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30 August 2021

Understanding Informality

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Abstract: This paper introduces a comprehensive database of informal economic activity. The database focuses on measures that have strong cross-country and over time coverage: it includes both model-based and survey-based measures of informality and covers more than 160 economies for the period 1990-2018. The paper illustrates two applications of the database. First, it distills stylized facts of informal activity, including its declining trend and pervasiveness in emerging market and developing economies (EMDEs). Second, it documents the cyclical features of the informal economy. Overall, informal economy recessions (recoveries) do not differ significantly from those of formal economy. Like formal-economy business cycles, informal-economy business cycles tend to be shallower in advanced economies than in EMDEs. Informal employment in both advanced economies and EMDEs appears to be largely acyclical.

1. Introduction

The livelihoods of the poor in emerging market and developing economies (EMDEs) often depend on informal economic activity. In these economies, informal-economy output on average accounts for about one-third of GDP and informal employment constitutes about 70 percent of total employment (of which self-employment accounts for more than one-half; Figure 1). In some economies in Sub-Saharan Africa (SSA), informal employment accounts for more than 90 percent of total employment and informal output for as much as 62 percent of official GDP (ILO 2018a; World Bank 2019).

A large informal sector is often associated with unfavorable macroeconomic and development outcomes (Figure 1; Ohnsorge and Yu 2021). On average, economies with larger informal sectors have tended to have less access to finance for the private sector, lower productivity, slower physical and human capital accumulation, less educated workforces, and smaller fiscal resources. Some studies show that informality is associated with higher income inequality and poverty. Lower physical investment in the informal sector could reflect an unwillingness of informal firms to adopt technologies or larger scales of production that might make them visible to tax and other authorities. The informal sector, on average, is characterized by lower productivity than the formal sector because it tends to employ less-skilled workers; use less capital; have restricted access to funding, services and markets; and lack economies of scale.[2] Over the business cycle, informal employment can provide a safety net when the formal sector sheds jobs. But workers in the informal economy are largely excluded from the social security system and less protected against negative shocks than workers in the formal sector, which could amplify business cycles.

Depending on country circumstances and worker characteristics, workers and firms may choose to participate in the informal economy for a wide range of reasons. These have resulted in various measures and definitions of the informal economy. For instance, informal workers range from agricultural day laborers to self-employed firm owners with a few employees. Some of these workers may choose the informal sector for its innovativeness and flexibility (Maloney 2004; Perry et al. 2007). Against this drawback, this paper reviews conceptual and measurement issues regarding the informal economy and documents its main features across countries and over time. It also summarizes the cyclical features of the informal economy.

Our paper makes the following contributions to the literature. First, it compiles a comprehensive database of informality measures developed in the literature, with a focus on measures that have broad cross-country and long historical coverage. The resulting

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[2] See a comprehensive analysis of long-term economic correlates of informality in Ohnsorge, Okawa, and Yu (2021). For work on informality and inequality, see Chong and Gradstein (2007), Loayza, Servén, and Sugawara (2010), Perry et al. (2007), and Rosser, Rosser, and Ahmed (2000). For features of economies with widespread informality, see Amaral and Quintin (2006), Docquier, Müller, and Naval (2017), Elgin et al. (2021), Galiani and Weinschelbaum (2012), La Porta and Shleifer (2014), Loayza (2018), Loayza and Rigolini (2011), and World Bank (2019 and 2020). For technology adoption in informal sector, see Dabla-Norris, Gradstein, and Inchauste (2008) and Gandelman and Rasteletti (2017).

dataset combines, and in some cases updates, twelve cross-country databases and data provided by almost 90 national statistical agencies.[3] Second, the paper presents two applications of this database. In a first step, it distills stylized facts about the informal economy, such as its size and evolution over time, using a wide range of informality measures, and tests the consistency of these stylized facts across these measures. In a second step, the paper documents the cyclical features of the informal economy, such as the duration and amplitude of recessions and recoveries.

We present several new findings. *First*, we summarize the advantages and drawbacks of existing informality measures. Previous literature on informality has relied solely on either survey-based or model-based estimates. Survey-based measures can cover many dimensions of the informal economy, but they suffer from poor country and year coverage (especially for EMDEs), reporting bias, and lack of consistency in survey methods.[4] Indirect, model-based measures of informal output stand out in their potentially comprehensive country and year coverage and their consistent economic meaning, but they rely on strong assumptions. We highlight the circumstances in which the various individual informality measures could be particularly helpful. This adds to earlier work that has focused on the limitations of a confined number of estimation methods.

Second, the paper argues that the combination of direct, survey-based indicators with indirect, model-based estimates can overcome the limitations of each. Informal employment measures tend to cover either the number of hours worked per day in informal employment ("intensity" of participation in informal employment) or, regardless of the number of hours worked per day, the presence of informal employment ("extent" of participation; Meghir, Narita, and Robin 2015). Since the extent of participation in the informal economy and its intensity may evolve differently, informal production may move asynchronously with informal employment.[5] Thus, measures of informal output are an important complement to measures of informal employment.

Third, the paper distills the main features of the informal economy and its evolution over time. Three different dimensions of informality are identified here: output, employment, and perception. Cross-country rankings of informal output and employment are typically consistent. Both output and employment measures of informality have trended downward since 1990 and have shown some cyclicality. In contrast, perception-based measures have

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[3] Official GDP statistics often make an adjustment for informal activity. However, the magnitude of such adjustments is rarely specified. In a survey in 2008, national statistical agencies for about 40 mostly advanced economies or economies in transition reported adjusting their official GDP statistics by amounts ranging from 0.8 to 31.6 percent for activity in the non-observed economy (NOE), which is a broader concept than the informal economy (United Nations 2008). For all reporting economies, the adjustments were well below those suggested by the measures of informality presented in this paper.

[4] Survey-based informality measures are based on income data from surveys or audits that differ from incomes declared for tax purposes (Binelli and Attanasio 2010; McCaig and Pavcnik 2015), or earnings from firm surveys (Almeida and Carneiro 2012; Putnins and Sauka 2015).

[5] For example, during a recession, labor may move from the formal sector to the informal sector and raise participation in the informal economy (Loayza and Rigolini 2011). However, due to the fall in demand during a recession, the intensity of participation, captured by the number of hours worked in informal employment, may remain the same or even drop, reducing informal output.

tended to be highly stable over time and could, therefore, be more appropriate for cross-country comparisons.

Fourth, this is the first study to document the cyclical features of the informal sector in both advanced economies and EMDEs. Cyclical movements in informal economy output do not differ statistically significantly from those in formal economy output. Like the formal economy, the informal economy undergoes larger output movements over the business cycle in EMDEs than in advanced economies. Steeper recessions and stronger recoveries in EMDEs contribute to greater output volatility, as shown in previous studies (Aguiar and Gopinath 2007). Meanwhile, unlike formal employment, which contracts significantly in advanced economies during formal economy recessions, informal employment in both advanced economies and EMDEs appears largely acyclical during informal output business cycles. This may reflect wage movements or changes in intensity (measured as number of hours worked per day) in labor markets, which may bear the brunt of adjustment during business cycles (Guriev, Speciale, and Tuccio 2019; Meghir, Narita, and Robin 2015).

The following section discusses definitions of informality and various measures of informality. Then, the paper documents the main features of the informal economy across EMDE regions and the main similarities and differences across various measures of informality. Next, it documents informal-economy business cycles, followed by concluding remarks.

2. Definition of informality

Informality is typically defined as market-based and legal production of goods and services that is hidden from public authorities for monetary, regulatory, or institutional reasons (Schneider, Buehn, and Montenegro 2010). Monetary reasons include the avoidance of taxes and social security contributions, regulatory reasons include the avoidance of government bureaucracy or regulatory burdens, and institutional reasons include corruption, related often to the poor quality of political institutions and weak rule of law. These factors affect firms and workers' decisions to participate in the formal sector (Perry et al. 2007; Ulyssea 2020). For the purposes of this paper, the informal economy involves activities that, if recorded, would contribute to GDP, and does not cover illegal activities or household production (Medina and Schneider 2018; Schneider, Buehn, and Montenegro 2010). This section summarizes the definitions and classifications of informality used by previous studies.

The definition and classification of informality are highly context-specific. Similarly, the choice of informality measures will depend on the question being explored. The general definition referred to above encompasses many types of informal activities by workers and firms.

Exit versus exclusion. Some workers and firms are "excluded" from the modern economy or from state benefit systems due to burdensome entry regulations and lack of human capital (de Soto 1989; Loayza, Oviedo, and Servén 2006; Perry et al. 2007). This type of

informality is frequently associated with low productivity and with poorly paid and low-skilled employment (La Porta and Shleifer 2014; Loayza 2018). Other informal workers voluntarily "exit" the formal sector and choose informal activity for its flexibility, independence, and lower regulatory compliance burdens (Blanchflower, Oswald, and Stutzer 2001; Falco and Haywood 2016; Günther and Launov 2012; Maloney 2004). Both "excluded" and "exiting" types of informality could coexist in an economy (Bosch and Maloney 2008, 2010; Lehmann and Pignatti 2007; Nordman, Rakotomanana, and Roubaud 2016).

Subsistence informality. Other studies focus on "subsistence informality," which is pervasive in lower-income countries and characterized by low-skilled technology and the fact that in the absence of such informal economic activity the incomes of the workers involved would fall below subsistence levels (Docquier, Müller, and Naval 2017).

Evaders, avoiders and outsiders. Yet another group of studies classify informal workers and firms into evaders, avoiders, and outsiders depending on their compliance with regulations and regulations' applicability (Kanbur 2009; Kanbur and Keen 2015). Evaders are firms that are covered by regulations but do not comply; avoiders are firms that adjust to be outside the remit of regulations; outsiders are firms that are simply not covered by regulations.

Margins. More recent studies distinguish different types of informality by the entities engaged in informal activity, without focusing on their motivation: firms that do not register their business (the extensive margin) and or registered firms that hire workers "off the books" (the intensive margin; Ulyssea 2018, 2020).

Specific definitions exit regarding informal workers and firms. Informal employment covers all workers in the informal sector and informal workers outside the informal sector (Perry et al. 2007; ILO 2018b). The former comprises all persons who were employed in at least one informal firm. The latter group consists of some self-employed and workers who are not employed in formal contractual arrangements or not subject to social security or employment benefits.[6] Some have defined informal employment more specifically as referring to workers who do not contribute to retirement pension schemes, which form part of social security (Loayza, Servén, and Sugawara 2010).

The most commonly used proxy for the relative size of informal employment is the share of self-employment in total employment, capturing workers who, working on their own account or with one or a few partners or in a cooperative, hold the type of jobs defined as "self-employment jobs" (Annex; ILO 1993; La Porta and Shleifer 2014). The other popular measure of informal employment comprises all workers in the informal sector (workers in at least one informal sector enterprise, irrespective of their status in employment and whether it was their main or a secondary job) together with informal workers outside the informal sector (the self-employed and employees holding informal

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[6] See the annex of Hussmanns (2003) for the overlap between informal employment and self-employment.

jobs). For the remainder of the paper, informal employment will be proxied by self-employment since data on informal employment is not available for advanced economies.

Some studies use the following criteria to define an informal firm (ILO 2018b). First, it is not an incorporated enterprise that is a legal entity separate from its owners, with its own complete set of accounts, and it is not owned or controlled by one person or a few household members. Second, it is a market enterprise that sells its goods or services. Third, it falls into one of the following categories: it keeps the number of workers employed on a continuous basis and below a threshold determined by the state; it is not registered; or its workers are not registered. Other studies provide an alternative definition of degrees of firm informality on a continuum depending on size, registration, honesty of accounting, tax payments, mobility of workplace and access to bank credit (Benjamin and Mbaye 2012; Mbaye, Benjamin, and Gueye 2017).

3. Database of informality measures

Reflecting the difficulty of measuring informality, researchers have developed a wide range of estimation methods to capture its scale. The database compiled for this study includes the twelve measures most commonly used in the literature. These can be categorized into two groups based on their estimation methods. The first group encompasses indirect model-based estimates of the relative size of informal output (that is, informal output in percent of official GDP). The second group encompasses direct measures gathered from surveys, such as labor force, household, firm, or opinion surveys. In the database, indirect and direct measures together cover up to 196 economies (36 advanced economies and 160 EMDEs) and for periods as long as 1950-2018 (Table 1a and Table A1). [7]

This section describes the informality database and the limitations and advantages of each measure included in it. Indirect measures stand out for their broad country and long year coverage, but they suffer from their narrow focus on economic production and strong reliance on model specifications and assumptions. Direct measures capture more dimensions of informality and do not involve particular model specifications and assumptions, but they tend to have limited country and year coverage, making them less well suited to cross-country, time-series analyses. Indirect measures provide only a macro perspective on the extent of informality in an economy, whereas direct measures can also provide a micro perspective on how firms and workers behave in the informal sector.

3.1 Indirect estimates

Previous studies have used various indirect approaches to estimate the size of the informal sector, including the currency-demand approach (Ardizzi et al. 2014), the electricity-demand approach (Schneider and Enste 2000), the Multiple Indicators Multiple Causes (MIMIC) model (Schneider, Buehn, and Montenegro 2010), and the dynamic general

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[7] Although some of the measures are available for periods as long as 1950-2018, the paper focuses on the period 1990-2018. The period choice is due to the general lack of data availability and reliability before 1990. See Table 1 for detailed country and year coverages for the period 1990-2018, and Table A1 for a summary of full data coverage between 1950 and 2018.

equilibrium (DGE) model (Elgin and Oztunali 2012; Ihrig and Moe 2004; Orsi et al. 2014). Among all indirect estimation methods, the MIMIC and DGE models stand out in terms of their long time-series and broad country coverage. For this reason, the focus here is mainly on the use of MIMIC and DGE models to estimate the size of informal economic activity. To make the measures comparable with those in the literature, both DGE-based and MIMIC-based estimates are reported in percent of official GDP.

The multiple indicators multiple causes model (MIMIC). This is a type of structural equations models that can be used to estimate the relative size of informal economic activity. Two features of MIMIC are particularly important: first, it explicitly takes into account multiple possible causes of informal activity and captures multiple outcome indicators of it; second, it can readily be used to estimate informal activity across countries and over time. Other indirect approaches, like the currency-demand approach and the electricity-demand approach, condense all the features of informal activity across product and factor markets into just one indicator.[8] The informal sector, however, shows its effects in various markets, which can be captured better in a MIMIC model (Schneider, Buehn, and Montenegro 2010). The data on causes and indicators of informal activity identified in the literature are largely macroeconomic data in a panel setting and can be updated annually.

The limitations of the standard MIMIC model, used by Schneider, Buehn, and Montenegro (2010) and others, have been widely discussed in the literature (Feige 2016; Medina and Schneider 2018). The limitations include: 1) the use of GDP (that is, GDP per capita and its growth rates) as both cause and indicator variables, 2) its reliance on another, independent study's base-year estimates of the informal economy to calibrate the size of the informal economy in percent of GDP, and 3) the sensitivity of the model's estimated coefficients to alternative model specifications and sample coverage.[9] These limitations can open the MIMIC estimates to charges of manipulation and misrepresentation (Breusch 2005).

Here we replicate the most cited MIMIC study, Schneider, Buehn, and Montenegro (2010), to estimate the size of the informal sector in percent of official GDP.[10] Six causes and three indicators are used in the estimation to capture the hypothesized relationships between the informal sector (the latent variable) and its causes and indicators. Once the relationships are identified and the parameters are estimated, the estimation results are used to calculate the MIMIC index, which gives the absolute values of the size of the

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[8] The electricity-demand and currency-demand approaches suffer from limited data availability and are each subject to specific caveats. The electricity-demand model rests on the strong assumptions that all informal economic activity requires only the use of electricity, and the association between informal production and use of electricity is constant over time. The currency-demand approach rests on the assumption that transactions in the informal sector are paid in cash and that there is no informal sector in the base year (Ahumada, Alvaredo, and Canavesa 2007).

[9] Medina and Schneider (2018) try to overcome the limitation of using official GDP (which may capture part of the informal economy) by using night-light data to independently capture economic activity.

[10] See Annex for details on the estimation method. The estimation results from the model specification that ensures maximum data coverage (shown in Annex Table A2) are used here.

informal sector after a benchmarking or calibration procedure. The MIMIC approach delivers a panel of estimates for 160 economies (36 advanced economies and 124 EMDEs) over the period 1993-2018.

The MIMIC estimates capture the combination of both employment and productivity in the informal sector, whereas measures of informal employment only reflect the level of employment in the informal sector. Despite the comprehensive country and long time-series coverage, MIMIC estimates do not fluctuate much over time, which makes the estimates less suited for time-series analyses (including the business cycle analysis in section 4 below).

The DGE model (DGE). The dynamic general equilibrium (DGE) model considers how optimizing households will allocate labor between formal and informal economies in each period and how the allocation changes over time (Ihrig and Moe 2004; Elgin and Oztunali 2012). In comparison with other estimation methods, the DGE approach stands out in the comprehensive country and year coverage that it allows, its clear theoretical basis, and its applicability to policy experiments and projections (Loayza 2016).

The DGE approach has some limitations. First, it relies on strong assumptions about the functional form of activity in the informal and formal sector and about the relationship between formal and informal productivity (Orsi, Raggi, and Turino 2014; Schneider and Buehn, 2016). Second, like the MIMIC approach, it requires base-year estimates of the informal economy from another independent study to calibrate the size of informal economy (Elgin and Oztunali 2012; Ihrig and Moe 2004). Third, a computable DGE model only captures some of the stylized facts of the informal sector. Data availability, especially for EMDEs, presents a challenge to matching DGE models with all aspects of informality.

Here we use a deterministic DGE model proposed by Elgin and Oztunali (2012) to estimate the size of the informal sector. The model captures the essence of labor allocation between the formal and informal sectors and provides a mapping between the formal and informal economies in a dynamic setting. The model relies on two key equilibrium conditions for calibration and data construction processes (see Annex for model details). The two key equilibrium conditions are one that connects the formal and informal economies through labor allocation, and another that captures intertemporal substitution. The model results in estimates of informal output in percent of official GDP for 158 economies (36 advanced economies and 122 EMDEs) over the period 1950-2018.

The DGE estimates reflect the levels of both employment and productivity in the informal sector and stand out in their broad country and long year coverage. The time variation of the DGE estimates is sufficient for time-series analysis, including the business cycle analysis in the following sections. But the time variation of the DGE estimates relies partially on strong assumptions. For instance, in Elgin and Oztunali (2012), the growth

rate of productivity in the informal sector is assumed to be a function of the growth rates of capital and productivity in the formal sector.[11]

3.2 Survey-based (direct) estimates

Four existing informality measures are labor-related, of which three are related to employment and one to pension coverage. These measures are gathered mainly from labor force surveys but sometimes from household surveys.

Labor force surveys. Labor force survey-related measures have the advantages of not relying on strong assumptions, having no need for base-year estimates for calibration, and having sufficient time variation for time-series analysis. But they also have several limitations: the data are costly to gather, contributing to limited country and year coverage; survey methodologies may vary over time and across countries, limiting the comparability of the data; there are the typical drawbacks of survey-based data (such as sample bias); and employment measures cannot reflect other changes in the informal sector, such as in productivity and the number of working hours.

Despite the limitations, survey-based labor-related measures can provide useful guidance for the construction and use of indirect informality measures. Among all labor-related measures, self-employment stands out in its year and country coverage and sufficient time variation, making it suitable for time-series analysis and cross-country comparisons.[12] For labor-related questions, such as employment creation and destruction in the informal sector or social security issues, labor-related measures are typically preferred.

The most frequently used measure is the share of self-employment in total employment (labeled *SEMP* here; La Porta and Shleifer 2014; Maloney 2004). As defined by the 1993 International Classification of Status in Employment, self-employed workers include four sub-categories of jobs, as classified in the World Bank's World Development Indicators (WDI) and by the International Labour Organization (ILO): employers, own-account workers, members of producers cooperatives, and contributing family workers.[13] Self-employed workers are those who, working on their own account (own-account workers or employers) or with one or a few partners or in a cooperative, hold "self-employment jobs"

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[11] In the case of Elgin and Oztunali (2012), the heavy reliance of DGE estimates on assumptions and base-year estimates on the informal economy for calibration could be reduced by using other sources of information on the informal economy (for instance, survey-based estimates of informal employment).

[12] ILO also produces model-based estimates which it uses to construct an internationally comparable data set on the share of self-employment in total employment (https://www.ilo.org/ilostat-files/Documents/TEM.pdf). Such model-based estimates largely rely on collected survey-based estimates but still could be sensitive to model specifications. Over the period 1990-2018, the pairwise correlation between survey-based estimates on self-employment shares and model-based estimates is 0.95. For the purpose of this study, survey-based estimates of self-employment shares are preferred.

[13] Self-employment largely overlaps with informal employment, but not all self-employed workers are in informal employment. For example, the owner of a formally registered firm is both self-employed and formally employed. Whereas contributing family workers are always classified as informal, workers who hold other types of "self-employment jobs" are classified as informal employment when their production units are informal sector enterprises or households. See 17th ICLS guidelines for details (https://www.ilo.org/public/libdoc/ilo/2013/480862.pdf).

as defined above. These are jobs where the remuneration is directly dependent upon the profits derived from the goods and services produced.

Two other measures are informal employment and employment outside the formal sector.[14] These are usually expressed in percent of total employment (or non-agricultural employment) and refer to different aspects of informality.[15] Whereas employment outside the formal sector is an enterprise-based concept that includes persons employed by informal sector enterprises or in households, informal employment is a job-based concept and has a broader definition. Informal employment comprises all workers in the informal sector and informal workers outside the informal sector. Almost all persons employed in the informal sector are in informal employment. But not all informal employment is in the informal sector. For example, informal employment includes internships in the formal sector without contracts or pension contributions.

For a comprehensive dataset on labor-related measures on informality, cross-country databases, provided by the WDI, ILO and OECD, are combined, with additional data gathered from various sources (see Annex for detailed information on methodologies). The resulting dataset on self-employment is a panel of 180 economies or regions over the period 1955-2018. The dataset on informal employment covers 72 EMDEs from various years during 2000-2018 whereas the dataset on employment outside the formal sector contains 76 EMDEs from various years during 1999-2018. Data on informal employment and on employment outside the formal sector are obtained from the ILO.

Data on pension coverage are gathered from various issues of the WDI (book version, reported until 2012). The measure is defined as the fraction of the labor force that contributes to a retirement pension scheme (Loayza, Servén, and Sugawara 2010). It yields a panel that covers 135 economies from 1990 to 2010. The measure is suitable for analyzing social security issues related to the informal economy.

Firm opinion surveys. Two datasets based on surveys of firms have outstanding coverage and data quality: the World Bank's Enterprise Surveys, and the Executive Opinion Surveys conducted by the World Economic Forum. The World Bank Enterprise Surveys cover 140 economies over the period 2006-2018 whereas Executive Opinion Surveys cover 154 economies over the period 2008-2018.[16]

Both surveys are answered by top managers and business owners, who can be expected to be familiar with the business climate in the country concerned. The surveys could

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[14] ILO presents detailed definitions of these two measures (ILO 2021a, b). Here, the harmonized series of these two measures, which allow for cross-country comparisons, are preferred, despite some remaining limitations (ILO 2021c).

[15] ILO reports these two measures both in percent of total employment and in percent of non-agricultural employment. Due to space limitations, the analysis here focuses on these two measures in percent of total employment, which are comparable with the self-employment measure.

[16] Due to survey design changes, the data collected by the Executive Opinion Surveys over the period 2004-2007 are not comparable with those for subsequent years. The World Bank also conducts Productivity and Investment Climate Surveys at the firm level. Although these surveys occasionally report measures of informality, they are obtained from various sources and use different methodologies.

reveal some dimensions of informality (for example, regarding the ease of doing business in the informal sector) that are not captured in the output or labor-related measures of informality. Similar to labor-related measures, measures from firm surveys also have the advantages of being independent of strong assumptions and base-year estimates for calibration.

There are two particular drawbacks of informality measures based on firm surveys. First, data from firm surveys tend to have limited year coverage. Second, since perceptions tend not to move much over time, these types of measures do not have much time variation. Both drawbacks limit their application in time-series analysis. Nonetheless, they shed light on the perceived extent of informality in a country and can provide useful guidance for constructing and validating indirect model estimates.

World Bank Enterprise Surveys compile responses on various topics (including informality) from face-to-face interviews with top managers and business owners in over 161,000 companies in 144 economies. The surveys yield the following measures of informality that have been used in the literature (La Porta and Shleifer 2014; World Bank 2019): percent of firms competing against unregistered or informal firms (*WB1*), percent of firms formally registered when they started operations in the country (*WB2*), (average) number of years firms operating without formal registration (*WB3*), and percent of firms identifying practices of competitors in the informal sector as a major constraint (*WB4*). Higher values of *WB1*, *WB3* and *WB4* and a lower value of *WB2* indicate higher levels of informality. *WB1* and *WB4* also provide some insights into informal firms' competitiveness whereas *WB2* and *WB3* are considered indicative of constraints imposed by registration requirements.

In comparison to Enterprise Surveys, Executive Opinion Surveys provide a more balanced panel dataset, making them more suitable for business cycle analysis. The World Economic Forum (*WEF*) has been conducting Executive Opinion Surveys every year since 1979. As reported in the 2014 edition, over 13,000 executives in 144 economies were surveyed. From 2006, the survey has asked the question, "In your country, how much economic activity do you estimate to be undeclared or unregistered? (1 = Most economic activity is undeclared or unregistered; 7 = Most economic activity is declared or registered)." The average responses at the country-year level constitute a series of informality measures with a lower average indicating a relatively larger informal economy.

Household surveys. Household surveys may report perceptions of the extent of informality in an economy or opinions on informal economic activities. The World Values Survey (*WVS*) stand out in terms of their extensive country and year coverage; others household surveys mainly focus on European economies.[17] The WVS asked whether respondents considered it justifiable to cheat on taxes, with the data averaged for five periods from 1981-1984 to 2010-2014. The responses could range from 1 (never justifiable) to 10 (always

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[17] These surveys, which include the Eurobarometer Survey, European Values Survey, and the European Social Survey, are not used in this study because of their limited coverage of EMDEs. Details about other social surveys are shown in annex (Tables A1 and A3).

justifiable). In total, 317,750 respondents from 96 economies participated in the survey. The average responses at the country and year level are used as a measure for attitudes towards informality. A higher average at the country level implies that people find cheating on taxes more justifiable and thus consider informal activity more acceptable. It is regarded as an indirect measure of informality as a lack of tax morality is associated with a higher level of informality (Oviedo, Thomas, and Karakurum-Özdemir 2009).

3.3 Comparison of statistical features across measures

For any economy, the various measures of informality will differ somewhat, both in the level of informality implied and in its variation over time. In general, MIMIC estimates indicate lower and less volatile informal sector activity than DGE estimates. This partly reflects the differences in the assumed underlying drivers of informality in the two approaches: MIMIC is based on slow-moving variables such as ones relating to institutional quality whereas DGE is based on more volatile variables such as employment, investment and productivity. In EMDEs, the share of informal activity in GDP (by either measure) tends to be well below the share of self-employment in total employment, which may reflect lower labor productivity in the informal economy than the formal economy or some self-employed workers contributing to the formal economy (Loayza 2018).[18] Survey-based measures tend to be stable over decades, potentially reflecting a profound rigidity in perceptions.

4. Size and evolution of the informal economy

This section distills the empirical findings on the main features of the informal economy and its evolution over time. The informal economy is more prevalent in EMDEs than in advanced economies but is widely heterogeneous across countries and regions. Both output and employment measures of informality have trended downward since 1990. In contrast, survey-based measures relating to perceptions have tended to be highly stable, making them more appropriate for cross-country comparisons than for over-time analyses.

Size of the informal economy. Globally, the informal economy accounted for 32-33 percent of GDP and 31 percent of employment over the period 1990-2018 (Table 1b). As shown in previous studies, a higher level of development, as measured by per capita income, is associated with lower informality, virtually regardless of the measure of informality, other than survey-based ones, or the year chosen (La Porta and Shleifer 2014). Thus, informality tends to be considerably more pervasive in EMDEs than in advanced economies: in advanced economies, it accounts for about 19 percent of GDP and 16 percent of employment, on average, whereas in EMDEs it accounts for 36-37 percent of GDP and 39 percent of employment.

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[18] In this section and below, self-employment is used to proxy for informal employment as in La Porta and Shleifer (2014), unless otherwise specified. In the following sections, "in percent of GDP or output" is used as the equivalent of "in percent of official GDP" in the context of the share of informal output (both DGE-based and MIMIC-based estimates), and "in percent of employment" is used as the equivalent of "in percent of total employment."

There is wide heterogeneity in informal activity among EMDEs. For example, the informal economy's share in GDP, while depending on the measure used, ranged from around 10 percent to 68 percent, and the share of self-employment in total employment ranged from near-zero to 96 percent. In addition, informality is common in all EMDE regions but takes different forms (World Bank 2012). On average, the informal economy's share of output is highest in SSA, Europe and Central Asia (ECA), and Latin America and the Caribbean (LAC). The share of self-employment, however, is highest in SSA, South Asia (SAR), and East Asia and the Pacific (EAP; Figure 2).

Evolution of the informal economy. The shares of both informal output and employment have declined since 1990, especially in EMDEs (Figure 3). Between 1990 and 2018, on average, the share of informal output in GDP fell by about 8 percentage points in EMDEs, to 31 percent, and by 3 percentage points in the advanced economies, to 17 percent. Over the same period, the average share of self-employment in total employment declined by about 3 percentage points in the advanced economies, to 14 percent, and by about 10 percentage points in EMDEs, to 36 percent. In EMDEs, the largest declines in the shares of informal output and employment occurred from the early-2000s, in a reversal of a decade of a rising share of informal employment and barely shrinking share of informal output.[19] In advanced economies, the largest declines in the share of informal employment occurred between the late 1990s and the global financial crisis of 2008-09; they have since partly reversed, amid anemic post-crisis growth.

The declines in informality between 1990 and 2018 were broad-based, especially for output- and employment-based measures. Country-specific regressions of the shares of the informal economy in GDP and employment on a time trend were estimated to capture this secular decline. In 69 (*SEMP*)-100 (*DGE*) percent of advanced economies (depending on the measure) and 54 (*SEMP*)-81 (*MIMIC*) percent of EMDEs, statistically significant downward trends in the share of the informal economy in GDP (or employment) were found. The trend decline in the share of informal output suggests that economic growth may be associated with more rapidly rising labor productivity in the formal economy than in the informal economy. As economies grow, formal-sector productivity growth may benefit from greater technological improvements and availability of capital than can be accessed by the informal sector (Amaral and Quintin 2006). In only a few cases did output and employment informality move in different directions. Noticeable drops in the share of informal output were associated with only moderate falls in the share of informal employment in some EMDEs, and even with increases in the share of informal employment in others.[20]

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[19] The persistence of high levels of informality in EMDEs in the early 1990s in part reflects the expanding informal sector in Eastern and Central European economies during their economic transition (Kaufmann and Kaliberda 1996). By construction, slow-moving indicators for institutional quality in MIMIC estimates dampen these estimates' movements over time.

[20] Vorisek et al. (2021) present a detailed discussion of the decline in informality across EMDE regions.

Perceptions of informality appear to have changed much more slowly than actual informal output and employment.[21] In the majority of advanced economies and EMDEs, perceptions of the scale of informality— as measured by the *WEF* and *WVS* indices— have not declined significantly since 1990. There are, however, a few exceptions. This often coincided with rapid GDP growth and reductions in the shares of both informal output and employment.

5. Consistency among the various measures of informality

The various measures of informality refer to three distinct aspects of it: output (DGE and MIMIC estimates), employment (for example, self-employment and workers without pensions), and perception (for example, the WEF and WVS surveys). While the common trends and correlates with economic development illustrated above suggest a considerable degree of commonality among some of these aspects, they also move slightly differently from time to time. This section explores the consistency among the various measures of informality.

We illustrate this by examining correlations among various informality measures (both levels and first-differenced measures).[22] First, we check whether various measures are consistent with each other in terms of capturing an economy's level of informality, or at least its position in cross-country rankings. Since the informality measures have different units and definitions, Spearman rank correlation, which checks the statistical dependence between the rankings of two data series, is preferred here. The median rank correlations between different variables across countries within a single year are shown in Table 2. Second, we investigate whether various measures share the same movements over time. To do so, the share of country-pairs in which first differences in two measures have the same sign are calculated and reported in Table 3.

Consistency in levels. The various measures for informality are generally positively correlated with each other, with the correlations within each block (output, employment, perception) being stronger than correlations between blocks (Table 2). The cross-country rank correlation between the two model-based estimates of informal output is close to 1 and significantly different from zero at the 1 percent level. In addition, the rank correlations between DGE estimates and both employment measures and some perception measures are also positive and significant. The correlations among the various measures of informal employment range from 0.20 to 0.94 and are mostly significant at the 10

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[21] Guiso, Sapienza, and Zingales (2009) demonstrate that perceptions of trustworthiness are largely historically determined with limited time-variance.

[22] Various additional correlations are calculated (e.g. both pairwise and rank correlations for a panel setting, cross-country within a specific year, and cross-year within a certain country, and with a longer time period). The results are largely in line with Table 2 and will be provided upon request. We also conduct a simple factor analysis using measures with sufficient coverage (i.e. *DGE, MIMIC, SEMP*, and *WEF*). The results show that these measures share a common factor, which explains 65-97 percent of the variation of the measures (97 percent for *DGE*, 97 percent for *MIMIC*, 65 percent for *SEMP*, and 69 percent for *WEF*).

percent level. On average, the correlation between an estimate of informal output and employment-based measures is above 0.60 and significant at the 1 percent level.

Perception-based estimates of informality tend to be more correlated with each other than with estimates of informal output or employment. The *WVS* is an exception: it tends to be uncorrelated or little correlated with all other measures, including perception-based ones. This suggests that a large informal sector reflects more than citizens' weak tax morality, which *WVS* purports to capture. Among the perception-based measures, the *WEF*, which purports to capture perceptions of the extent of informal economic activities, is the one most correlated with the other measures, both output-based (about 0.70) and employment-based (about 0.50.7 with the share of labor force without pension and self-employment as a share of total employment).

Consistency in changes over time. To examine the consistency of movements over time among various measures, the coincidence of the directions of movements in different variables is checked by looking at the shares of country-pairs in which first differences in two measures have the same sign (Table 3).[23] This is the case in about 50 percent of all the country pairs—and highest, at 82 percent of country-year pairs, for informal employment and employment outside the formal sector. The directions of changes in output measures and employment measures coincide in 55-65 percent of country-year pairs, suggesting that output measures capture important additional factors to employment measures, such as changes in labor productivity or intensity of work.

6. Cyclical features of the informal economy

Like formal economies, informal economies feature business cycles, which share some features with those in the formal economy: they are stronger in EMDEs than in advanced economies, and they feature downturns and recoveries with similar speeds. That said, they are not fully synchronized with business cycles in the formal economy. This section distills the main cyclical features of the informal economy.[24]

6.1 Volatility of formal and informal economies

Formal and informal output and employment are significantly more volatile in EMDEs than in advanced economies, possibly reflecting larger shocks, or lesser resilience to shocks, in EMDEs (Table 4; Aguiar and Gopinath 2007; Neumeyer and Perri 2005; Restrepo-Echavarria 2014).[25] In addition, in both EMDEs and advanced economies, self-employment is somewhat more volatile than formal employment (that is total

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[23] As a robustness check, the pairwise correlations of first-differenced informality measures over time for each country are calculated, with their medians computed across countries. The results are in line with Table 3. Whereas significant and positive correlations are observed among pension coverage, informal employment, and employment outside the formal sector, no significant correlations between informal employment (or perception) measures and informal output measures are found.

[24] Elgin et al. (2021) use the same set of informality measures to explore the links between formal and informal business cycles in greater detail and their implications for macroeconomic.

[25] Detailed results on the volatility of formal and informal economies are presented in Table 4.

employment excluding self-employment), perhaps reflecting greater rigidity in the formal labor market (Djankov and Ramalho 2009).

The business cycles of formal and informal economies are not entirely synchronous (as shown in Elgin et al. 2021). Employment growth in the informal sector is slightly, but statistically significantly, negatively correlated with employment growth in the formal sector.[26] As a result, formal and informal employment alone are each more volatile than total employment (the sum of formal and informal employment).[27]

6.2 Informal-economy business cycles

Dating informal business cycles. Formal and informal business cycles were identified using the commonly used algorithm of Harding and Pagan (2002). Business cycle turning points are years in which output peaks or troughs. When there are several peaks or troughs within a five-year interval, the deepest trough or steepest peak was used. A recession is defined as the period from peak to trough, whereas an expansion is the converse, the period from trough to peak. A recovery, the early part of an expansion, is defined as the period during which output rebounds from the trough to its pre-recession peak. The main characteristics of the recession and recovery phases, including duration, amplitude, and slope, are defined as in Claessens, Kose, and Terrones (2012; Annex). To remove the trend in employment, employment levels was logged and detrended using Hodrick–Prescott filter.

The results are in line with earlier studies (Bajada 2003; Birinci and Elgin 2013) of informal business cycle recessions and expansions in advanced economies. In contrast to these studies, however, the main focus here is on recessions and recoveries. Since recoveries are the early parts of expansions, they reflect more of an economy's short-term cyclical movements rather than its long-term growth path.

Output movements through informal-economy business cycles. Neither recessions nor recoveries in the informal economy differ statistically significantly from those in the formal economy (Tables 5a and 5b). The duration of both formal- and informal-economy recoveries was slightly longer than formal- and informal-economy recessions in EMDEs but not in advanced economies.[28] The speed of recessions resembled that of recoveries in both formal and informal economies. As for formal economies, informal-economy recessions were steeper and informal economy recoveries were stronger in EMDEs than in advanced economies. As a result, output and employment in EMDEs tended to be more volatile than in advanced economies—a feature well documented in the literature (Aguiar and Gopinath 2007). One of the reasons could be the tendency for fiscal policy

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[26] The pairwise correlation between employment growth in the informal sector and employment growth in the formal sector equals -0.2.

[27] This supports earlier findings that the informal sector may help stabilize total employment over business cycles (Fernández and Meza 2015; Loayza and Rigolini 2011).

[28] The differences in durations of recessions and recoveries are not significant for EMDEs when using MIMIC-based estimates.

to be procyclical in EMDEs, exacerbating the underlying business cycle (Frankel, Végh, Vuletin 2013).

Recessions. The average DGE-based informal economy recession lasted 1.5 years, with a GDP contraction, on average, of 3.5 percent per year, 5.2 percent from peak to trough, and 5.7 percent cumulatively—broadly in line with formal economy recessions.[29] Both formal-economy and informal-economy recessions were significantly shallower in advanced economies than in EMDEs.

Recoveries. On average, output in both formal and informal economies took about 2 years to return to their pre-recession peaks, expanding by 2-6 percent in the first year and by 2-5 percent per year during the entire recovery phase.[30] Like formal economy recoveries, informal-economy recoveries were significantly shallower in advanced economies than in EMDEs.

Informal employment during informal-economy business cycles. Informal employment, proxied by self-employment, in both advanced economies and EMDEs was broadly stable in informal recessions as well as recoveries. This finding applies to both formal and informal economy business cycles (Table 6a). This may be because wage movements or changes in work intensity (measured as number of hours worked per day) bore the brunt of the adjustment in labor markets during business cycles (Guriev, Speciale, and Tuccio 2019; Meghir, Narita, and Robin 2015).

Formal and total employment during formal-economy business cycles. Total and formal employment in advanced economies behaved significantly differently from in EMDEs during formal economy recessions and recoveries (Table 6b). Both total and formal employment contracted significantly (by 2.5 and 2.7 percent, respectively) in advanced economies during formal economy recessions, while neither total nor formal employment fell significantly in EMDEs. Employment changes during formal-economy recoveries were insignificant in both advanced economies and EMDEs. The lack of significant responses in employment during formal economy recoveries suggests delayed responses in the labor market and the emergence of "jobless" recoveries in recent decades (Farbar 2012; Hall 2005; Shimer 2010 and 2012).

7. Conclusion

Using a comprehensive database of model-based and survey-based estimates of informal economic activity, we compile a rich set of measures available for cross-country analysis and a more limited set of measures available for time-series or panel analysis. Among all

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[29] The recessions of MIMIC-based informal output are slightly shallower and more prolonged than those of formal output and DGE-based informal output (Tables 5a and 5b). The slightly shallower recessions of MIMIC-based informal output could be due to the slow-moving institutional measures embedded in MIMIC's estimation methods (for example, government effectiveness).

[30] MIMIC-based informal recoveries were significantly shorter, occurred less frequently, and were less pronounced than DGE-based informal recoveries and formal recoveries.

the measures, DGE-based estimates and survey-based estimates of self-employment stand out in their cross-country and time coverage. In contrast, survey-based measures of perceptions tend to be highly stable over time and, therefore, are mainly useful for cross-country comparisons. Lastly, for cross-country analyses of narrowly-defined questions, measures from labor, firm, and household surveys may be more suitable, especially when surveys are done consistently over time.

We illustrate two applications of our database here. First, using the widest possible range of measures, the paper illustrates the broad-based and steady decline in the shares of informal output and employment since 1990. Three somewhat distinct aspects of informality are identified: output, employment, and perceptions. Cross-country rankings of informal output or employment are typically consistent with each other while varying over time.

Second, we document that informal economies experience business cycles just as formal economies do. Like formal-economy output cycles, informal-economy output cycles tend to be shallower in advanced economies than in EMDEs. Informal employment tends to behave acyclically in EMDEs and advanced economies, being largely invariant to both output recessions and recoveries. In contrast to distinct cyclical movements in informal output, perceptions of the scale of informality shown by surveys are highly persistent.

Several possible areas for further research are worth noting. First, the limitations of existing measures of informality remain, despite the richness of the database compiled here. More work is needed to improve the quality of informality series and to explore new approaches to better capture the extent of informality in EMDEs. Second, the paper distills the main features of informal economy business cycles. It does not look into the factors and policies that could affect informal economy business cycles. Further analysis in this direction would be valuable.

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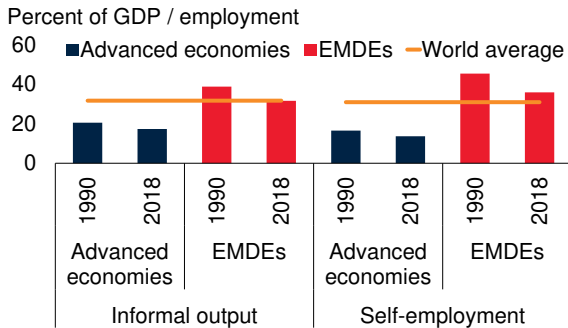
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Figure 1. Informality: Magnitude, variety, and development challenges

A. Shares of informal output and self-employment

Percent of GDP / employment

Advanced economies — EMDEs — World average

Informal output | Self-employment

B. Informal output and development

DGE-based informal activity (percent of GDP)

Advanced economies
EMDEs

Ln (GDP per capita)
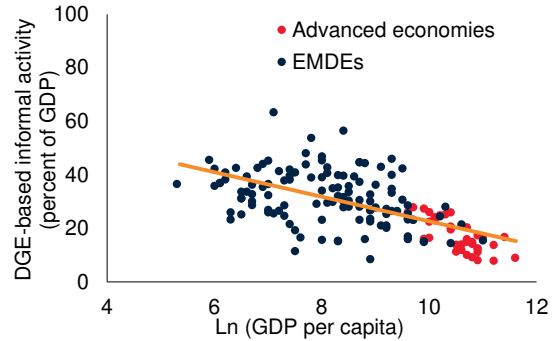
C. Informal output, poverty, and income inequality

Percent of population | Gini coefficient

Poverty headcount | Income inequality (RHS)
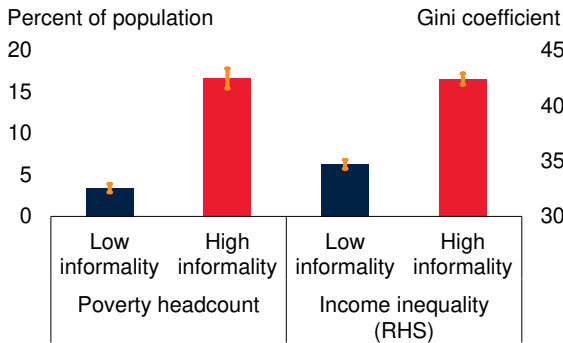
D. Governance in EMDEs, by output informality

Index (0 = worst, 4/6 = best)

High informality — Low informality

Bureaucracy quality | Control of corruption | Law and order
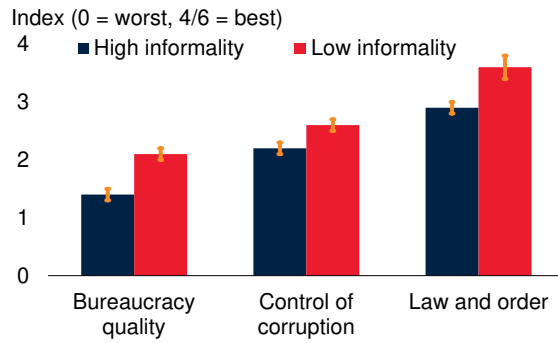
Sources: International Country Risk Guide (ICRG); International Labour Organization; World Bank (World Development Indicators, WDI; World Governance Indicators, WGI).

Note: "High informality" ("Low informality") indicates economies with above- (below-) median informal output (using DGE-based estimates). DGE = dynamic general equilibrium model-based estimates of informal output in percent of official GDP; EMDEs = emerging market and developing economies.

A. Unweighted averages. Informal employment uses self-employment shares (in percent of total employment). Missing values are interpolated or filled using the latest available observations. World averages between 1990-2018 are in orange.

B. Latest available year (2018). Orange line shows fitted values. "Ln (GDP per capita)" is the logarithm of GDP per capita (in constant 2010 U.S. dollars).

C. Data are for 1990-2018. Group means (bars) and 90 percent confidence intervals (whiskers) are shown for poverty headcount ratio (percent of population living on $1.90 a day at 2011 PPP) and Gini coefficients.

D. Data for 1990-2018 and EMDEs. Bars show unweighted averages of ICRG data; whiskers show 90 percent confidence intervals.

Figure 2. Informality in EMDE regions

A. DGE-based informal activity

Percent of GDP

B. MIMIC-based informal activity

Percent of GDP
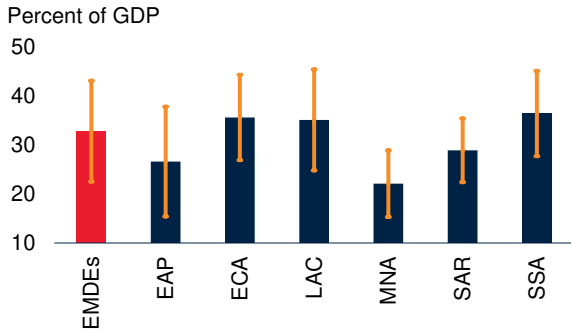
C. Self-employment
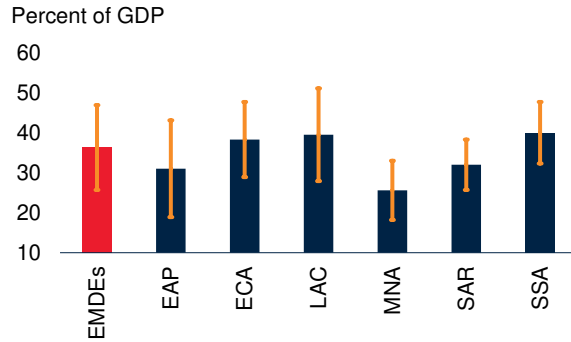
Percent of employment

D. Labor force without pension

Percent of labor force

E. Perceived informal activity

Average response: 1=low, 7=high
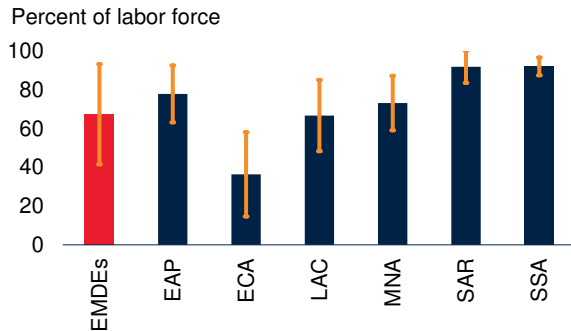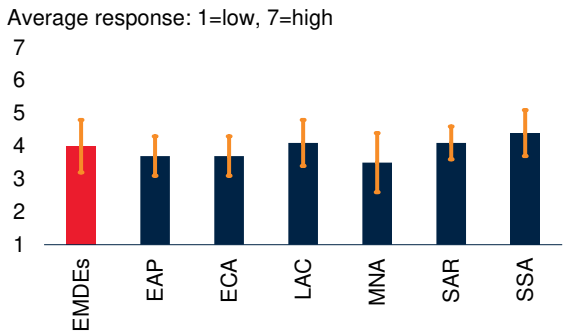
F. Shares of EMDE regions in world output and employment

Percent
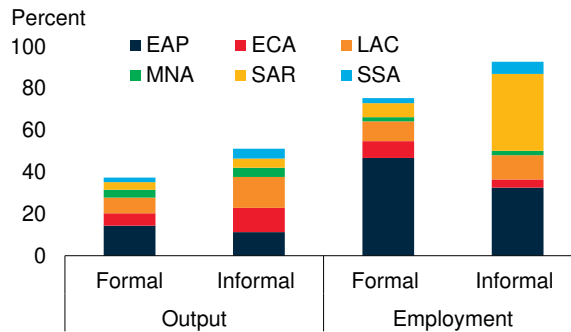
Sources: International Labour Organization; World Bank (World Development Indicators); World Economic Forum.

Note: Blue and red bars indicate group means for 2010-18 (2006-2016 for D), with whiskers indicating +/-1 standard deviation. DGE = dynamic general equilibrium model-based estimates on informal output; EAP = East Asia and Pacific; ECA = Europe and Central Asia; EMDEs = emerging market and developing economies; LAC = Latin America and the Caribbean; MIMIC = multiple indicators multiple causes model-based estimates on informal output; MNA = Middle East and North Africa; SAR = South Asia; SSA = Sub-Saharan Africa.

C. Self-employment shares (in percent of total employment) is used here.

E. Perceived informal activity is proxied by World Economic Forum Index, which ranges from "1= Most economic activity is undeclared or unregistered" to "7 = Most economic activity is declared or registered". See Table 1a for details on data definitions.

F. The stacked bars show the formal and informal output (employment) in each EMDE region as a share of the world's total formal or informal output (employment) using data averaged from 2010-18. Formal output is proxied by official GDP, while DGE-based estimates are used to capture the level of informal output. Informal employment is proxied by self-employment, while formal employment is the difference between total employment and self-employment.

Figure 3. Evolution of informality, 1990-2018

A. DGE-based informal activity

Percent of GDP — Percent of GDP

— Advanced economies — EMDEs (RHS)

B. MIMIC-based informal activity

Percent of GDP — Percent of GDP

— Advanced economies — EMDEs (RHS)

C. Self-employment

Percent of employment — Percent of employment

— Advanced economies — EMDEs (RHS)

D. Perceived informal activity

Average response: 1 = low, 7 = high

— Advanced economies — EMDEs

E. Advanced economies with downward trends in informality

Percent of advanced economies

— 50 percent

F. EMDEs with downward trends in informality

Percent of EMDEs

— 50 percent

Source: World Bank; World Economic Forum.

Note: See Table 1a for details on data definitions. DGE = dynamic general equilibrium model; EMDEs = emerging market and developing economies; MIMIC = multiple indicators multiple causes model; SEMP = self-employment in percent of total employment; WEF = World Economic Forum index of informality.

A-D. Group means are calculated for advanced economies (in blue) and EMDEs (in red).

C. Informal employment is proxied by self-employment in percent of total employment. Missing data for self-employment are interpolated in EMDEs for earlier years and filled using the latest available observation in recent years.

D. WEF (World Economic Forum) index of informality is used, which ranges from "1= Most economic activity is undeclared or unregistered" to "7 = Most economic activity is declared or registered".

E-F. Data for the period 1990-2018. Based on country-specific linear regressions of the share of informality by each of the four measures of informality with a sufficiently long-time dimension. Figures show the share of advanced economies (E) and EMDEs (F) for which the time trend is statistically significantly negative (at least at 10 percent level). In F, missing values for self-employment are interpolated. Red line indicates 50 percent.

Table 1a. Summary statistics

Estimation method	Aspect		Measures	# of obs	# of ctry	Time period	Mean	Median	Min	Max
Indirect	Output (a)		DGE (% of GDP)	4,540	158	1990-2018	31.8	31.6	8.0	67.7
			MIMIC (% of GDP)	4,150	160	1993-2018	33.3	33.5	8.1	69.3
Direct (Survey-based)	Labor force Surveys	Employment	Pension coverage (% of labor force)	359	135	1990-2010	44.4	36.0	1.1	99.0
			Self-employment (% of total employment)	2,711	179	1990-2018	31.0	25.8	0.0	95.5
			Informal employment (% of total employment)	369	72	2000-2018	64.7	67.9	18.9	99.7
			Employment outside the formal sector (% of total employment)	386	76	1999-2018	55.4	56.4	9.8	95.7
	Firm surveys	Perception — Firms (a)	WEF (1-7=Most informal)	1,548	154	2008-2018	3.7	3.8	1.4	6.6
			WB: % firms competing against informal firms	248	140	2006-2018	55.7	57.4	7.2	95.2
			WB: % firms formally registered when founded	233	138	2006-2018	89.0	91.3	29.1	100.0
			WB: Number of years operated without registration	233	138	2006-2018	0.7	0.5	0.0	6.8
			WB: % firms that found competitors in the informal sector as a constraint	249	139	2006-2018	30.0	29.2	0.0	76.0
	HS	(b)	WVS: Justifiable (Cheating on taxes)	200	94	1994-2010	2.3	2.1	1.0	4.7

Sources: World Bank; World Bank (Enterprise Surveys); World Economic Forum; World Values Survey.

Notes: Data for the period 1990-2018. DGE is benchmarked to Schneider et al. (2010). World Value Survey (WVS) asks whether cheating on taxes is justifiable (1 is "never justifiable" and 10 is "always justifiable") and reports average responses at the country-year level, with a higher level suggesting that the country is more tolerant towards the informal sector. World Economic Forum (WEF) asks "In your country, how much economic activity do you estimate to be undeclared or unregistered? (1= Most economic activity is undeclared or unregistered; 7= Most economic activity is declared or registered)" and reports average responses at the country-year level. Here the average responses have been reordered to make "7= Most economic activity is undeclared or unregistered; 1= Most economic activity is declared or registered" where a higher level suggesting a larger informal sector in the country. WB shows the results for World Bank Enterprise Surveys. HS stands for "Household surveys", (a) stands for "Output", and (b) stands for "Opinions/Tax Morality". Detailed information is listed in Table A1. Since the data on self-employment for Equatorial Guinea is only for year 1983, the data on self-employment are available for 179 countries (instead of 180 economies) here.

Table 1b. Summary statistics by country groupings

	World		AEs		EMDEs	
	Mean	Median	Mean	Median	Mean	Median
Output						
DGE (% of GDP)	31.8	31.6	18.7	17.2	35.7	36.0
MIMIC (% of GDP)	33.3	33.5	19.3	18.2	37.3	36.8
Employment						
Pension coverage (% of labor force)	44.4	36.0	86.5	90.0	30.5	24.0
Self-employment (% of total employment)	31.0	25.8	15.7	13.9	39.4	37.1
Informal employment (% of total employment)	64.7	67.9			64.7	67.9
Employment outside the formal sector (% of total employment)	55.4	56.4			55.4	56.4
Perception						
WEF (1-7=Most informal)	3.7	3.8	2.7	2.6	4.1	4.2
WB: % firms competing against informal firms	55.7	57.4	35.8	35.0	57.0	59.7
WB: % firms formally registered when founded	89.0	91.3	98.1	98.4	88.4	91.0
WB: Number of years operated without registration	0.8	0.5	0.2	0.1	0.8	0.6
WB: % firms that found competitors in the informal sector as a constraint	30.0	29.2	18.1	17.7	30.7	29.9
WVS: Justifiable (Cheating on taxes)	2.3	2.1	2.2	2.1	2.3	2.1

Sources: World Bank; World Bank (Enterprise Surveys); World Economic Forum; World Values Survey.
Notes: Data for the period 1990-2018. AEs = advanced economies; DGE = dynamic general equilibrium model-based estimates of informal output in percent of official GDP; EMDEs = emerging market and developing economies; MIMIC = multiple indicators multiple causes model-based estimates on informal output in percent of GDP. World Values Survey (WVS) asks whether cheating on taxes is justifiable (1 is "never justifiable" and 10 is "always justifiable") and reports average responses at the country-year level, with a higher level suggesting that the country is more tolerant toward the informal sector. World Economic Forum (WEF) asks, "In your country, how much economic activity do you estimate to be undeclared or unregistered? (1= Most economic activity is undeclared or unregistered; 7 = Most economic activity is declared or registered)" and reports average responses at the country-year level. Here, the average responses have been reordered to make "7= Most economic activity is undeclared or unregistered; 1 = Most economic activity is declared or registered" where a higher level suggesting a larger informal sector in the country. WB shows the results for World Bank Enterprise Surveys. Detailed information is listed in Table 1a. Country groupings follow the method used by World Bank (2020)

Table 2. Spearman rank correlations (across countries within individual years)

	DGE	MIMIC	PENSION	SEMP	IF_EMP	EMP_NF	WEF	WB1	WB2	WB3	WB4	WVS
Output												
DGE (% of GDP)	1											
MIMIC (% of GDP)	0.98***	1										
Employment												
Pension coverage (% of labor force)	-0.60***	-0.60***	1									
Self-employment (% of total employment)	0.64***	0.62***	-0.86***	1								
Informal employment (% of total employment)	0.27*	0.31**	-0.86***	0.83***	1							
Employment outside the formal sector (% of total employment)	0.20	0.25	-0.60	0.77***	0.94***	1						
Perception												
WEF (1-7=Most informal)	0.67***	0.70***	-0.47***	0.68***	0.54***	0.50***	1					
WB: % firms competing against informal firms	0.40***	0.40***	-0.07	0.33***	0.38*	0.36	0.56***	1				
WB: % firms formally registered when founded	-0.28**	-0.29**	0.67***	-0.54***	-0.53***	-0.57***	-0.54***	-0.60***	1			
WB: Number of years operated without registration	0.28**	0.28**	-0.30	0.40***	0.23	0.31*	0.41***	0.38***	-0.72***	1		
WB: % firms that found competitors in the informal sector as a constraint	0.40***	0.33***	0.08	0.19*	0.28	0.32*	0.51***	0.77***	-0.36***	0.26*	1	
WVS: Justifiable (Cheating on taxes)	0.20	0.27*	0.31*	-0.21	-0.2	-0.26	0.11	-0.21	0.33	-0.12	-0.21	1

Sources: World Bank; World Bank (Enterprise Surveys); World Economic Forum; World Values Survey.

Note: Data for the period 1990-2018. Medians of rank correlation of data across countries within each year. All survey-based measures are interpolated. DGE = dynamic general equilibrium model-based estimates of informal output in percent of official GDP; MIMIC = multiple indicators multiple causes model-based estimates on informal output in percent of GDP. PENSION = pension coverage in percent of labor force. SEMP=self-employment in percent of total employment. IF_EMP = informal employment in percent of total employment. EMP_NF = employment outside the formal sector in percent of total employment. World Values Survey (WVS) asks whether cheating on taxes is justifiable (1 is "never justifiable" and 10 is "always justifiable") and reports average responses at the country-year level, with a higher level suggesting that the country is more tolerant toward the informal sector. World Economic Forum (WEF) asks, "In your country, how much economic activity do you estimate to be undeclared or unregistered? (1= Most economic activity is undeclared or unregistered; 7 = Most economic activity is declared or registered)" and reports average responses at the country-year level. Here, the average responses have been reordered to make "7 = Most economic activity is undeclared or unregistered; 1 = Most economic activity is declared or registered" where a higher level suggesting a larger informal sector in the country. "WB" here stands for "World Bank. Enterprise Surveys." Detailed information is listed in Table 1a. "***" implies significance at 1% level, "**" implies significance at 5% level, "*" implies significance at 10% level.

Table 3. Coincidence of signs of first-differences

	DGE	MIMIC	w/o PENSION	SEMP	INF_EMP	EMP_NF	WEF	WVS
DGE (% of GDP)	100							
MIMIC (% of GDP)	56.9	100						
Labor force without pension (% of labor force)	53.2	53.5	100					
Self-employment (% of total employment)	59.1	58.1	50.0	100				
Informal employment (% of total employment)	61.9	59.4	51.4	61.3	100			
Employment outside the formal sector (% of total employment)	64.5	57.8	55.0	63.7	82.4	100		
WEF (1-7=Most informal)	50.3	56.2	50.0	50.3	57.9	54.5	100	
WVS: Justifiable (Cheat on taxes)	57.8	55.9	42.3	55.1	47.4	50.0	51.1	100

Source: World Bank.
Note: Data for the period 1990-2018. Shares of country-year pairs in which the first difference in the two measures has the same sign (opposite for PENSION) are shown. Survey-based estimates are interpolated to fill the gaps in data series. DGE is benchmarked to Schneider et al. (2010). World Value Survey (WVS) asks whether cheating on taxes is justifiable (1 is "never justifiable" and 10 is "always justifiable") and reports average responses at the country-year level, with a higher level suggesting that the country is more tolerant towards the informal sector. World Economic Forum (WEF) asks "In your country, how much economic activity do you estimate to be undeclared or unregistered? (1= Most economic activity is undeclared or unregistered; 7= Most economic activity is declared or registered)" and reports average responses at the country-year level. Here the average responses have been reordered to make "7= Most economic activity is undeclared or unregistered; 1= Most economic activity is declared or registered" where a higher level suggesting a larger informal sector in the country. WB shows the results for World Bank Enterprise Surveys. Detailed information is listed in Table 1a.

Table 4. Volatility of formal and informal economies

	Output		
	[1]	**[2]**	**[3]**
	Formal output	**DGE-based informal output**	**MIMIC-based informal output**
World	6.42	5.83***	5.04***
AEs	3.82^	3.89^	2.42^***
EMDEs	6.92	6.27***	5.55***
	Employment		
	[4]	**[5]**	**[6]**
	Total employment	**Formal employment**	**Self-employment**
World	3.46	5.16***	6.69***
AEs	2.05^	2.34^***	4.88^***
EMDEs	3.84	5.90***	7.31***

Source: World Bank.
Note: Data are for the period 1990-2018. Formal output is captured by official GDP, while informal output uses DGE-based or MIMIC-based estimates. Total employment is the sum of formal employment and self-employment. Volatility shows the standard deviations (SDs) of the concerning variables' annual growth rates. "***" implies significant differences at 1 percent level in the SDs of the annual growth rates of formal output and those of informal output in row [1]-[3] (in the SDs of the annual growth rates of total employment and those of formal/self-employment in row [4]-[6]). The shaded areas indicate that the SDs of the annual growth rates of DGE-based informal output (formal employment) significantly differ from those of MIMIC-based informal output (self-employment). "^" indicates significant differences at 5 percent level between advanced economies (AEs) and emerging markets and developing economies (EMDEs).

Table 5a Cyclical features of recessions in formal and informal economy

Formal Output

	# of observations	Duration (years)	Amplitude (%)	Cumulative loss (%)	Slope (%)
World	307	1.5 [1.0]	-5.6 [-3.1]	-6.5 [-1.8]	-3.7 [-2.2]
AEs	72	1.5 [1.0]	-4.0* [-2.4]**	-4.0 [-1.4]*	-2.6** [-2.0]
EMDEs	235	1.5 [1.0]	-6.0 [-3.1]	-7.3 [-2.0]	-4.0 [-2.4]

DGE-based Informal Output

	# of observations	Duration (years)	Amplitude (%)	Cumulative loss (%)	Slope (%)
World	336	1.5 [1.0]	-5.2 [-2.9]	-5.7 [-1.8]	-3.5 [-2.2]
AEs	87	1.6 [1.0]**	-4.2 [-2.7]	-4.8 [-1.6]	-2.7** [-2.0]
EMDEs	249	1.5 [1.0]	-5.6 [-3.2]	-6.1 [-1.9]	-3.8 [-2.2]

MIMIC-based Informal Output

	# of observations	Duration (years)	Amplitude (%)	Cumulative loss (%)	Slope (%)
World	155	1.4 [1.0]	-4.2 [-2.1]	-5.6 [-1.1]	-2.7 [-1.7]
AEs	44	1.6 [1.0]	-2.7* [-0.7]**	-3.1 [-0.4]***	-1.5*** [-0.7]***
EMDEs	111	1.4 [1.0]	-4.7 [-2.4]	-6.4 [-1.3]	-3.1 [-2.0]

Source: World Bank.
Note: Data for recession episodes starting and ending in the period 1990-2018. Business cycle turning points determined based on formal and informal GDP levels (i.e. official GDP statistics for formal output, DGE and MIMIC estimates for informal output) using the algorithm of Harding and Pagan (2002). Recession is defined as the phase from peak to trough while its corresponding "Duration", "Amplitude", "Cumulative loss" and "Slope" are defined as in Claessens et al. (2012). All statistics correspond to sample means. Medians are in brackets. Asterisks refer to the significant differences in means (or medians) between advanced economies (AEs) and emerging markets and developing economies (EMDEs). "***" implies significance at 1% level, "**" implies significance at 5% level, "*" implies significance at 10% level. Differences between informal and formal economies that are significant at 10 percent level are highlighted in shaded gray.

Table 5b Cyclical features of recoveries in formal and informal economy

Formal Output

	# of observations	Duration (years)	Amplitude (%)	Slope (%)
World	194	2.1 [1.5]	5.4 [3.3]	4.6 [2.1]
AEs	37	1.7 [2.0]	2.7** [2.3]**	2.0* [1.1]**
EMDEs	157	2.1 [1.6]	6.1 [3.6]	5.2 [2.4]

DGE-based Informal Output

	# of observations	Duration (years)	Amplitude (%)	Slope (%)
World	236	2.0 [2.0]	4.1 [3.1]	3.6 [2.2]
AEs	58	1.9 [2.0]	2.4*** [1.8]***	2.2** [1.5]***
EMDEs	178	2.1 [2.0]	4.7 [3.7]	4.0 [2.5]

MIMIC-based Informal Output

	# of observations	Duration (years)	Amplitude (%)	Slope (%)
World	87	1.6 [1.0]	3.5 [3.0]	2.3 [2.1]
AEs	22	1.5 [1.0]	1.9*** [1.7]***	1.4* [0.6]***
EMDEs	65	1.7 [1.0]	4.1 [3.4]	2.6 [2.1]

Source: World Bank.
Note: Data for recovery episodes starting and ending in 1990-2018. Business cycle turning points determined based on formal and informal GDP levels (i.e. official GDP statistics for formal output, DGE and MIMIC estimates for informal output) using the algorithm of Harding and Pagan (2002). Recovery is defined as the time it takes for output to rebound from the trough to the peak level before the recession while its corresponding "Duration", "Amplitude", and "Slope" are defined as in Claessens et al. (2012). All statistics correspond to sample means. Medians are in brackets. Asterisks refer to the significant differences in means (or medians) between advanced economies (AEs) and emerging markets and developing economies (EMDEs). "***" implies significance at 1% level, "**" implies significance at 5% level, "*" implies significance at 10% level. Differences between informal and formal economies that are significant at 10 percent level are highlighted in shaded gray.

Table 6a Informal employment during formal and informal business cycles

	Formal output		DGE-based informal output		MIMIC-based informal output	
	Recession	Recovery	Recession	Recovery	Recession	Recovery
World	0.5	0.6	0.2	-0.4	-0.7	0.9
	[1.1]	[0.3]	[0.7]	[0.2]	[0.5]	[0.1]
AEs	-0.7	-0.4	-0.6	-0.4	-1.3	-0.3
	[-0.2]**	[0.03]	[-0.3]*	[-0.1]	[-1.1]**	[0.4]
EMDEs	1.3	1.1	0.8	-0.4	-0.3	1.5
	[2.1]	[0.9]	[1.2]	[0.2]	[1.4]	[-0.9]

Source: World Bank.
Note: Data for the period 1990-2018. MIMIC = multiple indicators multiple causes model; DGE= dynamic general equilibrium model. Business cycle turning points determined based on formal and informal GDP levels (that is, official GDP statistics for formal output, DGE and MIMIC estimates for informal output) using the algorithm of Harding and Pagan (2002). Recession is defined as the phase from peak to trough while recovery is defined as the time it takes for output to rebound from the trough to the peak level before the recession (Claessens, Kose, and Terrones 2012). Expansion is defined as the period from trough to next peak (Claessens, Kose, and Terrones 2012). All statistics correspond to the sample means of the overall percentage changes in self-employment over the corresponding business cycle phases. Medians are in brackets. EMDEs with poor statistical capacity and three outliers (Democratic Republic of Congo, Gabon, and Zimbabwe) were dropped. Shaded cells represent numbers that significantly differ from zero. Asterisks refer to the significant differences in means (or medians) between advanced economies (AEs) and emerging market and developing economies (EMDEs). ***, **, * denote significance at the 1, 5, and 10 percent significance levels.

Table 6b Formal and total employment during formal business cycles

	Total employment		Formal employment	
	Recession	Recovery	Recession	Recovery
World	-0.6	1.3	-1.0	1.5
	[-0.3]	[0.6]	[-1.0]	[0.6]
AEs	-2.5***	-0.4**	-2.7***	-0.3**
	[-1.4]***	[-0.5]***	[-1.6]	[-0.3]***
EMDEs	0.7	2.1	0.1	2.5
	[1.2]	[1.6]	[-0.0]	[2.1]

Source: World Bank.
Note: Data for the period 1990-2018. Formal employment is proxied by total employment excluding self-employment. Business cycle turning points determined based on official GDP statistics for formal output using the algorithm of Harding and Pagan (2002). Recession is defined as the phase from peak to trough while recovery is defined as the time it takes for output to rebound from the trough to the peak level before the recession (Claessens, Kose, and Terrones 2012). All statistics correspond to the sample means of the overall percentage changes in total (formal) employment over the corresponding business cycle phases. EMDEs with poor statistical capacity and three outliers (Democratic Republic of Congo, Gabon, and Zimbabwe) were dropped. Medians are in brackets. Shaded cells represent numbers that significantly differ from zero. Asterisks refer to the significant differences in means (or medians) between advanced economies (AEs) and emerging market and developing economies (EMDEs). ***, **, * denote significance at the 1, 5, and 10 percent significance levels.

Annex

The following section describes the methodologies that are employed to estimate measures of informality. Detailed data description is presented in Table A1.

The multiple indicators multiple causes model (MIMIC model)

To estimate the size of the informal sector in percent of official GDP with the MIMIC model, this study closely follows Schneider, Buehn, and Montenegro (2010) and includes six causes and three indicators used in their study.[31] The six cause variables used are: 1) size of government (general government final consumption expenditure as a percent of GDP, from UN spliced with WDI); 2) share of direct taxation (direct taxes in percent of overall taxation, WDI); 3) fiscal freedom index from Heritage Foundation; 4) business freedom index from Heritage Foundation; 5) the unemployment rate and GDP per capita to capture the state of the economy (WDI, the latter is spliced with WEO); and 6) government effectiveness (Worldwide Governance Indicators). The three indicator variables include: 1) growth rate of GDP per capita (WDI, spliced with WEO); 2) the labor force participation rate (people over 15 economically active in percent of population, WDI, spliced with Haver Analytics), and 3) currency as a ratio of M0 (currency outside the banks) over M1 (IMF IFS and Haver Analytics).

The estimation results are shown in Table A2. The model specification that ensures maximum data coverage (i.e. Column (5)) is used to generate the MIMIC index of the share of informal output relative to official GDP ($\tilde{\eta}_t$). Then we conduct an additional benchmarking procedure where $\tilde{\eta}_t$t is converted into absolute values of the informal sector ($\hat{\eta}_t$) using the following equation:[32]

$$\hat{\eta}_t = \frac{\tilde{\eta}t}{\tilde{\eta}_{2000}} \eta^*_{2000}, \qquad (1)$$

where t denotes year, $\tilde{\eta}_{2000}$ is the value of the estimated index in the base year 2000, and η^*_{2000} is the exogenous estimate (base value) of the shadow economies in 2000. While the estimates ($\tilde{\eta}_t$) determine the movement of the absolute values of the informal sector over time, the base values η^*_{2000} decide the rankings of the countries' informal sector within the sample in year 2000. The base values η^*_{2000} are taken from Schneider (2007) or, for another 10 countries, from Schneider et al. (2010).

The dynamic general equilibrium model (DGE)

In the model, an infinitely-lived representative household is endowed with K_0 units of productive capital and a total of $H_t > 0$ units of time. The household has access to two productive technologies, denoted formal and informal, and maximizes its lifetime utility by solving the following optimization problem:

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[31] MIMIC is a type of Structural Equation Model (SEM). The estimation of a SEM with latent variables can be done by means of LISREL (used by Schneider, Buehn, and Montenegro 2010), SPSS, and Stata. Here, Stata is used.

[32] Calibration is performed separately for each country. Following Schneider et al. (2010), the MIMIC index has been adjusted to the positive range by adding a positive constant.

$$\max_{\{C_t, I_t, K_{t+1}, N_{It}, N_{Ft}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t U(C_t)$$

$$\text{s.t.} \quad C_t + I_t = (1 - \tau_t)A_{Ft}K_t^{\alpha}N_{Ft}^{1-\alpha} + A_{It}N_{It}^{\gamma} \quad (2)$$

$$K_{t+1} = I_t + (1 - \delta)K_t \quad (3)$$

$$N_{It} + N_{Ft} = H_t \quad (4)$$

$\beta < 1$ is a discount factor and the instantaneous utility function U(.) is strictly increasing and strictly concave. Eq(2) defines the household s resource feasibility constraint: the sum of consumption C_t and investment I_t should equal the amount produced using the formal and informal technologies. The right-hand side of Eq(2) shows that the formal technology (A_{Ft}) follows a standard Cobb-Douglas specification and is exclusive to the formal sector. K_t is the household s capital stock while N_{Ft} is the number of hours the household devotes to the formal sector. τ_t captures the tax rate imposed on formal output. Informal output depends on the number of hours the household devotes to the informal sector, N_{It} , and its technology, A_{It}.[33]

The rest of the household s problem is standard: Eq(3) specifies the law of motion for capital, where $\delta \in [0; 1]$ is the depreciation rate. Eq(4) is the household s time constraint. In this simple model, the government s policy τ_t is assumed to be exogenously given and the tax revenue is assumed to be used to finance an exogenous stream of government spending, G_t. Then, given the government policy variable tax burden $\{\tau_t\}$, a competitive equilibrium of the two-sector model is a set of sequences $\{C_t, I_t, K_{t+1}, N_{It}, N_{Ft}, G_t\}_{t=0}^{\infty}$ that maximize expected utility from consumption (i.e. $\sum_{t=0}^{\infty} \beta^t U(C_t)$).

The model provides a reasonable mapping between the formal economy and informal economy in a dynamic setting. The two key equilibrium conditions are the equilibrium condition that connects the formal and informal economy through labor allocation, and the equilibrium condition that captures the intertemporal substitution. Our calibration and data construction rely on these two conditions to estimate the ratio, $\frac{Y_{It}}{Y_{Ft}}$, which can be further expressed as $\frac{A_{It}N_{It}^{\gamma}}{A_{Ft}K_t^{\alpha}N_{Ft}^{1-\alpha}}$.

The calibration follows Elgin and Oztunali (2012) and takes parameter values suggested by the earlier literature (e.g. Ihrig and Moe 2004).[34] α is assumed to be equal to 0.36, and γ takes the value of 0.425. Data are gathered from PWT 9.0 for capital stock (K_t), private consumption (C_t), formal employment (N_{Ft}), depreciation rates (δ, country averages), and tax rates (τ_t). By matching the productivity in the informal sector to the informal economy size in 2007 of the series reported in Schneider et al. (2010) and assuming that

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[33] The model also assumes no cost for hiding income, that the government cannot enforce payment of taxes, and the household will attempt to hide any income received from the informal sector.

[34] Elgin and Oztunali (2012) are not using the model to do a full calibration exercise, where each equilibrium condition is satisfied for every period. Since only two of the equilibrium conditions are utilized, stationarity of empirical data for calibration is a lesser concern. Their approach is followed here.

A_{It} grows at the average growth rate of K_t and A_{Ft},[35] the DGE estimates are computed for 158 countries over the period 1950-2018.

The estimation results are qualitatively robust to different model specifications such as using alternative values for δ, α, γ, adding labor-leisure choice, tax enforcement parameter to informal sector income (for example, using revenue in percent of GDP rather than government spending in percent of GDP for τ_t), see Elgin and Oztunali (2012) for details.

Labor-related measures of Informality

Several cross-country databases report the survey-based estimates on the share of self-employment in total employment:[36] 1) the 2016 World Development Indicators (World Bank 2016), which cover 175 economies from 1980 (mainly from 1990s) to 2014; 2) the International Labour Organization (2016), which covers 109 economies from 1997 to 2014; and 3) OECD (updated in 2016, 2018, and 2020), which covers 34 OECD countries from 1955 to 2018. When regarding employment outside the formal sector and informal employment, ILO compiled statistics for up to 76 middle- and low-income countries for 1999-2018.

For a comprehensive dataset on labor-related measures on informality, we combine the cross-country databases, provided by WDI, ILO, and OECD, and gather additional data from the national statistical bureaus (offices), Haver Analytics, the disclosed Living Standards Measurement Studies (LSMS, World Bank), and spliced data from IADB and Eurostat to fill some gaps in years. Data priority is first given to cross-country databases (World Bank, ILO, and OECD) and then national statistical bureaus (offices), Haver Analytics, and LSMS, followed by estimates obtained from previous studies, IADB and Eurostat. IADB reports the share of self-employment in total employment (15-64 years old) for 19 Latin American economies between 1990 and 2018, while Eurostat reports the same measure for 29 EU economies and 5 non-EU economies for the period 19832018. By focusing on employment of the 15-64 years old groups, their data are systematically lower than those from other cross-country databases. The final step adds 105 more observations to the sample (3 percent of the full sample).

The national statistical bureaus (offices) that provided data or were contacted are: Angola, Argentina, Azerbaijan, The Bahamas, Bahrain, Belarus, Belize, Benin, Bhutan, Bosnia and Herzegovina, Botswana, Brunei Darussalam, Bulgaria, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Central African Republic, Chad, China, Comoros, Croatia, Cyprus, Democratic Republic of Congo, Republic of Congo, Arab Republic of Egypt, Equatorial Guinea, Eritrea, Ethiopia, Fiji, Gabon, The Gambia, Georgia, Ghana, Guinea, Guinea-Bissau, Guyana, Haiti, Islamic Republic of Iran, Jamaica, Jordan, Kenya, Kuwait, Kyrgyz Republic, Lao People's Democratic Republic, Latvia, Lebanon, Libya, Lithuania, Malawi, Maldives, Malta, Mauritania, Moldova, Morocco, Mozambique,

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[35] This assumption implies that growth in the formal sector can spillover to the informal sector via capital accumulation and technological diffusion.

[36] Both ILO and WDI only report model-based estimates from 2018 onward, which may suffer from caveats such as strong economic assumptions and reliance on other studies' independent estimates to do the benchmarking. Due to the issues related with model-based estimates, historical WDI and ILO reports are collected to obtain survey-based estimates. The model-based estimates from ILO and WDI were used to update the share of self-employment when no other source of information is available.

Myanmar, Nepal, Niger, Nigeria, North Macedonia, Oman, Papua New Guinea, Qatar, Romania, Rwanda, Saudi Arabia, Senegal, Sierra Leone, Singapore, Solomon Islands, Sudan, Suriname, Swaziland, Syrian Arab Republic, Tajikistan, Tanzania, Togo, Trinidad and Tobago, Tunisia, United Arab Emirates, República Bolivariana de Venezuela, Vietnam, and Republic of Yemen.

Dating informal business cycles

Identifying turning points. Following Claessens, Kose, and Terrones (2012), Berge and Jorda (2011), and Harding and Pagan (2002), the Bry and Boschan (1971)'s algorithm is applied to date the business cycles of formal and informal sectors. Peaks (troughs) are defined as occurring at time t whenever $\{\Delta y_t > (<)0, \Delta y_{t+1} < (>)0\}$. As the censoring rule, if there are additional peaks/troughs within a 5-year period around a peak, the one with the deepest contraction/expansion is picked. When calculating characteristics of business cycles, the closest peaks (troughs) before troughs (peaks) are used when there are several peaks (troughs) in a row.

Characteristics of business cycle phases. The main characteristics of the recession and recovery phases, including duration, amplitude, and slope, are defined as in Claessens, Kose, and Terrones (2012):

- The *duration* captures, for a recession, the period from peak to trough and, for a recovery, the period it takes for output to return to its pre-trough peak.

- The *amplitude* of a recession measures the change in output from a peak to the next trough. The amplitude of a recovery measures the change in output during the first year of an expansion, which is the period between a trough and its following peak.

- The *slope* measures the speed of a given cyclical phase. It is defined as the ratio of amplitude over duration for a recession phase and the ratio of the change from the trough to the last peak divided by the duration for a recovery phase.

For recessions only, another widely used measure, cumulative loss, is calculated. It captures the overall cost of a recession. The cumulative loss is defined as the difference between the sum of annual changes in output and half of the amplitude during a recession.

Table A1. Summary of Data Coverage

Data	Method	Sources	Measure	# of Ctry	Period	Setup
MIMIC-based informal output	Indirect estimates (MIMIC)	Author's calculations	Size of the informal sector as a percentage of official GDP estimated using the model of Schneider, Buehn, and Montenegro (2010)	160	1993-2018	Balanced panel
DGE-based informal output	Indirect estimates (DGE)	Author's calculations	Size of the informal economy as a percentage of official GDP estimated using the approach of Elgin and Oztunali (2012).	158	1950-2018	Balanced panel
Share of self-employment	Labor force survey and household survey	WDI, ILO, OECD, National Statistical Offices, Eurostat, IADB, Haver Analytics, and LSMS.	The share of self-employment in total employment (survey-based estimates).	180	1955-2018	Unbalanced panel
Share of informal employment	Labor force survey and household survey	ILO	The share of informal employment in percent of total employment (harmonized)	72	2000-2018	Repeated cross-sections
Share of employment outside the formal sector	Labor force survey and household survey	ILO	The share of employment outside the formal sector in percent of total employment (harmonized)	76	1999-2018	Unbalanced panel
Pension coverage	Labor force survey and household survey	WDI	The fraction of the labor force that contributes to a retirement pension scheme	135	1990-2010	Unbalanced panel
World Bank Enterprises Survey	Firm survey	World Bank Enterprise Survey	Four measures on informality: percent of firms competing against unregistered or informal firms, percent of firms formally registered when they started operations in the country, (average) number of years a firm operated without formal registration, and percent of firms identifying practices of competitors in the informal sector as a major constraint.	140	2006-2018	Repeated cross-sections
World Economic Forum (Executive Opinion Survey)	Firm survey	World Economic Forum	The extent of informal economy based on the question: "In your country, how much economic activity do you estimate to be undeclared or unregistered? (1 = Most economic activity is undeclared or unregistered; 7 = Most economic activity is declared or registered)"	154	2008-2018	Balanced panel dataset
Informal Market Index (Heritage Foundation)	Firm survey	Heritage Foundation	The subjective perceptions of general compliance with the law, with particular emphasis on the role played by official corruption. The index ranges from 1 to 5 with higher values indicating more informal market activity.	165	1995-2005	Balanced panel dataset
Non-observed activities (% of GDP)	National account approach	UN (2008)	Non-observed activities (% of GDP)	44	Various years	Cross-sectional data
The Eurobarometer Survey: Indirect measure of the informal economy	Household surveys and social opinion surveys	The Eurobarometer Survey	Interviewers ask respondents whether he/she has purchased goods or serviced embodied undeclared work or supplied labor in the informal economy. The survey also includes information on whether the respondents receive all or part of their regular salary or the remuneration for extra work or overtime hours as cash-in-hand and without declaring it to tax or social security authorities. Finally, the survey shows whether respondents find informal economic activities acceptable.	27	2007 and 2013	Repeated cross-sections
World Values Survey: Tax morale	Household surveys and social opinion surveys	World Values Survey	Interviewers ask whether respondents can justify cheating on taxes. Detailed descriptions are reported in Table A3.	94	81-84, 94-98, 99-04, 05-09, 10-14	Repeated cross-sections
European Values Survey: Tax morale	Household surveys and social opinion surveys	European Values Survey	Interviewers ask whether it is justifiable for the respondents or their compatriots to cheat on taxes or pay cash to avoid taxes.	16-47	1981, 1990, 1999, and 2008	Repeated cross-sections
European Social Survey: Indirect measure of the informal economy	Household surveys and social opinion surveys	European Social Survey	Interviewers ask whether respondents paid cash for goods or services with no receipt so as to avoid VAT or taxes over the past five years and whether respondents have a written employment contract.	24	Every two years from 2004-2014	Repeated cross-sections

Table A2. MIMIC Model Estimation Results (1993-2018)

	[1]	[2]	[3]	[4]	[5]
	88 Developing Countries	98 Developing Countries	120 Countries	151 Countries	161 Countries
Size of government	0.134***	0.144***	0.149***	0.161***	0.152***
	(0.024)	(0.020)	(0.022)	(0.018)	(0.018)
Share of direct taxation	0.016		0.013		
	(0.025)		(0.020)		
Business Freedom	0.047**	0.029	0.050**		
	(0.022)	(0.018)	(0.022)		
Fiscal Freedom	0.008	-0.018	-0.038		
	(0.024)	(0.019)	(0.023)		
Unemployment rate	0.077***	0.104***	0.059***	0.073***	0.071***
	(0.024)	(0.019)	(0.021)	(0.018)	(0.018)
GDP per capita	-0.311***	-0.239***	-0.348***	-0.327***	-0.334***
	(0.034)	(0.026)	(0.029)	(0.021)	(0.021)
Government effectiveness			-0.070***	-0.059***	-0.060***
			(0.019)	(0.017)	(0.017)
Growth rate of GDP per capita	-0.679***	-0.738***	-0.421***	-0.312***	-0.298***
	(0.119)	(0.105)	(0.079)	(0.060)	(0.060)
Labor force participation rate	-0.297***	-0.222***		-0.194***	-0.166***
	(0.089)	(0.084)		(0.053)	(0.052)
Growth rate of labor force			-0.100		
			(0.066)		
Currency (M0/M1)	1.000	1.000	1.000	1.000	1.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Statistical tests					
RMSEA	0.066	0.054	0.073	0.081	0.082
p(RMSEA<=0.05)	0.027	0.268	0.000	0.000	0.000
Chi^2 (p)	77.975	61.510	147.337	147.305	154.978
	(0.00)	(0.000)	(0.000)	(0.000)	(0.000)
AIC	30360.170	37812.139	46480.999	48963.901	50399.970
BIC	30437.337	37888.618	46568.955	49040.351	50476.798
CFI	0.755	0.827	0.733	0.781	0.773
TLI	0.572	0.689	0.543	0.589	0.574
SRMR	0.034	0.029	0.043	0.042	0.043
CD	0.602	0.930	0.975	1	1
Observations	1,267	1,742	1,803	2,646	2,724

Note: Absolute z-statistics in parentheses. ***, **, * denote significance at the 1, 5, and 10% significance levels. All variables are used as their standardized deviations from the mean. Data sources for variables used in the model are listed in Section II footnote 6. Following the MIMIC models' identification rule, the currency (M0/M1) variable is fixed to an a priori value. The currency variable shows the level of money(cash) in circulation. "AIC" stands for "Akaike's information criterion" and "BIC" stands for "Bayesian information criterion. "RMSEA" stands for "Root Mean Square Error of Approximation". "TLI" stands for "Tucker Lewis Index", "CFI" stands for "Comparative Fit Index", "SRMR" stands for "Standardized Root Mean Square Residual", and "CD" shows the coefficient of determination. These are goodness-of-fit statistics.

Table A3. World Value Survey, European Value Surveys and European Social Surveys

Survey	Coverage
World Value Survey (WVS)	Questions: "Justifiable: cheating on taxes". 1 is "never justifiable" and 10 is "always justifiable"
WVS 1981-1984	9 countries/regions: Argentina, Australia, Finland, Japan, South Korea, Mexico, South Africa, Sweden, and United States
WVS 1989-1993	16 countries/regions: Argentina, Brazil, Belarus, Chile, China, India, Japan, South Korea, Mexico, Nigeria, Poland, Russia, South Africa, Spain, Switzerland, Turkey.
WVS 1994-1999	52 countries/regions: Albania, Azerbaijan, Argentina, Australia, Bangladesh, Armenia, Bulgaria, Belarus, Chile, China, Taiwan, Colombia, Croatia, Czech Rep., Dominican Rep. , El Salvador, Estonia, Finland, Georgia, Hungary, India, Japan, South Korea, Latvia, Lithuania, Mexico, Moldova, Montenegro, New Zealand, Nigeria, Norway, Peru, Philippines, Poland, Puerto Rico, Romania, Russia, Serbia, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Ukraine, Macedonia, United States, Uruguay, Venezuela, West Germany, East Germany, Bosnia.
WVS 2000-2004	37 countries/regions: Albania, Algeria, Argentina, Bangladesh, Bosnia, Canada, Chile, China, India, Indonesia, Iran, Japan, Jordan, South Korea, Kyrgyzstan, Mexico, Moldova, Montenegro, Morocco, Nigeria, Pakistan, Peru, Philippines, Puerto Rico, Serbia, Singapore, Viet Nam, South Africa, Zimbabwe, Spain, Uganda, Macedonia, Egypt, Tanzania, United States, Venezuela.
WVS 2005-2009	56 countries/regions: Andorra, Argentina, Australia, Brazil, Bulgaria, Canada, Chile, China, Taiwan, Colombia, Cyprus, Ethiopia, Finland, France, Georgia, Germany, Ghana, Guatemala, Hong, Kong, Hungary, India, Indonesia, Iran, Italy, Japan, Jordan, South, Korea, Malaysia, Mali, Mexico, Moldova, Morocco, Netherlands, New, Zealand, Norway, Poland, Romania, Russia, Rwanda, Viet, Nam, Slovenia, South, Africa, Spain, Sweden, Switzerland, Thailand, Trinidad, and, Tobago, Turkey, Ukraine, Egypt, United, Kingdom, United, States, Burkina, Faso, Uruguay, Serbia, and, Montenegro, Zambia.
WVS 2010-2014	57 countries/regions: Algeria, Azerbaijan, Argentina, Australia, Armenia, Brazil, Belarus, Chile, China, Taiwan, Colombia, Cyprus, Ecuador, Estonia, Georgia, Palestine, Ghana, Hong, Kong, India, Iraq, Japan, Kazakhstan, Jordan, South, Korea, Kuwait, Kyrgyzstan, Lebanon, Libya, Malaysia, Mexico, Morocco, Netherlands, New, Zealand, Nigeria, Pakistan, Peru, Philippines, Poland, Romania, Russia, Rwanda, Singapore, Slovenia, South, Africa, Zimbabwe, Spain, Sweden, Thailand, Trinidad, and, Tobago, Tunisia, Turkey, Ukraine, Egypt, United, States, Uruguay, Uzbekistan, Yemen.