

SHADOW ECONOMY, TAX EVASION AND FACTOR PRICE DISTORTIONS IN PAKISTAN

Zafar Manzoor

Lecturer, Department of Economics, Forman Christian College, Lahore, Pakistan

Azma Batool

Assistant Professor, Department of Economics, Forman Christian College, Lahore, Pakistan

Saima Liaqat*

Assistant Professor, Department of Economics, Lahore College for Women University, Pakistan

Abstract

The study re-examines the informal sector and extent of tax evasion for Pakistan from 1980 to 2023. It considers a modified monetary method for estimation. This approach hypothesizes that an increase in tax burden causes a rise in cash transactions thereby giving rise to informal economic activity, while keeping other things the same. The study employs ARDL method after checking for stationarity of the data. Short run dynamics of ARDL are used to evaluate the volume of black economy in Pakistan as there is a weaker analogy about existence of long run cointegration between variables. To formulate currency demand equation, the study uses tax to gdp ratio as a proxy for tax burden, interest rate and inflation (GDP deflator) for factor price distortions, credit provided to private sector domestically for privatization and currency ratio as a proxy for weighing cash transactions. Through the currency demand approach, the shadow economy and tax evasion as a percentage of GDP is calculated. According to the study, the mean volume of underground economic activity remained 38.12% of GDP and tax evasion remained 3.92 % of GDP. The greater incidence of tax evasion in Pakistan suggests greater tax revenue losses for the government and difficulty in formulating effective macroeconomic policies.

Keywords: Shadow economy; Tax evasion; ARDL

INTRODUCTION

“Shadow economy is defined as all the legal and illegal market operations that are not included in the official estimates of GDP”. Literature associated with shadow economy has failed to provide its unified definition. The divergent definitions are underpinned in variations in researchers’ views belonging to different academic fields. Statisticians call it an “unobserved economy” or “underground production” while economists named the phenomenon as “Shadow, underground, hidden or black economy”. The labor economists went into further diversification of the concept and called it an “informal sector” or “informal productive activities” (Hassan and Shneider, 2016; Fatima et al., 2026). Market inefficiencies resulting from flawed institutions in developing nations enhance the prevalence of shadow economy in these countries. It is estimated that the size of the informal sector in the developing country is more than 40% (Dreher and Shneider, 2010). This highlights the inability and incompetence of public institutions in taxing a major share of nations’ output. Higher percentage of the black economy also highlights the presence of a parallel economic system whose income not only is undocumented but also goes untaxed (Kemal, 2007; Marc et al., 2026). This analogy supports the widely accepted notion that shadow economy and tax evasion goes hand in hand.

Bigger informal sector results in stunted tax revenues, thereby limiting the ability of the government in funding public goods (Ali & Audi, 2018; Riaz et al, 2024; Karim et al., 2026; Gillani et al., 2026). This undermines economic, political and social institutions, reduce national productivity, create inefficient markets, distorts competition and causes resource misallocation (Wang et al., 2024; Rauf et al., 2026). Some of the factors that contribute to hidden economy’s size are higher tax burden, inflationary pressures, lower interest rate and reduced credit to private sector. Informal sector also expands when government employees take advantage of their position to improve their private earnings (Allingham and Sandmo, 1972). On the other hand, entrepreneurs contribute to shadow economy when they try to hinder the fraudulent officer’s ability and distort his official duty for their vested interests and private gains. According to Friedman et al., (2014), entrepreneurs consider working in informal sector as an opportunity to reduce tax burden.

Main concern of the academics and researchers to measure the extant of black economy is to expose government policies made on inaccurate statistical accounts. This suggests that prevalence of the hidden economy not only

* Corresponding Author, saima.liaqat@lcwu.edu.pk

promotes meaningful taxation policies but also paves way for formulating better regulatory laws (Schneider, 2004). Better macroeconomic condition leads to higher growth (Yafiah and Jadoon, 2023; Nasir et al., 2025; Haider et al., 2026). Key objective of macroeconomic policies is to create stability and reduce inefficiencies in the market (Zahid, et al., 2024; Marc, 2024; Ahmad et al., 2025; Tahir et al., 2026). The effectiveness of fiscal and monetary policies is entirely dependent on precise calculation of important statistics including output, income and unemployment. Hence, presence of informal production and market transactions can malign the calculation of important statistics associated with economics. This causes hurdles for officials to devise and implement well informed strategies at federal and provincial levels. Therefore, the key concern for the government is to detect and create ways to mitigate informal economic transactions; aiding in better results associated with policy implementations. The region encounters adverse consequences due to untaxed economic activities, often hampering social cohesion, aggravating market inefficiencies and resulting in greater fiscal losses. Failure to firstly detect and secondly respond to higher volumes of shadow economy results in a dysfunctional country with ineffectiveness, unfairness and inefficiencies becoming its permanent trait.

In 1980's, there was intense recession and high unemployment rates in United States of America. However, it was also noted that many daily wagers were working in the shadow economy, so the employment figures were misreported. Therefore, the whole recession was declared a "mirage" by many economists (Schneider, 2004). Although the aforementioned example is considered a polarized viewpoint about the adverse impact of inaccurate estimation of the official economy; the measurement of shadow economy still holds dire importance. It is important to note that the matter of expansive shadow economy is not only the concern of the developed country. The discrepancies with respect to the national income poses a greater threat to the developing world like Pakistan and India as well. Large size of the underground Asian economy (41% of GDP) has made it pertinent to analyze the developing economies with focus on informality (Hassan & Schneider, 2016; Alvi et al., 2024; Marc et al., 2021). According to Sheharyar (2014), globalization and liberalization has slowly aided informality to transition into the formal sector in underdeveloped countries. Pakistan like most of the developing world face extractive institutions, instable political regimes and a narrow tax base. In such countries, there is a high probability of switching the economic activity from formal to underground settings because of fraudulent behavior in tax implementation and auditing (Gull et al., 2020). This results in tax evasion as well. Hence, apart from studying other macroeconomic variables, tax evasion and shadow economy has become a key subject of study for researchers as far as underdeveloped countries are concerned. According to the report published by the world bank in 2022, the shadow economy in Pakistan is 30 to 40 percent and tax evasion account for 6.5 percent of GDP. Therefore, the main objective of the study is to reevaluate the size of Pakistan's informal sector and extent of tax evasion by considering tax burden, interest rate, credit given to private sector and inflation into account.

OBJECTIVE OF THE STUDY

The study propagates that a greater tax burden results in higher cash transactions. These cash transactions are commonly done in an informal economic setting. This eventually gives way to expansive size of black economy and aggravated tax evasion. The objective of the study is to reevaluate the size of the shadow economy and tax evasion by taking privatization and factor price distortions into account. This study is divided into several different sections. Section 2 critically discusses literature, section 3 elaborates the variable selection and methodology, section 4 is about results and section 5 concludes the paper.

LITERATURE REVIEW

Shadow economy, due to its tricky nature, involves a very tedious job of detecting it. According to Ameer et al. (2025) informal sector causes notable challenges for policymakers by disturbing economies of scale, depleting public funds and hindering economic development. The study indicates that stricter tax regulations and rigid laws are the main determinants of larger shadow economy in Pakistan. According to the authors the average size of the informal sector is 35.54 percent of total output value in the developing and 16.97 percent of total output value in the developed countries. Schneider and Williams (2021) reported that shadow economy of around 9 to 12 percent of the total economic activity is usual for Anglo-Saxon countries and around 20 to 30 percent of GDP is prevalent in Southern Europe. Most activities in the shadow economy involve the use of cash rather than any other banking channel. The main reason behind this analogy is that cash transactions do not have a money trail. According to Hassan & Schneider (2016), while analyzing extent of informality in Egypt highlighted that shadow economic activities are mostly conducted in cash in order to avoid detection. The study postulated that increase in money supply caused by the money outside the banking system reached 24.2% in 2013, compared to 15.6% a year earlier

and to 8.7% in 2009. The authors concluded that an excess demand for cash could be signaling a greater black economy in Egypt. When this extra demand for cash is unmatched with other macroeconomic variables such as interest rates etc., economists infer that this excess cash is being utilized for unrecorded activities. There are various causes and consequences linked with the existence of shadow economy. Tax burden is considered a primary driver of informal economic activity. According to Jabbar & Iqbal (2021), business freedom along with unemployment rate increase the size of shadow economy in developing countries like Pakistan. The presence of less resources due to shadow economy and its negative impact on GDP leaves policymakers with no choice but to give less attention to other pressing issues.

Furthermore, Wang et al. (2024) postulated that shadow economy causes an adverse effect on climate change by increasing greenhouse gas emissions. The absence of regulatory supervision in sectors of shadow economy creates an atmosphere where environmentally harmful practices are carried out, including the use of old technologies, unsustainable management practices and poor fuel consumption. Understanding the impacts and evaluating the size of shadow economy is imperative because only then could this problem be mitigated. Tanzi (2002) suggested that one of key consequences of a large shadow economy is the distortion that it causes in the calculation of several vital macroeconomic indicators. Informal economic activities impose misleading figures of unemployment, output and national income. This causes discrepancies between reported and actual economic activities and creates problems for policy makers.

Arby et al. (2010) suggested that shadow economy doesn't only include illegal activities; it also includes legal economic work that isn't recorded in official statistics. The formal economy covers jobs that are fully reported and regulated, while the informal sector runs alongside it, often avoiding taxes and rules. This is important because even legal but unreported work can affect GDP, reduce tax revenue, and create unfair competition for businesses in the formal sector. The consequences caused by the activities performed in the informal economy are not confined only to those who are working in it. They are also felt by people who are working in the official sector. These consequences include increased tax burdens and varied government policies (Kemal, 2007; Choudhary et al., 2026). According to Bati (2025), the shadow economy in Sub-Saharan African (SSA) countries has become a menace that is reducing government revenue. Moreover, his estimates indicate that shadow economy is found to have a significant negative effect on tax revenue. Similarly, Schneider (2016) measured tax losses in OECD countries due to shadow economy. The study concluded a total tax loss of approximately 454.1 billion euros per annum on average from 2011 to 2013. Furthermore, Tanzi (2002) postulated that greater cost associated with compliance drives the potential taxpayers to the informal sector. This happens because people find higher tax compliance cost a burden and take measures to avoid it. When it comes to Pakistan, various methods are used in literature to estimate the size of informal sector. Notable ones include currency demand approach[†], MIMIC[‡] and electricity consumption[§] method. The estimation of shadow economy through currency demand approach was at an average 33 % of GDP; electricity consumption approach recorded Pakistan's informal sector to be around 25.5 % of GDP and MIMIC model resulted in shadow economic activity of around 30.5 % of GDP on average in Pakistan.

Strong empirical evidence is suggestive that political instability creates a greater size of informal sector. Mughal et al. (2018) notes that the shadow economy in Pakistan has been increasing overall since the year 1973 but the increase has accelerated during 1975-1980. East Pakistan declared its independence and became Bangladesh in the year 1971, this sharp increase in black economy during 1975-1980 might be due to the reason that a large part of the economy was lost. In Pakistan, the problem of the existence of shadow economy creates misleading statistics for policymakers, leading to inaccurate measurements of GDP, employment and tax revenue, which hinders progress. This issue prevents proper attention from being given to other pressing issues like infrastructure development, governance and establishing transparency.

METHODOLOGY

The idea that an increase in the tax burden results in people making use of currency outside the banking system to avoid taxation became the basis to measure tax evasion and shadow economy. The idea was first floated by Cagan (1958) and then used by Tanzi (1983) to measure the size of shadow economy of United States of America.

[†] Kemal (2007)

[‡] Arby et al (2010)

[§] Kemal (2007)

The study follows Tanzi's, currency demand approach to measure the size of the informal sector in Pakistan from 1979 to 2023.

The functional and the equational form of the model are as follows:

$$CC = f(\text{TRGZ}, \text{MMR}, \text{DCPS}, \text{INF}, \text{CC}(-1)) \quad (a)$$

$$CC_t = \beta_0 + \beta_1 \text{TRGZ}_t + \beta_2 \text{MMR}_t + \beta_3 \text{DCPS}_t + \beta_4 \text{inf}_t + \beta_5 \text{LagCC}_{t-1} + \varepsilon_t \quad (1)$$

Where:

CC_t = currency in circulation at a time $t = C_t$ divided by M_t (currency ratio)

M_t = total money supply at time t

$CC_t = C_t/m_t$ = proxy for shadow economy

Real GDP $_t$ = level of economic activities

MMR_t = Interest Rate = opportunity cost of holding money

TRGZ_t = Tax burden (T_t) = tax to gdp ratio at time t

inf_t = Inflation = GDP deflator

Financial innovation DCPS_t = Domestic credit to private sector

ε_t = error term

t is used to identify it's a time series model.

Equation 1 shows that tax burden TRGZ positively affects the shadow economy which is measured as a ratio of currency in circulation (M_0) and Broad Money (M_2) given by (CC). Interest rate (MMR) has a negative impact on the currency ratio (CC) whereas inflation positively impacts the (CC). Domestic credit to private sector ($DCPS$) causes a positive impact on (CC).

"For each year, the predicted final value for the ratio of currency in circulation with respect to M_2 (CC_t) is calculated by subtracting the regressed values of CC_t , (with tax to GDP ratio trgz) from the regressed value of CC_t (without tax to GDP ratio trgz). Once the subtraction is done, the predicted value of CC_t becomes equal to the coefficient of Tax to gdp ratio (β_1) multiplied by the tax to GDP ratio (trgz) variable."

$$CC = CC_t - CC_{wt} = (\beta_0 + \beta_1 \text{TRGZ}_t + \beta_2 \text{MMR}_t + \beta_3 \text{DCPS}_t + \beta_4 \text{inf}_t + \beta_5 \text{LagCFM}_{t-1} + \varepsilon_t) - (\beta_0 + \beta_2 \text{MMR}_t + \beta_3 \text{DCPS}_t + \beta_4 \text{inf}_t + \beta_5 \text{LagCFM}_{t-1} + \varepsilon_t) \quad 1.1$$

The reduced form of the equation is as follows:

$$CC_t = \beta_1 \text{TRGZ}_t \quad 1.2$$

The CC_t series we finally have after the procedure in eq 1.2 is part of the currency that is associated with shadow economic activity. We hypothesize that the increase in tax burden (tax to gdp ratio trgz) will increase the portion of after-change currency ratio CC_t . The final CC_t series is then multiplied by year wise series of broad money M_2 , and we get illegal money in circulation. Legal money can be calculated by subtracting illegal money from broad money (M_2). Thereafter, the money velocity is estimated by dividing GDP (Gross Domestic Product) with Legal money for each year. Here we assume that the money velocity for both the official and unofficial is the same. Although this is not the case in the real world. "*The velocity of money in the informal sector is much greater than the velocity of money in the formal sector. The year wise informal sector or shadow economy is obtained through the multiplication of illegal money with the corresponding money velocity. Lastly, tax evasion is calculated by multiplying underground economy with each year's tax to GDP ratio. Both the tax evasion and shadow economy are expressed as a percentage of GDP (Tanzi, 1983)*".

The formulae to measure the shadow economy and tax evasion are given as follows:

"Illegal money (ILM) = $CC * M_2$ "

"Legal money (LM) = $M_2 - ILM$ "

"Money Velocity (MV) = GDP / LM "

"Shadow economy (SE) = $ILM * MV$ "

"Evasion of Tax (ET) = $SE * (\text{Total tax to GDP ratio})$ "

"SE as a percentage of GDP = $(SE / GDP) * 100$ "

"ET as a percentage of GDP = $(ET / GDP) * 100$ "

DEFINING VARIABLES

Following is the table with Variables, Definition, Abbreviation and Sources used in this paper.

Table 1: Defining Variable and Sources

Variables	Definition	Abbreviation	Sources
Currency held by public	Currency held by public at a time t	CC t	Pakistan's Statistical Yearbook
Total money supply	Broad measure of money (M2) available in economy at a time t	M t	Pakistan's Statistical Yearbook
Real Gross Domestic Product	Shows the level of economic activity, after being adjusted for inflation	GDP t	World Development Indicators (WDI)
Interest Rate	Opportunity cost of holding money instead of any interest-bearing asset	MMR t	World Development Indicators (WDI)
Tax revenue	(proxy) incentive to conduct shadow (informal) transactions	T t	Pakistan's Statistical Yearbook
Inflation Rate (GDP deflator)	Estimates the rate of change in prices which are affecting money demand	Inf t	World Development Indicators (WDI)
Financial Innovation (proxy for the domestic credit to private sector)	Reflects development and efficiency of financial institutions in expanding credit access to private entities	DCPS t	World Development Indicators (WDI)

RESULTS AND DISCUSSION

Tanzi (1983) and Gutmann (1977) did not address the issue of stationarity and therefore their studies gave spurious results. However, the current study will consider the issue of stationarity and select optimal lag length before deciding for coefficient of tax burden. Tax burden bears key to measure the size of shadow economy. The study considers the data from 1979 to 2023, to measure the size of black economy and tax evasion in Pakistan. The results of the Augmented Dickey Fuller Test (ADF) reveal that MMR (interest rate) and DCPS (Domestic credit to private sector) are integrated of order 0, $I(0)$. Whereas TRGZ (tax to gdp ratio), CC (currency ratio) and inflation are integrated $1(1)$. Please refer to table A1 in Appendix to check for unit root tests. Therefore, we apply ARDL model to check for short run dynamics with optimal lag length. Based on AIC criteria, ARDL (1,1,1,1,0) was selected. Where, all variables were at first lag except inflation (INF) which was selected at no lag length. The results of the short run dynamics are as follows:

Table 3: Results of Short Run Dynamics (ARDL approach)

Dependent variable: Currency Ratio (CC)

	Coefficients	T-statistics
Currency ratio: CC (-1)	0.63	6.141***
Tax burden: TRGZ (-1)	1.249	2.422**
Interest Rate: MMR (-1)	-0.00425	2.107**
Domestic credit to Private Sector: DCPS (-1)	0.0028	2.081**
Inflation: Inf	0.000313	1.211
Intercept: C	0.0090	0.3746
R (squared) = 0.9491		F statistic: 81.58
Adjusted R (squared) = 0.9375		Degrees of freedom: 35

Note: (*), (**) and (***) signify 1, 5 and 10% level of significance.

The results of the short run ARDL dynamics show that lag of tax burden (TRGZ (-1)), lag of Domestic credit to private sector (DCPS (-1)), and lagged value of MMR (Interest Rate) is significant at 5% level of significance. Lag of currency ratio also shows highly significant (1% level) and positive relationship with the dependent variable. Furthermore, Inflation does not show significance at any level. A unit increase in tax burden results in a 1.249 unit increase in the currency ratio. This analogy is in line with (Arby et al., 2010) and Kemal (2009). The signs are in line with the literature.

DIAGNOSTIC TESTS

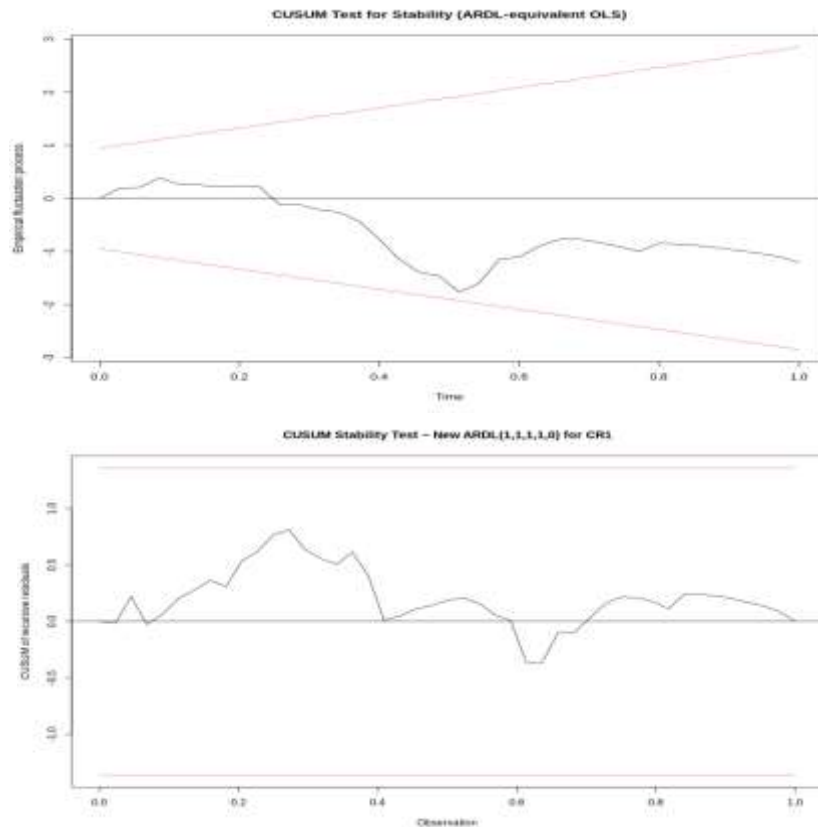
The diagnostics related to ARDL (1,1,1,1,0) suggest that the specification of the model is statistically stable. Suggesting no autocorrelation, serial correlation and heteroskedasticity. Jarque Bera test suggests that the residuals are normally distributed. Furthermore, the residual diagnostics are also suggestive of a correct functional form of

the model. The bound test, however, suggests a possible but weak long run cointegration. So, we will stick to short run dynamics only.

Table 4: Diagnostic Tests

Test	Statistics	P-value	Conclusion
Durbin-Watson	1.98	0.12345	No autocorrelation
Breusch-Godfrey LM	1.23	0.456	No serial correlation
Breusch-pagan	0.89	0.6123	No heteroskedasticity
Jarque-Bera	1.11	0.33221	Normal Residuals
RESET (powers 2-3)	0.77	0.47321	Correct functional form
Bound F-test (cointegration)	3.337	0.13100	There is weak but possible cointegration

STABILITY TEST



The current study also involves CUSUM and CUSUM square test for stability. The test shows that the model is stable at 5% level of significance.

MEASURING SHADOW ECONOMY AND TAX EVASION

Following the method provided in the methodology, we calculate the size of shadow economy and tax evasion as a percentage of GDP. The results are provided in table 5 below.

The estimation of the extent of shadow economy and tax evasion is suggestive that there is a large informal sector prevalent in the country. The average size of the shadow economy is 38.12 % of GDP and tax evasion is 3.92 % of GDP, which is in line with Kemal (2007) and Arby et al. (2010). The average of the shadow economy and tax evasion also coincide with the recent ILO (2022) report on the informal sector in developing countries.

CONCLUSION

The study used short run ARDL dynamics to measure the size of shadow economy and tax evasion in Pakistan after checking for stationarity. The results of the currency demand equation shows that higher tax burden, greater inflationary pressure and more domestic credit provided to private sector, increases dealing in cash transactions outside the banking system in Pakistan. Whereas higher interest rates reduce the incentive to deal with cash transactions. Furthermore, there is a strong prevalence of shadow economy in the country suggesting a parallel

economy running alongside the official sector. The greater incidence of tax evasion in Pakistan suggests greater tax revenue losses for the government.

Table 5: Shadow Economy and Tax Evasion as a percentage of GDP

Year	Shadow Economy % of GDP	Tax Evasion % of GDP
1980	41.73	5.21
1981	46.82	5.76
1982	46.13	5.49
1983	44.69	5.25
1984	44.10	5.29
1985	45.01	5.08
1986	42.33	4.90
1987	43.43	4.73
1988	40.92	4.54
1989	41.63	4.92
1990	44.31	5.25
1991	44.44	4.70
1992	39.69	4.64
1993	43.84	4.93
1994	42.22	4.52
1995	40.19	4.85
1996	45.26	5.66
1997	46.91	5.49
1998	43.91	4.86
1999	41.55	4.03
2000	36.40	3.31
2001	34.12	3.25
2002	35.73	3.25
2003	34.20	3.15
2004	34.63	3.13
2005	33.91	2.99
2006	33.06	3.05
2007	34.58	3.26
2008	35.40	3.28
2009	34.77	3.10
2010	33.51	2.84
2011	41.73	2.63
2012	46.82	2.76
2013	46.13	2.77
2014	44.69	2.71
2015	44.10	2.95
2016	45.01	3.07
2017	42.33	3.06
2018	43.43	3.03
2019	40.92	2.99
2020	41.63	2.95
2021	44.31	2.92
2022	44.44	2.88
2023	39.69	2.85
<i>Average</i>	<i>38.12</i>	<i>3.92</i>

REFERENCES

- Ahmad, M. M. Audi, K. Ahmad, (2025). Tax Burden, Incentives, And Informality: Determinants of SME Growth and Formalisation in Emerging Markets. *Contemporary Journal of Social Science Review*, 3(1), 1299-1308.
- Ali, A., & Audi, M. (2018). Macroeconomic Environment and Taxes Revenues in Pakistan: An Application of ARDL Approach. *Bulletin of Business and Economics (BBE)*, 7(1), 30-39.
- Allingham, M. G., & Sandmo, A. (1972). Income tax evasion: A theoretical analysis. *Journal of Public Economics*, 1(3-4), 323-338.
- Alvi, A. A., Audi, M., & Ashiq, R. (2024). *Is indirect Taxes Bad for the Poor? Examining the Determinants of Poverty in Pakistan*. University Library of Munich, Germany.
- Ameer, W., Sohag, K., Zhan, Q., Shah, S. H., & Yongjia, Z. (2025). Do financial development and institutional quality impede or stimulate the shadow economy? A comparative analysis of developed and developing countries. *Humanities and Social Sciences Communications*, 12(1), Article 17.
- Arby, M. F., Malik, M. J., & Hanif, M. N. (2010). *The size of informal economy in Pakistan* (SBP Working Paper Series No. 33). State Bank of Pakistan.
- Bati, B. E. (2025). Effect of the shadow economy on tax revenue in Sub-Saharan African countries: A dynamic panel data analysis. *Economy of Regions*, 21(2), 582-592.
- Cagan, P. (1958). The demand for currency relative to the total money supply. *Journal of Political Economy*, 66(4), 303-328.
- Choudhary, S., Ali, A., & Audi, M. (2026). *The Relations between Internal Controls, Corporate Governance, and the Credibility of Post-Issuance Disclosures of Green Finance: Evidence using Issuer-Level Panel Data* (No. 128864). University Library of Munich, Germany.
- Dreher, A., & Schneider, F. (2010). Corruption and the shadow economy: An empirical analysis. *Public Choice*, 144(1), 215-238.
- Fatima, M., Audi, M., & Ali, A. (2026). Nexus Among Financial Risks and Financial Performance: A Moderating Role of Corporate Governance. *Policy Journal of Social Science Review*, 4(1), 295-322.
- Friedman, B. A. (2014). The relationship between effective governance and the informal economy. *International Journal of Business and Social Science*, 5(9), 126-135.
- Gillani, S. I. H., Ali, A., & Audi, M. (2026). Examining the Impact of Environmental Taxation, Economic Growth, and Political Instability on Sustainability. *Journal of Management Science Research Review*, 5(1), 2574-2602.
- Gull, S., Kausar, R., & Saleem, A. (2020). Exploring and estimating the size of shadow economy by using monetary approach: Case study of Pakistan. *Journal of Contemporary Macroeconomic Issues*, 1(2), 35-48.
- Hassan, M., & Schneider, F. (2016). *Size and development of the shadow economies of 157 countries worldwide: Updated and new measures from 1999 to 2013* (IZA Discussion Paper No. 10281). IZA Institute of Labor Economics.
- Jabbar, A., & Iqbal, J. (2021). The shadow economy in Pakistan: An analysis with MIMIC model. *Pakistan Journal of Humanities and Social Sciences*, 9(3), 340-350.
- Kanwal, Z., Audi, M., & Alam, M. (2025). *Corporate Tax Strategy, Risk, and Long-Term Value Creation: Insights from Technology, Pharmaceutical, and Manufacturing Sectors* (No. 127563). University Library of Munich, Germany.
- Karim, D., Audi, M., & Ali, A. (2026). *The Role of Artificial Intelligence in Shaping Skill Requirements within the Accounting Profession* (No. 129018). University Library of Munich, Germany.
- Kemal, M. A. (2007). *Fresh assessment of the underground economy and tax evasion in Pakistan: Causes, consequences, and linkages with the formal economy*. Pakistan Institute of Development Economics.
- Marc, A. (2024). Exploring fiscal dynamics between resource and non-resource tax revenues in oil-dependent countries. *Journal of Energy and Environmental Policy Options*, 7(4), 20-30.
- Marc, A., Ali, A., & Poulin, M. (2026). Modelling Urban Expansion, Energy Consumption, and Environmental Sustainability: The Moderating Role of Environmental Taxes in Developing Countries. *Sustainability*, 18(9), 4473.
- Marc, A., Ali, A., & Roussel, Y. (2021). *Measuring the Tax Buoyancy: Empirics from South Asian Association for Regional Cooperation (SAARC)* (No. 109567). University Library of Munich, Germany.

- Mughal, K. S., Schneider, F. G., & Hayat, Z. (2018). *Shadow economy in Pakistan: Its size and interaction with official economy* (MPRA Paper No. 87812). University Library of Munich.
- Nasir, F. B. M. Audi, A. Ali. (2025). Determinants of Corporate Tax Planning Strategies Among Multinational Corporations in The United Arab Emirates. *Contemporary Journal of Social Science Review*, 3(2), 2187-2196.
- Rauf, S., Audi, M., & Ali, A. (2026). *Liquidity Risk Management in the Perspective of Asset Quality, Loan Quality & Governance: A Case Study of Pakistan Banking Industry* (No. 128920). University Library of Munich, Germany.
- Riaz, M. F., Jadoon, A. K., Liaqat, S., & Iqbal, M. (2024). Nexus between terrorism and shadow economy in developing countries: An empirical investigation by using structural equation models. *Journal of Asian Development Studies*, 13(2), 365–383.
- Schneider, F. (2004). Shadow economy. In *The encyclopedia of public choice* (pp. 286–296). Springer.
- Schneider, F. (2016). Tax losses due to shadow economy activities in OECD countries from 2011 to 2013: A preliminary calculation. *Turkish Economic Review*, 3(1), 1–15.
- Schneider, F., & Williams, C. C. (2021). *The shadow economy*. SSRN Electronic Journal.
- Sheharyar, M., Harun, M., & Fadzim, W. R. (2024). Developing a social accounting matrix framework to examine the impact of foreign investment on labour in Pakistan. *Pakistan Journal of Life and Social Sciences*, 22(2), 1–15.
- Tahir, S., Audi, M., & Ali, A. (2026). Growth Dynamics of Green and Brown Foreign Direct Investment in Central and Eastern Europe: Evidence from ARDL and NARDL Models. *Policy Journal of Social Science Review*, 4(2), 810-832.
- Tanzi, V. (1983). The underground economy. *Finance and Development*, 20(4), 10–13.
- Tanzi, V. (2002). *The shadow economy: Its causes and its consequences*. Brazilian Institute of Ethics in Competition.
- Wang, Y., Awad, S., Krawczak, P., Al Takash, A., Faraj, J., & Khaled, M. (2024). Shadow economy and environmental sustainability in global developing countries: Do governance indicators play a role? *Sustainability*, 16(22), 9852.
- Yafiah, & Jadoon, A. K. (2023). Major macroeconomic issues and economic growth of Pakistan. *Bulletin of Business and Economics*, 12(2), 80–86.
- Zahid, H., Audi, M., & Ali, A. (2026). *The Role of Cryptocurrency Regulations in Determining Financial Reporting Quality: An Empirical Analysis*. University Library of Munich, Germany.
- Zahid, J., Jadoon, A. K., Hamza, B., & Ali, M. (2024). Macroeconomic determinants of fiscal sustainability in the Asian countries. *Bulletin of Business and Economics*, 13(1), 1–12.

Appendix

Table A1: Augmented Dickey Fuller Test

Unit root	CC	TRGZ	DCPS	Inf	MMR
	Trend and intercept	Trend and intercept	Trend and intercept	Trend and intercept	Trend and intercept
Level	-2.649	-2.405	3.4426*	-3.0146	-3.9349***
First difference	3.3371*	-3.831**	3.5653*	-4.6946***	-3.1494*