DOI: 10.5281/zenodo.11633112

Journal of Contemporary Macroeconomic Issues
www.sceker.org

Unmasking the Dynamics: Drivers of the Shadow Economy in SAARC Countries

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PAPER INFO

Information:
Received: 2 April, 2024
Revised: 12 June, 2024
Published: June, 2024

Keywords:
Shadow economy, unemployment, tax, trade, governance, economic freedom, MM-QR analysis

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ABSTRACT

The study aims to investigate the determinants of shadow economy in SAARC countries, during the period of 1995 to 2021. The study uses three proxies for shadow economy as dependent variables, which are the ratio of reserve to narrow money (Shadow-1), the ratio of narrow to broad money (Shadow-2), and the ratio of currency in circulation to broad money (Shadow-3), while trade, tax, unemployment, government final consumption expenditure (GFCE), governance index (GI), and economic freedom index (EFI) used as independent variables. The study applies second generation panel unit root test and method of moments-quantile regression (MM-QR) technique. The finding of the study as theoretically expected independent variables, trade, tax, unemployment, and government final consumption expenditure (GFCE) have positive and significant coefficients, while governance index (GI), and economic freedom index (EFI) have negative and significant effect on the shadow economy in SAARC countries. The study suggests that the economic freedom and governance quality should be improved and government size, tax, and unemployment should be decreased to control the shadow economy in SAARC countries.

1 Introduction

In the early 1970s, the shadow economy became a topic of significant academic interest. Although research on measuring this phenomenon and its determining factors was already extensive (Manolas et al., 2013), accurately gauging the shadow economy posed challenges due to the clandestine nature of the activities involved. Those engaged in shadow economic activities deliberately operate covertly, making it difficult to gather precise data. The need for comprehensive information about the extent and evolution of the shadow economy over time holds both political and economic significance. Furthermore, understanding the entire spectrum of economic activities, encompassing both official and unofficial production of goods and services, is crucial within the framework of economic policies. These policies must adapt to fluctuations and foster economic progress over time and across regions. Additionally, the size of the shadow economy, often termed its volume, plays a pivotal role in estimating tax evasion and subsequently informs decisions regarding its potential regulation (Medina & Schneider, 2018). Empirical research into the scope of the shadow economy has expanded globally (Schneider & Williams, 2013; Schneider, 2015). Various terms such as informal economy, black economy, gray economy, hidden economy, cash economy, and lack economy are used interchangeably to describe the shadow economy. All these terms encompass activities that operate outside official channels for regulatory, monetary, and institutional reasons. The shadow economy includes activities evading bureaucratic or regulatory regulations (regulatory reasons), eluding tax payments and social security contributions (monetary reasons), and being influenced by corruption, weak rule of law, and the quality of political structures and institutions (institutional reasons). These

activities, if recorded, would contribute positively to the national GDP, indicating their legal and productive nature. Therefore, defining the shadow economy entails distinguishing it from illegal and criminal activities, household activities, or do-it-yourself endeavors (Medina and Schneider, 2018).

The shadow economy poses significant challenges to governance and economic development. Despite its fraudulent nature, it operates in parallel with the official economy, distorting market dynamics, perpetuating income inequality, and undermining taxation. This widespread phenomenon manifests in various forms, including unregistered businesses, undocumented work, and illicit activities. The issue at hand is that the shadow economy hampers economic growth and stability in a country. It obstructs the achievement of sustainable development goals, reduces state revenue, exacerbates income disparity, and hampers the effectiveness of public policies.

The primary objective of this study is to investigate the growth of knowledge concerning the shadow economy in SAARC countries from 1995 to 2021. Figure 1 portrays the average shadow economy as a percentage of GDP was 33.59% in Bangladesh, 26.93% in Bhutan, 23.91% in India, 27.44% in Maldives, 37.50% in Nepal, 33.10% in Pakistan, and 45.58% in Sri Lanka from 1991 to 2015, (Medina and Schneider, 2018).

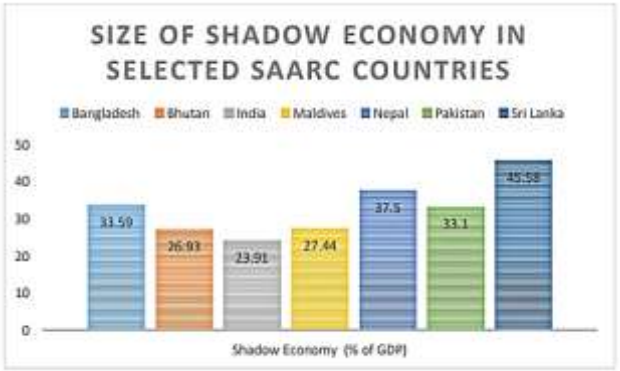

Figure 1
The Size of Shadow Economy in Selected SAARC Countries
Source: Medina and Schneider, 2018

The prevalence of the shadow economy poses a significant challenge in SAARC countries and is one of the key factors contributing to the underdevelopment of this region. To address this issue, we analyzed 26 years of data using the latest MM-QR technique to unveil the extent of the shadow economy in SAARC countries.

The study investigating the factors influencing the shadow economy in SAARC countries holds significant importance due to its potential to offer valuable insights into the underlying causes of clandestine economic activities in this region. Commissioned by the South Asian Association for Regional Cooperation (SAARC), the study focuses on eight member states: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. For policymakers, economists, and researchers, comprehending the elements driving the shadow economy in SAARC countries is crucial. This understanding can shed light on the root causes and ramifications of informal economic activities, enabling more informed decision-making and policy formulation.

The findings of this study have the potential to make a significant contribution to a deeper understanding of the economic conditions and structural factors that fuel the expansion of the shadow economy in SAARC nations. By analyzing various causes, including but not limited to instances of corruption, tax burdens, informal institutions, economic growth, and regulatory frameworks, the study can identify the primary drivers of the shadow economy. These findings can offer policymakers evidence-based insights, enabling them to design and implement successful

policies aimed at reducing the size of the shadow economy and mitigating its adverse effects, such as tax evasion, low formal sector employment, and decreased government revenue. Such insights are invaluable for creating and executing effective policies to minimize both the size and negative consequences of the shadow economy.

Secondly, this study can facilitate a comparative analysis across the nations comprising the SAARC, shedding light on disparities in the factors influencing the size of the shadow economy in each country within the region. Each member state operates within its distinct socio-economic milieu, legal frameworks, and institutional governance arrangements. The study holds the potential to uncover specific trends and elements unique to each country, which contribute to the growth of informal economic activities. This can be achieved by investigating the factors influencing the shadow economy in each nation as a starting point. This comparative research has the capacity to provide valuable insights to policymakers and other stakeholders, enabling them to identify distinctive challenges and formulate tailored solutions to effectively tackle this issue.

Lastly, the study's findings could significantly augment the existing body of literature on the shadow economy by enriching our understanding of the determinants of underground economic activities in developing countries, especially those within the SAARC region. Although this subject has been explored previously, there exists a notable gap in extensive studies solely focusing on SAARC nations. This work has the potential to advance academic discourse and lay a foundation for further research, bridging the identified gap. Furthermore, these findings could prove invaluable for international organizations, such as the World Bank and the International Monetary Fund, in their endeavors to support policy reforms and foster economic development in the SAARC region.

The purpose of this study is to investigate the determinants of the shadow economy in SAARC countries. The study uses data from 1995 to 2021 for SAARC countries, excluding Afghanistan due to data unavailability. We have applied the Method of Moments-Quantile Regression (MM-QR) technique. The dependent variables used are monetary indicators, namely the ratio of reserves to narrow money (Shadow-1), the ratio of narrow to broad money (Shadow-2), and the ratio of currency in circulation to broad money (Shadow-3). The independent variables include trade, tax, unemployment, government final consumption expenditure (GFCE), governance index (GI), and economic freedom index (EFI). This study introduces a novel approach by employing the MMQR technique, utilizing monetary aggregates to calculate the size of shadow economy. Notably, no prior research has specifically focused on the shadow economy (S.E) in SAARC countries using this innovative MMQR technique, nor has any study incorporated data spanning from 1995 to 2021 for these nations.

The study is organized as follows: Section 2 delves into the literature reviews. Section 3 outlines the concept and determinants of the shadow economy. Section 4 discusses the model, data, and methodology. Section 5 evaluates the determinants of the shadow economy through a method of moments-quantile regression (MM-QR) analysis. Section 6 presents the conclusions and policy recommendations. Section 7 provides suggestions for future research.

2 Literature Review

In this section, the study discusses literature reviews from various research papers related to the determinants of the shadow economy.

Manolas et al. (2013) examined the causes of the shadow economy (SE) in 19 OECD countries, utilizing panel data from 2003 to 2008. They employed the panel estimated generalized least squares (EGLS) methodology, considering shadow economy as the dependent variable. Independent variables included control of corruption, deregulations of the credit and labor markets, regulation of product market, government efficiency, and tax burden. The findings indicated adverse relationships between control of corruption, government efficiency, labor and credit market deregulations, and

product market regulation with the SE. However, tax burden was directly linked to the SE in these economies.

Remeikiene et al. (2014) investigated the causes of the SE in Greece, employing time series data from 2005 to 2013. Their study utilized correlation and multiple regression analyses, treating shadow economy as the dependent variable. Independent variables included domestic credit, tax rate, payment of tax, total labor force, unemployment rate, and GDP. The study revealed negative impacts of domestic credit, tax payment, and GDP per capita on the SE, while tax rate, unemployment rate, and total labor force positively affected the SE in Greece. The study suggested a deeper analysis of Greece's current tax structure.

Acosta-Gonzalez et al. (2014) conducted an empirical study on the causes of SE in 38 OECD economies, utilizing panel data from 1991 to 2007. Their research employed genetic algorithms and the SIC method. Shadow economy was the dependent variable, and independent variables included capital gains and corporate taxes, domestic credit, bank secrecy, globalization index, urban population, ethnic fractionalization index, corruption index, and socialist origin of state. The results indicated negative associations with taxes on capital gains, bank secrecy, globalization index, urban population, and ethnic fractionalization index, while corporate taxes, corruption index, and socialist origin of state positively affected the shadow economy.

Gaspareniene et al. (2016) investigated the influence of SE causes on Ukraine's economy using time series data from 2005 to 2012. Their study applied correlation and multiple regression analyses, treating shadow economy level as the dependent variable. Independent variables included imports of goods and services, GDP per capita, labor force, tax rate, and unemployment rate. The study found negative impacts of imports, GDP per capita, and labor force on the SE, while tax rate and unemployment rate positively affected the SE in Ukraine's economy.

Din (2016) probed the factors of the SE in Malaysia using time series data from 1971 to 2013. The study utilized modified cash deposits ratio (MCDR) and DOLS approaches, considering shadow economy as the dependent variable. Independent variables included government consumption, GDP per capita, domestic credit, personal income tax, and service tax. The findings showed negative relationships between government consumption, GDP per capita, service tax, and the SE. However, domestic credit and personal income tax positively affected the SE in Malaysia. The research suggested implementing programs to decrease the SE, improve credit market access, and reform the financial sector in Malaysia.

Goel and Nelson (2016) delved into the factors of SE in 133 economies using panel data from 2006 to 2015. Their study applied the currency demand approach and the MIMIC method. Shadow economy was the dependent variable, while independent variables included GDP, democracy, inflation rate, government size, start-up procedures, start-up time, start-up cost, registration procedures, registration time, and tax payment. The results indicated harmful relationships between GDP, democracy, government size, and tax total with the SE. Inflation rate, registration time, start-up procedures, start-up time, registration procedures, start-up cost, and tax payment were directly linked to the SE.

Davidescu (2017) inquired into the causes of SE in Romania's economy, using data from 2000 to 2013. Their research applied the MIMIC technique, treating shadow economy as the dependent variable. Indicator variables included the index of real GDP and the currency ratio M1/M2, while causal variables comprised the rate of unemployment, self-employment, government employment rate, and real interest rate. The results indicated negative associations between the index of real GDP, currency ratio M1/M2, and real interest rate with the SE. However, the rate of unemployment and self-employment rate positively affected the shadow economy in Romania's economy.

Medina and Schneider (2018) investigated SE in 158 nations worldwide using panel data from 1991 to 2015. Their study applied the CDA approach and MIMIC methods, considering shadow economy as the dependent variable. Causal variables included unemployment rate, size of government, rule of law, control of corruption, fiscal freedom, and government stability. Indicator variables included currency, labor force participation rate, and GDP per capita growth. The study revealed positive impacts of unemployment rate and government size on the shadow economy. However, openness of trade, GDP per capita, fiscal freedoms, rule of law, control of corruption, government stability, labor force, and GDP per capita growth negatively affected the SE.

Berdiev and Saunoris (2018) analyzed the impact of globalization on the shadow economy in 119 countries using panel data from 2000 to 2007. Their study applied the MIMIC technique and the dynamic general equilibrium model, treating shadow economy as the dependent variable. Independent variables included economic globalization, political globalization, social globalization, GDP per capita, education, credit market regulations, labor market regulations, and government size. The study found negative associations with political globalization, social globalization, GDP per capita, and credit market regulations, while economic globalization, education, government size, and labor market regulations positively affected the shadow economy.

Mughal and Schneider (2018) investigated the interaction and size of the shadow economy with the official economy in Pakistan using time series data from 1973 to 2015. Their study applied Autoregressive Distributed Lag (ARDL), Engel Granger, and currency demand approaches, considering shadow economy as the dependent variable. Independent variables included tax to gross domestic product (GDP) ratio, unemployment rate, public administration and defense expenditure, public administration and defense expenditure per capita, GDP per capita, inflation rate, and household consumption per capita. The findings indicated adverse connections with GDP per capita but positive relationships with tax to GDP ratio, unemployment rate, public administration and defense expenditure, public administration and defense per capita, inflation rate, and household consumption per capita in Pakistan's economy.

Navickas et al. (2019) explored the determinants of the unofficial economy in Eastern European countries using panel data from 2003 to 2016. Their study applied the MIMIC method, considering shadow economy as the dependent variable. Independent variables included tax burden on income, unemployment rate, corruption, income inequality, self-employed individuals, business freedom, and tax burden on consumption. The results showed negative impacts of the tax burden on income and business freedom on the shadow economy. However, the unemployment rate, corruption, income inequality, self-employed individuals, and tax burden on consumption positively affected the shadow economy.

Angour and Nmili (2019) explored tax evasion and the shadow economy in Morocco's economy. They analyzed data from 1985 to 2016 using the MIMIC methodology. The study considered gross domestic product (GDP) per capita and money supply as indicator variables, while unemployment rate, inflation rate, urbanization rate, tax burden, openness rate, public spending index, and Agricole added value were treated as causal variables. The results indicated that GDP per capita, inflation rate, urbanization rate, openness rate, public spending index, and Agricole added value were inversely related to the shadow economy, whereas money supply, unemployment rate, and tax burden showed a direct association with the shadow economy in Morocco.

Lahlou et al. (2020), the formation and size of the shadow economy in Morocco were examined using time series data from 1988 to 2018. The study employed CDA and MIMIC methods, considering variables such as GDP per capita, agriculture value-added per capita, interbank interest rate, private credit, financial market access index, tax revenue, and unemployment rate. The findings revealed a negative correlation between interbank interest rate and financial market access index with the

shadow economy, while per capita GDP, agriculture value-added per capita, tax revenue, private credit, and unemployment rate were positively associated with it.

Khan et al. (2021) investigated the role of shadow economy determinants in non-OIC and OIC countries using panel data from 1991 to 2015 and applying the GMM technique. Variables like GDP growth rate, money supply, government expenditure, GDP per capita, employment rate, tax, international trade, unemployment rate, political stability, regulation quality, rule of law, trade freedom, economic freedom, and business freedom were analyzed. The study found that GDP growth rate, money supply, employment rate, international trade, political stability, regulation quality, rule of law, economic freedom, and business freedom negatively impacted the shadow economy, whereas government expenditure, tax, unemployment rate, and trade freedom had a positive influence.

Elmirzaev and Elmurodov (2021) investigated factors contributing to the shadow economy in 35 Asian countries using data from 1991 to 2015 and employing panel regression analysis. Variables such as GDP per capita, inflation rate, trade openness, tax revenue, GDP per capita growth, individual internet usage, unemployment rate, and government indicators were examined. The study revealed a negative association between GDP per capita, tax revenue, trade openness, and governance indicators with the shadow economy. Conversely, the rate of unemployment and individual internet usage were positively correlated. The study suggested that transforming undocumented activities into documented ones, ensuring political stability, adhering to the rule of law, embracing technological advancements, and improving regulatory quality could enhance the economy and reduce the shadow economy.

Garcia and Sanches (2021) explored shadow economy determinants in Portugal's economy using time series data from 1983 to 2015. The study utilized Newey West correction and multiple regression analysis techniques, considering variables such as social security expenditure, unemployment rate, indirect rate, real GDP growth rate, and self-employment rate. The results indicated that social security expenditure and real GDP growth rate negatively affected the shadow economy, while the rate of unemployment, indirect tax, and self-employment rate had a positive impact.

Tran et al. (2022) examined the role of fiscal deficit, government spending, and shadow economy in 32 Asian countries using panel data from 2000 to 2017. DOLS and FMOLS methods were applied, and variables such as trade openness, government expenditure, fiscal deficit, GDP per capita, unemployment rate, and inflation rate were analyzed. The study found that GDP per capita and trade openness had a negative influence on the shadow economy, while government expenditure, fiscal deficit, unemployment rate, and inflation rate positively impacted it. The study suggested that governments should consider fiscal policy adjustments, as an increase in government spending also led to an increase in the shadow economy.

Alfoul et al. (2022) investigated shadow economy determinants in 132 countries using panel data from 1991 to 2017 and the extreme bounds analysis (EBA) method. Variables like law, internal conflict index, bureaucracy quality index, monetary freedom, corruption index, inflation level, and poverty level were considered. The study revealed a negative association between law, internal conflict index, bureaucracy quality index, monetary freedom, and corruption index with the shadow economy, while inflation level and poverty level were positively associated. The authors suggested that policymakers should create a transparent and democratic environment to reduce overregulation and bureaucracy.

In a comprehensive analysis of various studies on shadow economy determinants in OECD countries, OIC countries, and developing nations, both time series and panel data from 1961 to 2018 were utilized. These studies employed the MIMIC approach, CDA approach, and GMM approach. Commonly, variables such as unemployment rate, corruption indicator, real GDP growth rate, direct tax, indirect tax, income tax, self-employment, and corporate tax were found to have a positive association with the shadow economy. On the contrary, variables including employment rate,

democracy indicator, labor force, GDP per capita, governance index, and economic freedom index were negatively related to the shadow economy. Inflation rate, government size (expenditure), trade, and tax showed mixed effects on the shadow economy. The research gap in this study lies in the use of three unique proxies to identify the shadow economy. Prior to this study, very few research works employed these specific monetary aggregates for this purpose. The study applied the method of moments quantile regression technique, a method scarcely used in previous studies on shadow economy analysis.

3 Shadow Economy (SE): Concept and Determinants

Now, we delve into the concept and factors underlying the shadow economy (SE). This exploration relies on the conceptualization and definition of the shadow economy, as well as methods for measuring it. Three significant schools of thought have emerged in the study of the shadow economy: the dualist, structuralist, and legalist perspectives (ILO, 1972; Portes et al., 1989; Khan et al., 2021). The dualist school of thought posits that the shadow economy operates independently of the official economy. In contrast, the structuralist perspective emphasizes the influence of a nation's political climate, institutions, and historical context, shaping a structure where the shadow economy serves as a parallel component to the formal economy. Conversely, the legalist school of thought views the shadow economy as a response to excessive regulations within the formal economy (Khan et al., 2021). Considering these viewpoints, it can be concluded that the shadow economy is a sophisticated, complex, and heterogeneous phenomenon.

Defining the shadow economy presents a challenge for researchers involved in its measurement. A commonly employed definition encompasses all economic activities that are currently unregistered but are included in the estimated Gross Domestic Product (GDP) (Frey and Pommerehne, 1984; Feige, 1994; Schneider, 1994). Furthermore, Smith (1997) defines the shadow economy as the "market-based production of goods and services, whether legal or illegal, that escapes detection in the official estimates of GDP."

The principal reasons for the indicators of the shadow economy are outlined as follows:

Social Security and Tax Contribution Burdens

The overall tax burden is distorted, impacting leisure activities and potentially increasing demand for labor in the shadow economy. The incentive to reduce the tax burden and work in the shadow economy intensifies with the disparity between total labor costs in the formal economy and after-tax earnings. The survival of the shadow economy relies heavily on social security payments, a significant component of the overall tax burden (Schneider, 2005; Medina and Schneider, 2018).

Quality of Institutions or Corruption

The growth of the informal sector is significantly influenced by the quality of governmental institutions. More critical than the actual tax burden and regulations is how efficiently and fairly the government enforces laws and the tax code. This affects people's decisions to work in the unregulated sector. A robust legal system that safeguards property rights and enforceability enhances the benefits of being official. However, a corrupt bureaucracy is associated with substantial informal activities. Effective taxation, funding essential government services, indicates sound policy. Official production correlates inversely with taxation and benefits from productive government services, whereas the shadow economy exhibits the opposite relationship due to inadequate support for a market economy by political institutions (Dreher and Schneider, 2010; Schneider and Williams, 2013; Hassan and Schneider, 2016).

Regulations

Regulations such as trade barriers or labor market regulations limit individual choices in the formal economy. Economies with extensive regulations increase labor costs in the formal sector, motivating

individuals to engage in unofficial activities. Such economies often exhibit a significant contribution from the informal economy to the total gross domestic product due to insufficient enforcement of regulations, burdening individuals and firms and pushing them towards the shadow economy (Medina and Schneider, 2018).

Public Sector Services

A burgeoning shadow economy often reduces national revenue, leading to a decline in the quality and quantity of mass production. Consequently, tax rates for individuals and firms increase, while the quality of public goods and administration deteriorates. This deterioration encourages greater participation in the shadow economy. States with minimal tax rates, limited regulations, and a strong rule of law with consistent anti-corruption measures experience fewer shadow economy practices (Medina and Schneider, 2018).

Tax Morale

The size of the shadow economy indirectly depends on the effectiveness of the public sector, as it significantly impacts tax morale. A psychological agreement on taxation compliance arises when essential rights and duties between taxpayers and authorities are respected. Taxes are paid honestly when taxpayers believe they will result in public goods and services. How taxpayers are treated by authorities plays a crucial role; treating taxpayers as equal partners in a tax contract, rather than subordinates, fosters honest tax payments. Internalized tax morale and entrenched social norms reduce the likelihood of individuals resorting to the shadow economy (Kirchler, 2007; Medina and Schneider, 2018).

Deterrence

Surprisingly, empirical research on deterrence, despite its emphasis in policies combating the shadow economy and the clear stance of conventional economic theory on taxpayer non-compliance, is scarce. Limited data on legal proceedings and audits, especially for OECD countries, hinder our understanding. The lack of uniform fines and penalties proportional to the offense severity and individual income, coupled with reluctance to disclose data on shadow economic activities, weakens deterrence efforts. Existing data suggest fines and penalties do not deter the shadow economy significantly, although subjective deterrence policies have a negative impact. Interestingly, shadow economy activities tend to diminish deterrence rather than deterrence affecting the shadow economy (Medina and Schneider, 2018).

Development of the Official Economy

The shadow economy is significantly influenced by the development of the official economy. Higher unemployment rates amplify the motivation to work in the shadow economy, assuming other factors remain constant (Schneider and Williams, 2013).

Self-Employment

Higher self-employment rates increase informal activities in the shadow economy, assuming other factors remain constant (Medina and Schneider, 2018).

Unemployment

Higher unemployment rates raise the likelihood of working in the informal economy, assuming other factors remain constant (Medina and Schneider, 2018).

Size of the Agricultural Sector

A larger agricultural sector increases the potential for operating in the shadow economy, assuming other factors remain constant (Medina and Schneider, 2018).

Use of Cash

Increased use of cash raises the shadow economy. This is typically measured as cash per capita or M0/M1, M1/M2 outside the banking sector (Medina and Schneider, 2018).

Share of Labor Force

A lower official labor force participation rate results in a larger shadow economy, assuming other factors remain constant (Medina and Schneider, 2018).

GDP per Capita

The shadow economy is linked to additional economic activities migrating from the official economy, indicating reduced economic growth if all other factors remain constant (Schneider and Williams, 2013).

The study has explored nearly all conceivable hypotheses used in previous research, with some incorporated into this paper.

4 Model, Data and Methodology

In this section, we have discussed the model, data, and methodology of the determinants of shadow economy in SAARC countries.

4.1 Model Specification

We aim to delineate models to investigate the factors influencing the size of the shadow economy. The shadow economy, also known as the undocumented economy, lacks consensus in its definition. To measure the size of this phenomenon, we utilized three proxies: the ratio of reserves to narrow money (Shadow1), the ratio of narrow money to broad money (Shadow2), and the ratio of currency in circulation to broad money (Shadow3). Consequently, three models were developed to examine the determinants of the shadow economy in SAARC countries.

Model-1: Ratio of Reserve to Narrow Money (M_0/M_1)

SHADOW1 = *f* (TRADE, TAX, UNEMP, GFCE, GI, EFI) **(1)**

The econometric form of the model-1:

$$SHADOW1_{it} = \eta_0 + \eta_1 TRADE_{it} + \eta_2 TAX_{it} + \eta_3 UNEMP_{it} + \eta_4 GFCE_{it} + \eta_5 GI_{it} + \eta_6 EFI_{it} + \mu_{it} \quad \textbf{(2)}$$

Model-2: Ratio of Narrow to Broad Money (M_1/M_2)

SHADOW2 = *f* (TRADE, TAX, UNEMP, GFCE, GI, EFI) **(3)**

The econometric form of the model-2:

$$SHADOW2_{it} = \eta_0 + \eta_1 TRADE_{it} + \eta_2 TAX_{it} + \eta_3 UNEMP_{it} + \eta_4 GFCE_{it} + \eta_5 GI_{it} + \eta_6 EFI_{it} + \mu_{it} \quad \textbf{(4)}$$

Model-3: Ratio of Currency in Circulation to Broad Money (C/M_2)

SHADOW3 = *f* (TRADE, TAX, UNEMP, GFCE, GI, EFI) **(5)**

The econometric form of the model-3:

$$SHADOW3_{it} = \eta_0 + \eta_1 TRADE_{it} + \eta_2 TAX_{it} + \eta_3 UNEMP_{it} + \eta_4 GFCE_{it} + \eta_5 GI_{it} + \eta_6 EFI_{it} + \mu_{it} \quad \textbf{(6)}$$

Where:

SHADOW1= ratio of reserve to narrow money

SHADOW2= ratio of narrow to broad money

SHADOW3= ratio of the currency in circulation to broad money

TRADE = Trade (% of GDP)

TAX = Tax revenue (% of GDP)

UNEMP = Unemployment, total (% of total labor force) (modeled ILO estimate)

GFCE = General government final consumption expenditure (% of GDP)

GI = Governance index

EFI = Economic freedom index

4.2 Data: Definition and Sources

In this section, we provide an overview of the definitions and sources of the data utilized in our study. The data were sourced from a variety of reputable outlets. Data for various variables were gathered from the central banks of South Asian Association for Regional Cooperation (SAARC) countries, excluding Afghanistan, spanning from 1995 to 2021. Information on exchange rates, trade, tax revenue, total unemployment rate, and general government final consumption expenditure was obtained from the World Development Indicators (WDI). Governance indicators data were sourced from the Worldwide Governance Indicators (WGI). To calculate the Governance Index (GI), we averaged the values of six governance indicators. The Economic Freedom Index (EFI) data were acquired from The Heritage Foundation.

For monetary aggregates such as Reserve Money (M0), Narrow Money (M1), Broad Money (M2), and Currency in Circulation (CC), data were collected from the following sources:

- Bangladesh Bank
- Royal Monetary Authority of Bhutan
- Handbook of Statistics on Indian Economy (Reserve Bank of India)
- Maldives Monetary Authority
- Nepal Rastra Bank
- Handbook of Statistics on Pakistan Economy (State Bank of Pakistan)
- The Central Bank of Sri Lanka

For Bangladesh:

Initially, variables were recorded in crore Bangladeshi Taka. Subsequently, these figures were converted from crore to billion Bangladeshi Taka by dividing by 100. Finally, the data were converted from billion Bangladeshi Taka to billion US Dollars by applying the relevant dollar exchange rate[1].

For Bhutan:

The variables were initially recorded in million Bhutanese Ngultrum. Then, these figures were converted from million to billion Bhutanese Ngultrum by dividing by 1000. Finally, the data were converted from billion Bhutanese Ngultrum to billion US Dollars using the applicable dollar exchange rate.

For India:

[1] All the data for these variables are converted from their Local Currency Units (LCU) to US Dollars for comparative analysis. This conversion involves dividing the data by their respective exchange rates, making them suitable for relative comparison.

Initially, variables were recorded in crore Indian Rupees. Subsequently, these figures were converted from crore to billion Indian Rupees by dividing by 100. Finally, the data were converted from billion Indian Rupees to billion US Dollars using the relevant dollar exchange rate.

For Maldives:

Initially, variables were recorded in million Maldivian Rufiyaa. These figures were then converted from million to billion Maldivian Rufiyaa by dividing by 1000. Finally, the data were converted from billion Maldivian Rufiyaa to billion US Dollars by applying the appropriate dollar exchange rate.

For Nepal:

Variables were initially recorded in million Nepalese Rupees. These figures were converted from million to billion Nepalese Rupees by dividing by 1000. Finally, the data were converted from billion Nepalese Rupees to billion US Dollars using the relevant dollar exchange rate.

For Pakistan:

Initially, variables were recorded in million Pakistani Rupees. Subsequently, these figures were converted from million to billion Pakistani Rupees by dividing by 1000. Finally, the data were converted from billion Pakistani Rupees to billion US Dollars using the applicable dollar exchange rate.

For Sri Lanka:

Variables were initially recorded in million Sri Lankan Rupees. These figures were converted from million to billion Sri Lankan Rupees by dividing by 1000. Finally, the data were converted from billion Sri Lankan Rupees to billion US Dollars using the relevant dollar exchange rate.

Table 1 outlines the definitions of monetary aggregates, namely reserve money, narrow money, and broad money, as defined by their respective central banks (CD).

Table 1

Monetary Aggregates Definitions in SAARC Countries

Country	M_0	M_1	M_2
Bangladesh	Net foreign assets + net domestic assets	M_0 + demand deposits (DD)	M_1 + time deposits (TD)
Bhutan	Currency in circulation (CC) + Banks' deposits + excess reserve CD	M_0 + DD	M_1 + TD + foreign currency deposits
India	CC + other deposits with + bankers' deposits	M_0 + DD	M_1 + time deposits
Maldives	CC + liabilities to other depository corporation + liabilities to another sector	M_0 + DD with CD + DD of public non-financial company	M_1 + quasi money
Nepal	CC + currency with ODC + deposit with banks	M_0 + DD	M_1 + savings and call deposits + TD

Pakistan	CC + other deposit with CD + currency in tills of scheduled banks + Banks' deposits with CD	M_0 + DD	M_1 + TD + residents foreign currency deposit
Sri Lanka	Currency Outstanding + Commercial Bank Deposit	M_0 + DD	M_1 + TD and Saving Deposit

These monetary proxies are used as indicators for the calculation of the size and development of the shadow economy but these do not measure the shadow economy. The definitions and formulas of variables are given as:

Shadow Economy

We have used three proxy variables Shadow-1, shadow-2, and shadow-3.

Shadow1

Shadow1 is used to calculate the size and development of the shadow economy by taking the ratio of reserve to narrow money.

$$Shadow\ 1 = \frac{M_0}{M_1}$$

$$Shadow\ 1 = \frac{\text{Reserve Money}}{\text{Narrow Money}}$$

Shadow2

Shadow2 is used to calculate the size and development of the shadow economy by taking ratio of narrow to broad money.

$$Shadow\ 2 = \frac{M_1}{M_2}$$

$$Shadow\ 2 = \frac{\text{Narrow Money}}{\text{Broad Money}}$$

Shadow3

Shadow3 is used to calculate the size and development of the shadow economy by taking ratio of the currency in circulation to broad money.

$$Shadow\ 3 = \frac{CC}{M_2}$$

$$Shadow\ 3 = \frac{\text{Currency in Circulation}}{\text{Broad Money}}$$

Reserve money (M_0):

"A large amount of currency held by central banks and major financial institutions to use for international transactions."

$M_0 = CC + R$

4.3 Methodology

In this section, we explain the different econometric techniques used in this study.

4.3.1 Panel Unit Root Test

The panel unit root test has much debated in recent years. The literature has much developed about that test which is based on cross-sectional independence assumptions between units, and it is called 1st generation panel unit root test. This assumption has violated in several empirical applications, and while, O'Connell (1998) described that it has not considered possible dependence between units, which can initiate serious bias in the 1st generation panel unit root test.

However, the authors have interested to develop test invariant to the cross-sectional dependence, and it is called 2nd generation panel unit root test (Cerasa, 2008). Among the researchers, Pesaran introduced CIPS test, which based on a single common factor specify for cross-correlation structure. The assumption of the residuals known autocorrelation order and a single common factor, showed that the test of CIPS performs very well. The most famous 2nd generation panel unit root tests are cross-section of Augmented Dickey-Fuller, and cross-sectional Im, Pesaran, and Shin tests (Westerlund et al., 2016). If null hypothesis accepted then variable has unit root (non-stationary). Test of CIPS is simple the cross-section average of individual CADF tests, i.e.,

$$CIPS = M^{-1}\sum_{i=1}^{M} CADF_i \quad \textbf{(7)}$$

4.3.2 Cross Section Dependence Test

The study probed into the cross-sectional correlation significance among residuals. Cross-section dependence test has accomplished using Breusch & Pagan (1980), Pesaran CD test, and Pesaran LM tests statistic.

Breusch & Pagan LM Test (1980)

Breusch & Pagan (1980) has LM test formed on the correlation sum of square coefficient among residuals (μ_{it}) of cross-sectional captured through OLS. Test statistic $CD_{LM(1)}$ which can be calculated as;

$$CD_{LM_{(1)}} = \sum_{i=1}^{M-1}\sum_{j=i+1}^{M}\hat{q}_{ij}^2 \quad \textbf{(8)}$$

Where q^2 represent estimation of cross-section sample correlations among the residuals. Null hypothesis (H_0) of the test has no cross-section dependence correlation in residuals, fixed M (individuals observed) and Tp (time period) → α. The statistic $CD_{LM(1)}$ distribute as a chi-square with M(M-1)/2 degree of freedoms.

Pesaran CD Test

The test statistic $CD_{LM(2)}$ can be calculated as;

$$\boldsymbol{CD_{LM(2)}} = \sqrt{\frac{1}{M(M-1)}}\sum_{i=1}^{M-1}\sum_{j=i+1}^{M}\left(T\rho\hat{q}_{ij}^2 - 1\right) \quad \textbf{(9)}$$

Here the null hypothesis (H_0) is no cross-section dependence correlation in residuals with first Tp→α, and M→α. The test statistic ($CD_{LM(2)}$) Pesaran distributed as a standard normal asymptotically (Cinar and Nur, 2018).

Pesaran LM Test

Pesaran CD_{LM} test has inconsistent even when the bias-adjusted ($CD_{LM\,adj}$) LM test of cross-sectional independence has consistent. However, in small sample panel, LM test has reasonable powers. Here the null hypothesis (H_0) of no cross-section dependence correlation in residuals with first Tp→α, and then M→α (Cinar and Nur, 2018). The test statistic $CD_{LM(adj)}$ can be calculated as;

$$LM_{(ad_j)} = \sqrt{\frac{2}{M(M-1)}} \sum_{i=1}^{M-1} \sum_{j=i+1}^{M} \frac{(T_p - K)\hat{q}_{ij}^2 - u_{Tpij}}{v_{Tp_{ij}}} \quad \textbf{(10)}$$

4.3.3 Slope Homogeneity/ Heterogeneity Test

Delta Test Pesaran and Yamagata

Swamy (1970) described the structure to find "if coefficient of slope cointegration equations are homogenous." It further improved by Pesaran and Yamagata (2008), and $\tilde{\Delta}$ and $\tilde{\Delta}$ adj; two delta tests formed

$$\tilde{\Delta} = \sqrt{M}\left(\frac{M^{-1}S - K}{\sqrt{2K}}\right) \sim X_K^2 \quad \textbf{(11)}$$

$$\tilde{\Delta}_{ad_j} = \sqrt{M}\left[\frac{M^{-1}S - K}{(T,K)v}\right] \sim M(0,1) \quad \textbf{(12)}$$

Where cross-section unit number denoted by M, Swamy test statistic denoted by S, independent variables denoted by K. If null hypothesis accepted then cointegrating coefficient consider homogenous. Both $\tilde{\Delta}$ and $\tilde{\Delta}$ adj are applicable for small and large sample, where " $\tilde{\Delta}$ adj" is mean variance bias adjusted form of "$\tilde{\Delta}$". Therefore, $\tilde{\Delta}$ needs error not to autocorrelated.

HAC Robust Delta Adjusted Test by Blomquist and Westerlund 2013

The assumption of serial independence and homoscedasticity relaxed, (Pesaran and Yamagata, 2008; Blomquist and Westerlund, 2013) advanced robust form of slope homogeneity test, which is heteroscedasticity and autocorrelation consistent (HAC);

Δ_{HAC} and $\Delta_{\text{HAC (adj)}}$

$$\Delta_{HAC} = \sqrt{M}\left(\frac{M^{-1}S_{HAC}^{-K}}{\sqrt{2K}}\right) \sim X_K^2 \quad \textbf{(13)}$$

$$\Delta_{HAC(ad_j)} = \sqrt{M}\left[\frac{M^{-1}S_{HAC}^{-K}}{(T,K)v}\right] \sim M(0,1) \quad \textbf{(14)}$$

4.3.4 Cointegration Tests

In this section, we discuss the cointegration test, which are following as; (i). Kao test, (ii) Pedroni Test, and (iii) Westerlund test.

Kao Test

Kao test applied for exploring the cointegration in panel analysis. There is no cointegration, when null hypothesis accepted. While, there is cointegration, when alternative hypothesis accepted. Kao test has two types, which are following as: (i). Residual-based test: it explores the cointegration relationship, while consider residual obtains from a panel analysis, and (ii) Group-mean test: it explores the cointegration relationship, while consider average behavior of variables in panel data (Kao, 1999).

Pedrooni Test

Pedroni developed statistics of 7 tests which have the null hypothesis (H_0) of no co-integration in the panel of non-stationary. The statistics of seven test allowed both long run slope as well as short run dynamics heterogeneity in the panel and the coefficients of intercept. The statistics of seven test divided into two groups: panel statistics and group mean statistics. The test could include common dummies of time to address cross sectional dependency, which applied for the data of each variable as given;

$$\bar{y}_t = \frac{1}{N}\sum_{i=1}^{N} t\,, y_i \quad \textbf{(15)}$$

All the statistics of test are residual-based tests (Neal, 2014).

Westerlund Test

Westerlund test is a statistical test of the panel co-integration tests, which used to explore presence of cointegration in panel data variables. It has used to explore the long run relations among the variables. It is an extension of famous Pedroni panel cointegration test. It has allowed the cross-section dependency, and the heterogeneity in panel data. It is an importance that consider data relation across entities. There has no co-integration in the panel data, if the null hypothesis (H_0) has accepted. While, there is co-integration in the panel data, while if the null hypothesis (H_0) has rejected, which means there exist long run relationships in the variables (Westerlund, 2007).

4.3.5 Method of Moments Quantile Regression (MM-QR)

Quantile regression techniques applied to panel data are used to explore distributional effects and heterogeneity across various quantiles. In their influential paper, Koenker and Bassett (1978) introduced these techniques, which are generally employed to assess the conditional medians of different quantiles for response variables concerning specific values of the exogenous variable. This differs from regular regression, used in least squares variants, which provides estimations of conditional means of endogenous variables based on specific values of the exogenous variable. Quantile regression techniques are particularly robust in handling outliers in measurements and are especially relevant in cases where the relationship between the conditional means of two variables is either weak or nonexistent (Binder and Coad, 2011).

In contrast, Ike et al. (2020) employed the MMQR (Machado and Silva, 2019) with fixed effects in their research. Quantile regression, while robust against outliers, might not account for unobserved heterogeneity across individuals in a given panel. The panel MMQR technique enables the identification of conditional heterogeneity covariance effects while allowing individual effects to influence the entire distribution, not just reshuffling the mean. These estimation techniques are particularly relevant in scenarios where the panel data model incorporates individual effects and when explanatory variables are included in the model. The MMQR method is also noteworthy for its ability to avoid issues related to crossing measures of the regression quantile. The conditional quantile Q_y (τ | X) estimates for model of location scales variate are;

$$Y_{it} = \alpha_i + \beta\, X_{it} + (\delta_i + \gamma\, Z_{it})\, \mu_{it} \quad \textbf{(16)}$$

Where are parameters [α, β, δ, γ].1 = P [$\delta_i + Z_{it}\,\gamma > 0$] is probability to be measured. [α_i, δ_i], i=1,2,3…, n, nominates the individual "i" fixed effect. Z is k-vector of recognized components of X, with "l" given by

$$Z_l = Z_l\,(X),\ l = 1, 2, 3, \ldots, k \quad \textbf{(17)}$$

X_{it} is independent distribute for any of the fixed "i" while across the time [t]. μ_{it} has independent distribute across the individual "i" while time [t] and have orthogonal to the X_{it}. It normalizes to amuse moment condition in the Machado and Silva (2019), which amid other thing do not suggest strict exogeneous. Equation 4.16 signify as following;

$$Q_y\,(\tau \mid X_{it}) = [\alpha_i + q\,\delta_i(\tau)] + \beta\, X_{it} + \gamma\, Z_{it}\, q(\tau). \quad \textbf{(18)}$$

Our models can be expressed in MMQR form as:

Model-1: Ratio of Reserve to Narrow Money (M_0/M_1)

General form of the MMQR equation is:

$$Q_{SHADOW1_{it}}(\tau \mid \gamma_i, \delta_t, X_{it}) = \gamma_i + \delta_t + \eta_{1,\tau} TRADE_{it} + \eta_{2,\tau} TAX_{it} + \eta_{3,\tau} UNEMP_{it} + \eta_{4,\tau} GFCE_{it} + \eta_{5,\tau} GI_{it} + \eta_{6,\tau} EFI_{it} + \mu_{\tau,it} \quad \textbf{(19)}$$

At τ=0.10:

$$Q_{0.10}(SHADOW1) \mid = \gamma_{0.10} + \eta_{1,0.10} TRADE_{it} + \eta_{2,0.10} TAX_{it} + \eta_{3,0.10} UNEMP_{it} + \eta_{4,0.10} GFCE_{it} + \eta_{5,0.10} GI_{it} + \eta_{6,0.10} EFI_{it} + \mu_{0.10,it}$$

(20)

At τ=0.25:

$$Q_{0.25}(SHADOW1) \mid = \gamma_{0.25} + \eta_{1,0.25} TRADE_{it} + \eta_{2,0.25} TAX_{it} + \eta_{3,0.25} UNEMP_{it} + \eta_{4,0.25} GFCE_{it} + \eta_{5,0.25} GI_{it} + \eta_{6,0.25} EFI_{it} + \mu_{0.25,it}$$

(21)

At τ=0.50:

$$Q_{0.50}(SHADOW1) \mid = \gamma_{0.50} + \eta_{1,0.50} TRADE_{it} + \eta_{2,0.50} TAX_{it} + \eta_{3,0.50} UNEMP_{it} + \eta_{4,0.50} GFCE_{it} + \eta_{5,0.50} GI_{it} + \eta_{6,0.50} EFI_{it} + \mu_{0.50,it}$$

(22)

At τ=0.75:

$$Q_{0.75}(SHADOW1) \mid = \gamma_{0.75} + \eta_{1,0.75} TRADE_{it} + \eta_{2,0.75} TAX_{it} + \eta_{3,0.75} UNEMP_{it} + \eta_{4,0.75} GFCE_{it} + \eta_{5,0.75} GI_{it} + \eta_{6,0.75} EFI_{it} + \mu_{0.75,it}$$

(23)

At τ=0.90:

$$Q_{0.90}(SHADOW1) \mid = \gamma_{0.90} + \eta_{1,0.90} TRADE_{it} + \eta_{2,0.90} TAX_{it} + \eta_{3,0.90} UNEMP_{it} + \eta_{4,0.90} GFCE_{it} + \eta_{5,0.90} GI_{it} + \eta_{6,0.90} EFI_{it} + \mu_{0.90,it}$$

(24)

Model-2: Ratio of Narrow to Broad Money (M_1/M_2)

General form of the MMQR equation is:

$$Q_{SHADOW2_{it}}(\tau \mid \gamma_i, \delta_t, X_{it}) = \gamma_i + \delta_t + \eta_{1,\tau} TRADE_{it} + \eta_{2,\tau} TAX_{it} + \eta_{3,\tau} UNEMP_{it} + \eta_{4,\tau} GFCE_{it} + \eta_{5,\tau} GI_{it} + \eta_{6,\tau} EFI_{it} + \mu_{\tau,it}$$

(25)

At τ=0.10:

$$Q_{0.10}(SHADOW2) \mid = \gamma_{0.10} + \eta_{1,0.10} TRADE_{it} + \eta_{2,0.10} TAX_{it} + \eta_{3,0.10} UNEMP_{it} + \eta_{4,0.10} GFCE_{it} + \eta_{5,0.10} GI_{it} + \eta_{6,0.10} EFI_{it} + \mu_{0.10,it}$$

(26)

At τ=0.25:

$$Q_{0.25}(SHADOW2) \mid = \gamma_{0.25} + \eta_{1,0.25} TRADE_{it} + \eta_{2,0.25} TAX_{it} + \eta_{3,0.25} UNEMP_{it} + \eta_{4,0.25} GFCE_{it} + \eta_{5,0.25} GI_{it} + \eta_{6,0.25} EFI_{it} + \mu_{0.25,it}$$

(27)

At τ=0.50:

$$Q_{0.50}(SHADOW2) \mid = \gamma_{0.50} + \eta_{1,0.50} TRADE_{it} + \eta_{2,0.50} TAX_{it} + \eta_{3,0.50} UNEMP_{it} + \eta_{4,0.50} GFCE_{it} + \eta_{5,0.50} GI_{it} + \eta_{6,0.50} EFI_{it} + \mu_{0.50,it}$$

(28)

At τ=0.75:

$$Q_{0.75}(SHADOW2) \mid = \gamma_{0.75} + \eta_{1,0.75} TRADE_{it} + \eta_{2,0.75} TAX_{it} + \eta_{3,0.75} UNEMP_{it} + \eta_{4,0.75} GFCE_{it} + \eta_{5,0.75} GI_{it} + \eta_{6,0.75} EFI_{it} + \mu_{0.75,it}$$

(29)

At τ=0.90:

$$Q_{0.90}(SHADOW2) \mid = \gamma_{0.90} + \eta_{1,0.90} TRADE_{it} + \eta_{2,0.90} TAX_{it} + \eta_{3,0.90} UNEMP_{it} + \eta_{4,0.90} GFCE_{it} + \eta_{5,0.90} GI_{it} + \eta_{6,0.90} EFI_{it} + \mu_{0.90,it}$$

(30)

Model-3: Ratio of Currency in Circulation to Broad Money (C/M$_2$)

General form of the MMQR equation is:

$$Q_{SHADOW3_{it}}(\tau \mid \gamma_i, \delta_t, X_{it}) = \gamma_i + \delta_t + \eta_{1,\tau} TRADE_{it} + \eta_{2,\tau} TAX_{it} + \eta_{3,\tau} UNEMP_{it} + \eta_{4,\tau} GFCE_{it} + \eta_{5,\tau} GI_{it} + \eta_{6,\tau} EFI_{it} + \mu_{\tau,it} \quad \textbf{(31)}$$

At τ=0.10:

$$Q_{0.10}(SHADOW3) \mid = \gamma_{0.10} + \eta_{1,0.10} TRADE_{it} + \eta_{2,0.10} TAX_{it} + \eta_{3,0.10} UNEMP_{it} + \eta_{4,0.10} GFCE_{it} + \eta_{5,0.10} GI_{it} + \eta_{6,0.10} EFI_{it} + \mu_{0.10,it} \quad \textbf{(32)}$$

At τ=0.25:

$$Q_{0.25}(SHADOW3) \mid = \gamma_{0.25} + \eta_{1,0.25} TRADE_{it} + \eta_{2,0.25} TAX_{it} + \eta_{3,0.25} UNEMP_{it} + \eta_{4,0.25} GFCE_{it} + \eta_{5,0.25} GI_{it} + \eta_{6,0.25} EFI_{it} + \mu_{0.25,it} \quad \textbf{(33)}$$

At τ=0.50:

$$Q_{0.50}(SHADOW3) \mid = \gamma_{0.50} + \eta_{1,0.50} TRADE_{it} + \eta_{2,0.50} TAX_{it} + \eta_{3,0.50} UNEMP_{it} + \eta_{4,0.50} GFCE_{it} + \eta_{5,0.50} GI_{it} + \eta_{6,0.50} EFI_{it} + \mu_{0.50,it} \quad \textbf{(34)}$$

At τ=0.75:

$$Q_{0.75}(SHADOW3) \mid = \gamma_{0.75} + \eta_{1,0.75} TRADE_{it} + \eta_{2,0.75} TAX_{it} + \eta_{3,0.75} UNEMP_{it} + \eta_{4,0.75} GFCE_{it} + \eta_{5,0.75} GI_{it} + \eta_{6,0.75} EFI_{it} + \mu_{0.75,it} \quad \textbf{(35)}$$

At τ=0.90:

$$Q_{0.90}(SHADOW3) \mid = \gamma_{0.90} + \eta_{1,0.90} TRADE_{it} + \eta_{2,0.90} TAX_{it} + \eta_{3,0.90} UNEMP_{it} + \eta_{4,0.90} GFCE_{it} + \eta_{5,0.90} GI_{it} + \eta_{6,0.90} EFI_{it} + \mu_{0.90,it} \quad \textbf{(36)}$$

Where, τ shows the quantiles, i=1…, N shows cross sectional and t shows a time period starting from t=1…, T.

5 Determinants of Shadow Economy: A MMQR Analysis

We have explored the determinants of shadow economy. Although, it is difficult to measure the shadow economy due to the various proxies used to determine the size of shadow economy in the literature. We have used monetary aggregates-based proxies to calculate the size and development of the undocumented economy phenomenon.

5.1 Descriptive Statistics and Correlation of Key Variables

Now, we examine the descriptive statistics and correlations of the key variables. Table 2 presents the descriptive statistics of key variables (1995-2021) for selected SAARC countries. The ratio of reserve to narrow money (Shadow1) has a mean of 0.86, a median of 0.86, a maximum of 1.77, a minimum of 0, a standard deviation of 0.33, a negatively skewed skewness of -0.23, and a leptokurtic kurtosis of 3.62, indicating a non-normal distribution. The ratio of narrow to broad money (Shadow2) shows a mean of 0.39, a median of 0.33, a maximum of 0.94, a minimum of 0.13, a standard deviation of 0.05, an extremely skewed positive skewness of 1.22, and a leptokurtic kurtosis of 4.37, indicating a non-normal distribution. The ratio of currency in circulation to broad money (Shadow3) exhibits a mean of 0.16, a median of 0.14, a maximum of 0.29, a minimum of 0.07, a standard deviation of 0.05, a positively skewed skewness of 0.65, and a platykurtic kurtosis of 2.47, indicating a non-normal distribution. In terms of trade, the mean is 62.58, the median is 46.30, the maximum is 165.98, the minimum is 21.93, the standard deviation is 37.19, the skewness is 1.11 (extremely skewed positively),

and the kurtosis is 3.21 (leptokurtic), suggesting a non-normal distribution. Regarding tax, the mean is 10.68, the median is 10.03, the maximum is 19.81, the minimum is 6.60, the standard deviation is 2.82, the skewness is 0.65 (positively skewed), and the kurtosis is 2.89 (platykurtic), indicating a non-normal distribution.

Table 2

Descriptive Statistics of Key Variables (1995-2021)

Statistic	Variables								
	SHADOW1	SHADOW2	SHADOW3	TRADE	TAX	UNEMP	GFCE	GI	EFI
Mean	0.86	0.39	0.16	62.58	10.68	5.67	12.21	-0.41	54.58
Median	0.86	0.33	0.14	46.30	10.03	4.97	10.75	-0.34	54.60
Maximum	1.77	0.94	0.29	165.98	19.81	13.08	22.78	0.64	66.00
Minimum	0.00	0.13	0.07	21.93	6.60	0.40	4.63	-1.18	40.90
Std. Dev.	0.33	0.19	0.05	37.19	2.82	3.40	5.10	0.45	4.21
Skewness	-0.23	1.22	0.65	1.11	0.65	0.20	0.47	0.22	0.17
Kurtosis	3.62	4.37	2.47	3.21	2.89	1.85	2.10	2.18	3.35
Jarque-Bera	4.77	61.82	15.44	39.13	13.47	11.66	13.40	6.82	1.83
Prob.	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.40
Obs.	189	189	189	189	189	189	189	189	189

The unemployment rate exhibits a mean of 5.67, a median of 4.97, a maximum of 13.08, a minimum of 0.40, a standard deviation of 3.40, a positively skewed skewness of 0.20, and a platykurtic kurtosis of 1.85, indicating a non-normal distribution. Government final consumption expenditure (GFCE) shows a mean of 12.21, a median of 10.75, a maximum of 22.78, a minimum of 4.63, a standard deviation of 5.10, a positively skewed skewness of 0.47, and a platykurtic kurtosis of 2.10, suggesting a non-normal distribution. Governance Index (GI) has a mean of -0.41, a median of -0.34, a maximum of 0.64, a minimum of -1.18, a standard deviation of 0.45, a positively skewed skewness of 0.22, and a platykurtic kurtosis of 2.18, indicating a non-normal distribution. Economic Freedom Index (EFI) exhibits a mean of 54.58, a median of 54.60, a maximum of 66, a minimum of 40.90, a standard deviation of 4.21, a positively skewed skewness of 0.17, and a leptokurtic kurtosis of 3.35, suggesting a non-normal distribution.

Table 3 presents the correlations among the key variables. Shadow1 demonstrates a positive relationship with all variables except Shadow2 and Shadow3, which are negative. Shadow1 shows a weak relationship with all variables except Shadow2, which is moderately related to Shadow1.

Table 3

Correlation Matrix of Key Variables (1995-2021)

Correlation	SHADOW1	SHADOW2	SHADOW3	TRADE	TAX	UNEMP	GFCE	GI	EFI
SHADOW1	1								
SHADOW2	-0.42	1							
SHADOW3	-0.21	0.36	1						
TRADE	0.22	0.24	-0.21	1					
TAX	0.13	0.08	0.07	0.13	1				
UNEMP	0.19	-0.49	-0.02	-0.05	0.20	1			
GFCE	0.14	0.38	-0.26	0.72	0.13	-0.18	1		
GI	0.11	0.02	-0.37	0.63	0.20	-0.04	0.71	1	
EFI	0.06	0.11	-0.14	0.13	0.38	-0.12	0.33	0.28	1

Shadow2 shows a positive relationship with all variables except unemployment, which is negative. It has a weak relationship with all variables except Shadow3, unemployment, and government final consumption expenditure, which are moderately related to Shadow2. Shadow3 exhibits a negative relationship with all variables except tax, which is positive. It has a weak relationship with all variables except the governance index, which is moderately related to Shadow3. Trade demonstrates a positive relationship with all variables except unemployment, which is negative. It has a weak relationship with all variables except government final consumption expenditure, which is strongly related to trade. Tax displays a positive relationship with all variables but shows a weak relationship with all variables except the economic freedom index, which is moderately related to tax. Unemployment has a negative relationship with all variables and exhibits weak connections with them. Government final consumption expenditure has a positive relationship with all variables but weak connections, except with the economic freedom index, with which it has a strong relationship. Moreover, it has a weak relationship with the governance index. The governance index has a positive and weak relationship with the economic freedom index.

5.2 Cross-Sectional Dependence and Slope Homogeneity Tests

We have analyzed the results of cross-sectional dependence and slope homogeneity tests. Table 4 presents Pesaran's cross-sectional dependence tests. The variables shadow1, trade, tax, government final consumption expenditure, and economic freedom index are found to be insignificant, leading us to accept the null hypothesis. This indicates that there is no cross-sectional dependence among the selected SAARC countries.

Table 4

Pesaran's Cross Sectional Dependence (CD)Test

Variable	CD-test	P-Value
SHADOW1	0.5960	0.5510
SHADOW2	3.4270	0.0010
SHADOW3	15.0520	0.0000
TRADE	-0.4700	0.6390
TAX	-1.0670	0.2860
UNEMP	4.3710	0.0000
GFCE	-0.5010	0.6160
GI	5.7880	0.0000
EFI	-0.0910	0.9280

However, the variables shadow2, shadow3, unemployment, and Governance index are found to be significant, leading us to reject the null hypothesis. This implies the presence of cross-sectional dependence among the selected SAARC countries.

Table 5 presents the results of the slope homogeneity tests, which are based on two tests: the Delta test and the HAC robust adjusted Delta Test. Both tests provide unadjusted and adjusted statistics.

Table 5

Slope Homogeneity Test

Models	Delta Test				HAC Robust Adjusted Delta Test			
	Unadjusted	P-Value	Adjusted	P-Value	Unadjusted	P-Value	Adjusted	P-Value
Model – 1	**SHADOW1/ TRADE, TAX, UNEMP, GFCE, GI, EFI**							
	8.651	0.000	10.313	0.000	2.392	0.017	-2.852	0.004
Model – 2	**SHADOW2/ TRADE, TAX, UNEMP, GFCE, GI, EFI**							
	8.293	0.000	9.886	0.000	2.612	0.009	-3.114	0.002

Model – 3	**SHADOW3/ TRADE, TAX, UNEMP, GFCE, GI, EFI**							
	9.839	0.000	11.729	0.000	2.833	0.005	-3.377	0.001

In all models, the probability values of both unadjusted and adjusted statistics of Delta test and HAC robust test are significant. So, we reject null hypothesis, which means model has slope heterogeneity.

5.3 Unit Root Tests

Since we have identified cross-sectional dependence and slope heterogeneity in previous sections, first-generation unit root tests cannot be applied. In the presence of these issues, the most appropriate unit root test is the second-generation panel unit root tests. One of these tests is the cross-section-dependence based Im-Pesaran-Shin (CSDIPS) unit root test, which comprises two equations: one with trend and one without trend. Table 6 presents the results of the CSDIPS unit root test.

In the case without trend, the probability values of the variables shadow2, shadow3, tax, unemployment, government final consumption expenditure, governance index, and economic freedom index are significant. Therefore, we reject the null hypothesis, indicating that these variables have no unit root and are stationary. On the other hand, the probability values of the variables shadow1 and trade are insignificant. Hence, we accept the null hypothesis, signifying that these variables have a unit root and are non-stationary.

Table 6

Unit Root Test Results

Second Generation Panel Unit Root Test						
Cross-Section-Dependence based Im-Pesaran-Shin (CSDIPS) Unit Root Test						
Variables	**Without Trend**			**With Trend**		
	Lags	**Zt Statistics**	**P-Value**	**Lags**	**Zt Statistics**	**P-Value**
SHADOW1	1	-0.379	0.152	1	-0.183	0.027
SHADOW2	0	-0.163	0.035	0	1.236	0.092
SHADOW3	0	0.270	0.060	1	1.374	0.015
TRADE	0	0.262	0.603	1	2.792	0.197
TAX	1	0.525	0.003	1	-0.052	0.000
UNEMP	1	1.680	0.054	1	1.455	0.027
GFCE	0	-1.419	0.078	0	-0.914	0.008
GI	0	-4.092	0.000	0	-3.301	0.000
EFI	0	-3.200	0.001	1	-1.297	0.097

In case of with trend; the probability values of variables of shadow1, shadow2, shadow3, tax, unemployment, government final consumption expenditure, governance index, and economic freedom index are significant. So, we reject null hypothesis, which means these variables have no unit root (stationary). While the probability value of variable trade is insignificant. So, we accept null hypothesis, which means the variable has unit root (non-stationary).

5.4 Panel Cointegration Analysis

Our study delves into panel cointegration analysis to assess the presence of cointegration among the variables in the models. We employed the Kao test, Pedroni test, and Westerlund test, all of which indicate cointegration.

The Kao test comprises five modified Dickey-Fuller tests: Dickey-Fuller test, augmented Dickey-Fuller test, unadjusted modified Dickey-Fuller test, and unadjusted Dickey-Fuller test. The Pedroni test incorporates three tests: modified Phillips-Perron test, Phillips-Perron test, and augmented

Dickey-Fuller test. The Westerlund test involves four tests: two each for group dimension and panel dimension. The results of these cointegration tests are presented in Table 7.

For the Kao test, all three models (model-1, model-2, and model-3) are found to be significant. Therefore, we reject the null hypothesis, indicating the presence of a long-run relationship in all models. Similarly, the Pedroni test shows significance for model-1, model-2, and model-3, leading to the rejection of the null hypothesis, suggesting a long-run relationship in all models. The Westerlund test also demonstrates significance for model-1, model-2, and model-3, prompting the rejection of the null hypothesis and confirming the existence of a long-run relationship in all models

Table 7

Cointegration Tests Results

Cointegration Tests		**Model - 1**		**Model – 2**		**Model - 3**	
		Statistic	**P-Value**	**Statistic**	**P-Value**	**Statistic**	**P-Value**
Kao Test	**Modified Dickey-Fuller test**	-0.4299	0.0336	0.5417	0.0940	0.4180	0.0380
	Dickey-Fuller test	-1.1883	0.0174	0.5708	0.0841	0.7524	0.0259
	Augmented Dickey-Fuller test	-1.1449	0.1261	-0.5019	0.0079	1.0391	0.0494
	Unadjusted modified Dickey	-2.7964	0.0026	0.7222	0.0351	0.0048	0.0981
	Unadjusted Dickey-Fuller test	-2.4995	0.0062	0.7369	0.0306	0.4136	0.0396
	Modified Phillips-Perron test	2.0260	0.0214	2.9737	0.0015	2.0322	0.0211
Pedroni Test	**Phillips-Perron test**	-1.4399	0.0750	0.5532	0.0901	-1.3451	0.0893
	Augmented Dickey-Fuller test	-2.2087	0.0136	-1.0049	0.0575	-1.8074	0.0353
Westerlund Test	**Gt**	-1.7570	0.0590	-1.8000	0.0480	-1.4820	0.0930
	Ga	-2.6190	0.0000	-2.5490	0.0000	-2.4100	0.0000
	Pt	-5.6740	0.0830	-4.2830	0.0690	-3.9780	0.0160
	Pa	-3.2410	0.0000	-3.2800	0.0790	-3.0820	0.0820

5.5 Method of Moments-Quantile Regression Results for the Monetary Indicators of the Shadow Economy

In this section, we explain the Method of Moments-Quantile Regression (MM-QR) results for the monetary indicators of the Shadow economy. When there is cross-sectional dependence, slope heterogeneity, long run relationship existence, stationary and non-stationary variables, then best technique to apply is Method of Moments-Quantile Regression (MM-QR). Table 8 and Figure A.1 portrays the results of the MM-QR estimates for the monetary indicators of shadow economy based on ratio of reserve to narrow money.

Table 8

MM-QR Estimates for the Monetary Indicators of Shadow Economy Based on Ratio of Reserve to Narrow Money

DV: Ratio of Reserve to Narrow Money (Shadow-1)							
Variables	**Location**	**Scale**	**Q 0.10**	**Q 0.25**	**Q 0.50**	**Q 0.75**	**Q 0.90**
TRADE	0.0202***	0.0134***	0.00402	0.0122	0.0219***	0.0317***	0.0410***
	(0.00730)	(0.00473)	(0.0126)	(0.00875)	(0.00717)	(0.00750)	(0.00943)
TAX	3.954***	0.736**	2.830***	3.327***	3.837***	4.466***	5.308***
	(0.554)	(0.374)	(0.590)	(0.500)	(0.530)	(0.720)	(1.076)
UNEMP	19.55***	11.00***	2.749	10.18**	17.80***	27.20***	39.78***
	(5.470)	(3.688)	(5.894)	(4.973)	(5.244)	(7.159)	(10.72)
GFCE	11.96**	2.403	8.289	9.912**	11.58**	13.63**	16.38*
	(5.153)	(3.474)	(5.422)	(4.605)	(4.921)	(6.638)	(9.909)
GI	0.0961***	0.0145	-0.0726**	-0.0815***	-0.0945***	-0.106***	-0.119***
	(0.0143)	(0.0109)	(0.0283)	(0.0223)	(0.0149)	(0.0113)	(0.0139)
EFI	6.289***	4.697***	-1.308	-1.574	-5.789***	-9.607***	-13.75***
	(1.706)	(1.300)	(3.236)	(2.494)	(1.720)	(1.413)	(1.665)
Constant	-0.236**	-0.166*	0.0328	-0.0691	-0.218*	-0.353***	-0.499***
	(0.118)	(0.0896)	(0.231)	(0.181)	(0.121)	(0.0936)	(0.114)

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

In this table, the dependent variable is the ratio of reserves to narrow money (Shadow-1), and the independent variables include trade, tax, unemployment, government final consumption expenditure (GFCE), governance index (GI), and economic freedom index (EFI). The MM-QR results are based on location and scale models. The location indicates the measure of central tendencies and means, while scale represents the measure of dispersion.

Trade has a positive impact on Shadow-1 across all quantiles. The effect of trade on Shadow-1 is significant in all quantiles, except the 0.10th and 0.25th quantiles. This phenomenon can be attributed to trade's role in expanding the total money in circulation and promoting economic growth. Trade positively influences the ratio of reserves to narrow money because as countries engage in cross-border transactions, foreign currency is introduced. Typically, this foreign currency is converted into local currency, increasing the overall money supply. The influx of funds allows banks and financial institutions to maintain larger reserves, thereby enhancing the ratio of reserves to narrow money. Additionally, trade stimulates economic activity, leading to increased output, job creation, and higher incomes. This, in turn, encourages higher rates of saving and deposit formation, further strengthening banks' reserves. Overall, trade plays a crucial role in improving the ratio of reserves to narrow money (Schneider, 2005; Khan et al., 2021). Our findings align with previous studies, including Schneider (2005) and Khan et al. (2021).[2]

Taxation exerts a positive and significant impact on Shadow-1 across all quantiles. This effect is attributed to taxes stimulating the growth of reserves held by central banks, thereby favorably influencing the ratio of reserves to narrow money. Governments can choose to allocate a portion of their tax revenue to augment their reserves. By bolstering reserves, central banks enhance their capacity to manage economic fluctuations and stabilize the money supply. The increased reserves act as a cushion for the banking system, enabling it to meet liquidity requirements and maintain investor confidence in the financial system. Consequently, this strengthens the stability of the money supply, reducing the likelihood of financial crises and positively impacting the ratio of reserves to narrow

[2] However, we also found some studies which show the negative relationships such that Medina and Schneider, 2018; Angour and Nmili,2019; Tran et al., 2022.

money. Moreover, a higher reserve ratio fosters confidence in the economy, enhancing trust in the national currency. This, in turn, attracts both domestic and foreign investments. Through the augmentation of central bank reserves, the promotion of economic stability, and the encouragement of economic growth, taxes play a pivotal role in enhancing the ratio of reserves to narrow money (Schneider et al., 2010; Angour and Nmili, 2019). Our findings are consistent with previous studies, including Schneider et al. (2010), Gaspareniene et al. (2016), Angour and Nmili (2019), Khan et al. (2021), and Khan and Rehman (2022).[3]

Unemployment exerts a positive impact on Shadow-1 across all quantiles. This effect remains significant in all quantiles except the 0.10th quantile. Unemployment's influence on the total money in an economy has a favorable effect on the ratio of reserves to narrow money. Rising unemployment leads to decreased consumer spending as people have less money and reduced purchasing power. Consequently, companies witness a decline in demand for their products and services, affecting their earnings and capital expenditures. To counter this economic slowdown, central banks often implement expansionary monetary policies, such as lowering interest rates or engaging in quantitative easing, to inject liquidity into the financial system. These measures expand the money supply, ultimately resulting in a higher reserve-to-narrow money ratio. Increased bank reserves serve as a cushion, sustaining lending activities and fostering economic growth, which can ultimately reduce unemployment rates (Davidescu, 2017; Tran et al., 2022). Our findings are in line with prior studies, including Schneider et al. (2010), Davidescu (2017), Angour and Nmili (2019), Lahlou et al. (2020), and Tran et al. (2022).

Government final consumption expenditure (GFCE) also has a positive impact on Shadow-1 across all quantiles. This effect is significant in all quantiles except the 0.10th quantile. Increased government spending on consumption injects money into the economy, leading to a surge in aggregate demand. This heightened spending stimulates economic activity, prompting businesses to increase the production of goods and services. Consequently, banks experience a rise in deposit inflows and greater demand for loans, expanding the narrow money supply. To meet the escalating demand for money, banks may need to augment their reserves. Thus, the ratio of reserves to narrow money tends to increase as government final consumption expenditure fosters economic growth and augments the money supply (Berdiev and Saunoris, 2018; Khan and Rehman, 2022). Our findings align with previous studies, including Schneider et al. (2010), Berdiev and Saunoris (2018), Medina and Schneider (2018), Khan et al. (2021), and Tran et al. (2022), as well as Khan and Rehman (2022).[4]

The Governance Index (GI) exerts a negative and significant impact on Shadow-1 across all quantiles. The governance index can negatively influence the ratio of reserves to narrow money due to several factors. Countries with low governance indices often suffer from weak institutional structures, corruption, and a lack of transparency. This situation can erode public confidence in both the government and the financial system, leading to reduced demand for narrow forms of currency like cash and demand deposits. If individuals and businesses opt for alternative storage methods, such as foreign currencies or tangible assets, the ratio of reserves to narrow money could further decrease. Moreover, a low governance index may deter foreign investments and capital inflows, hindering the accumulation of reserves and reducing overall liquidity in the financial system. Consequently, a decline in reserves relative to narrow money can impact monetary stability and investor confidence. A low governance index compromises the credibility and effectiveness of governance institutions, negatively affecting the ratio of reserves to narrow money (Ruge, 2010; Manolas et al., 2013; Khan and Rehman, 2022). Our findings align with previous studies, including Schneider et al. (2010), Ruge (2010), Manolas et al. (2013), Elmirzaev and Elmurodov (2021), and Khan and Rehman (2022).

[3] Elmirzaev and Elmurodov, 2021.

[4] Din, 2016; Goel and Nelson, 2016.

The Economic Freedom Index (EFI) has a negative impact on Shadow-1 across all quantiles. This effect is significant in all quantiles except the 0.10th and 0.25th quantiles. The negative impact of the economic freedom index on Shadow-1 can be attributed to the index measuring a nation's level of economic liberty. Factors such as government regulations, protection of property rights, and ease of doing business are considered in this index. Lower economic freedom often leads to increased government regulations and intervention in the economy. This may result in inefficiencies, administrative hurdles, and barriers to entry for businesses. Consequently, limitations in the financial industry can arise, making it challenging for banks to operate freely and efficiently. In such a scenario, the ratio of reserves to narrow money, which indicates the percentage of reserves held by a central bank relative to the total issuance of narrow money, may suffer. Excessive regulations and governmental oversight can restrict the banking system's flexibility and independence, making it harder to maintain adequate reserve levels and effectively control the money supply. Ultimately, this could negatively impact the ratio of reserves to narrow money, potentially leading to financial system instability and diminished confidence in the currency (Schneider et al., 2010; Khan and Rehman, 2022). Our findings are consistent with previous studies, including Schneider et al. (2010), Khan et al. (2021), and Khan and Rehman (2022).

Table 9 and figure A.2 presents the results of the MM-QR estimates for the monetary indicators of the shadow economy based on the ratio of narrow to broad money. The dependent variable in this analysis is the ratio of narrow to broad money (Shadow-2), while the independent variables include trade, tax, unemployment (Unemp), government final consumption expenditure (GFCE), governance index (GI), and economic freedom index (EFI).

Trade exhibits a positive and significant impact on Shadow-2 across all quantiles, with values being higher compared to those in Table 8. Tax also has a positive impact on Shadow-2 in all quantiles. However, the effect of tax on Shadow-2 is significant except for the 0.10th, 0.75th, and 0.90th quantiles, and the values are smaller in comparison to those presented in Table 8.

Table 9

MM-QR Estimates for the Monetary Indicators of Shadow Economy based on Ratio of Narrow to Broad Money

DV: Ratio of Narrow to Broad Money (Shadow-2)							
Variables	**Location**	**Scale**	**Q 0.10**	**Q 0.25**	**Q 0.50**	**Q 0.75**	**Q 0.90**
TRADE	0.0257***	0.00733	0.0141***	0.0196***	0.0245***	0.0303***	0.0432***
	(0.00541)	(0.00500)	(0.00430)	(0.00282)	(0.00458)	(0.00817)	(0.0161)
TAX	0.0100*	0.00359	0.00433	0.00704***	0.00944**	0.0123	0.0186
	(0.00522)	(0.00483)	(0.00415)	(0.00272)	(0.00454)	(0.00798)	(0.0161)
UNEMP	-0.0251***	0.00521	0.0174***	0.0208***	-0.0239***	0.0287***	0.0346***
	(0.00435)	(0.00365)	(0.00340)	(0.00281)	(0.00371)	(0.00640)	(0.0103)
GFCE	0.0210***	0.00793**	0.00925**	0.0144***	0.0191***	0.0264***	0.0355***
	(0.00481)	(0.00403)	(0.00376)	(0.00313)	(0.00410)	(0.00703)	(0.0114)
GI	-0.200***	0.0723*	-0.0929**	-0.140***	-0.183***	-0.250***	-0.332***
	(0.0484)	(0.0406)	(0.0378)	(0.0314)	(0.0413)	(0.0708)	(0.115)
EFI	0.311***	0.166**	-0.0483	-0.174***	-0.284***	-0.416***	-0.707***
	(0.0821)	(0.0760)	(0.0668)	(0.0431)	(0.0690)	(0.125)	(0.241)
Constant	0.185***	0.105***	0.0449	0.0868*	0.156***	0.283***	0.346***
	(0.0554)	(0.0331)	(0.0554)	(0.0503)	(0.0543)	(0.0740)	(0.0910)

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Unemployment exerts a positive impact on Shadow-2 across all quantiles, except the 0.50th quantile. The effect of unemployment on Shadow-2 is significant, with values being smaller compared to those

in Table 9. Similarly, GFCE shows a positive and significant impact on Shadow-2 across all quantiles, with values smaller than those in Table 9. GI demonstrates a negative and significant impact on Shadow-2 in all quantiles, and the values are smaller than those in Table 9. On the other hand, EFI has a negative impact on Shadow-2 in all quantiles. The effect of EFI on Shadow-2 is significant except for the 0.10th quantile, and the values are greater than those in Table 9.

Table 10 and figure A.3 presents the results of MM-QR estimates for the monetary indicators of the shadow economy based on the ratio of currency in circulation to broad money (Shadow-3). The dependent variable in this analysis is the ratio of currency in circulation to broad money (Shadow-3), and the independent variables include trade, tax, unemployment (Unemp), government final consumption expenditure (GFCE), governance index (GI), and economic freedom index (EFI). Trade has a positive and significant impact on Shadow-3 across all quantiles, with values greater than those in Tables 8 and 9. Tax also demonstrates a positive and significant impact on Shadow-3 in all quantiles, with values being lower than those in Table 8 but higher than those in Table 9.

Table 10

MM-QR Estimates for the Monetary Indicators of Shadow Economy based on Ratio of Currency in Circulation to Broad Money

DV: Ratio of Currency in Circulation to Broad Money (Shadow-3)							
Variables	**Location**	**Scale**	**Q 0.10**	**Q 0.25**	**Q 0.50**	**Q 0.75**	**Q 0.90**
TRADE	4.359***	0.765*	3.151***	3.731***	4.279***	4.881***	5.969***
	(0.601)	(0.450)	(0.618)	(0.499)	(0.571)	(0.818)	(1.418)
TAX	0.0630***	0.00347	0.0576***	0.0599***	0.0627***	0.0660***	0.0682***
	(0.00784)	(0.00425)	(0.00957)	(0.00826)	(0.00782)	(0.00911)	(0.0107)
UNEMP	0.164***	0.0543	0.0803	0.116*	0.160**	0.212***	0.246***
	(0.0625)	(0.0338)	(0.0763)	(0.0660)	(0.0627)	(0.0726)	(0.0856)
GFCE	4.274***	0.0626	4.177***	4.218***	4.270***	4.330***	4.368***
	(0.642)	(0.348)	(0.783)	(0.676)	(0.639)	(0.746)	(0.878)
GI	0.211***	0.0687**	-0.105	-0.150**	-0.206***	-0.272***	-0.314***
	(0.0572)	(0.0310)	(0.0699)	(0.0605)	(0.0578)	(0.0664)	(0.0786)
EFI	2.346	-7.322***	-6.065***	-0.254***	-4.502*	-0.220**	-0.302***
	(1.812)	(2.378)	(2.134)	(0.0372)	(2.418)	(0.0954)	(0.114)
Constant	0.209***	-0.0239	0.243***	0.230***	0.214***	0.191***	0.164
	(0.0533)	(0.0367)	(0.0481)	(0.0432)	(0.0489)	(0.0724)	(0.108)

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Unemployment has a positive impact on Shadow-3 across all quantiles. The effect of employment on Shadow-3 is significant, except for the 0.10th quantile, with values being lower than those in Table 8 but higher than those in Table 9. Government final consumption expenditure (GFCE) shows a positive and significant impact on Shadow-3 across all quantiles, with values being lower than those in Table 8 but higher than those in Table 9. Governance index (GI) exhibits a negative impact on Shadow-3 in all quantiles. The effect of GI on Shadow-3 is significant, except for the 0.10th quantile, with values being lower than those in Tables 8 and 9. Economic freedom index (EFI) has a negative and significant impact on Shadow-3 across all quantiles, with values being lower than those in Tables 8 and 9.

6 Conclusions and Policy Recommendations

The aim of this study is to explore the determinants of the shadow economy in SAARC countries, aiming for a deeper understanding of the factors contributing to its size and scope. This research significantly contributes to knowledge by delving into structural variables and economic conditions influencing the expansion of the shadow economy. These factors include policy formulation, revenue

collection, economic development, social welfare, governance and corruption, and integration of the informal sector. The study applies the MM-QR technique, utilizing three proxies for the monetary indicators of the shadow economy: shadow1 for the ratio of reserves to narrow money, shadow2 for the ratio of narrow to broad money, and shadow3 for the ratio of currency in circulation to broad money. The independent variables considered are trade, tax, unemployment, government final consumption expenditure (GFCE), governance index (GI), and economic freedom index (EFI).

The results indicate that trade, tax, unemployment, and GFCE have a positive and significant impact, while GI and EFI have a negative and significant impact on the ratio of reserves to narrow money in SAARC countries. Similarly, trade, tax, unemployment, and GFCE have a positive and significant effect, while GI and EFI have a negative and significant impact on the ratio of narrow to broad money in SAARC countries. Additionally, trade, tax, unemployment, and GFCE have a positive and significant impact, while GI and EFI have a negative and significant impact on the ratio of currency in circulation to broad money in SAARC countries.

This study distinguishes itself by employing three proxies to identify the determinants of the shadow economy in SAARC countries, making a theoretical contribution. Few studies have utilized these proxies of monetary aggregates to explore the shadow economy. Furthermore, the practical contribution lies in the application of the MM-QR technique, which has been sparingly used in previous research to uncover the determinants of the shadow economy.

The findings of this study carry essential policy implications.

- The study proposes that the governments of SAARC countries should enhance the quality of governance and economic freedom. This improvement can pave the way for progress and prosperity within these nations. When the governance index and economic freedom index increase, the shadow economy decreases.
- The study suggests that governments in SAARC countries should work on reducing government final consumption expenditure (GFCE) and the unemployment rate. These factors have a positive impact on the shadow economy. An increase in these variables leads to a rise in the shadow economy, which is detrimental to any country's economic health.
- Furthermore, the study recommends that governments in SAARC countries should consider lowering taxes. High tax rates have a positive impact on the shadow economy. An increase in these variables results in a rise in the shadow economy, which, in turn, reduces government revenue, hampers consumer protection efforts, and undermines formal labor practices.

7 Recommendations for Future Research

The study proposes recommendations for future research, suggesting the exploration of various proxies to measure the shadow economy. For instance, researchers could consider variables such as unemployment rates, the size of the agricultural sector, labor force participation rates, and GDP growth per capita, in addition to the monetary indicators used in this study.

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Appendix

Table A.2: Data: Description and Sources

Variables	Description	Measurement Units	Sources
SHADOW1	Ratio of reserve to narrow money	US$ Billion	Central Banks of SAARC countries
SHADOW2	Ratio of narrow to broad money	US$ Billion	Central Banks of SAARC countries
SHADOW3	Ratio of the currency in circulation to broad money	US$ Billion	Central Banks of SAARC countries
TRADE	Trade	% of GDP	WDI
TAX	Tax revenue	% of GDP	WDI
UNEMP	Unemployment Rate	% of total labor force (modeled ILO estimate)	WDI
GFCE	Government Final Consumption Expenditure	% of GDP	WDI
GI	Governance Index	Index	WGI
EFI	Economic freedom Index	Index	The Heritage Foundation

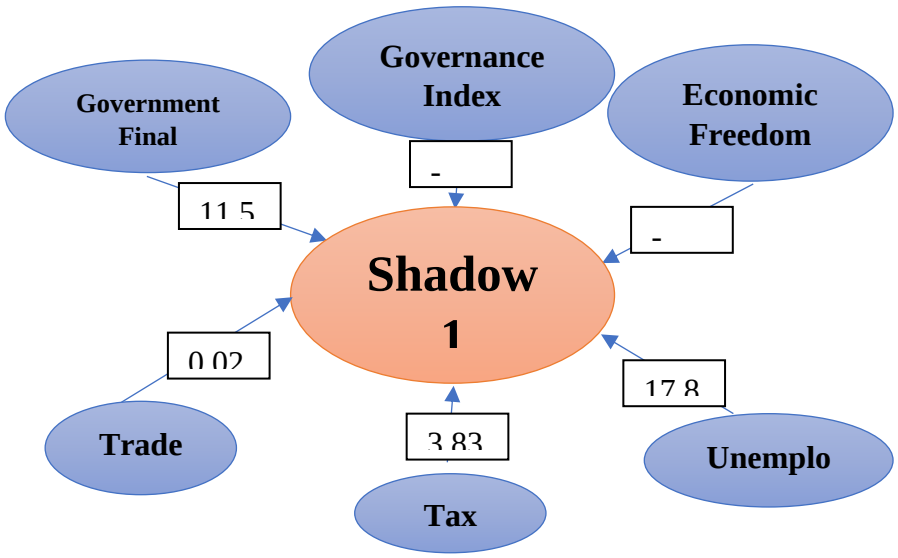

Figure A.1: MMQR Estimates for the Monetary Indicators of Shadow Economy based on Shadow 1 (at $Q_{0.50}$)

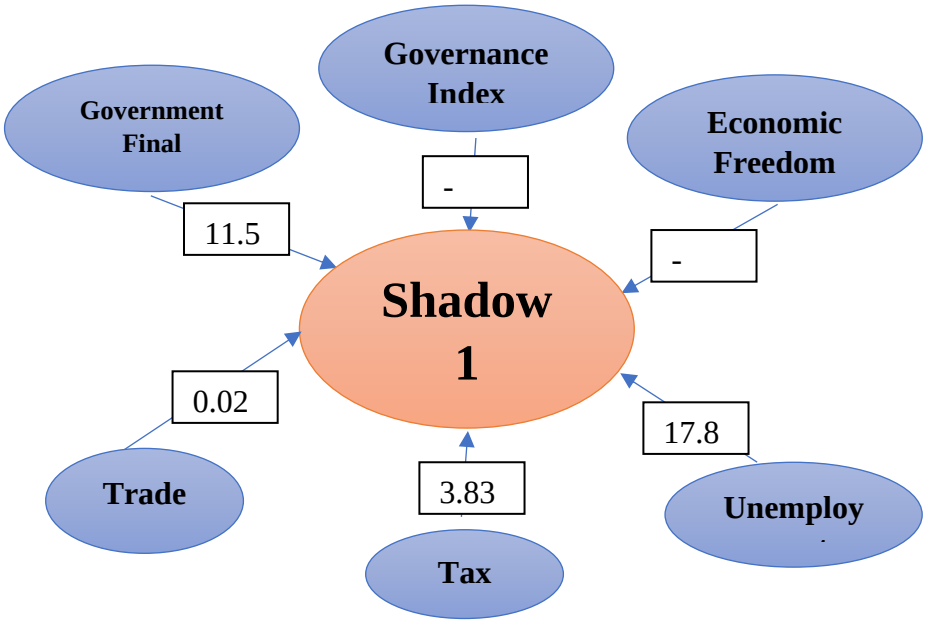

Figure A.2: MMQR Estimates for the Monetary Indicators of Shadow Economy based on Shadow 2 (at $Q_{0.50}$)

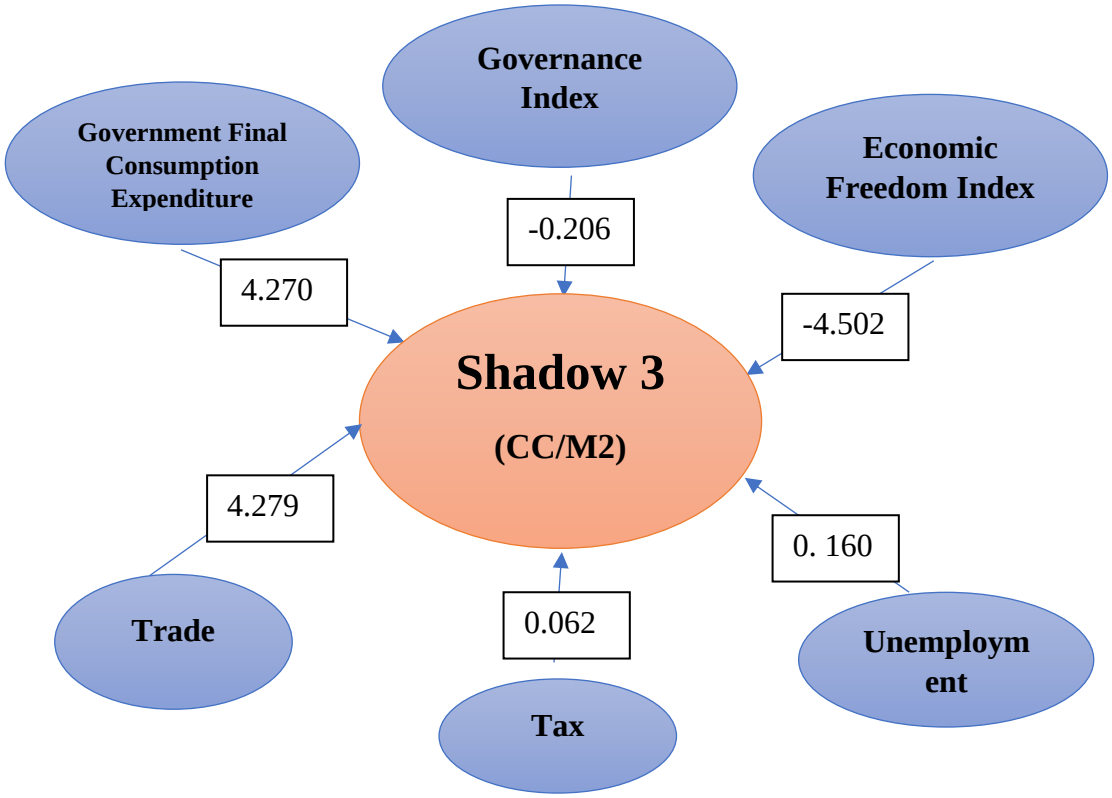

Figure A.3: MMQR Estimates for Monetary Indicators of Shadow Economy based on Shadow 3 (at $Q_{0.50}$)