not as estimates of the actual share of the shadow economy in GDP.

Future research may benefit from extending the temporal coverage of the dataset and incorporating additional explanatory variables, such as institutional quality, corruption, digitalization, tax morale, and governance effectiveness. Moreover, comparative analyses integrating Northern, Southern, and Eastern European countries within a common modeling framework could provide deeper insights into the regional determinants and dynamics of the shadow economy.

In conclusion, although the shadow economy appears to be relatively limited in the Nordic region, labor market conditions, fiscal institutions, and demographic processes continue to play a significant role in shaping its development. Consequently, policies aimed at reducing the shadow economy should extend beyond the promotion of economic growth and place greater emphasis on strengthening institutional quality, improving governance effectiveness, and expanding opportunities for formal employment. Such an integrated policy approach is likely to be more effective in fostering economic transparency, enhancing fiscal sustainability, and reducing the incentives for participation in informal economic activities.

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