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An Ordinary Least Squares Approach Measuring the Impact of Factors Affecting the Underground Economy of Bangladesh and Their Implications in the Context of the Country's Supply Chain

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Abstract

The underground economy, also known as the shadow, informal, or unobserved economy, operates beyond government oversight, encompassing legal and illegal activities. Its substantial size, estimated at 36.4% of Asia's GDP, prompts examination of its determinants and policy implications. This study focuses on Bangladesh, aiming to identify factors influencing the underground economy. Using data from 2000 to 2020, the study employs Ordinary Least Squares analysis with variables including inflation, unemployment, internet users, GDP growth, tax revenue, economic freedom index, and population growth. Findings reveal that the size of underground economy of the country has significant positive relationships with inflation, internet users and tax revenue. Implications for Bangladesh's supply chain include inflation driving up costs, internet users affecting online commerce, and tax revenue influencing formalization efforts. Policymakers and stakeholders can use these insights to promote transparency and reduce the underground economy's adverse impacts.

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1. Introduction

In recent years, the underground economy has acquired significant attention in academic circles, with numerous studies exploring its various facets (Voicu, 2012). It is also known as shadow economy or informal economy, as it encompasses activities that evade government oversight. It creates income, employs people, and produces products and amenities just like the mainstream economy. However, it differs in that its output is untaxed, unrecorded, and unregulated. In the underground economy, the illicit and legal sectors are both present (Frey and Schneider, 2000). Its clandestine nature makes it difficult to estimate its size accurately. However, recent estimates suggest that in Asia, its weighted average size is 36.4% of the official GDP (Schneider, 2022). This high figure necessitates an examination of the factors contributing to the underground economy, with the aim of formulating policies to manage the impact of factors by minimizing their scale. Accurately estimating the social and economic circumstances of individuals is made more difficult by the underground economy's covert character. When individuals are employed in the underground economy, their contributions are not reflected in the official GDP, leading to inflated unemployment rates, and underestimated national income. This significantly impacts macroeconomic and public policies (Lisi, 2010). Moreover, the evasion of taxes by the underground economy reduces tax revenue, adversely affecting the provision and quality of public goods and services (Omodero, 2019). It also has negative repercussions on income distribution. To compensate for lost tax revenue, governments often increase tax rates, inadvertently fostering further tax evasion and expanding the underground economy. Consequently, an economy becomes ensnared in a vicious cycle, resulting in a weakened state and eroding public trust in the government. The challenges posed by the underground economy are numerous and detrimental to ignore. If it persisted, overall tax income would eventually decline, and the monetary and economic framework would be impeded (Dabla-Norris and Feltenstein, 2006). As such, it is critical to investigate this matter, pinpoint the fundamental factors influencing its scope and expansion, and develop legislation aimed at addressing these factors. The government's regulatory and legislative structure would need be strengthened if most black market enterprises were to be brought into the mainstream market. This study attempts to identify the main drivers of the underground economy, evaluate their damage, and estimate their implications on the nation's supply chain considering the serious repercussions of shadow economies and the proportion of sizable underground businesses in developing nations that call for reform. The study utilizes secondary data spanning from 2000 to 2020. However, it would be beneficial to discuss the potential limitations of using such a broad time range, as economic conditions and policy landscapes may have evolved significantly over this period. Overall, the introduction effectively contextualizes the study within the existing literature, establishes its relevance, and outlines the research objectives and methodology. It sets a strong foundation for the subsequent analysis and contributes to the reader's understanding of the significance of the study.

2. Literature Review

The underground economy, a significant area of study, is often treated as a dependent variable in existing literature (Ene and Hurduc, 2010). This research stands out as it utilizes the most recent estimates of the underground economy’s size from the World Bank, a source not previously employed in any other study. This approach provides a fresh perspective and allows for a more current understanding of the underground economy’s scale. This study revolves around several key themes that directly impact the underground economy. These include taxation, inflation, unemployment, institutional quality, and internet usage. Each of these factors plays a crucial role in shaping the underground economy (Mara and Sabau-Popa, 2013; Koreshkova, 2006). Taxation influences how businesses operate, inflation and unemployment affect the financial stability of individuals, institutional quality can either encourage or

discourage participation in the underground economy, and internet usage can bring about increased awareness and transparency (Orsi, Raggi and Turino, 2012).

The existing literature has predominantly focused on the impact of taxation on the underground economy, with tax rates and tax revenues being the primary metrics for taxation (Blackburn, Bose and Capasso, 2012). It's necessary to bear in mind that research has shown that taxes have an influence that cannot be considered in a vacuum. Instead, it must be considered alongside other variables, particularly the regulatory framework. A well-functioning tax system loses its efficacy in the presence of weak law enforcement, which is a significant finding in the literature (Annicchiarico and Cesaroni, 2016). The relationship between the underground economy and inflation has been a topic of debate in many studies (Kaghazian, Jojadeh and Naghdi, 2015). Some suggest a negative relationship (Koreshkova, 2006), while others suggest a positive one (Berger et al, 2014). The decision to engage in the underground economy is influenced by factors such as tax morality, cultural norms, and expectations regarding future price levels (Anderberg, Balestrino and Galmarini, 2003). Unemployment's impact on the size of the shadow economy has also been a topic of debate. Some researchers suggest a positive relationship, positing that high unemployment in the official economy drives individuals to informal work (Lisi, 2021). On the other hand, some scholars contend that there is a negative correlation, highlighting the fact that recessions can result in job losses in both the formal and informal sectors. (Bajada, 2005). Prior research on unemployment has usually expressed it as a proportion of the labor pool overall. An array of factors, most notably literacy level, affect how much the unofficial economy employs.

The scholarship has addressed state standards and administrative integrity in detail. The informal economy is typically inversely associated with institutional quality. (Khan and Rehman, 2022). On the other hand, stringent regulations can drive up business costs, pushing them into the underground (Dreher, Meon and Schneider, 2007). Multiple investigations have shown that corruption is more common in emerging economies, which contributes to the growth of the informal economy (Baklouti and Boujelbene, 2020). There is a mixed observation in the literature regarding the relationship between GDP and the size of the underground economy, with both positive and negative associations reported (Tedds, 2005; Restrepo-Echavarria, 2015). Studies often utilize GDP per capita and annual GDP growth to measure GDP. Over time, it has become evident that the impact of GDP cannot be examined in isolation but is intertwined with institutional quality and governance. The existing literature shows a negative relationship between the number of internet users and the size of the underground economy. This is explained by the fact that more people are using the internet, which raises knowledge of the negative repercussions of illicit activity. A spike in people using the internet may reduce the size of the underground economy by lowering levels of corruption, since big shadow economies are frequently correlated with elevated degree of corruption (Elgin, 2013). This study aims to further explore this relationship and its implications for the underground economy. Previous scholarship fails to establish a clear and direct connection between population growth and the shadow economy. It does, nevertheless, have an effect on how corrupt things are in developing nations. Research indicates that in emerging countries, an underground market and corruption work hand in hand, with high levels of corruption fueling substantial black markets. (Hoinaru et al., 2020; Goel and Saunoris, 2014). The sample country in this study, Bangladesh, exhibits high corruption levels, which have likely contributed to its large underground economies. Since population growth is a factor contributing to corruption, especially in developing nations, an indirect and positive link between underground economies and population growth, via corruption, can be established for this study. This study aims to investigate the impact of high population growth, particularly in developing countries, where

limited resources must support a growing population, potentially leading individuals to seek income sources in the underground economy.

Scholarship based on the underground economy of subcontinental countries including Bangladesh are not vast yet worth mentioning. Haque in 2013 estimated the size of Bangladesh's underground economy from 1973-2008 using Tanzi's currency demand approach, revealing a growth from 7% to 62.75% of GDP, and highlights the negative impacts of this economy on tax and macroeconomic variables (Haque, 2013). Study by Khan and Rahman measured the size of the shadow economy from 1980-2010 and concluded that, not only restricts the government's fiscal ability and confuses development planning, but also exhibits a fluctuating trend relative to the official GDP, underscoring the importance of its measurement (Rahman and Khan, 2012). Another study found factors like bureaucracy, corruption and tax burden as primary factors impacting the informal economy of Bangladesh, thereby concluding that, while it may boost short-term economic growth, it ultimately hinders development by reducing productivity, reflecting policy failures, and perpetuating discrimination, necessitating measures such as improved information transmission, tax reduction, macroeconomic stabilization, and regulatory enhancements for sustainable economic development (Hassan, 2018). Erdinc and Suhail in 2017 compared sizes of informal economies of subcontinental countries and used OLS as the methodology and concluded that respective governments should take steps to reduce the size of the informal economies. Another study attempted to estimate the size of the informal economy in Pakistan from 1972 to 2010, using factors such as employment level, political stability, tax to GDP ratio, and the cost of working in the informal economy, and finds that about 71% of the economy was informal, suggesting that efforts to combat informality must be properly targeted. Study by Kiani, Zaman and Ahmed investigated the underground economy in Pakistan from 1975 to 2010 using a monetary approach, examining the long-term relationship between currency circulation and variables such as GNP, tax revenue, interest rates, and inflation, and finds that an increase in GNP and inflation positively affects currency circulation, while tax revenues and interest rates have a negative association, leading to the conclusion that the size of Pakistan's underground economy has increased from less than 30% in 1975 to 19.8% in 2010. A paper by Jones, Ram and Edwards examined the interplay between the informal economy and migration in advanced economies, focusing on the clothing and catering sectors in a British city, and reveals that low wages and illegal migration, while not organized by the firms, are key to their survival, suggesting that managing the issue may require encouragement rather than strict enforcement. The study by Orsi, Raggi and Turino in 2014, examined the underground economy using a dynamic and stochastic general equilibrium framework, combining limited tax enforcement with a two-sector neoclassical stochastic growth model, and finds, based on Bayesian estimation of Italian data, that the size of the underground sector has steadily increased due to rising taxation, suggesting that a moderate tax cut and stronger monitoring could reduce the size of the underground economy, stimulate the regular economy, and increase total fiscal revenues.

From a review of the literature, several gaps have been identified that this study seeks to address. First off, while underdeveloped countries needing reform deserve an examination of their underground economies, much research has concentrated on the industrialized world's underground economies. Secondly, previous studies have primarily measured the size of underground economies, neglecting to delve into the underlying reasons for their existence. Thirdly, ambiguities in the relationships between unemployment, GDP, and the underground economy warrant further investigation. It is also possible to investigate the relationship between the underground economy and the relatively recent variable of internet users.

Population needs to be examined, especially in relation to emerging nations. Finally, this analysis expands on earlier research by using estimates of the shadow economy from 2000 to 2020. Previous studies have frequently relied on outdated projections. These gaps in the literature provide the motivation for the present study and its unique contributions.

3. Hypothesis

Based on the literature review conducted in this study, several key factors influencing the underground economy in Bangladesh have been identified. These variables include growth in gross domestic product, increase in population, revenues from taxes, usage of the internet, price inflation, joblessness, and freedom in the economy. Previous research suggests that these variables may have significant effects on the size and dynamics of the underground economy.

Underground Economy and Inflation: Prior research has demonstrated a strong correlation between the extent of the underground sector and inflation. People may turn to the unofficial sector for alternate sources of income as inflation grows in order to pay for growing expenses (Kaghazian, Jojadeh and Naghdi, 2015). Therefore, it is hypothesized that there is a positive relationship between inflation and the underground economy in Bangladesh.

H1*: There is a positive relationship between the size of the underground economy and the inflation rate, ceteris paribus. This hypothesis suggests that all else being equal, as the inflation rate increases, the size of the underground economy also increases.*

Underground Economy and Unemployment: Similar to inflation, unemployment rates have been found to influence participation in the underground economy. High unemployment may drive individuals to seek informal employment opportunities to supplement their income. However, the direction of this relationship is ambiguous, with some studies suggesting a positive association while others propose a negative relationship (Bajada, 2005; Lisi, 2021). Thus, it is hypothesized that there is a significant relationship between unemployment and the underground economy, but the direction of this relationship is not clearly defined.

H2*: The extent of the black market economy and the rate of unemployment are significantly correlated, yet inversely, the relationship's direction is unclear. Here, the hypothesis suggests that there is a relationship between unemployment and the scale of the informal market, although it is unclear exactly what this relationship entails. It might have a good or bad effect.*

Underground Economy and Internet Usage: Internet usage has emerged as a potentially influential factor in shaping the underground economy, particularly with the growth of online commerce. Increased internet access may facilitate both legal and illegal transactions, affecting the size and composition of the underground economy (Elgin, 2013). Therefore, the following can be hypothesized.

H3*: With other conditions remaining same, there is an opposite association between the number of people using the internet and the size of the informal market. This hypothesis posits that, holding other factors constant, as the number of internet users increases, the volume of the informal economy decreases.*

Underground Economy and Tax Revenue: Tax revenue is another important determinant of the underground economy, as higher tax burdens may incentivize individuals and businesses to engage in informal economic activities to evade taxation. Previous research suggests a positive relationship between tax revenue and the underground economy(Blackburn, Bose and Capasso, 2012). Therefore, it is hypothesized that there is a positive relationship between tax revenue and the informal economy in Bangladesh.

***H4**: While all other conditions remain constant, tax income and the extent of the shadow economy are strongly associated. This hypothesis suggests that all else being equal, a higher level of tax revenue corresponds to a larger underground economy.*

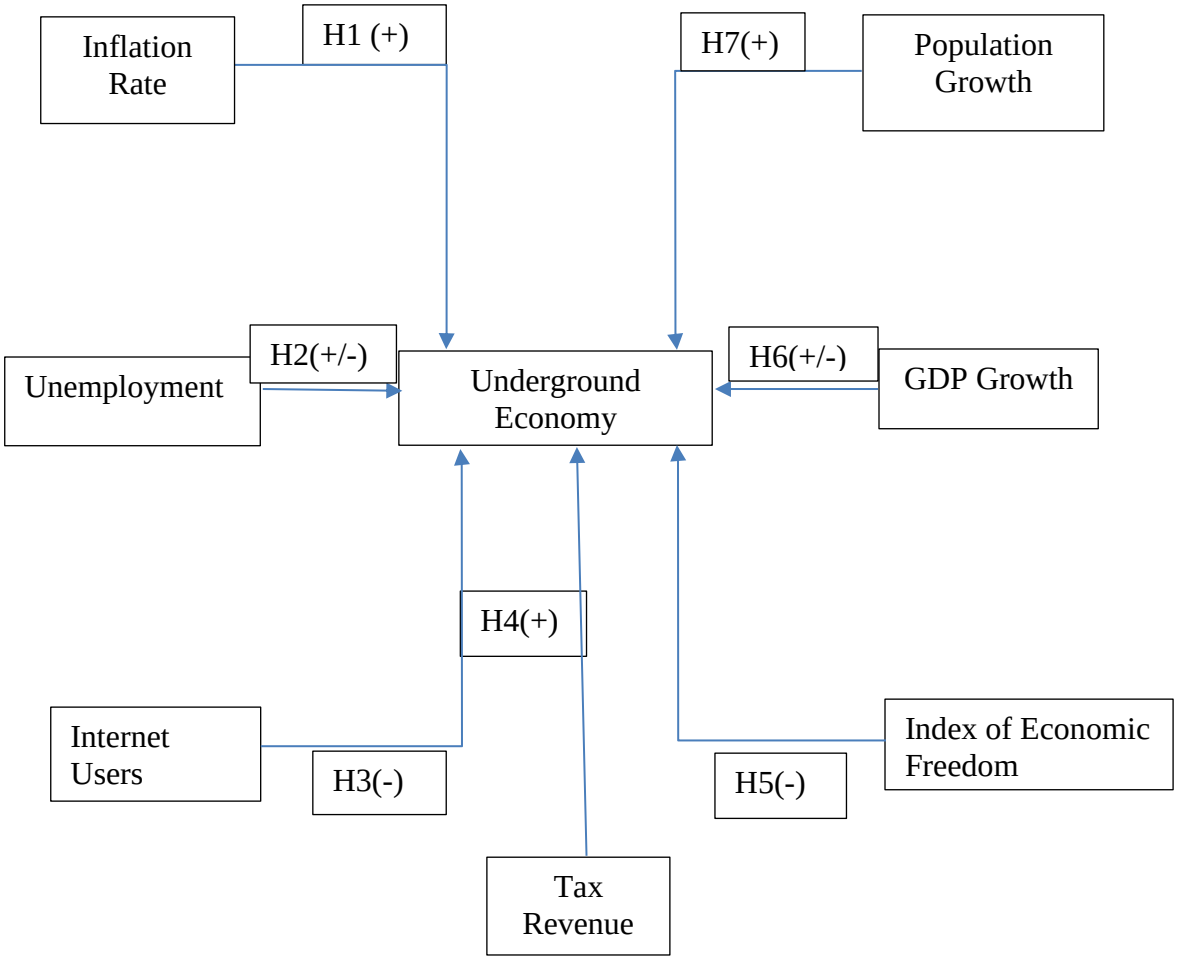

Figure: Research model for the study. Also used in previous research by Erdinc and Suhail in 2017.

Underground Economy and Economic Freedom: Economic freedom, as measured by indices such as property rights, freedom from corruption, and fiscal freedom, is expected to influence the underground economy. Countries with greater economic freedom may have lower barriers to entry for formal economic activities, thereby reducing the size of the underground economy (Khan and Rehman, 2022). Conversely, countries with more restrictive economic policies may experience larger underground economies (Dreher, Meon and Schneider, 2007). Therefore, a significant association between free enterprise and the economy of the underground is theorized, whereby smaller underground economies are linked to greater degrees of financial liberty.

***H5**: There is a negative relationship between the Index of Economic Freedom and the size of the underground economy, ceteris paribus. Here, the hypothesis proposes that as the Index of Economic Freedom decreases (indicating less economic freedom), the size of the underground economy increases.*

GDP Growth, Population Growth and Underground Economy: GDP growth and population growth are additional variables that may impact the underground economy (Tedds, 2005; Restrepo-Echavarria, 2015). Previous research has yielded mixed findings regarding the

relationship between GDP growth and the underground economy, while population growth may indirectly affect the underground economy through its influence on factors such as unemployment and tax revenue (Amzuica and Mititelu, 2023). Therefore, it is hypothesized that there is a significant relationship between GDP growth and the underground economy, as well as between population growth and the underground economy, but the directions of these relationships are ambiguous.

H6*: All factors held constant, there is a substantial but unclear correlation between the growth of GDP and the extent of the shadow economy. This hypothesis indicates that there is a connection between GDP growth and the size of the underground economy, but the direction of this relationship is not clearly defined.*

H7*: When all other factors are held constant, there is a significant association between the rise in population and the magnitude of the shadow economy. This hypothesis suggests that, holding other factors constant, as population growth increases, the size of the underground economy also increases.*

In summary, hypothesis development in this study is informed by prior investigations into the determinants of the underground economy in Bangladesh. By drawing on existing literature, relevant hypotheses have been formulated to guide the empirical analysis and contribute to a deeper understanding of the factors influencing underground economic activities in the country.

4. Research Methodology

The methodology section outlines the data sources, variable measurements, and analytical approach used in the study. This study will implement Ordinary Least Squares for the analysis. The ordinary least squares (OLS) algorithm is a method for estimating the parameters of a linear regression model. The OLS algorithm aims to find the values of the linear regression model's parameters (i.e., the coefficients) that minimize the sum of the squared residuals. Yasmin and Rouf implemented OLS to measure the size of informal economy in Pakistan (Yasmin and Rouf, 2003). Capasso and Jappelli in 2013 implemented the same method to conduct a comparative analysis of underground economies around the world. Goel. Saunoris and Schneider in 2019, applied the method to investigate the frivers of underground economy in the United States of America for a century (Goel, Saunoris and Schneider, 2019). The selection of variables and the econometric model employed appear appropriate for addressing the research questions and testing the hypotheses.

4.1. Quantification of Variables

This quantitative analysis, which has Bangladesh as its target nation, makes use of annual secondary data covering the years 2000 to 2020. Data pertaining to the underground economy is sourced from the World Bank, while information on the Index of Economic Freedom is obtained from The Heritage Foundation (Elgin et al, 2021). Remaining independent variables are gathered from The World Bank. The study employs Ordinary Least Squares analysis to estimate the model, with the dependent variable being the underground economy as a percentage of GDP, derived from World Bank data.

In terms of independent variables, the study employs the Headline Consumer Price Index (HCPI) on an annual basis to measure inflation. This index reflects changes in the cost of acquiring a basket of goods and services for an average consumer and is widely used in the literature for its effectiveness in capturing price changes over time. The proportion of the work force that is unemployed is used to calculate the unemployment rates for men and women. The percentage of individuals per total population using the internet is employed to gauge the

extent of internet usage within the population over the past 12 months. GDP growth is determined by the annual growth rate of GDP at market prices based on local currency. Despite its less common usage, this study includes it to explore its impact on GDP growth, particularly in the context of Bangladesh. Since data on the rates of taxation is not available, tax revenue is given as a proportion of gross domestic product (GDP). An overall governance index, comprising various indicators such as property rights, freedom from corruption, and fiscal freedom, is employed as a crucial determinant of shadow economies globally. This index is considered indispensable in understanding the dynamics of underground economies and thus cannot be overlooked in this study. Annual population growth, calculated as the exponential rate of growth of the midyear population from the previous to the current year, expressed as a percentage, is included to assess its impact on developing countries' underground economies. While previous studies primarily focused on developed countries' underground economies and overlooked this variable, its inclusion in this study aims to shed light on its significance for developing countries.

4.2 Model

The model's econometric form approximates what follows:

$$Y = \alpha + \beta1 \pm \beta2 - \beta3 \pm \beta4 + \beta5 - \beta6 + \beta7 + \mu$$

In this model, the magnitude of the shadow economy, represented as a percentage of GDP, is denoted by Y. The model includes a fixed value, α. The rate of inflation, measured by the Consumer Price Index, is represented by β1. The joblessness rate, calculated as a percentage of the total workforce, is denoted by β2. The online population, expressed as a percentage of the total populace, is represented by β3. The annual increase in GDP, given in percentage terms, is denoted by β4. Government revenue from taxes, expressed as a percentage of GDP, is represented by β5. The Economic Liberty Score, which is measured on a scale of 100, is denoted by β6. The yearly population increase, expressed in percentage terms, is represented by β7. Lastly, μ represents the deviation in the model.

5. Findings and Interpretation

The overall suitability of the model to the data is represented by the R value. It ranges from 0 to 1, with a value of 1 indicating a perfect fit. In table 1, the R value is 0.960. The R-squared value is another measure of the overall fit of the model to the data. It is calculated by squaring the R value, and it ranges from 0 to 1, with a value of 1 indicating a perfect fit. In the same table, the R-squared value is 0.922. The adjusted R-squared value is a version of the R-squared value that takes into account the number of predictor variables in the model. It is generally considered to be a more reliable measure of the model's fit than the R-squared value. In the table, the adjusted R-squared value is 0.880.

Table 1: Summary of Regression Model Predicting Underground Economy Size as a Percentage of GDP

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.960[a]	.922	.880	.307507984696875

a. Predictors: (Constant), H7_PopGro, H5_EconFreeIndx, H6_GDPGrowRate, H4_TaxRev, H2_Unemp(%of total labour force), H1_Inflation (CPI_a), H3_IntUsers(% of pop)

The ordinary least squares (OLS) regression model used in the study examines the impact of various factors on the underground economy in Bangladesh. The model reveals strong relationships:

R: A correlation coefficient of 0.960 indicates a robust positive relationship between predictors and the dependent variable (underground economy).
R Square: Approximately 92.2% of the variance in the underground economy can be explained by the model.
Adjusted R Square: Even after adjusting for predictors, the model remains strong at 0.880.
Key predictors include population growth, economic freelancing index, GDP growth rate, tax revenue, unemployment percentage, inflation, and internet users. These findings have implications for Bangladesh's supply chain dynamics.

Table 2: Regression Analysis of Factors Impacting the Underground Economy Size as a Percentage of GDP in Bangladesh

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	36.221	2.624		13.805	.000
	H1_Inflation (CPI_a)	.163	.062	.369	2.626	.021
	H2_Unemp(%of total labour force)	.362	.227	.200	1.599	.134
	H3_IntUsers(% of pop)	-.081	.017	-.927	-4.742	.000
	H4_TaxRev	-.444	.153	-.376	-2.904	.012
	H5_EconFreeIndx	.015	.045	.056	.340	.740
	H6_GDPGrowRate	-.109	.085	-.138	-1.281	.223
	H7_PopGro	.341	.455	.120	.749	.467

a. Dependent Variable: Y_Inf Eco Size(as % ofGDP)

The findings from the statistical output of the OLS model can be concluded as such:
Inflation (CPI): The coefficient of 0.163 suggests that for every unit increase in the Consumer Price Index (a measure of inflation), the size of the underground economy as a percentage of GDP increases by 0.163 units, holding all other variables constant. The p-value of 0.021 indicates that this effect is statistically significant at the 5% level. It supports the H1 of the study. This finding is consistent with that of the recent research on the context (Koreshkova, 2006; Ahiabu, 2006; Cziraky and Gillman, 2004; Cesaroni, 2014).

Internet Users (% of pop): The negative coefficient of -0.081 suggests that for every percentage point increase in the proportion of the population that uses the internet, the size of the underground economy as a percentage of GDP decreases by 0.081 units, holding all other variables constant. The p-value of less than 0.001 indicates that this effect is statistically significant at the 5% level. This result supports the H3 of the study also consistent with the recent finding regarding the matter (Kraiwanit, 2016; Zhuge et al, 2009; Herley and Florencio, 2010; Yip, 2010).

Tax Revenue: The negative coefficient of -0.444 suggests that for every unit increase in tax revenue, the size of the underground economy as a percentage of GDP decreases by 0.444 units, holding all other variables constant. The p-value of 0.012 indicates that this effect is statistically significant at the 5% level. And this supports the H4 of this study and also consistent with the recent scholarship (Tedds and Giles, 2002; Sam, 2010; Wang and Zhang, 2022; Tatariyanto, 2014). The other variables in the table (Unemployment, Economic

Freedom Index, GDP Growth Rate, and Population Growth) are not statistically significant at the 5% level, suggesting that they do not have a significant impact on the size of the underground economy as a percentage of GDP, given the other variables in the model.

6. Implications

The implications of factors affecting the underground economy of Bangladesh—Inflation, Number of Internet Users, and Tax Revenue—on the country's supply chain are significant. Here's an integrated analysis of how each factor can impact Bangladesh's supply chain:

Inflation:

Inflation, a general increase in prices and fall in the purchasing value of money, can have significant implications on the supply chain (Padiyar et al., 2022). One of the primary impacts is the potential for shrinking demand. As prices rise due to inflation, consumers may find themselves with less disposable income. This reduction in spending power can lead to a decrease in demand for goods and services. For businesses, this necessitates better demand planning and forecasting (Sfetcu et al, 2017). Understanding consumer behavior becomes crucial as it directly influences manufacturing, transportation, inventory management, and sourcing of raw materials (Amorim et al., 2014). Another significant impact of inflation on the supply chain is the increase in costs. Inflation can drive up the direct costs for materials, labor, energy, and transportation (Padiyar et al., 2022; Furceri et al., 2022). As a result, it becomes more expensive to manufacture, store, and ship goods. This increase in costs can put significant pressure on profit margins, requiring businesses to plan their resources and materials more effectively. Inflation can also lead to instability in the supply chain. Problems such as port congestion, import container issues, and labor availability can be exacerbated by inflation. These issues can lead to capacity constraints, rate and price increases, longer lead times, delayed orders, and continued issues with shipping containers (Ye et al, 2023). The impact of inflation on working capital is another important consideration. In an attempt to control inflation, central banks like the Bangladesh Bank may increase interest rates. This makes borrowing more expensive, which can affect a business's working capital (Fraisse, Le and Thesmar, 2015; Beutlar et al., 2020). As a result, businesses need to monitor and optimize their working capital and inventory buffers closely. Lastly, inflation can exacerbate supply chain disruptions, which have been shown to significantly influence inflation. These disruptions can result in order backlogs for many raw and intermediate goods. Simultaneous bottlenecks in transportation can further exacerbate these issues. In conclusion, inflation can have a profound impact on various aspects of the supply chain, from demand planning to cost management, supply chain stability, and working capital management. It's crucial for businesses to understand these impacts and develop strategies to mitigate them. This understanding allows businesses to navigate the challenges posed by inflation and ensure the smooth operation of their supply chains.

Number of Internet Users:

The rise in the number of internet users has significant implications on supply chain management. One of the primary impacts is the potential for direct purchasing and selling. The internet has reduced the need for intermediate agencies and professionals in supply chain management (Ranganathan, Dhaliwal and Teo, 2004). Consumers can now purchase directly from manufacturers, and businesses can sell directly to customers through internet selling activities. This shift has streamlined the supply chain, reduced costs and increasing efficiency. Another significant impact of the rise in internet users is the digital transformation of the supply chain, often referred to as Supply Chain 4.0. This transformation involves the application of the Internet of Things (IoT), the use of advanced robotics, and the application of

advanced analytics of big data in supply chain management. The digital transformation enables supply chains to become faster, more granular, and much more precise. It allows businesses to track and manage their supply chains in real-time, leading to improved efficiency and reduced costs (Khan et al, 2022; Al Shorman et al., 2023).

The Internet of Things (IoT) plays a crucial role in this digital transformation. IoT creates a connected network between physical objects and devices through the internet. These connected devices can be located, identified, and controlled remotely, leading to improved supply chain management. IoT has a positive impact on supply chain performance metrics, enhancing supply chain capabilities and indirectly enhancing supply chain management competitive advantages. The use of the internet in supply chain management can also lead to increased efficiency. It can reduce service levels, decrease the allocation of resources, and reduce transportation costs. This increase in efficiency can lead to cost savings for businesses, making their supply chains more sustainable and profitable (Vaas, Shee and Miah, 2020). In conclusion, the number of internet users can significantly impact the supply chain, from direct purchasing and selling to digital transformation, IoT, increased efficiency, and improved supply chain capabilities. It's crucial for businesses to understand these impacts and develop strategies to leverage the internet effectively in their supply chain management. This understanding allows businesses to navigate the challenges posed by the digital age and ensure the smooth operation of their supply chains.

Tax Revenue:

Firstly, taxes directly impact the cost of production. When taxes are imposed on producers, they increase the cost of production as producers now have to allocate a portion of their revenue to pay these taxes. This increase in production cost shifts the supply curve to the left, resulting in a decrease in the quantity supplied at each price level. This can lead to a decrease in the overall output of the economy, which can have a ripple effect on the supply chain (Blanchard and Perotti, 2002). Secondly, tax revenue can cause disruptions in the supply chain. Economic recovery is gaining traction, but there are many signs of sustained pressure on global supply chains. Capacities are severely impacted by factors such as extended lockdowns, labor shortages, protectionist measures, and increased demand for transparency. These disruptions require close collaboration among companies' teams in developing sound and sustainable solutions (Zhang and Gao, 2021). Thirdly, tax policy affects the pace of digitalization in the supply chain. Digitalization is being embraced at an unprecedented rate, and this is creating new opportunities for data-enabled decision-making. However, the barriers to entry and the opportunities that come along with digitalization are all affected by tax policy (Ivanov, Dolgui and Sokolov, 2018). Fourthly, tax revenue has implications on global restructurings in the supply chain. Restructuring and reorganization are common tactics in implementing supply chain strategies. However, companies need to address key considerations especially in light of emerging tax and legal policy developments (Balaji and Viswanadham, 2008). Fifthly, tax revenue can trigger international trade issues. Companies need to understand trade, tax, customs, and transfer pricing issues in relation to planning and implementing sourcing and manufacturing strategies. This is particularly important in the context of trade wars and other international trade triggers. Lastly, tax revenue impacts consumer prices. Taxes are typically introduced to increase government revenue, but they also have the effect of raising the cost of goods and services to the consumer. Because of the increased cost, we generally see a reduction in the quantity of goods and services produced and consumed after the introduction of taxes.

In summary, inflation, the number of internet users, and tax revenue all have significant implications on the supply chain in Bangladesh. Inflation can increase the cost of goods and services within the supply chain, affecting both suppliers and consumers, and is influenced by various factors such as natural disasters, oil prices, and currency depreciation. The number of internet users, which stood at 52.58 million as of January 2022, can enhance supply chain management through improved communication and more efficient operations (Hasan, 2023). Lastly, tax revenue influences production costs and consumer prices. While tax reforms in Bangladesh have improved the efficiency of the tax administration and equity in the tax system, they can also lead to a reduction in the quantity of goods and services produced and consumed. Therefore, understanding these factors is crucial for businesses to make informed decisions and optimize their operations in the context of Bangladesh's supply chain.

Implications of the significant factors on the country's underground economy:
The presence of a significant underground economy can create inefficiencies in the formal supply chain, as informal businesses may offer lower prices due to tax evasion and reduced regulatory costs. Consumers may struggle to ascertain the quality and authenticity of products and services within an economy where underground activities are prevalent, affecting the entire supply chain. Regulating and enforcing standards in a dual economy scenario can be challenging, leading to difficulties in maintaining fair competition and ensuring consumer protection. A large underground economy may deter both foreign and domestic investment in the formal sector due to perceived higher risks associated with informal, unregulated activities.

Understanding these implications is crucial for policymakers, businesses, and stakeholders in Bangladesh's supply chain. Efforts to reduce the size of the underground economy and promote formalization can lead to a more transparent, competitive, and sustainable supply chain ecosystem. This might involve measures such as improving tax compliance, promoting digital literacy and formal online platforms, and creating incentives for businesses to operate within the formal sector. Additionally, it's essential to acknowledge the limitations of the research, such as data availability and potential omitted variables, when drawing conclusions about the factors influencing the underground economy. Further research would be necessary to fully understand the nuances and specific mechanisms at play.

Conclusion
In conclusion, this study provides an in-depth analysis of Bangladesh's underground economy. The research utilizes an Ordinary Least Squares (OLS) approach to determine the effect of key aspects such as inflation, internet usage, and tax revenue on the underground economy. The title reflects the study's methodological approach and its focus on the underground economy's implications for Bangladesh's supply chain. The OLS approach allows for a robust and precise estimation of the relationships between the variables of interest. This methodological choice is a significant contribution of this study, as it provides a rigorous framework for understanding the dynamics of the underground economy.

High inflation disrupts supply chains, pushing businesses towards the informal sectors. This study quantifies this effect, providing a clear understanding of the relationship between inflation and the growth of the underground economy. The proliferation of the internet has led to the emergence of digital black markets. These digital black markets can disrupt the supply chain by creating parallel, unregulated channels for goods and services. Furthermore, tax evasion and inefficient collection systems have been found to exacerbate the size of the underground economy, thereby hindering government revenue. This lack of revenue can lead

to underinvestment in infrastructure and services that are critical to a well-functioning supply chain.

To address these challenges, this study proposes a comprehensive approach that includes promoting formalization, enhancing tax compliance, and strengthening regulatory frameworks. It underscores the importance of digital literacy and incentives for participation in the formal sector, providing concrete recommendations for policymakers. Despite its limitations, this study makes a significant contribution over past studies by offering valuable insights for policymakers to mitigate these challenges and foster economic growth in Bangladesh. It provides a robust foundation for future research to build upon and refine these findings.

Applications

The findings of this study have several practical applications. Policymakers can use these insights to develop strategies that encourage formalization and tax compliance, thereby reducing the size of the underground economy. The study's findings can guide efforts to enhance digital literacy, which can help curb the growth of digital black markets. The study also provides concrete recommendations for improving tax collection systems, which can help increase government revenue and support the development of infrastructure critical to the supply chain.

Limitations and Future Research Directions

While this study provides valuable insights, it is not without its limitations. The study primarily found three factors influencing the underground economy - inflation, internet usage, and tax revenue. Future research could explore other potential factors influencing the underground economy that were not covered in this study. Additionally, longitudinal studies could provide a more in-depth understanding of the dynamics of the underground economy over time. Future research could also investigate the effectiveness of different strategies for promoting formalization and tax compliance, providing a more critical understanding of how to tackle the challenges posed by the underground economy.

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