RESEARCH ARTICLE

The role of tax evasion in the rapid growth of the informal sector in developing countries

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Under-taxation is a major feature of economies in developing countries and one that has been little ignored in the subsequent literature on the informal sector. Tax evasion is an endemic and more predictable problem in developing countries striving to balance their budgets. Its effects have been extensively studied in the empirical literature. In this article, we examine the role of tax evasion on the size of the informal sector. Using a sample of 99 developing countries, we specify and estimate a panel data model using the ordinary least squares, fixed effects and generalized least squares methods. Our analysis of tax evasion implies significant improvement for the informal sector. Controlled by two complementary measures of the informal sector (the 'multiple indicators, multiple causes' indicator and share of informal firms), our results remain statistically significant, robust and stable overall. We suggest a policy of using carrots, for example, by digitizing tax procedures, and sticks, such as tax adjustments, to promote the development of the informal sector.

Introduction

The informal sector is an indispensable component of the economy in developing countries, though it presents major challenges in terms of regulation, social security

and economic development. It continues to dominate economic activity in developing countries. For illustrative purposes, its contribution to gross domestic product (GDP) rose from 11.5 per cent in 1995 to 16.6 per cent in 2020 (World Bank, 2022). The growth of the informal sector, which parallels the weaknesses of the environment and institutional arrangements, the state's fragility, and the narrowness of the tax base in countries rich in natural resources, remains highly heterogeneous (constituting 34.3 per cent of GDP in Tunisia, 28.4 per cent in Morocco, 14.2 per cent in Cameroon, 8.1 per cent in Chad and 6 per cent in Nigeria in 2019). The size of the informal sector remains higher than in other regions, such as Asia and the Pacific (68.2 per cent of GDP), the Arab states (68.6 per cent), the Americas (40 per cent) and Europe and Central Asia (25.1 per cent). In countries like India, the informal sector accounts for up to 50 per cent of GDP. The informal sector contributes almost a third of GDP and accounts for over 70 per cent of total employment, around half of which is in the form of self-employment. Worldwide, it is estimated that the informal sector accounts for around 60 per cent of total employment in developing countries. Around 40 per cent of workers in Latin America are employed in the informal sector. In countries like Brazil and Argentina, this proportion can reach or exceed 50 per cent. On average, informal workers are paid 19 per cent less than formal sector employees. The emergence of the informal sector implicitly implies a loss of earnings for economies in terms of capital flight and constitutes a safety margin due to its resilience and its significant contribution to GDP. It also implicitly leads to the need for tax optimization, which is the source of tax evasion.

The informal sector refers to all income-generating activities carried out, to varying degrees, outside institutional rules or the framework of state regulations (criminal, social or fiscal legislation, national accounting and so on) (De Soto, 1986; Feige, 1990). Literature on the informal sector dates back to the analyses of the socio-anthropologist Hart (1971; 1973), who coined the term 'informal income', and reports by the International Labour Organization (ILO, 1972). Since then, this concept has become one of the main subjects of political and academic debate, thus opening up a wide field of analysis. The growth of the informal sector is the result of renewed interest following successive global crises, notably the 2008 financial crisis, the COVID-19 health crisis and the Russo-Ukrainian conflict. The predominance of the informal sector in developing countries hampers development prospects, the ability to mobilize the budgetary resources needed to stimulate economic activity in a sustainable way, the ability to pursue inclusive macroeconomic policies and the post–COVID-19 recovery. The informal sector is correlated with greater poverty, lower per capita incomes, slower progress, greater inequality and lower investment. The preponderance of the informal sector is accompanied by significantly lower levels of revenue and expenditure, less effective public institutions, significant regulatory and fiscal burdens, and weaker governance. In emerging and developing economies where the degree of informality is above the median, public revenues are between 5 and 12 percentage points of GDP lower than in other economies. The need to address these challenges is spelt out in the sustainable development goals (SDGs) of the '2030 Agenda for sustainable development' – in particular, SDG-16.4: 'By 2030, significantly reduce illicit financial flows, strengthen asset recovery and restitution and combat all forms of organized crime' – and the African Union's 'Agenda 2063: the Africa we want'.

Despite the increased commitment of countries to the tax transparency programme, tax evasion by companies and individuals around the world costs governments USD427 billion a year in tax havens. Tax evasion in developing countries is a major problem that has a significant impact on the ability of governments to finance public services and promote sustainable economic development. However, tax evasion exacerbates income losses and economic inequalities through such mechanisms as tax havens, the under-declaration of income and offshore bank accounts. Its emergence is explained by the weakness of institutions and corruption. According to the Organisation for Economic Co-operation and Development (OECD, 2021), tax evasion costs Africa nearly 9.4 per cent of its GDP, or around USD356 billion. This tax leakage increases the tax burden in countries, which in turn strongly discourages people from engaging in formal economic activities. Despite the risks, tax evasion offers opportunities for socio-economic integration and influences the current and future size of the informal sector. In sub-Saharan Africa, workers turn to informal activity out of necessity in a context where priority is given to developing human capital and improving access to finance, markets and inputs in order to increase labour productivity. By contrast, in Europe and Central Asia, Latin America and the Caribbean, and much of the Middle East and North Africa, the focus has been on easing regulatory constraints and building more efficient and accountable institutions, with a particular emphasis on strengthening law enforcement and fighting corruption. While tax evasion has fallen in some countries, such as Angola (–USD1.8 billion) and Egypt (–USD1.3 billion), it appears to be on the rise in Chad (+USD1.6 billion), Congo-Brazzaville (+USD460 million), Cameroon (+USD175.3 million) and Gabon (+USD93.6 million).

In order to meet the challenges of formalizing and modernizing the informal sector, in particular, recognizing the economy of tax evasion, the lack of tax fairness and the lacklustre quality of institutions, it is necessary to take tax evasion into account. International resolutions have led to the emergence of information and communication technologies (ICTs)[1] that offer opportunities to develop sustainable economic, social and environmental taxation (Ilavarasan, 2019). The spread of communication networks, the Internet of Things (IoT) and Big Data are major factors influencing the growth of the informal sector. A number of tax administration reforms have been introduced, focusing on tax fairness and improving the efficiency and effectiveness of tax bodies, such as the creation of autonomous tax authorities and the simplification of tax procedures. However, the informal sector and tax evasion are not congruent, as the activities of the informal sector directly and indirectly lead to cases of tax evasion, meaning that the factors affecting tax evasion also influence the informal sector (Harris et al, 2024).

The analytical exploration of the effects of taxation on the growth of uncertainty, the economy and risk taking has been the subject of renewed interest since the work of Mossin (1968), Becker (1968), Stiglitz (1969) and Arrow (1970). Thus, large budget deficits in developing countries as a result of recessions, crises and corporate tax avoidance schemes have led to growing concerns that governments are losing significant amounts of tax revenue. Yet, the scale of tax evasion and avoidance is fuelling the growth of illicit activities and the informal sector. The theoretical underpinning of the willingness to pay legal tax, particularly tax evasion, dates back to Allingham and Sandmo (1972). The literature stresses the importance of tax evasion for the socio-economic integration of disadvantaged groups (Luttmer and Singhal, 2014). Tax evasion worsens countries' prospects for economic growth and

development, and the effect of tax evasion on the size of the informal sector remains debated and conditioned by the existence of transmission channels (Kesselman, 1989; Argentiero et al, 2021). In addition, tax evasion leads to losses of tax revenue, crowds out transaction costs and undermines tax discipline and the effectiveness and efficiency of the tax administration (Dell'Anno, 2016).

The consolidation of theoretical foundations making it possible to distinguish between the nature, consequences and causes of informality has led to the emergence of three dominant theoretical approaches to understanding the origins and causes of the informal economy (Bacchetta et al, 2009). First, the neoclassical approach, based on the formalization of both microeconomic and macroeconomic models, explains the growth of the informal sector as a result of a reasoned choice by economic agents (Amaral and Quintin, 2006). Second, the macroeconomic approach, oriented towards econometric modelling, provides the basis for estimating the size of the informal sector in terms of hidden value added as a percentage of GDP (Cagan, 1958; Tanzi, 1999). Finally, there is the approach based on a constellation of schools of thought, such as the structuralist school, the legalist school, the voluntarist school, the free–rider school and the bi–sectoral school, which justify and explain the growth of the informal sector through the social channel of the rate of growth of the demand for labour (Tokman, 1978). In addition, other approaches have fostered romantic, parasitic and dualist views of the informal sector (La Porta and Shleifer, 2008), as well as modernizing, structuralist, neo–liberal and institutionalist theories (Castells and Portes, 1989), while the dualist school (Lewis, 1954) is concerned with the supply of labour.

Therefore, two contending approaches have emerged: the pessimistic approach, which emphasizes the harmful effects of the informal sector, as illustrated by the emergence of a destructive cycle, the lack of compliance, the inefficiency of administrations in terms of production and revenue mobilization, and the increase in risks (Farrell, 2004; Schneider, 2011; Nguimkeu and Okou, 2021); and the optimistic approach, which emphasizes beneficial effects, such as job creation, capacity building and the reduction of inequality and poverty (Sam, 2010). Research at the microeconomic and macroeconomic levels emphasizes that the informal sector is associated with tax evasion (Hassan and Schneider, 2016). The literature on the informal sector has three orientations: first, the construction of informal sector indicators (Petersen et al, 2010; Dell'Anno, 2021); second, the effects of the informal sector on microeconomic and macroeconomic variables (La Porta and Shleifer, 2014; Dell'Anno and Davidescu, 2019); and, third, the microeconomic and macroeconomic determinants of the informal sector, which include labour market frictions, education, marital status, number of dependent children, crises, population, climate change, tax pressure, legal origin, globalization, the quality of institutions and ICTs (Schneider and Enste, 2000; Acosta–González et al, 2014; Atangana–Ondoa and Seabrook, 2022; Zhanabekov, 2022). Nevertheless, while the effects of tax evasion on the size of the informal sector are undeniable, there is a lack of consensus given the differences in econometric methodologies, geographical areas and time horizons.

The informal sector and tax evasion are two important realities of contemporary economic systems. Their rise coincides with the emergence of the state, the strengthening of capacities and rules, international cooperation, and legislative reforms aimed at closing loopholes and reducing opportunities for evasion. According to

Smith (1994: 3), the informal sector is 'a part of the national economy that goes unobserved because of the efforts of some firms and households to keep their activities undetected', while Feige (2004) argues that the informal sector encompasses the totality of unrecorded economic activities contributing to the official estimate of GDP. Tax evasion is seen as a channel for avoiding the tax burden and facilitating the dynamics of the informal economy. It is linked to institutional constraints that act as a buffer to the development and risks associated with the official economy. Consequently, the informal economy may have a non-linear relationship with tax evasion, opposite to the official sector (U shape).

Considering the theoretical framework and drawing on empirical methodologies documented in the literature, the objective of this article, which is also its originality, is to examine the effects of tax evasion on the size of the informal sector in developing countries. This article contributes to the literature in three ways. The first contribution relates to the relevance of the tax evasion indicator used. In addition to conventional determinants, it considers tax evasion to explain the growth of the informal sector in developing countries. Specifically, this study not only considers the tax burden in relation to the mobilization of tax resources but also analyses the impact of tax evasion on the size of the informal sector. To the best of our knowledge, this is one of the first studies to empirically investigate the impact of tax evasion on the informal sector in developing countries, where tax revenue mobilization remains weaker. The second contribution is also due to the relevance of the informal sector indicator used. Thus, we specify the informal sector by estimating informal production, the 'multiple indicators, multiple causes' (MIMIC) model and the rate of firms working informally. The third contribution is specific to the exploration of the non-linear effects of tax evasion on the size of the informal sector. The non-linearity is illustrated by an inverted U shape not explored in the empirical literature. The literature emphasizes that tax avoidance at a low level would benefit formal economic activities up to a certain threshold, beyond which tax avoidance appears detrimental due to the growth of a sizeable informal sector. Nevertheless, developing countries continue to adhere favourably to global calls through the actions on peacebuilding and security of the United Nations, which contribute to SDG-16.

Considering a sample of 99 countries and using the arithmetic mean over the period 2010–20, we specify and estimate a model using the ordinary least squares (OLS) method. Our results show that tax evasion implies significant improvement for the informal sector. This result remains robust with the consideration of two complementary measures of the size of the informal sector (the MIMIC indicator and share of informal firms).

Following this introduction, the rest of the article is organized into four sections. The first identifies and analyses some stylized facts. The second presents a selective literature review. The third briefly exposes the different stages of the empirical strategy. The fourth discusses the results. Finally, we conclude with economic policy suggestions.

Some stylized facts

Three stylized facts emerge from the observation of the concomitant evolution of tax evasion and the informal sector in developing countries.

Tax evasion is evolving and remains costly for economies

Figure 1 shows the up-and-down trend in tax evasion in developing countries. Overall, tax evasion has risen from 21.74 per cent of GDP in 2010 to 21.85 per cent in 2020. The reasons for this lie in the weakness of tax institutions, the size of the informal economy, the inefficiency of legal and political systems, the complexity of tax policies, international evasion practices, and socio-economic factors. These aspects justify the need to strengthen tax institutions, simplify tax systems, improve governance and promote better international cooperation.

However, the development of tax evasion is accompanied by significant disparities in different regions of the world. Figure 2 shows that tax evasion (the difference between tax potential as a percentage of GDP and tax revenue as a percentage of GDP) is a major concern, costing an average of USD427 billion a year. However, the concept of tax potential arises from the modern theory of optimal taxation, following the path-breaking contributions of Nobel Prize-winner James A. Mirrlees (1971) on optimal tax modelling, that is, the principle of proceeding with a system of compulsory deductions that maximize tax revenues while minimizing disincentives for taxpayers to make efforts through a marginal

Figure 1: Evolution of tax evasion in developing countries (as a percentage of GDP)
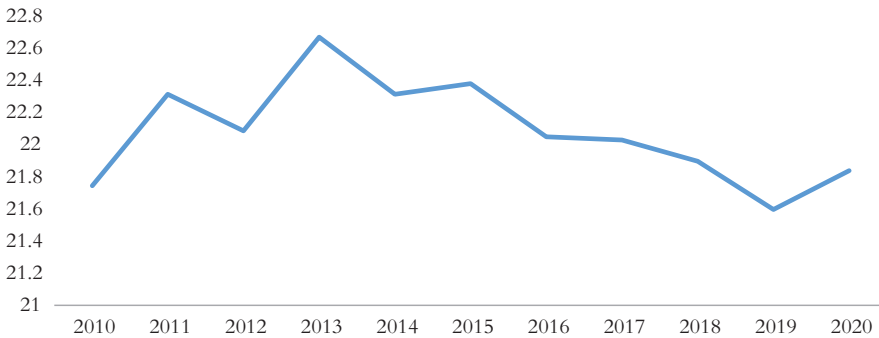
Source: Based on World Bank (2022).

Figure 2: Tax evasion (annual average in 2015) as a percentage of GDP
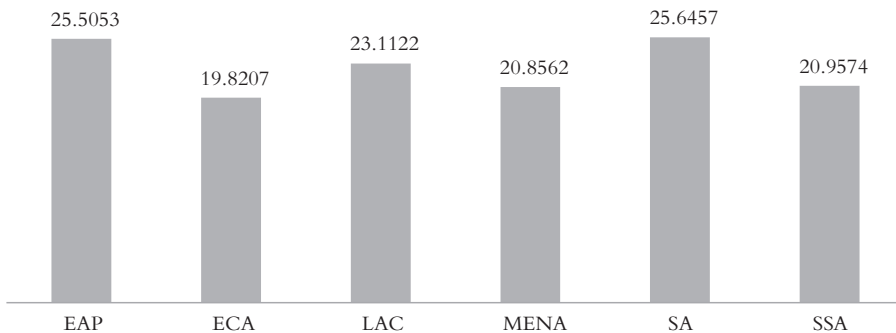
Notes: LAC = Latin America and the Caribbean; EAP = East Asia and the Pacific; ECA = Europe and Central Asia; SA = South Asia; SSA = sub-Saharan Africa; MENA = Middle East and North Africa.

Source: Based on World Bank (2022).

tax rate. In this perspective, Mawejje and Sebudde (2019) consider tax potential as the ratio of tax revenue that an economy can generate if it uses its resources and its capacity to collect it. Recently, Dwyer and Nanhthavong (2023) have emphasized that the fiscal potential of a country is the ability to collect taxes based on laws, national revenue volume and income distribution. Tax evasion allows some individuals to take advantage of the extensive mobility opportunities for their assets in order to avoid tax. The regions that benefit most are South Asia, East Asia and the Pacific, and Latin America and the Pacific. The motives and methods of these practices are described as tax optimization, tax evasion or tax avoidance. Although tax evasion is low in sub-Saharan Africa, the Middle East and North Africa, and Europe and Central Asia, it is concentrated in the extractive industries, which account for 50 per cent of total exports on average and are the main source of foreign direct investment (FDI). In sub-Saharan Africa, around 60 per cent of multinationals' margins are repatriated legally (dividends) or illegally to the countries of origin of the multinationals and/or to tax havens due to a lack of capacity on the part of tax administrations and a lack of integrity and fairness in tax systems.

The informal sector is growing and posing challenges

Figure 3 shows that the evolution of the informal sector in developing countries remains significant, despite the considerable decline observed between 2010 and 2020. This evolution is shaped by a combination of economic, institutional, political and social factors. While the informal sector plays a crucial role in providing jobs and services, it also presents significant challenges for economic growth, taxation and sustainable development. Policy responses must aim to improve institutions, simplify formalization and promote financial inclusion to transform the informal sector into a driver of inclusive economic development.

As Figure 4 illustrates, the informal sector is an essential component of most economies. Although it is a source of opportunity for the integration of young people and productive investment in the urbanization process, offering jobs and modest remuneration to a flow of new urban dwellers, with the cost of low and almost stagnant productivity, the informal sector raises many challenges. These include the challenges of tax fairness, tax revenue mobilization, the transparency of administrative procedures, the inaccessibility of public services and bureaucratic obstruction. Developed economies remain the most affected (South Asia, East Asia and the Pacific, Latin America and the Pacific, Central Asia, and Europe and Central Asia) because of its 'unofficial' nature, particularly as regards compliance with wage regulations and social security cover. In emerging and developing economies, the informal sector contributes almost a third of GDP and accounts for over 70 per cent of total employment, around half of which is in the form of self-employment.

In developing countries, particularly those in sub-Saharan Africa, the growth of the informal sector is explained by the precariousness and heterogeneity of the players, the production units, the tax burden, the weak quality of the institutions, the official unemployment rate, and the lack of openness of the economies, all of which lead to dysfunctional markets (for labour, goods and services, and money), with the workforce not being absorbed by the formal sector. Its contribution

Figure 3: Evolution of the informal sector in developing countries (as a percentage of GDP)
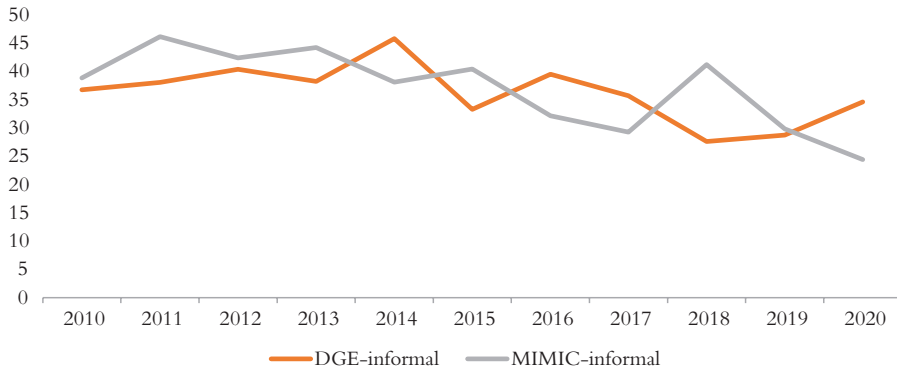
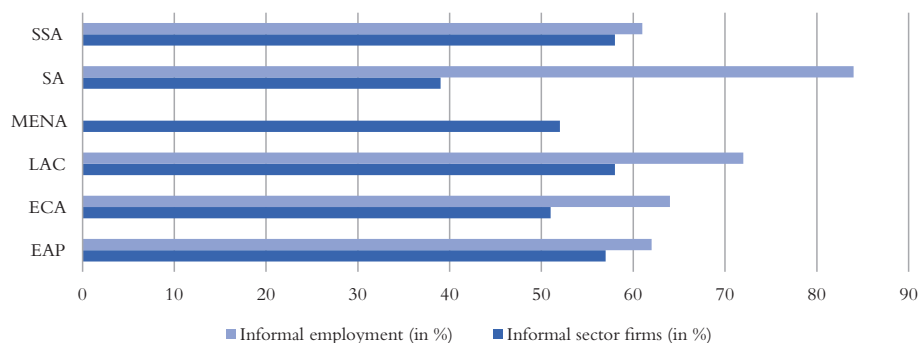*Source*: Based on World Bank (2022). and WEF (2022).

Figure 4: Situation of the informal sector (annual average in 2015)
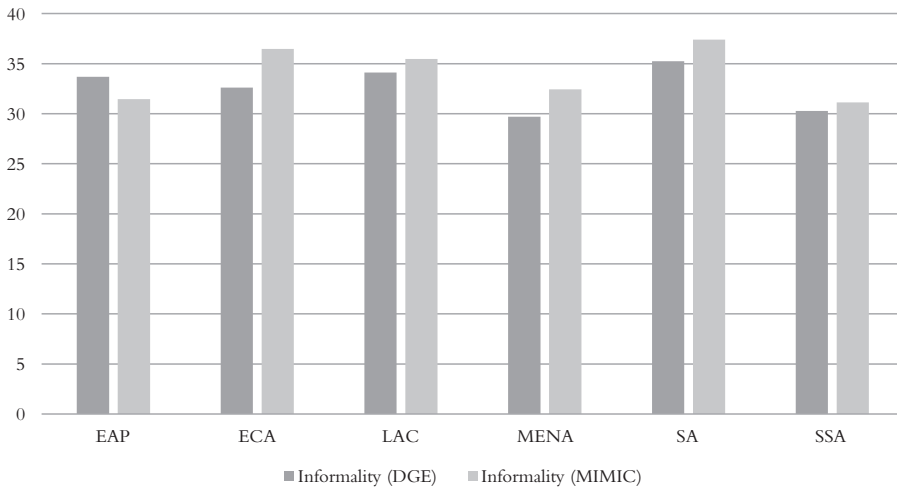
Notes: LAC = Latin America and the Caribbean; EAP = East Asia and the Pacific; ECA = Europe and Central Asia; SA = South Asia; SSA = sub-Saharan Africa; MENA = Middle East and North Africa.

Source: Based on World Bank (2022) and WEF (2022).

to GDP is estimated at between 25 per cent and 65 per cent, and it accounts for between 30 per cent and 90 per cent of non-agricultural employment. International experience shows that the share of the informal economy decreases as the level of development increases. As Figure 5 shows, informal employment exceeds the share of firms in the informal sector. Without claiming to be exhaustive, the informal sector brings with it the challenge of modernization, aimed at closing the productivity gap between informal production units, and the challenge of formalization, in terms of taxation and access to rights in the informal sector.

Figure 5: Informal sector jobs and firms (annual average in 2015)

Notes: LAC = Latin America and the Caribbean; EAP = East Asia and the Pacific; ECA = Europe and Central Asia; SA = South Asia; SSA = sub-Saharan Africa; MENA = Middle East and North Africa.

Source: Based on World Bank (2022) and WEF (2022).

Tax evasion and the size of the informal sector are correlated

Figure 6 shows that tax evasion is positively correlated with the size of the informal sector. This correlation partly explains the emergence of a new behavioural environment. Economies continue to be active in reducing tax evasion, despite the institutional and technological constraints that remain. Tax evasion increases the size of the informal sector and hampers the policies put in place. Tax evasion stimulates the informal sector by reducing compliance costs for businesses and creating an environment where non-compliance becomes commonplace. Economic players in the informal sector benefit from this competitive advantage by evading tax obligations, which strengthens their market position and encourages others to follow their example. This phenomenon has important implications for public policy, tax revenues and economic planning, underlining the need for reforms to improve formalization and tax compliance.

Literature review

This section presents the conceptual framework of the informal sector, which is useful for a theoretical understanding of and empirical evidence for the effects of tax evasion.

The informal sector: a heterogeneous concept

The theoretical roots of informality go back to the pioneering contributions of Hart (1971; 1973) and the ILO (1972), which laid the foundations for the emergence, evolution and impact of the informal economy. Then, Clement (2015) underlined a disagreement with the dominant theory of economic development (modernization theory), which considered the informal sector as a transitory phase in the process of economic development and doomed to disappear. According to Charmes (2016: 6), the informal sector is 'a unicorn because the literature abounds in definitions, without having the opportunity to meet one, because it does not exist'. Still referred to as the 'informal economy', 'the underground economy' and 'the informal sector', it is the subject of divergent conceptions and assessments in terms of institutional definitions

Figure 6: Correlations between tax evasion and the informal sector
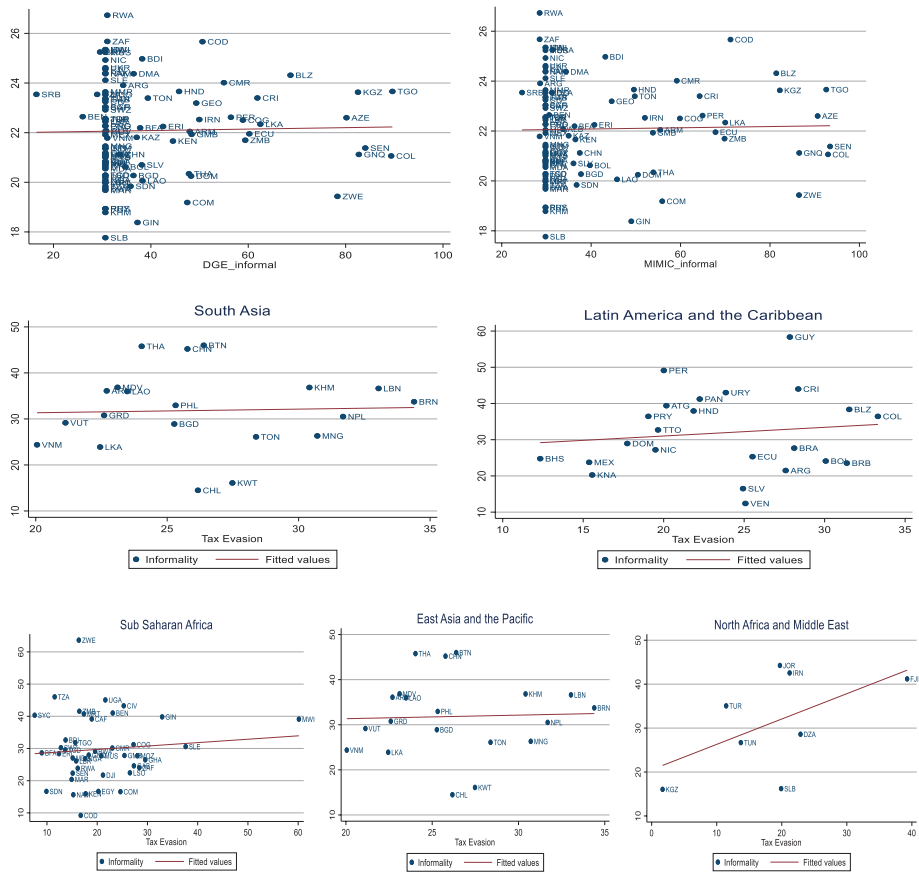
Source: Based on World Bank (2022) and WEF (2022).

and standards concerning the treatment of illegal activities. These different aspects have led the ILO (2021), the OECD (2002) and Dell'Anno and Davidescu (2019) to distinguish three approaches: (1) the underground economy, rooted in statistical and economic reasons, is characterized by a lack of response, updating and registration; (2) the illegal economy is characterized by illegal and unrecorded production; and (3) the informal economy groups together informal and unrecorded productive activities. It can be likened to a strategy for avoiding unemployment and poverty, referring to the informal sector as anchored on the value added generated by the activities of productive units as a percentage of GDP. However, the informal sector is the result of a rational voluntary choice by economic agents to migrate from the formal to the informal sector in order to reduce the tax and regulatory burden. In this case, it focuses on the value added of the informal sector as a percentage of GDP. Regardless of the approach considered, informality is effected in the behaviour of companies, economic units and the institutional sector due to tax evasion. The informal economy can therefore be understood in two ways: first, the underground component resulting from tax evasion, which includes income that is deliberately under-declared and concealed to avoid the burden of taxation (Alm, 2019); and, second, the informal sector, explained by employment, macroeconomic and sectoral matching models (Dell'Anno, 2021).

A theoretical synthesis of tax evasion effects on the informal sector

Tax evasion was first introduced by Lotz and Morss (1967) through theoretical analyses of the international tax ratio. It appears explicitly in Barro's (1990) endogenous growth model, which incorporates the tax variable through the role of public spending in economic growth. Without claiming to be exhaustive, the literature highlights three theoretical approaches for assessing the growth of the informal sector. First, the neoclassical approach, based on the formalization of microeconomic and macroeconomic models, explains the growth of the informal sector through a reasoned choice to undertake tax evasion and shadow production in order to maximize agents' well-being (Amaral and Quintin, 2006; Elgin and Ertuk, 2019). Second, the macroeconometric approach, anchored in econometric models, lays the foundations for estimating the size of the informal sector in terms of hidden value added as a percentage of GDP, rather than the number of people involved in informal activities, and for testing causal hypotheses. It considers as potential drivers of the informal sector the overall tax burden, the tax composition, tax complexity, the tax rate, tax compliance, the regulatory system and the governance and institutional environment (Cagan, 1958; Gutmann, 1977; Tanzi, 1980; Gaertner and Wenig, 1985; Schneider, 2019; Afonso et al, 2020). Finally, there is the schools-of-thought approach, notably the dualist school, the structuralist school, the legalist school, the voluntarist school, the free-riding school and the bi-sectoral school (Moser, 1978; Tokman, 1978; De Soto, 1989; Maloney, 2004). These various schools explain the rise of the informal sector by the rate of growth in demand for employment, the deficiencies of the formal sector, poverty and the structure of capitalism; they do not provide any information on the composition of the informal sector. Thus, Chen (2012) highlights holistic conceptual models that emphasize the heterogeneous composition of the informal sector and its growth through economic and mesoeconomic factors.

These approaches favoured the emergence of romantic, parasitic and dualist visions of the informal sector (La Porta and Shleifer, 2008), as well as modernization, neoliberal, structuralist and institutionalist theories (Lewis, 1954; Castells and Portes, 1989; Williams and Kedir, 2018), thus laying the foundations for the theory of tax evasion, which explains the growth of the informal sector through the behaviour of taxpayers in relation to the tax burden. Specifically, economic agents will simply shift their economic activities to unofficial sectors to escape high taxation (Schneider and Enste, 2000). These aspects consolidate the quantitative theory of tax avoidance developed by López (2017), which points out that larger and more productive firms spend more resources on tax avoidance or evasion activities and benefit from a lower tax burden.

The theoretical anchoring of tax evasion on the size of the informal sector is first explained by the 'benefit received' theory of taxation established by Wicksell (1896) and Lindahl (1919), which focuses on the efficiency of tax revenues in order to provide sufficient public goods and services to the population. Then, the path-breaking contributions of Allingham and Sandmo (1972), through the theory of the economics of crime, the theory of planned behaviour (Ajzen, 1985) and the theory of deterrence (Traxler, 2014), established the framework for analysing the impact of taxation on economic activity. The crucial element linking tax evasion to the informal sector is the tax gap. This refers to the difference between the value of the tax that would have been collected assuming perfect compliance and the tax revenue actually collected (Dybka et al, 2024). This tax evasion is also a challenge

and an economic policy issue for countries. Theoretical contributions on tax evasion suggest that, as intuited, economic agents may have a propensity to operate in the informal sector in order to reduce their tax burden (Cowell, 1985). Their effects (microeconomic and macroeconomic) influence the resilience of countries and offer opportunities for inclusion, as well as insurance mechanisms (Dell'Anno, 2016). In this perspective, López (2017) propose a quantitative theory of tax evasion, illustrating how agents optimally choose the tax-evading efforts just described as a function of their productivity, market prices and the institutional environment.

The emergence of the informal economy and/or economic crime will prolong the debate, leading to the emergence of two contending visions. On the one hand, the optimistic view emphasizes the contribution of tax evasion to reducing poverty and inequality while, at the same time, enabling the underprivileged to become integrated through entrepreneurial activities and the creation of goods and services (Goel and Saunoris, 2016). On the other hand, the pessimistic vision highlights that the resurgence of losses and inefficiencies caused by tax evasion distorts the quality of statistics and competition on the market, which is said to be the cause of falling tax revenues, falling official productivity and socio-political conflicts (Bethencourt and Kunze, 2018; Mpabe Bodjongo and Kamdem, 2024). In addition, tax evasion leads to a loss of efficiency in the allocation of resources, discourages investment, reduces incentives to invest and diminishes the productivity of the overall investment (Acosta-González et al, 2014). Moreover, at the expense of the state, it is a source of income, social inclusion and improved well-being for households operating illegally.

Empirical synthesis of tax evasion effects on the informal sector

The effects of evasion on the informal sector have been poorly documented, with complexity and a lack of consensus due to the size of the sample, the methodological approach and the indicators used. Tax evasion stimulates the informal sector by offering competitive advantages to informal businesses over formal businesses. Studies show a positive relationship between tax evasion and the size of the informal sector, underlining the need for tax and administrative reforms to encourage formalization and improve tax compliance. The existing empirical evidence emphasizes the poor quality of institutions, particularly taxation, as the driving force behind the growth of the informal sector (La Porta et al, 1999; Tanzi, 1999; Alm, 2012). The existence of red tape, coupled with restrictive regulations, leads to transaction costs, which encourage economic agents to conceal their activities in the informal sector (Dreher et al, 2009; Canh et al, 2018; Canh and Thanh, 2020). Thus, Tanzi (1983), investigating the extent of tax evasion suffered by the informal economy over the period 1930–80 in the US, found that tax evasion consolidates the size of the informal sector. Mara (2011), analysing the causal effects of the informal sector in the member states of the European Union in 2009, concludes that the behaviour of economic agents towards restrictive taxation encourages tax evasion, which increases the size of the informal sector. Busato et al (2011), using a single-sector dynamic general equilibrium (DGE) model, found that a high level of tax evasion increases the size of the informal sector regardless of the stage of development. Schneider (2015) and Bittencourt et al (2014), considering standard monetary production economies with overlapping generations, found that tax evasion increases the size of the informal sector. Araujo and Rodrigues (2016) and Schneider and Enste (2000) found that in

a context of low tax morality and increased penalty rates, tax evasion contributes to the growth of the informal sector in both developed and developing countries. Berdiev and Saunoris (2016) and Capasso and Jappelli (2013) concluded that tax evasion hinders the smooth functioning of the economy to the detriment of the informal sector. A significant rise in tax evasion increases the size of the informal sector. Hassan and Schneider (2016), Schneider and Williams (2013) and Schneider and Buehn (2012) pointed out that a higher overall tax burden and/or control and enforcement induce tax evasion, which stimulates the growth of the informal sector through the under-declaration of personal income and corporate profit.

However, some empirical studies have found that tax evasion hinders the growth of the informal sector. Besley and Persson (2011) found that the ease of taxation builds a widely respected tax system that collects taxes at a reasonable cost over a broad base, helping to inhibit the growth of the informal sector and the informal economy. Mutascu and Fleischer (2011), considering a sample of 27 European Union countries over the period 1997 to 2005 and using an unrestricted vector autoregression model (VAR), concluded that a positive increase of 1 per cent in tax evasion determines a very weak rise in the level of the informal sector in the medium and long term. Acosta-González et al (2014), considering a sample of 38 countries over 1991–2007, found that tax evasion, approximated by personal income taxes, reduces the size of the informal sector. Ameyaw et al (2015), using data collected from 153 respondents, including 44 interviewees with the informal sector tax authorities of the Tema Metropolitan Assembly in Ghana, and making use of regression analysis, found that personal income tax evasion reduces the growth of the informal sector in terms of socio-economic development. Similarly, Goel and Saunoris (2016), considering a sample of 72 developed countries and using econometric techniques based on OLS and double least squares, found that in a context of advanced fiscal decentralization, tax evasion mitigates the growth of the informal sector. Weigel (2020) found that tax evasion strategies led to an increase in property tax compliance and political participation by citizens in public meetings organized by the government, to the detriment of the growth of the informal sector, in the Democratic Republic of Congo. Fernández-Bastidas (2023), analysing the long-term effects of switching from a progressive to a proportional income tax in a model with heterogeneous agents and incomplete markets, concludes that taking explicit account of tax evasion leads to a significant increase in the informal sector, reflected in a weakness in capital accumulation and output.

Three lessons can be drawn from the aforementioned developments. First, most studies determine the effect of tax evasion on a simple measure of the informal sector. This limits our understanding of the effects of tax avoidance on the growth of the informal sector. Second, due to their complexity, any analysis of the impact of tax evasion must be comprehensive in order to better identify the factors that strengthen the resilience of countries. Third, the incongruous conclusions of the empirical work justify new investigations in the context of the growth of the informal sector in developing countries.

Methodological strategy

The methodological strategy is presented in three successive stages: the theoretical and empirical models; the estimation technique; and the data.

Theoretical and empirical models

The theoretical model

There are three approaches to capturing the activities of the informal sector: the sampling approach; the monetary approach; and the empirical approach (Cagan, 1958; Tanzi, 1983). The empirical approach generally brings together a set of causes and indicators of the phenomenon under study that lead to an increase in the size of the informal sector and its effects on the economy. Over the last two years, measurement of the informal sector has mainly been based on a combination of the MIMIC procedure and the money demand method (Schneider and Williams, 2013). To illustrate the growth of the informal sector, Giles (1999), Giles et al (2002) and Dell'Anno and Adu (2020) use the MIMIC model, which combines the structural model and the factorial model. Thus, the MIMIC model allows us to consider multiple potential causes of this phenomenon, while the currency demand approach offers a totally distinct monetary perspective on the same phenomenon, even capturing different components of this hidden activity. However, the limitations of the MIMIC model lie in the fact that the results obtained are very sensitive to the period studied and the individuals studied (Medina and Schneider, 2018). In addition, the causal and indicator variables used are not exhaustive. Although this approach is not supported by economic theory, the estimation strategy is complex. Taking into account the existing literature that presents the determinants of the informal sector and its indicators, we use a simple linear model that relates causes and indicators directly.

The MIMIC model takes the following form:

$$\eta = Y_1 X_1 + Y_2 X_2 + \ldots\ldots\ldots + Y_q X_q + \xi, \tag{1}$$

decomposed into two sub-equations. The first MIMIC equation is translated by Equation 2:

$$\mu = \theta' X + \vartheta, \tag{2}$$

where: μ refers to the latent viability that captures informality in the economy; X represents the matrix of causes of informality; X is such that $X = (X_1; \ X_2; \ldots\ldots; X_q)$; $\theta\prime$ is the matrix of coefficients relating to each cause-variable presented in the form, $\theta\prime = (\theta_1; \ \theta_2; \ldots; \theta_q)$; and ϑ is a structural disturbance following a normal distribution. For each equation, it highlights observation errors relating to exogenous causes $(\varepsilon_1; \ \varepsilon_2; \ldots; \ \varepsilon_p)$, which follow a normal distribution.

The second MIMIC equation is the indicator equation, formulated by Equation 3, as follows:

$$Y = \gamma\eta + \tau, \tag{3}$$

where $Y\prime = (Y_1; \ Y_2; \ldots; Y_p)$ is a unit matrix of informality indicator variables, $\gamma\prime$ is the vector of coefficients and $\tau\prime$ is Gaussian white noise.

Three econometric approaches have been developed in the empirical literature to estimate the size of the informal sector: first, direct approaches

aimed at determining the size of the informal sector using survey methods; second, indirect approaches using macroeconomic indicators to quantify the development of the informal sector over time; and, third, structural equation models that measure the informal sector as an unobserved variable (Enste and Schneider, 2000). Equations 2 and 3 are pooled and describe a correlation between informality indicators and the different causes, described through a simple linear model by Equation 4:

$$Y = \alpha + \beta X + \delta,$$

(4)

where X is the matrix of explanatory variables for the dependent variable Y (informality). X includes tax evasion, imports of goods and services, inflation, mobile phone ownership, access to electricity, level of Internet penetration in the population and natural resource rents. In other words:

$$\ln(\text{informality\_sector})_{it} = \alpha + \beta_1(\text{Tax\_evasion})_{it} + \beta_2(\text{Tax\_evasion})_{it}^2$$
$$+ \beta_3 \text{Importations}_{it} + \beta_4 \text{Inflation}_{it} + \beta_5 \text{Mobile\_phone}_{it}$$
$$+ \beta_6 \text{Rents}_{it} + \beta_7 \text{Energy}_{it} + \delta_{it},$$

(5)

where the indices i and t represent the individual and temporal dimensions, respectively. Some variables, such as informality and mobile phone ownership, are expressed in logarithms in order to put them on the same scale as the others. The study variables are contained in Appendix 1. We use two measures of informality. First, we use DGE estimates of informal production (as a percentage of official GDP). It is noted in the 'DGE–informal' estimates. The second measure is taken from the MIMIC model. This variable is labelled 'MIMIC–informal' in the database.

Variables and measures

Dependent variable

Our dependent variable is the size of the informal sector measured as a proportion of GDP and captures the share of economic activity that escapes national accounting (Medina and Schneider, 2018). In the study, we follow the work of Dellas et al (2024), who used one solid measure of informal activities. Therefore, we first consider the dynamic estimates based on a general equilibrium model (GEM) of informal production (percentage of official GDP). It is noted in the DGE–informal estimates. This variable is the main variable capturing the informal sector through DGE model-based estimates of informal output, as, according to Dellas et al (2024), informal output is the sum of output produced by the informal economic sector. Following the deep analysis of the World Bank (2021), informal economic activity comprises informal workers and informal firms. For this reason, informality is considered the market-based and legal production of goods and services that is hidden from public authorities for monetary, regulatory or institutional reasons. The second variable is given by the MIMIC model. This variable is marked 'MIMIC–informal' in the database. We use it to address the robustness of the results.

Interest variable

Our interest variable is tax evasion, approximated by the difference between tax potential as a percentage of GDP and tax revenue as a percentage of GDP (Mawejje and Sebudde, 2019). Tax potential is observed as the maximum level of tax revenue that a country can realize in the presence of a certain level of economic, social, demographic and institutional factors. For Mawejje and Sebudde (2019), potential tax can be computed using a production function approach. In the function, we included 19 variables. The weight of the variables depended on high levels of income, large shares of non-agricultural output, large trade shares in GDP, more investment in human capital development, more developed financial sectors, more stable domestic environments (with low inflation), more urbanized populations and lower corruption. In the calculation of potential tax, we generally exclude informal activities. Kobyagda and Binin (2021), through the stochastic frontier model, found that the tax pressure is determined by structural factors and that the countries of the West African Economic and Monetary Union could have further exploited their tax potential over the period 1987–2017. Two main explanations are offered. First, the measurement of informal activities in tax revenue is complex. Moore (2023) considered that the tax administration must be included in the calculation of the potential tax. Second, the analytic definition of the informal sector is given when the economy is least growing. For these reasons, many studies use data on informality without including a tax analysis (Junior and Garcia-Cintado, 2024). However, this indicator of tax avoidance, including tax potential, has been regarded as an incomplete, distorted and uncertain indicator of tax wealth (Guengant, 1991).

Nevertheless, fiscal potential is influenced by a range of structural factors, such as the degree of openness to trade, the degree of monetization of the economy, the level of development, the contributions of sectoral value added as a percentage of GDP and the degree of monetization of the economy (Bousselhami and Hamzaoui, 2018). Therefore, 0 per cent is the minimum level and 100 per cent is the maximum. According to Busato et al (2011), it describes the process that reduces legally due tax revenues, thereby reducing the government's ability to provide public services while increasing the nation's debt burden. Globally, tax evasion is considered an illegal activity in which a person or entity deliberately avoids paying their true tax liability. The hypothesis based on this variable is that tax evasion increases the size of informality. The expected sign is negative. For the square of tax evasion, the hypothesis is that it should reduce the size of informality. The expected sign is positive. This implies that there is a threshold of tax evasion after which it will decrease the size of informality.

Control variables

Our control variables are as follows:

- Imports of goods and services (percentage of GDP): this represents the total value of goods and services imported by a country, expressed as a percentage of GDP. Countries with a high volume of imports are more open to the rest of the world. This openness influences the level of informality by generating opportunities or competitive pressures for local businesses. An economy with high imports has flexible regulations that inhibit the size of the informal sector (Marjit et al, 2007; Paz, 2014). The expected sign is negative.

- Inflation: the annual percentage rate represents the inflation rate, which refers to the annual variation in the general price level. High inflation in an economy indicates high macroeconomic instability. Inflationary pressures lead companies and individuals to turn to the informal sector to avoid being taxed in an attempt to preserve purchasing power. In the presence of inflationary pressures, informal businesses can adapt better because of their flexibility and the absence of regulatory costs (Alberola and Urrutia, 2020). The hypothesis based on inflation is that inflation increases the size of informality. The expected sign is positive.

- Mobile phone (in percentage of population): this represents the percentage of the total population that has access to a mobile phone. The spread of mobile telephony facilitates activities in the informal sector by stimulating rapid communication and mobile transfers. The use of technology can also increase transparency and facilitate integration into the formal sector via mobile financial services and electronic payment systems (Ndoya et al, 2023). The expected sign is negative.

- Natural resource rents (percentage of GDP): this represents natural resource rents as a percentage of GDP. Countries that depend on natural resources are generally less diversified, with a strong predominance of the informal sector. High resource rents can also be associated with weak governance and high levels of corruption, which can encourage informality as a way of avoiding bureaucratic and corrupt practices (Sachs and Warner, 1995). The hypothesis based on natural rents is that they increase the size of informality. The expected sign is positive.

- Access to electricity (percentage of population): this refers to the percentage of the total population that has access to electricity. High access to electricity is an indicator of better infrastructure, which can disincentive remaining in the informal sector. Access to electricity improves the productivity of businesses, enabling them to grow, and formalizes their activities. The expected sign based on access to electricity is negative.

The estimation technique

Equation 5 is estimated using four different estimation techniques. The basic estimation uses the OLS method borrowed from the empirical literature for two reasons: (1) it minimizes the impact of measurement errors, and (2) it assumes that the countries in the sample are perfectly homogeneous. This econometric technique is generally used as an initial framework for analysis to give the general trend of the results (Legendre, 1805; Gauss, 1809). However, the fact that one and two tax evasion variables are dependent on each other in Equation 5 reduces the consistency of the OLS results. Also, in the presence of panel data, OLS is biased in the presence of unobserved specific effects. For this reason, the fixed effects technique controls for unobserved specific effects correlated with the explanatory variables, thus reducing the bias, and is taken into account after performing the Hausman (1978) test. Post-estimation tests of fixed effects simultaneously confirm the presence of heteroscedasticity and autocorrelation. In the presence of these problems, estimates using generalized least squares (GLS) offer more reliable results. There are three reasons for choosing GLS. The first is that in a situation

of heteroscedasticity, when the errors have a variance different from the mean, this can bias the estimation of the parameters. The second reason is specific to the nature of endogeneity. When one of the model's explanatory variables is correlated with the model's error term, this leads to biased parameter estimation. Third, data with temporal correlations, autocorrelations or seasonal variations can reduce the relevance of the results obtained. By using GLS, it is possible to reduce these biases to obtain more accurate parameter estimates (Wooldridge, 2013). Also, in the presence of autocorrelation, heteroscedasticity and spatial correlation, the Driscoll–Kraay estimator (Driscoll and Kraay, 1998) provides robust standard error estimates for hypothesis testing of the coefficients.

The data

This study covers a sample of 99 developing countries (see Appendix 2) over the period 2010–20. The choice of sample is dictated by the availability of data, as well as the fragility of tax revenues that characterizes developing countries. The countries selected form a group with fairly similar characteristics, in particular, poor institutional quality, a low and sometimes flat tax burden, and the highest levels of tax evasion in the world. As a result, tax revenues as a percentage of GDP are low and tax collection systems are less efficient. In addition, these countries have undergone major economic, social and political transformations over the last two decades, coupled with a slow process of reform in the functional market economy. The choice of this study period is justified by the considerable growth of the informal sector since the beginning of the 2000s, which has led to the need for tax reforms and innovations in developing countries.

The data are sourced from Medina and Schneider's (2018) database, the World Bank's (2021) database, World Governance Indicators (2021) and the World Economic Forum (2022). Our dependent variable is the informal sector, obtained from the World Bank's (2021) database, using the MIMIC model, which federates the structural model and the factor model to estimate the size of the informal economy as a percentage of GDP. The interest variable is tax evasion, extracted from the World Bank Database. Drawing on the literature on the determinants of the informal sector, we use some control variables obtained from the World Bank's (2021) database and the World Governance Indicators (2021).

Table 1 reports the descriptive statistics of the variables used. In general, the standard deviation is lower than the mean, suggesting a low dispersion of the variables in our sample. It is generally accepted that small data fluctuations lead to unbiased results. The correlation matrix shows low interdependencies, suggesting an absence of multicollinearity problems between the dependent variable and the explanatory variables (see Appendix 3).

MIMIC-informal values range from 8.5 per cent for Fiji in 2017 to 97.71 per cent for Colombia in 2013. The DGE-informal variable ranges from 10.69 per cent for Serbia in 2018 to 93.88 per cent for Kenya in 2011. The lowest values for the tax evasion variable of interest were observed in Georgia in 2012 and in Bangladesh and Dominica in 2010. The highest values were observed in Cameroon in 2014. The results of the correlation matrix also show that tax evasion is positively linked to informality. The countries list and the correlation matrix are contained in Appendices 2 and 3.

Table 1: Descriptive statistics

Variables	Obs	Mean	SD	Min	Max
MIMIC-informal	956	37.114	19.407	8.535	97.71
DGE-informal	957	36.333	16.378	10.69	93.88
Tax evasion	1,089	22.091	8.331	1.05	60.15
Imports of goods and services	713	10.074	55.265	−96.364	1247.42
Inflation	1,040	6.195	20.346	−4.295	557.202
Mobile phone	983	10.182	17.012	0	121.282
Natural resource rents	26	15.398	15.855	0	55.875
Access to electricity	1,089	72.931	30.558	4.1	100
Voice and responsibility	992	2.094	8.221	−64.992	140.367
Business freedom	927	71.586	15.628	0	90.3
Financial freedom	931	.512	6.887	−2.009	70

Results

This section presents and discusses the results of the basic model and those of the robustness analysis, derived from the empirical investigations.

Basic results

Table 2 presents the effects of tax avoidance on informality. The first and second columns provide the OLS results, the third column the fixed effects results, and the fourth the GLS results. Considering the results of the GLS estimation, the interpretation shows that tax evasion has positive and statistically significant effects on the size of the informal sector. All other things being equal, increases in tax evasion lead to more proportional improvements in the size of the informal sector. This improvement in the size of the informal sector is illustrated by the theory of tax evasion, which explains the shortfall in revenue for the tax authorities. Tax evasion contributes to the growth of the informal sector by creating incentives for businesses and workers to avoid tax obligations, distorting competition, reducing state revenues and increasing uncertainty and risk for economic actors. As tax evasion is seen as a viable option for reducing costs, it may lead to an increase in the number of informal businesses seeking to avoid tax charges and regulations (Schneider and Enste, 2000). As a result, informal businesses that avoid taxes may offer lower prices than formal businesses that comply with tax obligations, creating unfair competition. Tax evasion reduces the revenue that governments can raise, limiting their ability to fund public services and invest in infrastructure. The reduction in public revenues due to tax evasion can affect the quality of public services, which in turn can increase the dependence of individuals and businesses on informal services. In addition, tax evasion contributes to increased uncertainty for businesses, as tax rules can change in response to evasion attempts, increasing the risks for informal businesses. Informal businesses can face legal risks and a negative reputation, which can affect their growth and integration into the formal sector. The result is consistent with Berdiev and Saunoris (2016), Goel and Saunoris (2016) and Schneider and Williams (2013), who found that tax evasion favours the growth of the informal sector in both developed and developing countries. Regarding the case of Africa, two plausible reasons can be put forward. First, the lack of inclusiveness of economic growth, which encourages an

Table 2: Effects of tax evasion on the size of the informal sector

Estimation technique	Dependent variable: DGE-informal		
	Robust-OLS	**FE**	**GLS**
Tax evasion	0.085*** (0.005)	0.071*** (0.007)	0.044*** (0.009)	0.125*** (0.008)
(Tax evasion)²	−0.053*** (0.015)	−0.034*** (0.005)	−0.173*** (0.020)	−0.043*** (0.008)
Imports of goods and services		−0.011 (0.004)	−0.010 (0.009)	−0.003 (0.005)
Inflation		0.231 (0.165)	0.101 (0.177)	0.068 (0.127)
Mobile phone		−0.090*** (0.011)	−0.031*** (0.006)	−0.098*** (0.012)
Natural resource rents		0.012* (0.007)	0.037*** (0.005)	0.013* (0.007)
Access to electricity		−0.068*** (0.022)	−0.277*** (0.096)	−0.060*** (0.019)
Constant	36.652*** (5.126)	34.737*** (7.418)	64.689*** (9.156)	34.805*** (4.382)
Observations	957	957	957	957
Countries	99	99	99	99
R^2	0.724	0.754	0.769	
r2_o			0.0153	
r2_b			0.0214	
Chi²				16.66***

Notes: *, ** and *** are significant at the 10 per cent, 5 per cent and 1 per cent levels, respectively. Robust standard deviations in parentheses.

increase in informal work opportunities, increases the vulnerability of the employment rate through illegal techniques that conceal the formal sector. Second, the lacklustre environment and institutional arrangements make it easier to circumvent tax rules. In addition, the lack of a tax culture and low tax morality lead to a growth in the size of the informal sector.

As regards the results for the control variables, importing goods and services does not significantly reduce informality. There are three explanations for this result. First, importing goods and services provides access to a greater variety of high-quality products and services at affordable prices than those available on the informal market. Second, competition from imported products and services leads local businesses to standardize in order to position themselves on the market and become competitive. Finally, importing goods and services through the transfer of technology and know-how helps to reduce informality. Inflation has a non-significant negative effect on informality. This result can be explained by the fact that inflation increases the cost of goods, services and labour, resulting in low profit margins for businesses. Inflation also erodes consumer purchasing power, which reduces demand.

Mobile phones have a non-significant negative effect on informality. Mobile phones have a significant impact on the informal sector by facilitating access to markets, improving transaction efficiency, supporting entrepreneurship, reducing barriers to entry and providing empowerment opportunities. However, in the context of our sample, they also have negative effects, such as over-indebtedness and digital exclusion

(Gurumurthy and Bhardwaj, 2014). There are several explanations for this result. First, as Ndoya et al (2023) point out, the use of mobile phones reduces transport and communication costs, which in turn reduces the obstacles to formalization. It also contributes to the better coordination of communication, favouring a structured organization conducive to formalization. Another explanation is that mobile phones provide easier access to formal financial and banking services. Finally, the mobile phone makes it possible to record and trace commercial transactions efficiently. This prevents informal businesses from concealing their activities from the authorities. Easy access to mobile financial services can also lead to risks of over-indebtedness and financial problems for informal workers if the services are not properly regulated (Zhou and Li, 2018). Unequal access to technology can exacerbate disparities between those who have access to mobile phones and those who do not, creating tensions in the informal sector. Specifically, mobile phones, particularly mobile financial services (such as M–Pesa), offer informal workers access to banking and financial services, facilitating their integration into the formal economy. They enable easier and more transparent management of businesses, including tax registration and declaration, which encourages informal businesses to formalize. In addition, they reduce transaction costs for businesses, including the costs associated with finding information, negotiating and managing a business, which can encourage informal workers to enter the formal sector. Mobile phones enable the more accurate and transparent tracking of financial transactions, reducing opportunities for fraud and facilitating tax compliance (Kshetri, 2017). Other explanations include the fact that they enable informal businesses to connect with new customers, suppliers and business partners, thereby expanding their market opportunities and encouraging them to formalize.

Natural resources contribute directly to the growth of the informal sector. Without claiming to be exhaustive, the explanations lie in the preponderance of natural resources, which leads to a myriad of challenges to economic prospects, including reduced economic growth, autocratic governance, repression and conflicts, which increase the propensity of agents to engage in informal and illicit activities. These natural resources also generate state deficiencies, with low taxation associated with informal trade in smallholdings contributing to the undermining of public finances and political order. Specifically, natural resources increase the size of the informal sector through a variety of mechanisms, including unregulated exploitation, the creation of alternative income for local communities, the concentration of economic activity in specific areas and weak institutions and governance. These factors contribute to the growth of the informal sector by offering economic opportunities that often escape formal regulation. In countries rich in natural resources, the exploitation of these resources by informal actors can escape formal regulation. Indeed, the costs associated with complying with environmental regulations and safety standards can encourage companies and workers to operate in the informal sector to avoid these costs. In regions rich in natural resources, local communities may turn to informal activities, such as the sale of products derived from natural resources, to generate additional income. These natural resources can support informal economies based on the harvesting and sale of natural products, such as medicinal plants or non-timber forest products. The abundance of natural resources can therefore concentrate economic activity in specific areas where the exploitation of these resources is predominant, often to the detriment of the formal economy. This result corroborates that of Blanton (2021).

Access to electricity significantly decreases informality. However, although access to electricity has economic benefits, it can also contribute to an increase in the informal sector. This result can be explained by the fact that in areas where informal activity is already widespread, the arrival of electricity can allow these businesses to develop further without being declared. In addition, the complexity of the procedures for official connection to the electricity network pushes businesses and households to turn to the informal sector. Access to electricity reduces the size of the informal sector by improving working conditions, facilitating access to markets and financial services, reducing operating costs, and strengthening management and compliance capabilities. These factors help to make businesses more competitive and encourage their formalization. Specifically, access to electricity enables small businesses to equip themselves with modern machinery and equipment, thereby increasing their production capacity and competitiveness in the formal sector. Electrification creates safer and more productive working environments, encouraging informal businesses to formalize in order to improve working conditions and comply with safety standards. Electricity enables the use of digital financial services, such as electronic payments and microfinance platforms, which are often used by formal businesses. Access to a reliable energy source reduces the costs of using alternative energy sources, modern management tools like accounting software and inventory management systems, which help businesses comply with formal standards and improve their management. Formal businesses benefit from access to digital tools for tax declaration, recording transactions and managing employees, which encourages them to formalize. This result is in line with those obtained by Zhen and Zhang (2018) and Dinkelman (2011). Therefore, see Appendix 4 for more results.

Robustness results

To test the robustness of our results, we consider two additional measures of the size of the informal sector. The first takes into account the MIMIC indicator and the second the share of businesses in the informal sector.

Overall, the results confirm the positive and statistically significant effect of tax evasion on the size of the informal sector, depending on the measure considered (see Tables 3 and 4). Two explanations can be put forward. First, tax evasion is subject to the ineffectiveness of existing controls and poor governance and becomes a source of illicit practices, particularly money laundering and financial crime. Specifically, corruption undermines public action by increasing the costs of public intervention, which makes certain public projects economically unviable (Shleifer and Vishny, 1993). As a result, it is directed more towards financing informal activities and harmful activities that do not always contribute to the creation of national wealth. Second, tax evasion reduces the propensity of governments to create jobs and boost inclusive investment. In other words, tax evasion represents a loss of revenue flows and hinders formal sources of capital and trade. It contributes to the growth of the informal sector without really supporting the economy. Given the conflicts and financial and health crises that characterize the world, as well as the repercussions of the Russo-Ukrainian war, tax evasion hampers formal economic activities. (see Appendix 5 for more results).

Although tax evasion is widely regarded as a problem that undermines public finances and economic development, it can paradoxically offer certain benefits to the informal sector. These benefits include the stimulation of entrepreneurship and job creation, economic flexibility and resilience, product innovation and diversity, and a reduction

Table 3: Robustness results using the MIMIC method

	Dependent variable: MIMIC-informal			
	Estimation technique: GLS			
Tax evasion	0.0440*** (0.001)	0.0228* (0.013)	0.4826*** (0.006)	0.0250* (0.013)
(Tax evasion)^2	−0.1524*** (0.024)	−0.0035*** (0.001)	−0.0398*** (0.009)	− 0.0295*** (0.008)
Imports of goods and services	0.014** (0.006)	0.010 (0.007)	0.002 (0.010)	0.013** (0.006)
Inflation	0.085 (0.125)	0.084 (0.125)	0.122 (0.106)	0.219* (0.132)
Mobile phone	−0.057 (0.040)	−0.047 (0.040)	−0.073* (0.043)	−0.052 (0.049)
Natural resource rents	0.574*** (0.210)	0.561*** (0.211)	0.735*** (0.247)	0.933*** (0.307)
Access to electricity	0.052*** (0.017)	0.052*** (0.017)	0.045*** (0.015)	0.056*** (0.018)
Voice and responsibility		0.203* (0.117)		
Business freedom			−0.144*** (0.047)	
Financial freedom				−0.010 (0.079)
Constant	29.401*** (3.246)	29.106*** (3.274)	42.805*** (4.803)	27.676*** (3.328)
Observations	947	997	987	942
Countries	99	99	99	99
Chi^2 (*P*-value)	20.12***	23.03***	70.54***	25.93***

Notes: *, ** and *** are significant at the 10 per cent, 5 per cent and 1 per cent levels, respectively. Robust standard deviations are in parentheses.

in the regulatory burden. However, it is crucial to understand that these benefits do not justify tax avoidance, which has significant negative implications for the economy and society. Specifically, in contexts where tax burdens are perceived to be too high, tax avoidance can encourage individuals to set up informal businesses to avoid high tax liabilities (Schoar, 2010). This can stimulate entrepreneurship and job creation in difficult economic environments. As a result, informal businesses can react more quickly to changing economic conditions, offering flexibility that formal businesses may not have. This flexibility can be increased when tax and regulatory obligations are avoided. Tax avoidance can encourage informal businesses to innovate and diversify their products and services to attract customers, as they seek to stand out in the market without regulatory constraints. It can allow informal businesses to better penetrate local markets by avoiding regulatory barriers that might otherwise limit their access.

The variables contributing to the results are trade openness, GDP per capita, natural resources and employment. They influence the measures of the size of the informal sector considered. Thus, as the abundance of natural resources leads to conflict and poor governance, on the one hand, and poverty and the curse of natural resources, on the other, it encourages the growth of the informal sector (Collier, 2007). For example, weak governance contributes to the expansion of the informal sector by increasing

Table 4: Robustness by taking into account the alternative estimation technique

Variables	Estimation technique: Driscoll–Kraay			
	DGE-informal	DGE-informal	MIMIC-informal	MIMIC-informal
Tax evasion	0.5015*** (0.100)	0.0326** (0.015)	0.1798*** (0.036)	0.0063** (0.011)
(Tax evasion)^2	–0.0212** (0.009)	–0.0163*** (0.003)	–0.0843*** (0.010)	–0.0295*** (0.008)
Imports of goods and services		–0.001 (0.002)		0.008 (0.005)
Inflation		0.231*** (0.067)		0.328** (0.141)
Mobile phones		–0.046*** (0.009)		–0.041*** (0.008)
Natural resource rents		0.273* (0.149)		0.450*** (0.115)
Access to electricity		0.068*** (0.011)		0.078*** (0.009)
Constant	36.652*** (6.316)	34.737*** (6.886)	34.017*** (3.181)	29.776*** (3.443)
Observations	957	584	956	583
R^2	0.823	0.724	0.821	0.633
Countries	99	74	99	74
F-statistic (P-value)	0.0638***	45.37***	13.22***	100.8***

Notes: *, ** and *** are significant at the 10 per cent, 5 per cent and 1 per cent levels, respectively. Robust standard deviations are in parentheses.

compliance costs for formal businesses, distorting competition and encouraging favouritism, reducing the application of laws and regulations, and establishing an ecosystem where informal practices become the norm. These dynamics encourage companies and individuals to turn to the informal sector to avoid the burdens and risks associated with corruption. As a result, corruption in public administrations can lead to more onerous regulatory requirements and increased compliance costs for formal businesses. This can make operating in the formal sector costly and complex, leading businesses to turn to the informal sector to avoid these burdens (see Appendix 6 for more results).

Businesses often have to pay bribes or informal fees to obtain licences or permits, which increases compliance costs and can encourage operating in the informal sector. Corruption can lead to the uneven or lax application of laws and regulations. Informal businesses can benefit from this, as they do not face rigorous monitoring or sanctions for their illegal activities. Corruption creates an ecosystem where informal practices become the norm. Where corruption is pervasive, businesses and individuals may perceive the informal sector as a viable or even necessary alternative to succeed in the economy. The results are consistent with those obtained in the basic model and in the empirical literature (La Porta et al, 1999; World Bank, 2021; Bardhan, 1997).

Conclusion

This article has aimed to examine the impact of tax evasion on the size of the informal sector. There are two main reasons for this: the sharp increase in tax

evasion, and the considerable growth in the size of the informal sector. Based on these two facts, we mobilized theoretical and empirical developments to build a model that could be used to test the hypothesis that tax evasion increases the size of the informal sector. Several variants of the model were estimated by OLS, fixed effects and GLS. The sample comprised 99 developing countries. The time horizon represented the arithmetic mean over the period 2010–20 and was dictated by data availability. The originality of our study compared with the existing literature is to have proposed an analysis of the size of the informal sector through the prism of tax evasion. We have shown that tax evasion implies significant improvement for the informal sector in developing countries. Controlled by two complementary measures of the size of the informal sector, our results remain statistically significant, robust and stable overall.

Reducing the size of the informal sector requires a multifaceted approach, including improving the business environment, strengthening compliance and enforcement, promoting financial inclusion, reforming the tax and regulatory system, and improving transparency and governance, as well as providing assistance and training programmes. Based on these results, a number of non-exhaustive economic policy suggestions can be made with a view to mitigating the growth of the informal sector. First, the institutional environment should be cleaned up by putting in place tax rules that guarantee good tax citizenship, confidence in public action, tax transparency and institutional efficiency. It is important to strengthen the capacity of law enforcement institutions to ensure that tax and trade regulations are complied with fairly. Second, digital taxation should be promoted by setting up a simple, stable and fair tax system that encourages e-identification, e-declaration, e-finance and the automatic exchange of information to reduce tax evasion. Effectiveness lies in the implementation of an integrated approach that includes the development of a robust technological infrastructure, the promotion of financial inclusion, support for innovation, the development of an appropriate regulatory framework, data protection and ongoing evaluation. Third, the tax base should be extended to all sectors of activity to take account of property taxes, excise duties and the carbon tax.

This study suggests the potential for research on a broad sample incorporating both developed and developing countries. However, attention can also be paid to countries in situations of multidimensional fragility and to exploring transmission channels.

Note
[1] These are communications techniques that enable users to access, retrieve, store, transmit and manipulate information in digital form.

Data availability
Data can be accessed from https://databank.worldbank.org/source/world-development-indicators and http://info.worldbank.org/governance/WGI.

Conflict of interest

The authors declare that there is no conflict of interest.

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Appendix 1

Table A1: Study variables

Variables	Descriptions	Sources
Informality	Dynamic estimates based on a general equilibrium model (GEM) of informal production (% of official GDP); it is noted in the DGE-informal estimates The multiple indicators, multiple cause (MIMIC) model; this variable is marked MIMIC-informal in the database	WDI (2021)
Tax evasion	Difference between tax potential as a % of GDP and tax revenue as a % of GDP	Mawejje and Sebudde (2019)
Imports of goods and services	Volume of goods and services brought into the country from abroad	WDI (2021)
Inflation	Consumer price index	WDI (2021)
Internet	Internet subscription rate (% of population per 100 people)	WDI (2021)
Mobile phone	Mobile phone subscriptions per 100 people	WDI (2021)
Electricity	Number of kilowatts consumed per hour	WDI (2021)
Natural resources	Total natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents and forest rents divided by GDP	WDI (2021)
Money supply	Money supply is the sum of currency outside banks and demand deposits other than those of the central government divided by GDP	WDI (2021)

Appendix 2: List of countries

Table A2: List of countries

Albania, Algeria, Argentina, Armenia, Azerbaijan, Bangladesh, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Central African Republic, Chad, China, Colombia, Comoros, Congo, Dem, Congo, Rep, Costa Rica, Cote d'Ivoire, Djibouti, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Eswatini, Fiji, Gabon, Gambia, Georgia, Ghana, Grenada, Guatemala, Guinea, Guyana, Honduras, India, Indonesia, Iran, Jordan, Kazakhstan, Kenya, Kyrgyz Republic, Lao People's Democratic Republic, Lebanon, Lesotho, Liberia, Madagascar, Malawi, Malaysia, Maldives, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nepal, Nicaragua, Nigeria, Pakistan, Papua, New Guinea, Paraguay, Peru, Philippines, Russian Federation, Rwanda, Senegal, Serbia, Sierra Leone, Solomon, Islands, South Africa, Sri Lanka, Sudan, Tajikistan, Tanzania, Thailand, Togo, Tunisia, Turkey, Uganda, Ukraine, Vietnam, Zambia, Zimbabwe.

Appendix 3

Table A2: Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) MIMIC-informal	1.000										
(2) DGE-informal	0.491	1.000									
(3) Tax evasion	0.113	0.207	1.000								
(4) Imports of goods and services	0.196	0.105	0.229	1.000							
(5) Inflation	0.149	0.239	0.394	0.468	1.000						
(6) Mobile phone	0.476	0.598	0.026	−0.017	−0.325	1.000					
(7) Natural resource rents	0.120	−0.243	0.052	0.633	−0.014	−0.411	1.000				
(8) Access to electricity	0.177	0.386	0.110	−0.658	−0.402	0.654	−0.736	1.000			
(9) Voice and responsibility	0.490	0.057	0.043	−0.213	−0.432	0.435	0.008	0.381	1.000		
(10) Business freedom	0.394	0.520	0.092	−0.348	−0.289	0.908	−0.676	0.824	0.488	1.000	
(11) Financial freedom	−0.326	−0.412	−0.139	0.326	0.288	−0.878	0.636	−0.814	−0.447	−0.961	1.000

Appendix 4

Table A3: OLS results, effects of tax evasion on the size of the informal sector

Variables	Dependent variable: DGE-informal			
	OLS		FE	GLS
Tax evasion	0.018 (0.141)	0.205 (0.206)	0.162 (0.142)	0.025 (0.153)
(Tax evasion)^2	–0.118 (1.279)	–0.823 (1.730)	–1.699 (1.160)	0.498 (1.242)
Import		–0.031** (0.013)	–0.003 (0.023)	–0.016 (0.012)
Export		–0.029 (0.038)	–0.112 (0.127)	–0.016 (0.029)
Log (GDP per cap)		0.255 (0.426)	–1.592 (2.057)	0.388 (0.328)
ManuVal		–0.250* (0.138)	–0.013 (0.455)	–0.229** (0.094)
AgriVal		–0.329** (0.164)	0.720 (0.481)	–0.266** (0.104)
SerVal		0.014 (0.156)	–0.613* (0.341)	–0.054 (0.092)
FiDev		0.168*** (0.052)	–0.175 (0.140)	0.151*** (0.043)
M2/PIB		–0.242*** (0.044)	0.118 (0.133)	–0.161*** (0.037)
Constant	36.652*** (5.126)	52.905*** (12.748)	75.365*** (24.677)	43.867*** (8.193)
Observations	957	408	408	408
Countries	76	60	60	60
R-squared	0.02	0.077	0.035	
Fisher Chi^2 (Prob)	9.08***	42.84***	12.11***	29.76***

Notes: *, ** and *** are significant at the 10 per cent, 5 per cent and 1 per cent levels, respectively. Robust standard deviations in parentheses.

Appendix 5

Table A4: OLS robustness results using the MIMIC method

	Dependent variable: MIMIC-informal					
	OLS			GLS		
	(1)	(2)	(3)	(1)	(2)	(3)
Tax evasion	0.234 (0.236)	0.257 (0.339)	0.209 (0.247)	0.178 (0.246)	0.190 (0.250)	0.327 (0.252)
(Tax evasion)²	−0.004 (0.005)	−0.003 (0.007)	−0.003 (0.004)	−0.002 (0.004)	−0.003 (0.004)	−0.005 (0.005)
Import		−0.007 (0.017)	−0.007 (0.016)	−0.012 (0.017)	−0.042 (0.031)	−0.009 (0.018)
Export		−0.008 (0.043)	0.020 (0.036)	0.003 (0.037)	−0.003 (0.041)	0.041 (0.033)
Log (GDP per cap)		−0.112 (0.534)	−0.087 (0.447)	0.010 (0.465)	−0.609 (0.523)	−0.429 (0.705)
ManuVal		−0.304* (0.174)	−0.287** (0.124)	−0.268** (0.126)	−0.236* (0.136)	−0.348*** (0.130)
AgriVal		−0.365* (0.189)	−0.400*** (0.120)	−0.423*** (0.123)	−0.259* (0.140)	−0.485*** (0.117)
SerVal		−0.079 (0.181)	−0.301*** (0.108)	−0.286*** (0.109)	−0.205 (0.131)	−0.466*** (0.097)
FiDev		0.198*** (0.063)	0.117** (0.049)	0.127** (0.049)	0.140*** (0.054)	0.123** (0.050)
M2/PIB		−0.269*** (0.050)	−0.168*** (0.043)	−0.171*** (0.043)	−0.175*** (0.048)	−0.168*** (0.041)

(Continued)

Table A4: Continued

	Dependent variable: MIMIC-informal				
	OLS			**GLS**	
Voice and responsibility			0.242** (0.119)		
Business freedom				−0.270*** (0.066)	
Financial Freedom					0.104 (0.134)
Constant	56.070*** (13.406)		62.335*** (8.348)	75.699*** (10.938)	71.347*** (7.987)
Observations	407		406	329	373
Countries	60		60	56	59
R-squared	0.063	0.02			
Chi2	30.79***		38.85***	34.97***	67.51***

Notes: *, ** and *** are significant at the 10 per cent, 5 per cent and 1 per cent levels, respectively. Robust standard deviations in parentheses.

Appendix 6

Table A5: OLS robustness by taking into account the alternative estimation technique

Variables	Estimation technique: Driscoll–Kraay			
	MIMIC-Informal		DGE-informal	
Tax evasion	0.234 (0.178)	0.257 (0.322)	−0.018 (0.273)	0.149 (0.434)
(Tax evasion)^2	−0.004 (0.004)	−0.003 (0.008)	0.000 (0.005)	−0.001 (0.008)
Import		−0.007 (0.013)		−0.031*** (0.006)
Export		−0.008 (0.038)		−0.026 (0.031)
Log(GDP per cap)		−0.112 (0.465)		0.261 (0.399)
ManuVal		−0.304*** (0.039)		−0.255*** (0.041)
AgriVal		−0.365*** (0.091)		−0.327*** (0.077)
SerVal		−0.079 (0.065)		0.015 (0.093)
FiDev		0.198*** (0.048)		0.171*** (0.036)
M2/PIB		−0.269*** (0.032)		−0.245*** (0.035)
Constant	34.017*** (4.262)	56.070*** (6.692)	36.479*** (5.221)	49.477*** (5.241)
Observations	956	407	957	408
R-squared	0.001	0.063	0.000	0.076
Countries	99	60	99	60
Fisher	6.141	513.8	0.0286	517.0

Notes: *, ** and *** are significant at the 10 per cent, 5 per cent and 1 per cent levels, respectively. Robust standard deviations are in parentheses.

Source: Based on Bruinsma and Weisburd (2014).