Estimating the Size and Dynamics of Informal Economy in the Southern African Development Community (SADC) Countries: A Theoretical and Empirical Approach

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Abstract

This paper uses a two-sector dynamic general equilibrium model that deterministically accounts for the trends among time-series variables to estimate the size of the informal economy for 15 Southern African Development Community (SADC) countries from 1990 to 2019. Among the countries, Mauritius, on average, maintains the smallest informal economy at 23 percent of GDP; followed by South Africa, averaging 25 percent of GDP, while the largest informal economies as a percent of GDP are Zimbabwe and Tanzania at 60.8 percent and 53 percent respectively. In addition, this paper explores the determinants of this informal economy measure using a panel vector autoregressive model (PVAR), and the nonlinear relationships among dependent variables from the impulse-response functions, show that, on average, countries with larger real GDPs, higher levels of control of corruption, higher regulatory barriers and higher levels of economic freedom have smaller informal economies. While countries with higher tax burdens, on average, exhibit increasing informal economies. Hence, this confirms the dynamics of informality vary across SADC countries and their governments should relax some restrictions, enforcements and projections based on dynamics of the informal sectors.

Keywords: Informal economy, DGE models, PVAR, SADC countries

JEL Classification: C33, E26, E32.

1. Introduction

The classical model of development predominantly argues that the working population would gradually shift from the traditional and informal sector (with low productivity) to the modern and formal sector (with high productivity). Such gradual transformation into the high-productivity sector accelerates the pace of growth and development. Contemporary evidence does not support this doctrine and reveals the parallel existence of low productivity and traditional activities persisted in the informal sector. All countries from advanced economies like United States of America (U.S.A) or European Countries to those in developing economies like Southern Asia and Southern African Development Community (SADC) countries experience different sizes and kinds of informal economic activities, from production, and distribution to sales, and they are also known as shadow economies, or black economies or unreported economies or informal economies or unorganized sectors (Schneider, 2011), and in various economies viewed as a site for primitive capital accumulation (Maiti and Sen, 2010).

One thing that is common across all is that Informal economies they are neither officially registered to carry out economic transactions nor recognized in the official calculation of the GDP, but contribute to adding economic and welfare values for a specific country (Schneider, 1994). For example, recent studies from Medina and Schneider (2019) estimated the average of informal economy for all countries to be around 30.9 percent, the size of the informal economy as a percent of GDP averaging 14.2 percent in advanced countries, 27.9 percent in emerging economies, and 36.3 percent in low-income economies. Figure 1 shows that the informal economies of Sub-Saharan Africa, SADC, Latin America & Caribbean, and South are above global average in both periods (1990 & 2020), except South Asia by 2020. Above the global average indicates that the governments of these countries should push-up efforts by focusing on the policies that can address and reduce the size of informal sectors. For example, investing in digital technologies that can increase connectivity, detect informalities, accelerate transparency, improve accountability, and boosts productivity. While the informal economies of Europe & Central Asia, East Asia & Pacific, Middle East & North Africa, and North America are below global average.

While the economies have been trying to accelerate economic growth after financial and Covid-led crises, the revenue loss from this sector has become an important area of concern. However, the existence of such a sector should not be viewed as a shadow economy in a typical developing economy. Because the size of formal sector happens to be small for various factors and

cannot absorb all working population therein. Hence, those who do not find work in the formal sector crowd into the informal sector to survive when the unemployment benefits are almost zero in developing economies. Therefore, this paper aims to identify the factors influencing the size of informality in SADC countries.

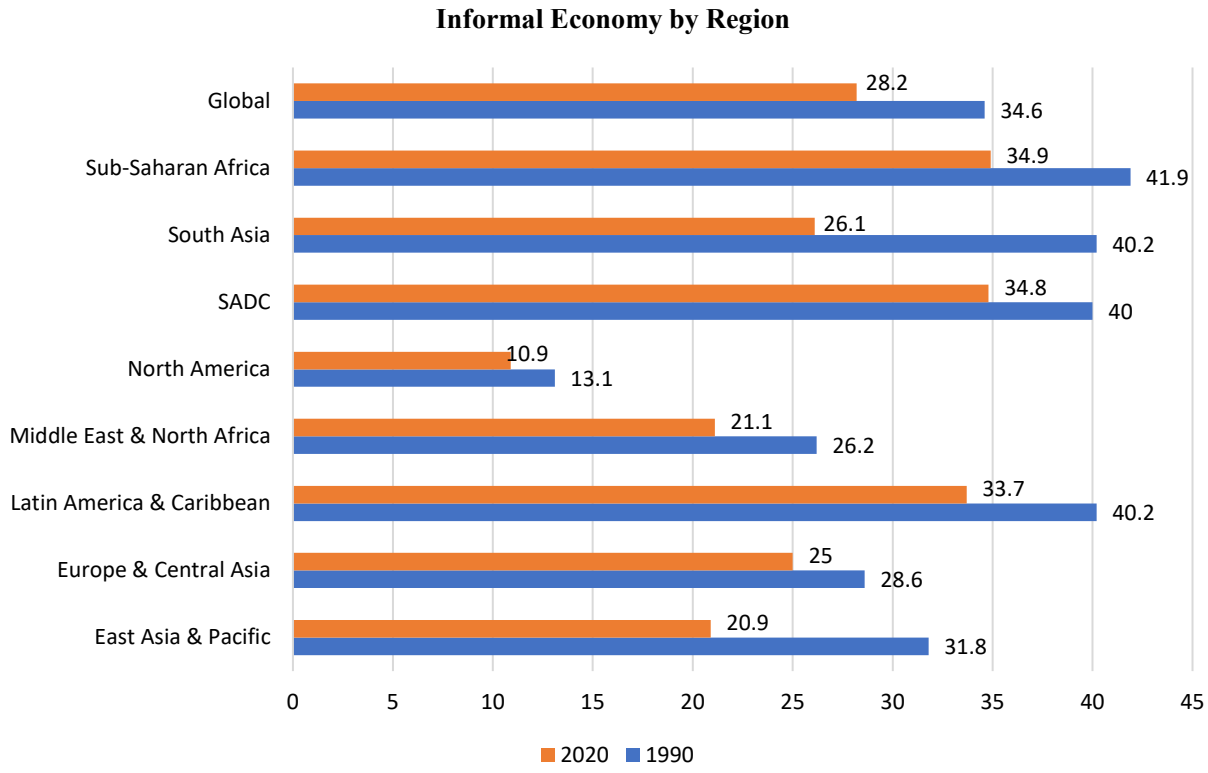

Fig. 1. Region's informal economy. *Source*: Author's illustration based on the world bank enterprise surveys

Informal economic activities pose a substantial challenge to the economy of most countries related with poor development outcomes (Ohnsorge and Yu, 2022) and weaker institutional quality (Huynh and Nguyen, 2020), but are more predominant in developing economies than advanced ones. Special challenges created by the informal economies in SADC countries are unofficial allocation of resources that could be officially relocated, reduction of government revenue collections that result in low quality and suboptimal levels of public goods provisions, increase criminality (such as smuggling, prostitution, etc.), and reduce the quality of official macroeconomic statistical data used in policy formulation. Therefore, a larger size of informal sector in SADC countries weakens policy effectiveness and reduces the ability of governments to extremely generate fiscal revenues and therefore, expand fiscal deficit. From these perspectives,

researchers and policymakers have been interested in understanding the dynamics of the informal economies in order to paramount formulate effective policies to reduce the size of informal economic activities or to transform them to formality.

SADC countries are still dominated by the informal economies which represent the share of many sectors especially in commerce, manufacturing, mining, transportation and finance. Retail trade activities, including street vending, peddlers, hawkers and unpaid jobs in family shops are the most common forms of activities in Africa's informal sector. The informal sector is like a built-in economic stabilizer growing when the economy is in a downtrend and narrowing when there is an uptrend and hence helps in promoting inclusive growth (Cassim *et al.*, 2016). Various countries experience economic growth without significantly affecting the size of the informal sector (Aryeetey, 2010). Tax avoidance and regulation detection are key to informality, but the productivity of informal industries is too low for them to flourish in the formal sector (La Porta and Schleifer, 2014). Researchers including Medina *et al.* (2017) support this view by stating that although informality seems to fall with the level of income but recent evidence also show that the informal economy is becoming a long-term feature of developing economies including SADC countries because they buy inputs for cash, hire informal workers for cash, sell their products for cash, are highly unproductive and unlikely to benefit much from becoming official (formal) regardless of lowering registration costs, permits, fees and minimum capital requirements. International experience and the World Bank asserted that the increase in the level of development decreases the share of the informal economy but most countries in SADC are expected to persist in large informal sectors for many years to come due to the imminent increase in population growth, thus presenting both challenges and opportunities for policymakers.

SADC countries are widely covered by informal activities and have not been able to establish a modern formal sector that is capable for provision of adequate employment opportunities for their rapidly growing population due to limited fiscal resources, unimplemented development and socio-economic policies (protection, rural-urban migration, education, housing, etc.), higher levels of corruption, poor technology adoption and poor legal institutional frameworks that are not suitable for the development of formal businesses. These countries are without unemployment insurance benefits. Hence, the informal sector remains a major alternative source of employment, where it is made-up by own-account or small enterprises with limited capital and relies more on labor-intensive technology that employs unskilled and poorly paid workers, and is adversely connected with financial sector development (Capasso *et al.*, 2022). The youth labor

force between the ages of 15–24 years dominates the informal sector, and this is a partial reflection of the deterioration of economic progress in Africa (ILO, 2018). Also, a negative correlation between informal employment and the level of education exists with workers without education or with primary education which account for more than 70 percent of people employed in the informal sector in all the developing regions. Self-employment makes up a greater share of informal employment with about 50 percent, 46 percent and 41 percent recorded in SSA, Asia and the Pacific, and the Americas, respectively (ILO, 2018).

Poor business environments and registration procedures add up the expansion of informal sectors in SADC countries. Business registration costs are very high, and bureaucratic process till the business gets the license takes longer than the scheduled period, which makes many businesses fail to comply with the conditions created by the government officials. Yet, higher rates of corruption and taxation which are predominant in the government officials, may discourage SADC citizens from officially registering their economic activities because majority of these businesses have small initial start-up capitals. Sub Saharan Africa (SSA) (includes SADC) ranks highest in the number of bureaucratic procedures and requires 63 days to establish a new business compared to all regions of the world. On average, it takes 251 days to obtain a business license, and there are 20 licensing procedures to build a storage warehouse, which is higher than anywhere else other than Eastern Europe or Southern Asia. SSA ranks last of all the world's regions on the World Bank's Most Friendly Business Regulations list (World Bank, 2009). All these procedures attract few people to register their businesses, and more businesses find their business suitable if they undertake their productions unofficially. However, the prevalence of informal economy remains a cornerstone of national economic agendas and represents the livelihoods of millions with little tax revenue contribution. Regulation policies and reforms are still the central key towards transforming into a mainstreaming economy. During the past twenty years, many SADC governments started to make socio-economic reforms to streamline and simplify the mechanisms of launching a new business through creating a conducive business-friendly environment and relaxing improper regulations. It is remarkable that of the top ten 2008/09 reformers, six were evidenced from SSA and Rwanda led the list. The region successively passed two new orders that significantly facilitated bankruptcy laws and eased business registration. However, the informal sector has instead become a notable significant and durable feature of SSA's economic landscapes (World Bank, 2009).

Measuring the size and dynamics of informality is important given that labors in informal conditions have little market standards or no social protection or employment benefits; and these conditions weaken inclusiveness in the labor market rights. Furthermore, informal economic activity critically bounds tax revenue collections for developing economies most needing a stable tax base for fiscal health improvement. This proposes that developing economies should have an incentive to understand the scale of unofficial economic activities and how to allocate production from the informal to the formal sector (Medina *et al.*, 2017). This study uses a dynamic general equilibrium (DGE) model of the country-level economy to estimate the size of the informal economy for the 15 SADC countries from 1990 to 2019, which especially captures the trends observed amongst time-series variables. This methodology also captures the dynamics of the informal economy by differentiating labor-augmenting technological progress across both sectors of the economy based on deterministic trends in the time-series variables (Marshall *et al.*, 2023). Furthermore, this paper applies to Panel Vector Autoregressive Model (PVAR) to explore the influential drivers that affect the size of the informal economy in SADC region.

The 4 remainders of this paper proceed with a prevalent review of the literature on measures of informality in the next section. Section 3 outlines the theoretical model. Section 4 describes data and parameterization. Section 5 discusses applications of the informal economy measure, and Section 6 concludes.

2. Literature review

Over the decades, researchers, consultants and economists from various international organizations and universities have struggled with the enigma of estimating the size of the informal economy. Direct and indirect approaches have been suggested to measure the estimate of the size of the informal economy. Direct approaches rely on surveys and samples, voluntary replies, tax auditing and other official compliance methods to estimate the size of the informal economy, and therefore unlikely to capture all informal activities due to sensitive results from the formulated questionnaires (interviewees are not able to confess fallacious activities). Indirect approaches use indirect information to estimate the size of the informal economy, also called indicator approaches. For instance, the variance between the official and actual labor force approach states that a decline in labor force participation in the formal economy can be used as an indication of an increase in the size of the informal economy, if total labor force participation is assumed to be invariant (Medina *et al.*, 2017). The nature of operations of informal economic

activities are done under the umbrella of secrecy where the legal detection is not possible, for example, firms participating in this unofficial economy use cash transactions instead of the banking system to prevent a paper trail (Marshall *et al.*, 2023). This brings incapable challenges for researchers when trying to estimate how much economic activities take place unofficially. Schneider *et al.* (2010) provide a key summary of informal economic measures and comments on the potential benefits and possible problems with the several methods.

Researchers employ different techniques to measure the informal economy depending on determinable indicator variables of the informal economy. Some researchers use only one indicator to estimate the shadow economy, for example, Cagan (1958), the first researcher to use the currency demand approach by considering the correlation between currency demand and tax pressure for the United States over the period 1919–1955. Also, Gutmann (1977) employed the same technique but without any statistical procedures. Tanzi (1983) developed further the Cagan's approach to calculate the size of the informal economy by estimating a currency demand function for the United States for the period 1929 to 1980. This approach assumes that informal transactions are primarily undertaken in the form of cash so as to leave unobservable signals for the authorities. Hence an increase in the size of the informal economic activities cause the increase in the demand for currencies (Alm and Embaye, 2013). One of the main criticisms of this approach is that not all transactions in the informal economy are paid in cash. Isachsen and Strøm (1985) applied the survey method in Norway and roughly find out 80 percent of all transactions in the informal sector were paid in cash. An electricity consumption plays as another indicator that has been used to estimate the size of the informal economy.

Kaufmann and Kaliberda (2016) regarded electric power consumption as the single best physical indicator of unofficial economic activity and the growth of total electricity consumption is an indicator for growth while Lackó (2000) assumes that a certain part of the informal economy is associated with the household consumption of electric power. One of the main shortcomings of this approach is their reliance on only a considerable amount of electricity to measure the informal economy but also other energy sources can also be. Accordingly, model-based approaches such as the MIMIC method have been used to measure the size of the informal economy (Frey and Weck-Hanneman, 1984; Wiseman, 2013a). The MIMIC estimation technique is a new method based on econometric estimations which has been applied to all countries, therefore allowing an international comparison of unofficial economies (see Schneider *et al.*, 2010). The MIMIC model uses simultaneous equations to examine the relationships between a latent variable size of

informal economy and observable variables in terms of the connections among a number of observable variables by using covariance criteria information.

The observable variables are grouped into causes and indicators of the latent variable (Schneider and Buehn, 2013). The key significances of the MIMIC method are that it allows modelling of informal economic activities as an unobservable (latent or unofficial) variable and that it considers its multiple determinants (causes) and multiple effects (indicators) (Schneider and Buehn, 2016). Schneider *et al.* (2010) use the MIMIC method to quantify the extent of the informal economy for 151 countries to the ample time span from 1996 to 2007. By using the most twelve causal variables (size of government; the share of direct taxation; the total tax burden; fiscal, business and economic freedom; the unemployment rate; GDP per capita; regulatory quality; government effectiveness; openness; and the inflation rate) and five indicator variables (growth rate of GDP per capita; GDP per capita; the labor force participation rate; the growth rate of labor force and currency). They find that the size and the consequences of informal economies vary in each country. The multiple indicator-multiple cause (MIMIC) method has been criticized by Medina *et al.* (2017) because it uses GDP as both a cause and an indicator variable. Medina *et al.* (2017) addressed this challenge in their paper by applying for the light intensity approach instead of GDP. They also applied the Predictive Mean Matching (PMM) method to estimate the size of the informal economy for SSA countries over 24 years. Results showed that the informal economy in SSA stands among the largest size in the world regardless of this share has been declining slowly. It also reveals substantial informal heterogeneity ranging from a low of 20 percent to 25 percent in Mauritius, South Africa and Namibia to a high of 50 percent to 65 percent in Benin, Tanzania and Nigeria.

Recent scholars have adopted DGE models to associate informal economy with the business cycle frequencies to better understand the impacts of economic policy. Busato and Chiarini (2004) used a dynamic general equilibrium model to estimate the equilibrium effects of policy where tax evasion and underground activities are explicitly incorporated from a revenue-maximizing perspective, and that may give a rational justification for a variant of the Laffer curve for a plausible parameterization. The key policy messages from Busato and Chiarini (2004) are that bringing taxpayers to compliance would be better than threatening to punish them if convicted and that an economy without problems of compliance is much more sensitive to myopic behavior. Furthermore, Orsi *et al.* (2014) used Italian quarterly data for the interval from 1982: Q1 to 2006: Q4 to study the underground economy within a dynamic and stochastic general equilibrium

framework by combining limited tax enforcement with an otherwise standard two-sector neoclassical stochastic growth model. The Bayesian estimation of the model provided evidence in favor of an important unofficial sector in Italy. Thus, a steady increase in taxation over this period caused an increase in the size of the Italian informal economy. They included labor supply and investment-specific shocks that play incredible roles in explaining data variability at business-cycle fluctuations (see Smets and Wouters, 2007; Justiniano *et al.*, 2010). Also, they did not need to detrend the data before estimation because their model features a deterministic growth rate driven by labor-augmenting technological progress.

Regardless of the limitations of the DGE approach such as it strongly relies on a base-year assumption (Orsi *et al.*, 2014; Schneider and Buehn, 2016), like MIMIC approach, it takes base-year estimates on the informal economy from another independent study to calibrate the size of informal economy (e.g., Ihrig and Moe 2004), and it only captures some of the stylized facts of the informal sector. Merely, it is still essential for policy studies, for example, it considers how households allocate labor between formal and informal economies within each period and how the allocation changes over time (Elgin and Oztunali, 2012). The difference between the two economies is that the formal economy is taxed and enjoys higher productivity, whereas the informal economy evades taxes and has lower productivity (See Marshall *et al.*, 2023).

A panel data measures of the informal economy based on two-sector (official and unofficial) DGE model adapted from Roca *et al.* (2001), Ihrig and Moe (2004), and Busato and Chiarini (2004) has drawn attention to various pioneer researchers to provide the largest cross-country panel data set on the size of informal economy including the work by Elgin and Oztunali (2012), where, the representative household chooses to allocate their labor to the taxed official sector or the untaxed unofficial sector. Formal sector production is modelled by a standard Cobb–Douglas production function that uses productivity, labor, and capital, while the informal sector depends on only the level of productivity and labor. Elgin and Oztunali (2012) use a two-sector dynamic general equilibrium to estimate the size of the black economy by constructing a new unbalanced 161-country panel dataset over the period 1950 to 2009. The authors reported a complete dataset on a country-by-country and year-by-year basis. The judgment from the standard deviations shows that the size of the shadow economy experienced a significant variation both across groups and within groups, and Latin American and SSA economies have significantly larger shadow economies than the other groups of countries. In contrast, the OECD-EU group has a significantly smaller informal economy.

Trend components in macroeconomic time series are very crucial in attempting to estimate the size of the underground economies. For example, the model by Busato and Chiarini (2004) had improved by Orsi *et al.* (2014) by explicitly account for trend growth in their two-sector dynamic stochastic general equilibrium (DSGE) model. Solis-Garcia and Xie (2018) also explicitly employ for the trend component in their two-sector DGE model combined with Bayesian technique to estimate the size of the shadow economy for seven countries in Latin American and Asian. Also, Chung *et al.* (2020) employed the same methodology to measure the size of the informal economy for 60 countries for the period spanning from 1950 to 2015. In this paper, we estimate the size of informal economies for the SADC countries by using the two-sector DGE model that exploits trends in the observed formal macroeconomy from 1990 to 2019.

3. Model economy

This paper considers an economy composed of perfectly competitive producers producing homogeneous goods. Firms sell goods to the households for consumption and investment reasons, and the government collects tax revenues from both households and firms for public spending finance. The economy is comprised of two sectors, the formal and the unofficial sector, and the government authorities are not able to record the transactions undertaken in the latter economic activities. Firms employ factors from the shadow markets to hide part or full portion of their production to escape tax enforcements and standard regulations from the authorities. However, in each period, firms face significant probability of being inspected by the government authorities, if convicted to tax evasion are forced to pay tax which augmented by a penalty surcharge. Also, households might avoid personal income tax by allocating their entire labor hours in the informal sector or by reallocating their labor services from regular sector to the informal sector. Productivity, preferences, investment, and fiscal shocks are the key drivers of the dynamics for the interactions between firms, households and the government.

3.1 Firm

The production functions of formal output and unofficial output are respectively both constructed using Cobb-Douglas production functions as

$$Y_t^F = A_t^F (K_t^F)^{\alpha} (\xi_t^F L_t^F)^{1-\alpha} \tag{3.1}$$

$$Y_t^U = A_t^U (K_t^U)^{\alpha_U} (\xi_t^U L_t^U)^{1-\alpha_u} \tag{3.2}$$

where $\alpha, \alpha_u \in (0,1)$ are the capital income shares in formal and unofficial output production, and $(1-\alpha)$ and $(1-\alpha_u)$ are the labor shares in formal and unofficial output production respectively. A_t^F and A_t^U are purely transitory technological shock for formal and unofficial production, and ξ_t^F and ξ_t^u are labour-augmenting technological progresses for formal and unofficial production respectively, which follows a deterministic trend of the form $\xi_t^i = \mathrm{g}^i \xi_{t-1}^i$, where $i = F, U$ and g (growth) > 0 represents the growth factor (shocks) of productivity in both sectors.[1] The total output produced by formal and unofficial sector, is therefore be defined as

$$Y_t = Y_t^F + Y_t^U \tag{3.3}$$

Firms have the following net revenues:

$$NR_t^F = (1-\tau_t) Y_t^F \tag{3.4}$$

$$NR_t^U = \begin{cases} (1-\rho\hat{s}\tau_t) Y_t^U & \text{if detected} \\ Y_t^U & \text{otherwise} \end{cases} \tag{3.5}$$

also bear the following costs:

$$TC_t^F = (1+\tau_t^F) w_t^F L_t^F + r_t^F K_t^F \tag{3.6}$$

$$TC_t^U = w_t^U L_t^U + r_t^U K_t^U \tag{3.7}$$

where NR_t^F, NR_t^U, TC_t^F, and TC_t^U are formal net revenue, unofficial net revenue, formal total cost and unofficial total cost respectively. Each unit of income is defined as formal output produced by a firm that is taxed at the tax rate, τ_t $(0 \le \tau_t < 1)$ (See Ihrig and Moe, 2004). Nevertheless, compliance is only partial, and firms can hide part of their production to evade taxes. This paper assumes the government cannot tax the shadow sector output unless it is exposed by a tax audit; parameter ρ $(0 \le \rho < 1)$ represents the probability of a tax audit and $\hat{s}$ $(\hat{s} > 1)$ is a tax surcharge (an additional charge due to unofficial production). The associated optimal planning satisfies the following four conditions, which describe optimal demands for factors supplied in both regular and unofficial markets:

[1] See Fernández and Meza (2015) to know more about growth shocks of productivity.

$$\alpha(1-\tau_t)\frac{Y_t^F}{K_t^F} = r_t^F \tag{3.8}$$

$$\frac{(1-\alpha)(1-\tau_t)}{(1+\tau_t^F)}\frac{Y_t^F}{L_t^F} = w_t^F \tag{3.9}$$

$$\alpha_U(1-\rho\hat{s}\tau_t)\frac{Y_t^U}{K_t^U} = r_t^U \tag{3.10}$$

$$(1-\alpha_U)\frac{Y_t^U}{L_t^U} = w_t^U \tag{3.11}$$

3.2. Household

The representative household chooses sequences of consumption C_t, hours worked L_t, and investment X_t to maximize utility given by:

$$\sum_{t=0}^{\infty}\beta^t\,\mathbb{E}_t\left(\frac{C_t^{1-\sigma}}{1-\sigma} - \phi\frac{(L_t^F)^{1+\chi}}{1+\chi} - \psi\frac{(L_t^U)^{1-\lambda}}{1-\lambda}\right) \tag{3.12}$$

where $\beta \in (0,1)$ is the household's discount factor, $\sigma > 0$ is the intertemporal elasticity of substitution, $\phi > 0$ and $\psi > 0$ measures the disutility of labour from formal and informal employment, respectively, and $\chi \geq 0$ and $\lambda > 0$ are the inverse of the Frisch elasticity of formal and informal labour supply, respectively. Household maximizes the utility function subject to the following budget constraint:

$$B_{t+1} = r_t^B B_t + w_t^i L_t^i + r_t^i K_t^i + \Pi_t^i - P_t^i\left(C_t^i + \xi_t^X X_t^i\right) \tag{3.13}$$

where B_t is the dividends from government bonds, r_t^B is the interest rate on bond, P_t^i is the general price level, C_t^i is a consumption, X_t^i is the investment, and Π_t^i is the profit. The law of motion is given by the capital constraint below

$$K_{t+1}^i = (1-\delta)K_t^i + \xi_t^X X_t^i \tag{3.14}$$

where $\delta \in (0,1)$ is the depreciation rate, ξ_t^X is a permanent shock to the production of investment goods and K_t represents the stock of physical capital is given by

$$K_t = K_t^F + K_t^U \tag{3.15}$$

and a household total labor hours constraint is given as

$$L_t = L_t^F + L_t^U \tag{3.16}$$

where L_t^F and L_t^U denote hours devoted in the formal and unofficial sector, respectively.

3.3. Government

The government finances its development and non-development projects by using revenues collected from various registered (formal production) and unregistered (unofficial production if exposed to tax audit). I assume that in each period the government experiences balanced budget so that the model recommended for the budget constraint is given by

$$G_t = \tau_t^F w_t^F L_t^F + \tau_t A_t^F (K_t^F)^{\alpha} (\xi_t^F L_t^F)^{1-\alpha} + \rho \hat{s} \tau_t A_t^U (K_t^U)^{\alpha_U} (\xi_t^U L_t^U)^{1-\alpha_u} \tag{3.17}$$

where G_t (government expenditures) is an endogenous variable.

3.4. Productivity processes

The paper expresses the levels of labor-augmenting productivity in both sectors as accumulated product of the growth shocks:

$$\xi_t^i = \xi_0^i \prod_{j=0}^{t} \mathrm{g}_j^i \tag{3.18}$$

for $i = F, U$. That means, the values for ξ_t^F and ξ_t^U is connected by the trend stated in section 3.1. The gap between the productivity shocks of the two sectors at the steady state is governed by parameter μ $(0 < \mu < 1)$. However, the paper assumes that the initial difference between ξ_0^F and ξ_0^U is monitored via $\xi_t^U = \nu \xi_t^F$ (See Fernández and Meza, 2015). Now, we use Lagrangian to solve the maximization problem. Substitute $K_{t+1}^i = (1-\delta)K_t^i + \xi_t^X X_t^i$ from equation (3.14) into the budget equation (3.13). Then, Lagrangian equation is given as

$$\mathcal{L} = \sum_{t=0}^{\infty} \beta^t \, \mathbb{E}_t \left(\frac{C_{i,t}^{1-\sigma}}{1-\sigma} - \phi \frac{\left(L_{F,t}\right)^{1+\chi}}{1+\chi} - \psi \frac{\left(L_{D,t}\right)^{1-\lambda}}{1-\lambda} \right.$$
$$\left. + \lambda_t^i \left[r_t^B B_t + w_t^i L_t^i + r_t^i K_t^i + \Pi_t^i - B_{t+1} - P_t^i \left(C_t^i + K_{t+1}^i - (1-\delta) K_t^i \right) \right] \right) \tag{3.19}$$

where λ_t^i is the Lagrangian multiplier. The first order conditions for consumption, labors, and capitals are given as:[2]

$$\frac{\partial \mathcal{L}}{\partial C_t^i} = \left(C_t^i\right)^{-\sigma} - \lambda_t^i P_t^i \tag{3.20}$$

$$\frac{\partial \mathcal{L}}{\partial L_t^F} = -\phi (L_t^F)^{\chi} + \lambda_t^F w_t^F \tag{3.21}$$

$$\frac{\partial \mathcal{L}}{\partial L_t^U} = -\psi (L_t^U)^{-\lambda} + \lambda_t^U w_t^U \tag{3.22}$$

$$\frac{\partial \mathcal{L}}{\partial K_{t+1}^i} = -\lambda_t^i P_t^i + \beta \mathbb{E}_t \lambda_{t+1}^i \left[(1-\delta) \mathbb{E}_t P_{t+1}^i + \mathbb{E}_t r_{t+1}^i \right] \tag{3.23}$$

Combine equation (3.20) and (3.21), by removing λ_t^F gives the following relationship:

$$\phi (C_t^F)^{-\sigma} (L_t^F)^{\chi} = \frac{w_t^F}{P_t^F} \tag{3.24}$$

Equation (3.24) represents the formal labor supply equation by equating the marginal rate of substitution between formal consumption and leisure on the left-hand side to their relative formal prices on the right-hand side. Combine equation (3.20) and (3.21), by removing λ_t^U gives the following relationship:

[2] i stands for formal or informal. For example, C_t^i stands for C_t^F (formal consumption) and C_t^U (informal consumption), P_t^i stands for P_t^F (price of formal goods) and P_t^U (price of informal goods), X_t^i stands for X_t^F (investments in the production of formal goods) and X_t^U (investments in the production of informal goods), λ_t^i stands for λ_t^F (formal lagrangian multiplier) and λ_t^U (informal lagrangian multiplier), etc.

$$\psi(C_t^U)^{-\sigma}(L_t^U)^{-\lambda} = \frac{w_t^U}{P_t^U} \tag{3.25}$$

Also, equation (3.25) represents the informal labor supply equation by equating the marginal rate of substitution between informal consumption and leisure on the left-hand side to their relative informal prices on the right-hand side. Substituting the value of λ_t^i from equation (3.20) into (3.23) to generate the Euler equation that is expressed as:

$$\mathbb{E}_t\left(\frac{C_{t+1}^i}{C_t^i}\right)^{\sigma} = \beta\left[(1-\delta) + \mathbb{E}_t\left(\frac{r_{t+1}^i}{P_{t+1}^i}\right)\right] \tag{3.26}$$

3.5. Equilibrium

The equilibrium conditions of the model are expressed as

$$Y_t^F = A_F(K_t^F)^{\alpha}(\xi_t^F L_t^F)^{1-\alpha} \tag{3.27}$$

$$Y_t^U = A_U(K_t^U)^{\alpha_U}(\xi_t^U L_t^U)^{1-\alpha_u} \tag{3.28}$$

$$Y_t = Y_t^F + Y_t^U \tag{3.29}$$

$$\mathrm{NR}_t^F = (1-\tau_t)Y_t^F \tag{3.30}$$

$$\mathrm{NR}_t^U = \begin{cases}(1-\rho\hat{s}\tau_t)Y_t^U & \text{if detected}\\ Y_t^U & \text{otherwise}\end{cases} \tag{3.31}$$

$$\mathrm{TC}_t^F = w_t^F L_t^F + r_t^F K_t^F \tag{3.32}$$

$$\mathrm{TC}_t^U = w_t^U L_t^U + r_t^U K_t^U \tag{3.33}$$

$$r_t^F = (1-\tau_t)\frac{Y_t^F}{K_t^F} \tag{3.34}$$

$$w_t^F = \frac{(1-\alpha)(1-\tau_t)}{(1+\tau_t^F)}\frac{Y_t^F}{L_t^F} \tag{3.35}$$

$$r_t^U = \alpha_U(1-\rho\hat{s}\tau_t)\frac{Y_t^U}{K_t^U} \tag{3.36}$$

$$w_t^U = (1-\alpha_U)\frac{Y_t^U}{L_t^U} \tag{3.37}$$

$$C_t + \xi_t^X X_t + G_t = \tau_t^F w_t^F L_t^F + A_t^F (K_t^F)^{\alpha}(\xi_t^F L_t^F)^{1-\alpha} + A_t^U (K_t^U)^{\alpha_U}(\xi_t^U L_t^U)^{1-\alpha_u} \tag{3.38}$$

$$B_{t+1} = r_t^B B_t + w_t^i L_t^i + r_t^i K_t^i + \Pi_t^i - P_t^i\left(C_t^i + \xi_t^X X_t^i\right) \tag{3.39}$$

$$K_{t+1} = (1-\delta)K_t + \xi_t^X X_t \tag{3.40}$$

$$K_t = K_t^F + K_t^U \tag{3.41}$$

$$L_t = L_t^F + L_t^U \tag{3.42}$$

$$\frac{w_t^F}{P_t^F} = \phi(C_t^F)^{-\sigma}(L_t^F)^{\chi} \tag{3.43}$$

$$\frac{w_t^U}{P_t^U} = \psi(C_t^U)^{-\sigma}(L_t^U)^{-\lambda} \tag{3.44}$$

$$\mathbb{E}_t\left(\frac{C_{t+1}^i}{C_t^i}\right)^{\sigma} = \beta\left[(1-\delta) + \mathbb{E}_t\left(\frac{r_{t+1}^i}{P_{t+1}^i}\right)\right] \tag{3.45}$$

$$G_t = \tau_t^F w_t^F L_t^F + \tau_t A_t^F (K_t^F)^{\alpha}(\xi_t^F L_t^F)^{1-\alpha} + \rho\hat{s}\tau_t A_t^U (K_t^U)^{\alpha_U}(\xi_t^U L_t^U)^{1-\alpha_u} \tag{3.46}$$

4. Parameterization and data sources

To complete the exercise, we normalize A_t^F and A_t^U both equals 1 and we present the standard calibrated parameters shown in Table 1.

Table 1 Parameter values

Parameter	Description	Value	Source
α	Capital share in formal production function	0.33	Parente & Prescott (1992)
α_U	Capital share in Unofficial production function	0.20	Restrepo-Echavarría (2011)
β	Discounting factor	0.96	Parente & Prescott (1992)
σ	Intertemporal elasticity of substitution	1.00	Marshal *et al.* (2023)
δ	Depreciation	0.05	Aguiar & Gopinath (2007)
χ	Frisch elasticity of formal labour (inverse)	1.00	Marshal *et al.* (2023)
λ	Frisch elasticity of informal labour (inverse)	0.62	Cho & Cooley (1994)
τ_t	Statutory corporate tax rate	0.46	Busato and Chiarini (2004)
τ_t^F	Tax on wage bill	0.11	Mendoza *et al.* (1994)
p	Probability of being detected	0.03	Busato and Chiarini (2004)
$\hat{s}$	Surcharge factor rate	1.30	Busato and Chiarini (2004)
ϕ	Disutility of formal labour	0.55	Busato and Chiarini (2004)
ψ	Disutility of informal labour	1.75	Cho & Cooley (1994)

5. Applications

In this section, this paper shows the size and dynamics of the informal economy measure constructed above from the 15 SADC countries. First, we use descriptive statistics to measure the size of the informal economy. Next, we use a panel vector autoregressive (PVAR) model to explore determinants of informal economic activity including economic freedom, tax burden, regulation policy, control of corruption and real GDP.

5.1 Size of the shadow economy

Here, the paper summarizes the informal economic measures generated by our methodology. In Table 3, we present the average value for each variable including: formal sector output (Formal Y), formal sector labor (formal L), informal sector output (Informal Y), total (formal + informal) sector output (Total Y), and shadow-to-formal sector output ratio (Shadow/Formal) by SADC countries from 1990 to 2019. Formal Y, Informal Y and Total Y are at constant 2017 national prices (in million 2017 USD). Table 5 shows some simple business cycle statistics for 15 SADC countries from 1990 to 2019. The standard deviations of values were calculated as follows. All data series were naturally logged and detrended using a Hodrick–Prescott filter with parameter ($\lambda = 100$). Table 5 contains reported values correspond to the extracted standard deviation of the cyclical (filtered) values.

Table 2 presents the average levels of formal and informal economy production of countries from 1990 to 2019 in the SADC are $65988.928 and $21326.036) in million per country (at a constant 2017 national prices) respectively and ranges from South Africa ($546215.673 & $135236.474) to Comoros ($1827.873 & $713.795). On average, Angola has the second largest informal economy with the average of $56486.760 in million dollars, while on average, Lesotho hold the second smallest informal economy averaging $4136.404 in million dollars. More than half of countries, their averages of informal economy are less than the average of all countries ($21326.036 in million).

The informal economy as a percent of the formal economy averages 38.3%, with a minimum mean of 23% (Mauritius) and a maximum mean of 60.8% (Zimbabwe), South Africa, on average, has the second smallest informal economy at 25% of GDP, while on average, Tanzania maintain the second largest informal economy as a percent of GDP at 53%, over the sample time frame. The variation in size of the informal economy by country is evident. More than half of the countries their informal economies as percentage of GDP, on average, have the average greater than the average of all countries (38.3%). The average for the formal sector is 60% more than the average for the informal sector.

Table 2 Estimated Means from 1990 to 2019

Country	Formal Y	Informal Y	Total Y	Formal L	Informal/Formal
Angola	138097.512	56486.760	194584.272	10.834	0.413
Botswana	22661.408	7161.284	29822.692	0.663	0.332
Comoros	1827.873	713.795	2541.668	0.140	0.387
Congo, Dem. Rep.	52191.238	22910.303	75101.540	17.866	0.442
Eswatini	6750.159	2665.825	9415.983	0.245	0.396
Lesotho	4136.408	1188.237	5324.646	0.615	0.298
Madagascar	30129.399	11294.045	41423.444	8.861	0.376
Malawi	12659.727	5057.964	17717.692	5.249	0.401
Mauritius	18136.709	4015.735	22152.444	0.490	0.230
Mozambique	18672.360	6482.458	25154.819	7.788	0.377
Namibia	15658.960	4369.720	20028.680	0.516	0.287
South Africa	546215.673	135236.474	681452.147	14.919	0.250
Tanzania	65246.762	32889.138	98135.899	16.049	0.530
Zambia	30138.695	12772.392	42911.088	3.407	0.426
Zimbabwe	27311.034	16646.410	43957.444	5.531	0.608
Average	65988.928	21326.036	87314.964	6.211	0.383

Table 3 shows the standard deviation of the cyclical values of the formal and informal economies generated by our model. Zimbabwe and Angola represent the largest standard deviation of the cyclical values of the formal with values 1.693 and 0.554, while Zimbabwe and Tanzania represent the largest standard deviation of the cyclical values of the informal with values 1.615 and 0.550, respectively, while, Zambia and Eswatini show the smallest standard deviation of the filtered values of the formal economy with values 0.169 and 0.184, and Zambia and Namibia show the smallest standard deviation of the filtered values of the informal economy with values 0.109 and 0.134, respectively. The distance of the standard deviation from the average of the standard deviations varies across economies. In informal economy, for example, Democratic Republic of Congo and Malawi are approximately lower bound close to the average of the standard deviation by 0.015 and 0.099, while South Africa and Comoros are approximately upper bond close to the average of the standard deviation by 0.017 and 0.090, respectively. For more than half of the countries, the standard deviation of total cyclical (informal + formal) output is lower than the formal sector output. Also, the average of the standard deviations of total cyclical (informal + formal) output is lower than the formal sector output. Furthermore, the standard deviation of cyclical ratios (informal/formal) is less than its total average in more than half of the countries. This suggests that the informal economy is not working as an alternative economy in these countries.

Table 3 Business Cycle Statistics from 1990 to 2019

Country	SD (Formal Y)	SD (Informal Y)	SD (Total Y)	SD (Formal L)	SD (Informal/Formal)
Angola	0.554	0.520	0.544	0.355	0.037
Botswana	0.247	0.149	0.221	0.227	0.099
Comoros	0.470	0.459	0.467	0.630	0.014
Congo, Dem. Rep.	0.345	0.354	0.348	0.551	0.020
Eswatini	0.184	0.174	0.181	0.655	0.011
Lesotho	0.265	0.196	0.249	0.025	0.070
Madagascar	0.279	0.260	0.274	0.203	0.021
Malawi	0.315	0.270	0.300	0.184	0.046
Mauritius	0.271	0.148	0.243	0.346	0.124
Mozambique	0.250	0.218	0.243	0.524	0.036
Namibia	0.189	0.134	0.177	0.228	0.057
South Africa	0.458	0.386	0.442	0.223	0.072
Tanzania	0.511	0.550	0.521	0.434	0.044
Zambia	0.169	0.109	0.149	0.030	0.062
Zimbabwe	1.693	1.615	1.767	0.301	0.079
Average	0.413	0.369	0.408	0.328	0.053

5.2. Determinants of the informal economy

In this section, we measure the country-level informal economy by employing a PVAR model (Holtz-Eakin *et al.*, 1988; Love and Zicchino, 2006).[3] The PVAR model is rested on the foundation of dynamic equilibrium theory and is used to examine the relationships between multiple endogenous variables, and its framework extends for the presence of unobservable individual heterogeneity and time effects. The k-variate homogeneous panel VAR of order p with panel-specific fixed effects represented by the following system of linear equations:

$$y_{it} = \sum_{j=1}^{p} \alpha_j y_{i,t-j} + v_i + \tau_t + \epsilon_{it} \qquad i = 1, \dots, N \qquad t = 1, \dots, T_i \tag{5.1}$$

where i indexes a country ($i = 1, \dots, 15$), t indexes a year ($t = 1999, \dots, 2019$), y is a $1 \times k$ vector of the endogenous variables, the $k \times k$ matrices α_j are p parameters to be estimated, v_i are $1 \times k$ country-specific panel fixed-effects (which may be correlated with the covariates), τ_t are the time-specific effects, and ϵ_{it} represent $1 \times k$ vectors of idiosyncratic errors which are independent and identically distributed over the whole sample with variance σ_ϵ^2. The v_i and the ϵ_{it} are assumed to be independent for each i over all t, and the innovations have the following characteristics: $\mathbb{E}(\epsilon_{it}) = 0$, $\mathbb{E}(\epsilon'_{it}\epsilon_{it}) = \Sigma$ and $\mathbb{E}(\epsilon'_{it}\epsilon_{is}) = 0$ for all $t > s$.

Apart from the informal economy, the endogenous variables in our model are based on the existent informal economy literature and include economic freedom (econfreedom), tax burden (taxburden), regulatory policy (regpolicy), control of corruption (cocorrupt) and log of real GDP (lnGDP). Variable descriptions and summary statistics can be observed in Table 4. Regulation policy, control of corruption and real GDP prosperity are expected to reduce the size of the informal economy, whereas tax burden and economic freedom are expected to increase the size of the informal economy.

To calculate consistent estimates of the PVAR model jointly with the presence of specific fixed-effects (v_i) and lagged dependent variables in the right-hand side of the system of equations (Nickell, 1981), especially in fixed T and large N settings, and serially uncorrelated errors assumption (Abrigo and Love, 2016). We purge the fixed effect and minimize data loss using forward orthogonal deviations (Helmert transformation) that transform each variable by

[3] See Abrigo and Love (2016) for details about the PVAR model and estimation.

subtracting the average of all future observations for each variable while maintaining past realizations as valid instruments for the untransformed variables (Arellano and Bover, 1995). The model considers GMM-style instruments where the instrument lags with missing values are replaced with zeros which increases the estimation sample and results in efficiency gains (See Anderson and Hsiao, 1981, 1982).

To choose the optimal lag order in both PVAR specification and moment condition, we rely on Andrews and Lu (2001) who proposed maximum likelihood-based model-selection criteria (MMSC) for Generalized Methods of Moments (GMM) models based on Hansen's (1982) J statistic of overidentifying restrictions, that are, the Akaike information criteria (AIC), the Bayesian information criteria (BIC), and the Hannan – Quinn information criteria (HQIC). The MMSC selects the pairs of vectors (p, q) that minimizes

$$\mathrm{MMSC}_{\mathrm{BIC},n}(k,p,q) = J_n(k^2p, k^2q) - (|q| - |p|)k^2 \ln n \tag{5.2}$$

$$\mathrm{MMSC}_{\mathrm{AIC},n}(k,p,q) = J_n(k^2p, k^2q) - 2k^2(|q| - |p|) \tag{5.3}$$

$$\mathrm{MMSC}_{\mathrm{HQIC},n}(p,q) = J_n(k^2p, k^2q) - Rk^2(|q| - |p|) \tag{5.4}$$

where $J_n(k^2p, k^2q)$ is the Hansen J statistic test for overidentifying restrictions for a k-variate panel VAR of lag order p and moment conditions based on q lags is statistically insignificant (p-value = 0.1096), indicating that there is insufficient evidence to reject the null hypothesis and instrumental variables may be effective.

We follow Lütkepohl (2005) and Hamilton (1994) approach to show that a PVAR model is stable since all moduli of the companion matrix α are strictly less than one and all the eigenvalues lie inside the unit circle. Stability implies that the panel VAR is invertible and has an infinite-order vector moving-average representation, thus providing possible interpretation to estimated impulse–response functions (IRFs). We employ Cholesky decomposition to impose recursive structure (identification restrictions) on the parameters of the PVAR model (Sims, 1980). Cholesky decomposition, nevertheless, is not unique but depends on the ordering of endogenous variables such that shocks on variables that come earlier in the ordering have a contemporaneous and lagged effect on the variables that come later in the ordering. In the same meaning, the variables are ordered from least dependent to most dependent. In our case, we order the variables

as: econfreedom (economic freedom), taxburden (tax burden), regpolicy (regulation policy), cocorrupt (control of corruption), lnGDP (log of real GDP), and informal (informal economy expressed as a percent of GDP). This ordering shows that the informal economy is the most dependent relative to its determinants.

Table 4 Variables used in PVAR

Variable	Definition	Source
Informal	The size of the informal economy estimates as a percent of official GDP based on the DGE method	Elgin *et al.* (2021)
cocorrupt	Percentile rank of control of corruption, 0 and 100 represent no control and full control, respectively.	Worldwide Governance Indicators
regpolicy	Regulatory Policy Index. The index measures the number of standard deviations "freer" than the mean that a country scores in a year.	Fraser Institute
econfreedom	The country's economic climate is measured as an overall score (based on the World Bank index) between 0 and 100, where 100 represent the maximum degree of economic freedom.	The Heritage Foundation
lnGDP	Log of Annual real GDP at constant 2017 national prices (in million 2017 USD) expressed in natural logarithm.	Penn World Table (10.01)
taxburden	Tax burden is a composite measure of taxes (including direct & indirect as a percentage of GDP. The country's fiscal freedom ranges between 0 and 100, where 100 represent the maximum degree of fiscal freedom.	The Heritage Foundation

The orthogonalized impulse response functions (IRFs) based on Cholesky decomposition and cumulative IRF are reported in Figure 2. The first variable is the shock variable, and the second variable is the response variable. The solid line illustrates the response of each endogenous variable to the one standard deviation shock. The shaded area shows the 95 percent confidence bands that are constructed using 200 Monte Carlo simulation drawings from the distribution of the reduced-form PVAR model. The first column shows the response of the informal economy to shocks in each of its determinants arranged in order, while the first row represents the response of the variables from the informal economy shocks. The first graph shows that the informal economy exhibits considerable decreasing persistence given shocks to itself.

A standard deviation shocks to the formal economy, measured by the log of real GDP (lnGDP), decreases the size of the informal economy for about the entire periods shown by the second graph downward in the first column. This indicates a statistically significant in the economy for the whole period of economic activities. Elgin and Oztunali (2014) used a cross-

national panel data estimation technique and a two-sector dynamic general equilibrium (DGE) model for 141 countries over the period 1984-2009 to examine the evolution of the informal economy through the economic development course, proxied by gross domestic product (GDP) per capita. Their findings suggest that institutional quality strongly influences this relationship. Therefore, they concluded that a higher GDP per capita is associated with a larger informal sector size in countries where the institutional quality is low, and the opposite is true in countries with good institution quality.

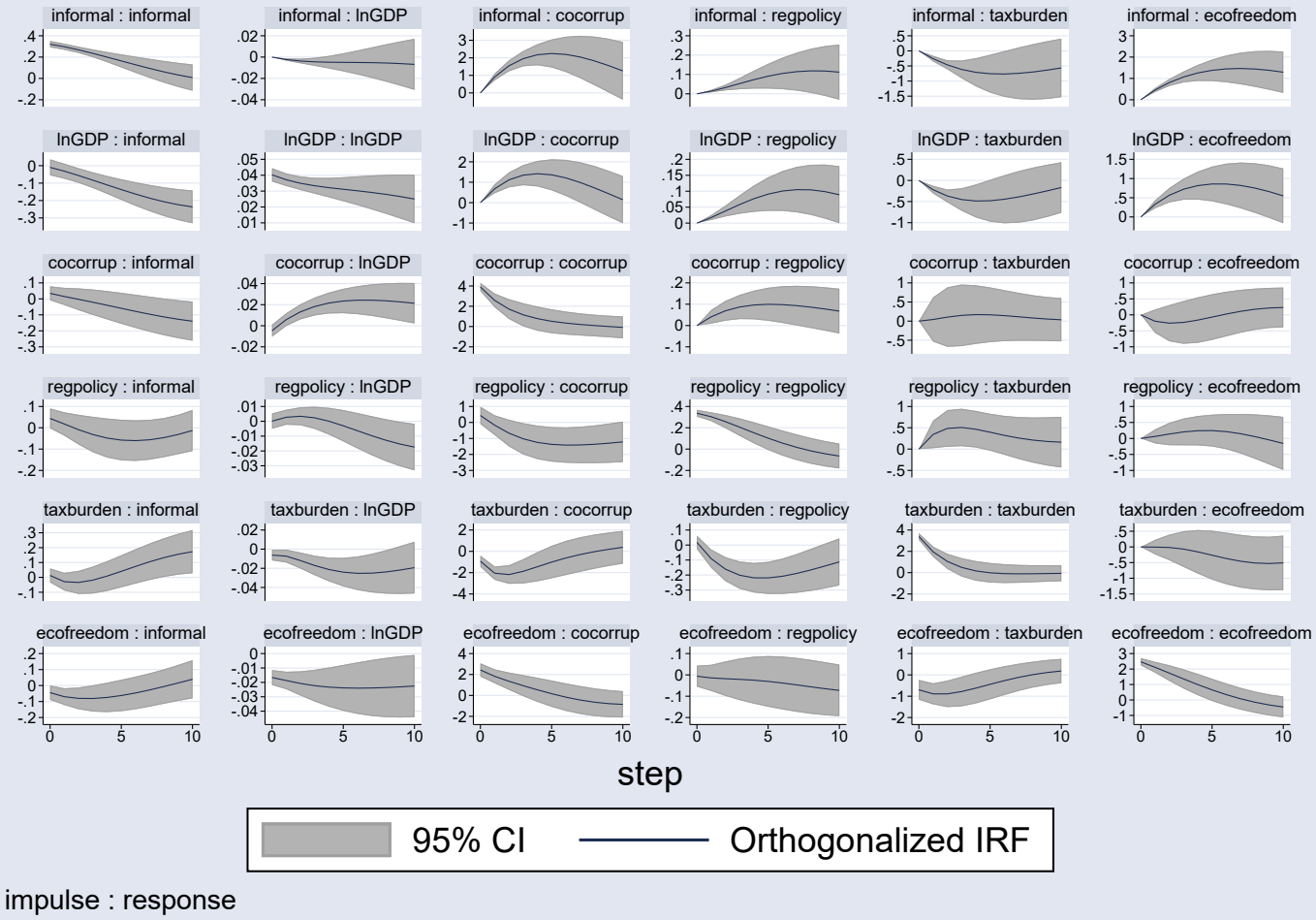

Fig. 2. Orthogonalized IRF.

The third graph downward from the first column shows that the control of corruption efforts adopted by the SADC countries succeeded in reducing the size of the informal economy. Mveng and Henry (2024) employed ordinary and two-stage least square estimation techniques with data

from 110 countries for the period 1993–2018 to examine the relationship between state history and the size of the informal sector through control of corruption and its sub-components. Their results show that the longer state history reduces the size of the informal economy through strict control of corruption. Furthermore, among the four sub-measures of control of corruption studied, the strongest indirect effects occur via the control of executive (68%) and public sector (64%) corruption. Therefore, the fight against the expansion of the informal sector may face obstacles in countries with a short history of statehood, where the fight against corruption has not had sufficient time to grow. This informs policymakers to be careful and keep in mind when designing their economic policies aimed at reducing the size of the informal sector.

Regulation policy and the size of informal economy experience a nonlinear relation traced out from the fourth graph in the first column. A standard deviation shocks to regulation policy increases the size of informal economy for the first two years and eventually insignificant above the negative region. Beyond period two, the size of informal economy decreases below its steady state value and remains in the negative region and hence statistically significant for future predictions. Thus, regulation policy shocks have a positive impact on the size of informal economy in the short-run and negative impact in the long-run. This was partly confirmed in Vietnam by Chuc *et al.* (2014) who used Multiple Correspondence Analysis (MCA) and found that formal sector is switching to informal sector and implemented by official businesses who want to escape government regulations. Therefore, informal firms are champions in rejecting the bureaucratic trammels of overregulated institutions, and informality is a rational economic maneuver pursued by firms strangled by country-imposed restrictions (Packard *et al.*, 2012).

The next graph downward indicates that the tax burden has a nonlinear impact on the informal economy. For the first five periods, the standard deviation positive shocks to tax burden leads to a decrease in the informal economy and after that leads to an increase in the informal economy. The upper and lower bound confidence intervals range within which the impulse response may vary significantly. Also, some empirical studies have examined the impact of tax burden on the size of the informal economy. For instance, Loayza (1996) used data from 14 Latin American countries and find the strong association between tax burden and informal sector. Likewise, Cebula (1997) shows evidence of a similarly positive tax effect on informal sector using United States of America data, finds that, for every increase of income tax rate by one per cent there is expansion in the size of the informal sector by 1.4 percent. Similar results evidenced in Brazil are confirmed by Tumen (2016) who found that a 6.5 percent decline in the size of the

informal sector is due to 5 percent reduction in taxes, and vice versa holds true, a large informal sector may lead to a higher tax burden on registered labors and firms because of a narrow tax structure (Moyo, 2022), and firms competing in the same industry face unparallel costs in marginal product of labor and taxes, thus, leading to inefficient allocation of productive resources (Levy, 2010).

The last figure in the first column reveals how the informal economy responds to an increase in economic freedom. An increase in economic freedom affects the informal economy negatively which reveals statistically significant for the SADC government towards control of informalities. The negative correlation between economic freedom and the informal economy is evidenced in Berdiev et al. (2018), where they used a panel dataset on over 100 countries drawn from 2000 to 2015. The informal economy responds positively to economic freedom shocks in the short-run and long-run. Also, this result is consistent with the study implemented by Sweidan (2017) who used a sample of 112 countries to empirically investigates the effect of economic freedom on the informal economies over the period 2000–2007. He employed two methodologies: generalized methods (GMM) and fixed effect models and found a statistically significant negative relationship between economic freedom and the informal economy. This finding indicates how strong the SADC economic system is in seizing the expansion of informal economy. The policy implication in SADC countries is that economies with a high share of informal economy should work with flexible economic restrictions.

6. Conclusion

This paper shows the estimate of the dynamics of the informal economy employed a DGE model for 15 SADC countries from 1990 to 2019, and these data can be used by researchers interested in Africa country-level informal economic activity. The results indicate that, Mauritius, on average, maintains the smallest informal economy at 23 percent of GDP; followed by South Africa, averaging 25 percent of GDP, while the largest informal economies as a percent of GDP are Zimbabwe and Tanzania at 60.8 percent and 53 percent respectively. In addition, this paper explores the determinants of this informal economy measure using a panel vector autoregressive model (PVAR), and the nonlinear relationships among dependent variables from the impulse-response functions, show that, on average, countries with larger real GDPs, higher levels of control of corruption, higher regulatory barriers and higher levels of economic freedom have smaller informal economies. While countries with higher tax burdens, on average, exhibit increasing informal economies. Hence, this confirms the dynamics of informality vary across SADC countries

and their governments should relax some restrictions, enforcements and projections based on the dynamics of the informal economy. Notwithstanding, institutions alone cannot succeed to reduce the size of recent expanded informal economies, but the use of digitalization could help to reduce the spread of informal sectors. For example, the governments South Asian countries are increasingly investing in the digital infrastructure that help to increase transparency, accountability and ultimately transform the economic activities from informal to formal. Also, the researchers can apply the results found from this study for comparative analysis for the developing economies related to these of SADC countries, for instance, Southern Asia economies and other developing countries in other regions.

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