Informality, tax policy and the business cycle: Exploring the links

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Abstract

Despite the worldwide prevalence of informality, consensus on a reliable and consistent set of drivers and consequences of this phenomenon has been elusive to both researchers and policymakers. This study partly addresses this shortcoming by exploring the interactions between the informal economy and tax policy and how these are shaped by business cycle fluctuations. To this end, we identify robust determinants of both informality and taxation by means of an econometric analysis that accounts for bi-directional causality. Focusing on two different dimensions of informal activity and three tax policy instruments and employing numerous determinants over dozens of model combinations, we find that the significance of the relationship between informality and taxation depends on the specific tax instrument under consideration. Thus, the informal economy may particularly affect the design of direct taxes. Also, the business cycle may have distinctive influences on informality and tax policy, so direct taxes appear to be acyclical or countercyclical while indirect taxes are strongly procyclical. We conclude by noting that how the business cycle affects the informal economy and taxation allows to substantiate evidence on the role of informality in the adoption of potentially destabilizing fiscal policies.

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Informalidad, ciclos económicos y política fiscal: una exploración de los nexos*

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Abstract

Este estudio explora las interacciones entre la economía informal y la política tributaria y cómo estas son afectadas por las fluctuaciones del ciclo económico. Para ello, se identifican determinantes robustos tanto de la informalidad como de la tributación por medio de un análisis econométrico que considera causalidad bidireccional. Enfocado en dos dimensiones diferentes de la actividad informal y en tres instrumentos de política tributaria y empleando numerosos determinantes a través de docenas de combinaciones de modelos, se encuentra que la significancia de la relación entre informalidad y tributación depende del instrumento impositivo específico bajo análisis. Así, la economía informal puede afectar el diseño de impuestos directos. También, el ciclo económico puede afectar particularmente la informalidad y la política tributaria, de modo que los impuestos directos parecen ser acíclicos o contracíclicos mientras que los impuestos indirectos son fuertemente procíclicos. Se concluye notanto que la manera en que el ciclo económico influye sobre la economía informal y la tributación permite explicar cierta evidencia acerca del rol de la informalidad en la adopción de políticas fiscales potencialmente desestabilizadoras.

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1 Introduction

This paper aims to explore the interactions between informality and tax policy and how these are shaped by business cycle fluctuations. To this end, we identify robust determinants of these two phenomena by means of an econometric analysis that accounts for bi-directional causality. Focusing on two different dimensions of the informal economy and three tax policy rates and employing numerous determinants over dozens of model combinations, we find that the significance of the relationship between informality and taxation depends on the specific tax instrument under consideration. Also, explanatory factors, but especially the business cycle, may have distinctive influences on alternative measures of the informal economy and tax policy.

Informal economic activity is a fact of life around the world.[1] Recent estimates suggest that the informal economy comprises more than half of the global labor force (International Labor Organization, 2020) and around one third of GDP worldwide (Medina and Schneider, 2018). Even though informality is highly prevalent and poses considerable economic and social challenges, many issues about its nature and consequences remain largely underexplored and unresolved. Despite the existence of a substantial body of research studying this phenomenon in the past few decades, consensus on a set of consistent measures, determinants and effects has failed to emerge (Elgin and Erturk, 2019). This lack of consensus generates problems for the design of effective policies to curb the expansion of the informal sector.

In this regard, one of the factors affecting informality that has received more attention in the literature is taxation (Schneider and Enste, 2000; Elgin and Erturk, 2019). At the same time, recent studies have shown that tax policy is mostly procyclical in developing countries and acyclical in industrial nations (Vegh and Vuletin, 2015; Aizenman et al., 2019). And, while there is no consensus on what drives such differences in tax policy cyclicality, empirical evidence points out that the existence of large informal economies might influence the conduct of fiscal policy in developing countries (Eng and Wong, 2008; Çiçek and Elgin, 2011).

Another factor has to do with the cyclical behavior of informality. In this

[1] The informal economy—often called unofficial, shadow, hidden, black, parallel, second or underground economy (or sector)—is defined by Hart (2008) as a set of economic activities that take place outside the sphere of bureaucratic and institutional public and private sector establishments. Individuals operating in the informal economy usually do not pay taxes and social security contributions, nor do they comply with government regulations (including labor and environmental legislation). Yet this definition excludes unpaid private household production, voluntary non-profit (social) services and criminal activities.

respect, empirical studies suggest that the informal sector tends to adjust countercyclically in the short run, providing resilience to the economy when times are hard (Loayza and Rigolini, 2011; Abdel-Latif et al., 2017). Yet growing informality erodes the tax base at the same time, and thereby complicates the task of policy makers as budget deficits get bigger. Moreover, economic crises make a larger share of people in developing countries resort to the informal sector and cause a sharper deterioration of public finances, thus limiting governments' ability to engage in countercyclical fiscal policies (Colombo et al., 2016, 2019).

The present study aims to contribute to a better understanding of these interactions by identifying robust determinants of both the informal economy and tax policy cyclicality and conducting an econometric analysis that accounts for bi-directional causality. In particular, the estimated model includes separate equations to estimate determinants of informality and taxation, respectively, with the focus being on assessing the influence of one phenomenon and the business cycle on the prevalence of the other. In this regard, we employ qualitatively different measures of the informal economy and tax policy and consider dozens of model variations in the determinants of these two phenomena. The model variations allow evaluating the role of economic fluctuations from various angles, but also of institutional and financial conditions, among other aspects. Finally, to address potential endogeneity issues in determining taxation, we perform an instrumental variable approach in which the identified robust determinants are an important factor.

The structure of the paper is as follows. Section 2 provides motivation and reviews the related literature. Then, an outline of the model and the empirical methods used, as well as the data employed, is presented in Section 3. These are followed by results and discussion in Section 4. Section 5 offers some concluding remarks.

2 Related literature

In the following, we present an overview of several important influences identified in the literature to affect informality and tax policy. Although we cannot claim these influences to be exhaustive, the relationships described are meant to provide some motivation for the exploration conducted in this study.

2.1 Informality and its determinants

The extant literature has examined numerous informality determinants, with many showing mixed degrees of significance (see Schneider and Enste, 2000). However, the relative influence of various factors in driving the informal economy remains unclear.

One of such factors is taxation. Disregarding other determinants, one can conjecture that higher indirect tax rates and higher marginal income tax rates tend to raise the amount of labor and goods bought and sold in the informal sector (Schneider and Enste, 2000). Yet Friedman et al. (2000) argue that higher tax rates have two potentially offsetting effects: the direct effect increases the incentive to hide activity, but the indirect effect—through the provision of a better legal environment—encourages production in the official sector. These authors find in a cross-country analysis that higher tax rates are associated with less unofficial activity as percent of GDP.

One more such factor concerns the cyclical behavior of the informal sector. In this regard, economic theory explains the business cycle properties of the informal economy as the outcome of an income effect and a substitution effect (Bajada, 2003; Elgin, 2012). Thus, while the income effect implies that negative shocks to an economy affect both sides of that economy, and hence lends support to the procyclical behavior of informality, the substitution effect indicates that laid-off formal workers are enticed to go informal in response to these shocks, which legitimizes the countercyclicality notion.

Although, theoretically speaking, it may seem unclear whether the informal economy is procyclical or countercyclical, empirical research suggests that it tends to display a countercyclical adjustment, backing the substitution hypothesis. Abdel-Latif et al. (2017) show that, in most countries, the informal economy appears to comove negatively with GDP over the business cycle, implying that the informal economy may play a buffering role in harsh times. Further, Loayza and Rigolini (2011) find that informal employment acts primarily as a safety net since it behaves countercyclically in the short run.[2]

Among other determinants, some of the most widely examined factors in the literature have to do with institutional quality in a broad sense including corruption control, law enforcement, bureaucratic quality, political stability and democracy. In this regard, some studies argue that entrepreneurs go

[2]Likewise, in regard to financial crises, Colombo et al. (2016) find evidence pointing at the informal sector as a powerful buffer that expands at times of banking disruptions and absorbs a large proportion of the fall in official output. Also, Colombo et al. (2019) show that the informal economy acts countercyclically by taking in workers in bad times (and vice versa), and as a crisis amplifier for the formal economy.

informal to reduce the burden of bureaucracy and corruption.[3] Accordingly, businesses hide their activities 'underground' when faced with onerous bureaucracy, high levels of corruption and a weak legal system (Friedman et al., 2000). Furthermore, the risk of exposure and a relatively transparent legal process in democratic societies are likely to rein the informal sector and other illegal activities (Goel and Nelson, 2016).

Moreover, some authors contend that income inequality, particularly in conjunction with institutional quality, is a crucial factor in determining the scope of informality. In particular, Chong and Gradstein (2007) claim that high inequality, by lowering the relative benefits from becoming formal for the poor, causes a bigger informal sector, more so the weaker the institutions. These authors' empirical findings are consistent with a positive relationship between income inequality and the size of the informal economy as well as the interaction between institutions and inequality in their impact on informality.

Also, the overall state of an economy might have a significant influence on the incentives to operate informally. Thus, informality would likely decline with greater prosperity due to increased opportunity costs of working in the shadows, as prosperity comes with more and better prospects in the formal sector, and strengthened monitoring of unlawful activities in wealthier nations (Schneider and Enste, 2000; Goel and Nelson, 2016).

Finally, it is often claimed that openness to trade leads to a rise in informality as formal establishments may respond to the intensified competition from abroad by laying off workers who subsequently seek employment in the informal economy. Alternatively, trade liberalization may give rise to an expansion of the non-tradable service sector, which is characterized by a larger share of informality (Goldberg and Pavcnik, 2003).

2.2 On informality and tax policy variations in developing countries

Albeit less studied, informality has considerable implications on macroeconomic and fiscal performance. Among these implications, one strand of the optimal taxation literature states that taking the informal economy into ac-

[3]It is worth noting that corruption might be intricately associated with the informal economy in that the two activities might feed off each other. In this sense, the literature on the interdependence between corruption and informality posits how these may be substitutes as the informal economy can serve as an escape from predatory behavior by government officials. Alternatively, entrepreneurs pay bribes in order to be able to hide their operations, supporting a complementarity relationship. Yet corruption and informality share some of the same determinants and empirical evidence to resolve the substitution-complementarity issue is not conclusive (see Goel and Saunoris, 2019).

count can easily explain many of the seemingly perverse policies seen in poorer countries, suggesting that these policies may be sensible ways to deal with the economic pressures these countries face. In particular, Gordon and Li (2009) conclude that, for countries where banks play a limited role in tax enforcement due to prevalence of informality, the optimal tax structure includes capital income taxes (such as the corporate income tax) in order to focus the tax burden on those firms least willing to forego use of the financial sector.

Furthermore, two-sector dynamic frameworks imply that the informal economy should affect the conduct of tax policy. Thus, García Peñalosa and Turnovsky (2005) show that the conventional proposition that tax burdens should be borne more heavily by labor and that capital income should not be taxed are dramatically altered when the government is unable to tax one of the two sectors. Cerda and Saravia (2013) argue that such government's inability makes it optimal to subsidize capital income, and possibly labor, in order to induce firms into production in the formal sector, then making these taxable through a tax on profits and thus completing the tax system. Likewise, Espino and Gonzalez-Rozada (2013) find that capital should be taxed at a relatively high rate in the long run, labor should be subsidized in order to avoid distortions in the labor market and the consumption tax should be used more intensively since it is less distortionary.

As mentioned, empirical evidence points out that informality tends to display a countercyclical behavior. In regard to banking crises, Colombo et al. (2016) and Colombo et al. (2019) notice that this means that, although the existence of an informal sector may add resilience to the economy when times are hard, tax base erosion greatly complicates the task of policy makers at a time of ballooning budget deficits. Moreover, this implies for developing countries that financial crises expose a larger fraction of the population to the adverse effects of informality (i.e. limited ability to manage individual income shocks) and cause a sharper deterioration of public finances, limiting governments' capacity to supply public goods and to engage in stabilizing fiscal policies.

In this sense, there is substantial evidence to suggest that fiscal policy in developing countries has been procyclical, whereas it has been countercyclical or acyclical in industrial nations (Aizenman et al., 2019). The concept of policy cyclicality is important so long as it can be of help to understand or guide actual policy. Thus, a procyclical fiscal policy involves higher (lower) government spending and lower (higher) tax rates in good (bad) times. Such a policy is procyclical because it tends to reinforce the business cycle, as it is expansionary in booms and contractionary in recessions. This contrasts with stabilizing (Keynesian) countercyclical policy and with the neoclassical

'tax-smoothing' hypothesis that tax rates should be held constant over the business cycle and the budget surplus move procyclically (Kaminsky et al., 2005).

As regards taxation, Vegh and Vuletin (2015) show that tax policy is, broadly speaking, acyclical in industrial economies and procyclical in developing countries. These authors find that such cyclical behavior is present not only at the aggregate level (i.e., a tax index), but also for personal and corporate income tax rates as well as value-added taxation. Furthermore, they show that countries with more procyclical spending policy typically have more procyclical tax policy and vice versa. Their evidence coincides with Frankel et al.'s (2013) findings on the spending side, allowing them to conclude that both tax and spending policies are subject to the same key determinants and are usually conducted in a symmetric way over the business cycle.

Several hypotheses have been put forth in the literature to explain the procyclical behavior of fiscal policy in developing countries, ranging from limited access to international credit markets and lack of financial depth (Gavin and Perotti, 1997; Aizenman et al., 2001; Caballero and Krishnamurthy, 2004) to political-economic interactions that tend to encourage expansionary policies during booms (Tornell and Lane, 1999; Talvi and Végh, 2005; Alesina et al., 2008). While there is no consensus on what drives differences in fiscal policy cyclicality among countries, some empirical studies document that procyclical fiscal policies are more pronounced in countries with large informal economies (Eng and Wong, 2008; Çiçek and Elgin, 2011).

The evidence provided in these empirical studies can be interpreted in the context of the just mentioned hypotheses. Thus, previous research has claimed that most developing countries typically face credit constraints that prevent them from borrowing in bad times, which forces governments to cut spending and raise taxes (Gavin and Perotti, 1997; Aizenman et al., 2001). In this perspective, Elgin and Uras (2013) argue that pervasive informality limits the set of credible future fiscal policy adjustments and increases the probability of default, thereby affecting the interest rates charged on sovereign debt. These authors show that a larger size of the informal economy is associated with higher public indebtedness, higher credit ratings on government debt, a higher level of financial instability, and higher default risk.

Moreover, institutional weaknesses induce voters to demand more public goods or lower taxes during good times rather than allowing a corrupt government to appropriate rents (Alesina et al., 2008). Talvi and Végh (2005) make a similar point, but instead consider that policymakers, unable to resist political pressures, would find it optimal to run smaller primary surpluses

by increasing government spending and reducing tax rates. These two approaches are complementary in that fiscal policy procyclicality is the outcome of a political distortion interacting with tax revenue variability. Using this mechanism, Çiçek and Elgin (2011) conjecture that, by amplifying fluctuations in the tax base, informality can diminish the countercyclicality of budget deficits, so that fiscal policy is expected to be procyclical in countries with large informal economies.

Given that numerous influences can affect the cyclical behavior of fiscal policy, the factors mentioned above are by no means all-inclusive. Indeed, other determinants related to informality have to do with trade openness and social polarization of preferences over government policies arising from inequality. In particular, Woo (2009) finds that countries with highly polarized societies (as measured by income inequality) are more likely to exhibit procyclical fiscal stances. Also, as with financial integration, some studies have shown that countries are less prone to conduct procyclical fiscal policies when they are more trade open (Aizenman et al., 2019). In what follows, we set out the formal model and describe the data and estimation techniques employed.

3 Methodology and data

The aim of this paper is to assess robust and feedback effects between tax policy and the informal economy. To fulfill this objective, we collect a set of determining factors and proxies consistent with the previous literature. Since explanatory variables related to informality and taxation are ample, and in order to narrow the adequate determinants, we loosely rely on the methodologies developed by Goel and Nelson (2016) and Goel and Saunoris (2019) as explained in the following:

3.1 The model

The estimated model includes separate equations to evaluate determinants of the informal economy and tax policy, respectively, with the focus on determining the influence of one variable and the business cycle on the prevalence of the other.

Given that the main direction of causality is unclear, we run sets of regressions, alternately taking the informal economy (Table 1) and tax policy (Table 2) to be the dependent variables. In each case, we account for bi-directional causality. To examine the effects of the business cycle, we consider indicators of output fluctuations in the prevalence of informality and

tax policy.

Letting subscript i denote a country and t a year, the general function for determinants of the informal economy is:

$$\text{Informality}_{ijt} = f(\text{Tax policy}_{ikt}, \text{Business cycle}_{imt}, X_{ipt}) \tag{1}$$

and the representative equation for explaining cross-national tax policy takes the following form:

$$\text{Tax policy}_{ikt} = f(\text{Informality}_{ijt}, \text{Business cycle}_{imt}, Z_{iqt}) \tag{2}$$

where

i = 1, 2, 3 ... 74

t = 1991-2015

j = Shadow economy size, Self-employment

k = Corporate income tax rate, Personal income tax rate, Value-added tax rate

m = Cyclical component of real GDP (GDP cycle), Percentage change in real GDP (GDP growth)

p = Corruption control (Corruption ICRG, Control of corruption, Government integrity), Bureaucratic quality, Law and order, Political stability (Government stability, Political stability), Democracy (Polity2, Democracy), Income inequality (Gini WIID, mean Gini market SWIID, median Gini market SWIID), GDP per capita, Trade openness

q = Corruption control (Corruption ICRG, Control of corruption, Government integrity), Bureaucratic quality, Law and order, Democratic accountability, Political stability (Government stability, Political stability), Investment profile, Political constraints (Constraints on the executive, Checks and balances), Democracy (Polity2, Democracy), Income inequality (Gini WIID, mean Gini market SWIID, median Gini market SWIID), Financial conditions (Chinn-Ito index, Liquid liabilities to GDP), Output volatility, GDP per capita, Trade openness.

Based on the above arguments, the informal economy (tax policy) is a function of tax policy (the informal economy) and the business cycle. Note that the discussion in Section 2 does not provide a clear direction of positive or negative influence of one phenomenon on the incidence of the other.

To control for other aspects that affect the informal economy (tax policy), we include several control variables. Notice that, while informality and taxation are related phenomena, the discussion in Section 2 suggests there are qualitative differences that warrant different sets of controls in each case. Thus, the vector X in Equation (1) accounts for other factors influencing the informal economy, whereas the vector Z comprises those factors affecting

tax policy in Equation (2). Let us turn to the data and the econometric techniques used to estimate these two equations.

3.2 Estimation techniques

Fiscal policy and informality variables are likely to generate feedback effects. To address this issue, we propose a two-pronged approach.

To begin, we estimate the baseline model using a fixed effects panel data approach. Explanatory variables include those identified and accepted in the literature as key determinants of the informal economy and tax policy instruments. Given the multiplicity of alternative measures for the dependent and independent variables, we conduct a robustness analysis slightly following Goel and Nelson (2016). Thus, by using numerous model combinations in both equations, we identify the most relevant explanatory variables, without controlling for reverse causality.

Yet conceivable simultaneity issues might carry on if only left with the robustness analysis. Consequently, an instrumental variable approach emerges as a solid second step to tackle potential feedback effects. We explain the econometric methods used in detail as follows:

3.2.1 Baseline model: fixed effects panel regressions and robustness analysis

We first use fixed effects panel data regressions, allowing to exploit within-country variability as opposed to cross-country variability while addressing unobserved heterogeneity.[4] We use three indicators of fiscal policy and two alternate measures of informality. Each model includes business cycle indicators and control variables, which in turn are occasionally replaced with alternative proxies to provide further evidence of coefficient significance.

Our baseline model using tax policy instruments as dependent variables provides preliminary results requiring caution. In this regard, the literature on both informality and fiscal policy cyclicality highlights a vast configuration of determinants and an array of proxies in different combinations and model setups. For this reason, we perform a robustness analysis by which, following Goel and Nelson (2016) and Young and Holsteen (2017) to some extent, we report the percentage of the significance of the coefficients associated with possible combinations of the variables in the model.[5] This procedure allows

[4]Note that the previous literature on fiscal policy cyclicality adopts this technique as standard Klemm (2014).

[5]Model uncertainty is a serious issue leading to false positives, that is, coefficients that appear as significant in a regression due to lack of information and model misspecification

us to select the most relevant and appropriate set of variables to be used for the instrumental variable approach.

3.2.2 Instrumental variable regressions

As has been recognized in recent literature, empirical estimates of the cyclicality of fiscal policy need to take account of the endogeneity of the output gap or growth, as these are affected by fiscal policy through the multiplier (Klemm, 2014; Vegh and Vuletin, 2015). Similarly, one could argue that the observed relationship between tax policy cyclicality and informality may reflect the fact that procyclical (countercyclical) fiscal policies that tend to destabilize (stabilize) the economy might enlarge (decrease) the informal sector. That is to say, the causality may run from cyclicality of tax policies to informality and not the other way around.

To overcome these issues, the conventional approach is to use instrumental variable regressions, with common instruments being terms of trade and the U.S. real interest rate. Accordingly, we conduct an instrumental variable approach in which these two variables instrument for the cyclical component of GDP and growth rate. As for the informal economy, results from the robustness analysis satisfying the criteria (i.e., a robust determinant of informality in Equation (1) that does not significantly determine tax policy in Equation (2)) are to be chosen as conceivable instruments.

Adequate instrumental variables are both relevant (i.e., sufficiently correlated with the endogenous regressor) and valid (orthogonal to the error term). To ensure our external instruments meet these criteria, we apply several diagnostic tests. In particular, we employ the Hansen J test of overidentifying restrictions to establish the validity of our instruments and the Kleibergen and Paap rk statistics to determine their relevance and strength.[6]

3.3 Data

3.3.1 Informality dimensions

The dependent variable in Equation (1) concerns the informal economy. In this regard, it is worth noting that informality is hard to measure, especially when individuals and small businesses cover their operations in hopes

(Muñoz and Young, 2018). In this sense, using few model specifications increases the probability of inaccurate and misleading relationships among variables. As estimates depend on both the data and model specification, this may result in ignoring the true econometric model for the intended relations to be modeled. For these reasons, computational robustness analysis aids in the quest for consistent and precise coefficient estimates.

[6]For details, see Baum et al. (2007).

to avoid tax collectors, governmental regulations or red tape. For this reason, we consider two alternative indicators of informality, capturing different dimensions and sources of this phenomenon in each economy.

First, Medina and Schneider (2018) provide estimates of the size of the shadow economy for an ample pool of countries and years. This indicator includes "all economic activities which are hidden from official authorities for monetary, regulatory, and institutional reasons". Hence it includes a wider measure that encompasses informality but also includes illicit activities. We are inclined to believe that this measure depicts better the behavior of informal firms.

Yet informality also has a labor dimension, arising from working activities and actions taken by individuals. In this respect, self-employment constitutes a significant portion of informal workers, almost 52 percent in developing countries in comparison to 15 percent in advanced economies. The International Labor Organization (ILO) collects and estimates a self-employment indicator for a significant array of territories and timeframes. This organization defines self-employment as "jobs where the remuneration is directly dependent upon the profits derived from the goods and services produced". Own-account workers and contributing family workers are among self-employed workers, not necessarily included in a shadow economy measurement. Nonetheless, self-employment and shadow economy variables have a moderate correlation of 0.69.

3.3.2 Tax policy instruments

The dependent variable in Equation (2) concerns tax policy. In this sense, we use instruments instead of outcomes (or tax-revenue-based measures) due to inherent feedback effects. As explained in Kaminsky et al. (2005) and Vegh and Vuletin (2015), tax revenues or revenue-based measures constitute an endogenous outcome affected by the stance of the economy and non-policy factors. Thus, in line with these studies, we think that it only makes sense to consider tax policy by looking at policy instruments.

More specifically, we consider three measures of tax instruments: standard value-added and highest marginal personal income and corporate tax rates. The source of these measures is Vegh and Vuletin (2015), who have compiled an annual dataset comprising value-added, corporate and personal income tax rates for 76 countries, 33 industrial and 43 developing, available since 1960.[7] This dataset collects information obtained from several

[7]While governments also resort to other taxes (e.g., social security, trade, wealth, and financial transactions taxes), Vegh and Vuletin (2015) note that value-added, corporate, and personal income taxes represent around 65 percent of total tax revenues in developing

primary and secondary sources including the World Development Indicators, the World Tax Database, countries' revenue agencies, tax law experts and international tax advisory firms, offering the most comprehensive coverage of effective tax rates thus far and updated periodically.[8]

3.3.3 Business cycle

This study includes as business cycle measures the cyclical component of (log of) real GDP, or output gap (GDP cycle), which is defined as the log deviation of GDP from its Hodrick-Prescott trend. We have also run regressions using the percentage change in real GDP, or GDP growth, instead of the output gap. Data for these two measures come from the International Monetary Fund's World Economic Outlook (WEO).

3.3.4 Control variables

Institutional quality

As mentioned in Section 2, many studies have pointed to the importance of institutions in determining both informality and various aspects of public policy. In this spirit, we consider several dimensions of institutional quality including corruption control, law enforcement, bureaucratic quality, political stability and democracy, among others. We describe the data used as follows:

Like informality, corruption is difficult to accurately measure. One widely used indicator of corruption is from the Political Risk Services Group's International Country Risk Guide (ICRG), which assesses the political risk associated with corruption in the political system. Another widely used index is Control of corruption, available in the World Bank's Worldwide Governance Indicators (WGI). These two measures are decreasing in the amount of corruption. Yet we also take into account the Government integrity index constructed by the Heritage Foundation.

Other indicators of institutional quality considered in both Equation (1) and Equation (2) concern bureaucratic quality, law and order, political stability and democracy. While bureaucratic quality provides an assessment of the strength and expertise to govern without drastic changes in policy or interruptions in government services, law and order evaluates the strength and impartiality of the legal system and the popular observance of the law. These two indicators have been drawn from the ICRG.

countries and almost 80 percent in industrial nations.

[8]The dataset is publicly available at `https://openknowledge.worldbank.org/handle/10986/29303`.

As for political stability, we consider two indicators: government stability and the percentage of veto players who defect from government in a given year. The former is obtained from the ICRG, while the latter comes from the Inter-American Development Bank's Database of Political Institutions (DPI). Similarly, to capture how democratic a country is, we rely on the variable Polity2, which subtracts a country's score in an 'Autocracy' index from its score in a 'Democracy' index, from the Polity IV Project database.

In addition to the above indicators, other institutional controls considered for estimating Equation (2) concern democratic accountability, investment profile and political constraints. Democratic accountability is an ICRG measure of how responsive a government is to its people. In turn, investment profile assesses factors affecting the risk to investment that are not covered by other political, economic and financial risk components of the ICRG (e.g., contract viability/expropriation, profits repatriation, and payment delays).

Finally, we address political economy arguments that stress common pool problems and fragmented policymaking (Tornell and Lane, 1999) by using a measure of political checks and balances from the DPI. An alternative measure of political constraints that we use refers to the extent of institutionalized constraints on the executive, constructed by the Polity IV Project.

Income inequality

This study uses income inequality as a proxy for social polarization. In particular, we employ both the mean and the median of the hundred estimates of the Gini coefficient in market (pre-tax) form available in the Standardized World Income Inequality Database (SWIID). Also, we make use of the Gini coefficient as reported by the originating source to the United Nations University World Institute for Development Economics Research's World Income Inequality Database (WIID).

Financial conditions

To account for the precarious creditworthiness channel, estimating Equation (2) involves controlling for the degree of financial integration and depth. For that, we measure financial integration using the Chinn-Ito index of financial openness and financial sector depth using the ratio of liquid liabilities to GDP accessible from the International Monetary Fund's Global Financial Development Database.

Other economic conditions

This research uses GDP per capita from the WEO as a proxy of economic development. Also, we take into consideration the degree of trade openness by using the share of exports plus imports to GDP reported in the World Bank's World Development Indicators (WDI).

In addition, estimating Equation (2) involves controlling for the variability of tax revenues—proxied by output volatility—to account for the channel emphasized by Talvi and Végh (2005). To do that, we measure output variability using the square of the cyclical component of real GDP.

Finally, relying on a variety of instrumental variables proposed in the literature on fiscal policy cyclicality (see Klemm, 2014; Vegh and Vuletin, 2015), this paper uses terms of trade and 1-year U.S. Treasury constant maturity rate to instrument for business-cycle-related variables.[9] The source for the terms of trade series is the WDI, while that of the Treasury rates is the Saint Louis Fed's Federal Reserve Economic Data (FRED).

4 Results

4.1 Robustness analysis and baseline model

In this section, we look at the relationships between informality, tax policy and the business cycle in a comprehensive and systematic manner. More specifically, we examine the significance of individual determinants of informality and tax policy across dozens of model variations and ascertain which regressors and control variables, if any, are robust.

To this end, OLS regressions are run on all possible combinations of the control variables that can be included along with the variables of interest. In Tables 1 and 2, both the mean parameter estimates and the mean coefficient of determination of each variable over all these regressions are reported. In addition, the percentage of these regressions where the parameter estimate was positive (negative) and statistically significant (at any confidence level) are also summarized.

In undertaking this robustness analysis, we consider the determinants of the informal economy (Equation (1), Table 1) and tax policy (Equation (2), Table 2) in such a way that computations for each dimension of informality and tax policy instrument are reported separately. Also, in examining the results, we adopt the convention that whereby if 50 percent or more of the

[9]One natural criticism of using this interest rate as an instrument is that it might be endogenous in the case of the United States. To address this concern, all instrumental variable regressions exclude the U.S.

results have the same sign and are statistically significant, the results are said to be "weakly robust;" if that percentage reaches 95 percent, the results indicate "strong robustness." Either outcome is displayed in bold in the tables presented below.

4.1.1 Robust determinants of the informal economy

To begin, note that there are nine possible control variables to be included in the OLS regressions. As described in the data section, we consider two alternative proxies for three control variables (business cycle, political stability, democracy) and three different indicators for two control variables (corruption control and income inequality). With this set of determinants, 72 models are estimated in total for each tax policy instrument and dimension of the informal economy. The results, reported in Table 1, are organized into two panels, each for a dependent variable. Every panel, in turn, has three divisions corresponding to each tax instrument and for which computations are referred to under the so-called "tax policy" regressor.

These results show the effect of corporate taxation on the informal economy to be positive and significant in most of the 72 models estimated for all possible combinations of control variables. This holds true for both self-employment (see leftmost columns of panel (a)) and the size of the shadow economy. In contrast, personal income tax exerts a strongly negative and significant influence on shadow economy size (center columns of panel (b)), while value-added tax affects the two dimensions of informality considered in this study in a negative and significant manner but it does not seem to be a strong determinant (rightmost columns of both panels).

Furthermore, the business cycle has a negative impact on the size of the shadow economy (see panel (b)). Indeed, the influence of GDP growth is shown to be negative and significant in over 90 percent of the 72 models estimated for every tax policy instrument and all possible combinations of control variables. Also, the effect of GDP cycle is negative and weakly robust for corporate and value-added tax rate and all possible controls. While this is consistent with informality acting as a buffer for the economy, the results for these two business cycle indicators turn out to support the existence of an income effect in regard to self-employment, as the influence of GDP growth is significant but positive in 53 percent of the models for personal income tax rate and all possible control variables (center columns of panel (a)). For the remaining model variations, the effect of this proxy is positive but not robust, as is that of GDP cycle.

Examining the results for the rest of the control variables in this table, the only other variables exceeding the 50 percent significance threshold

Table 1: Robustness of determinants of informality

(a) Dependent variable: self-employment

	Corporate income tax				**Personal income tax**				**Value-added tax**			
	Mean beta	**Positive & Significant (%)**	**Negative & Significant (%)**	**Mean R2**	**Mean beta**	**Positive & Significant (%)**	**Negative & Significant (%)**	**Mean R2**	**Mean beta**	**Positive & Significant (%)**	**Negative & Significant (%)**	**Mean R2**
Tax policy	**0.073**	**100**	**0**	**0.472**	0.025	32	0	0.469	**-0.113**	**0**	**58**	**0.451**
GDP cycle	3.389	39	0	0.485	3.244	39	0	0.462	3.091	25	0	0.466
GDP growth	0.031	33	0	0.485	**0.033**	**53**	**0**	**0.466**	0.035	25	0	0.466
Corruption	**0.256**	**100**	**0**	**0.476**	**0.359**	**100**	**0**	**0.463**	**0.400**	**100**	**0**	**0.460**
Ctrl corruption	-0.712	0	25	0.451	-0.663	0	17	0.444	-0.696	0	8	0.439
Govt integrity	*NA*	0	0	*NA*	*NA*	0	0	*NA*	*NA*	0	0	*NA*
Bureau quality	-0.301	0	13	0.483	-0.352	0	33	0.463	-0.400	0	11	0.473
Law and order	**0.488**	**100**	**0**	**0.472**	**0.480**	**100**	**0**	**0.458**	**0.521**	**100**	**0**	**0.454**
Govt stability	**0.105**	**75**	**0**	**0.455**	**0.125**	**75**	**0**	**0.444**	**0.112**	**100**	**0**	**0.441**
Polit stability	0.036	14	0	0.488	0.038	22	0	0.478	0.039	28	0	0.474
Polity2	**0.088**	**64**	**0**	**0.476**	**0.092**	**67**	**0**	**0.462**	**0.095**	**67**	**0**	**0.452**
Democracy	0.015	8	0	0.491	*NA*	0	0	*NA*	*NA*	0	0	*NA*
Gini WIID	**0.082**	**100**	**0**	**0.472**	**0.063**	**100**	**0**	**0.461**	**0.056**	**100**	**0**	**0.457**
Medi Gini mkt	**8.138**	**92**	**0**	**0.468**	**5.702**	**54**	**0**	**0.451**	*NA*	0	0	*NA*
Mean Gini mkt	**20.772**	**100**	**0**	**0.478**	**18.368**	**100**	**0**	**0.462**	**14.036**	**100**	**0**	**0.456**
GDP per capita	**-7.724**	**0**	**100**	**0.472**	**-8.370**	**0**	**100**	**0.458**	**-8.380**	**0**	**100**	**0.454**
Trade openness	-0.002	3	6	0.480	-0.003	3	6	0.464	-0.007	0	6	0.470

Note: analysis based on 72 models estimated for each tax policy instrument. NA: not available.

(b) Dependent variable: shadow economy size

	Corporate income tax				Personal income tax				Value-added tax			
	Mean beta	**Positive & Significant (%)**	**Negative & Significant (%)**	**Mean R2**	**Mean beta**	**Positive & Significant (%)**	**Negative & Significant (%)**	**Mean R2**	**Mean beta**	**Positive & Significant (%)**	**Negative & Significant (%)**	**Mean R2**
Tax policy	**0.059**	**51**	**0**	**0.650**	**-0.071**	**0**	**100**	**0.606**	**-0.181**	**0**	**50**	**0.533**
GDP cycle	**-5.634**	**0**	**75**	**0.594**	-5.569	0	44	0.605	**-7.109**	**0**	**69**	**0.566**
GDP growth	**-0.082**	**0**	**100**	**0.603**	**-0.067**	**0**	**94**	**0.613**	**-0.072**	**0**	**100**	**0.583**
Corruption	-0.260	0	13	0.527	*NA*	0	0	*NA*	-0.338	0	25	0.524
Ctrl corrupti	**-1.337**	**0**	**100**	**0.594**	**-1.065**	**0**	**63**	**0.606**	**-1.323**	**0**	**71**	**0.558**
Govt integrit	-0.014	0	13	0.533	0.011	4	0	0.651	-0.008	8	17	0.540
Bureau qualit	**-1.278**	**0**	**100**	**0.600**	**-1.199**	**0**	**100**	**0.606**	**-1.425**	**0**	**100**	**0.581**
Law n order	**-0.438**	**0**	**53**	**0.615**	**-0.394**	**0**	**51**	**0.627**	**-0.470**	**0**	**51**	**0.599**
Govt stability	0.105	14	0	0.518	0.109	39	0	0.556	0.111	39	0	0.541
Polit stability	*NA*	0	0	*NA*	*NA*	0	0	*NA*	*NA*	0	0	*NA*
Polity2	**-0.151**	**0**	**86**	**0.602**	**-0.159**	**0**	**97**	**0.606**	**-0.152**	**0**	**75**	**0.592**
Democracy	**-0.053**	**0**	**100**	**0.600**	**-0.049**	**0**	**100**	**0.606**	**-0.053**	**0**	**100**	**0.582**
Gini WIID	**0.258**	**100**	**0**	**0.560**	**0.230**	**100**	**0**	**0.574**	**0.262**	**100**	**0**	**0.545**
Med Gini mkt	**40.631**	**100**	**0**	**0.612**	**35.725**	**100**	**0**	**0.614**	**41.906**	**100**	**0**	**0.591**
Mean Gini mk	**60.875**	**100**	**0**	**0.629**	**56.112**	**100**	**0**	**0.631**	**62.650**	**100**	**0**	**0.609**
GDP per capi	**-13.869**	**0**	**100**	**0.600**	**-14.443**	**0**	**100**	**0.606**	**-13.760**	**0**	**100**	**0.581**
Trade openes	**-0.028**	**0**	**100**	**0.600**	**-0.032**	**0**	**100**	**0.606**	**-0.030**	**0**	**100**	**0.581**

Note: analysis based on 72 models estimated for each tax policy instrument. NA: not available.

are, in regard to self-employment, corruption control (Corruption ICRG), law and order, government stability, democracy (Polity2), income inequality, and GDP per capita. Notice that the institutional quality variables just mentioned have a positive and significant effect on self-employment regardless of the tax policy instrument used as regressor. Although this may seem counterintuitive, an interpretation compatible with this outcome could be that greater institutional quality allows for a plural entrepreneurial environment in which informal activities can be tolerated.[10] More consistent with the extant literature, income inequality has a positive and significant effect while GDP per capita leads to a decrease in self-employment in 100 percent of the models throughout all three tax policy instruments.

As for the size of the shadow economy, the other variables exceeding the 50 percent significance threshold are control of corruption, bureaucratic quality, law and order, democracy (Polity2, Democracy), income inequality (Gini WIID, Median Gini market SWIID, Mean Gini market SWIID), GDP per capita, and trade openness. These results are all in line with the literature. Moreover, the effect of bureaucratic quality and democracy and the mentioned economic conditions on this dimension of informality is significant in 100 percent of the models for all three tax policy instruments. The same result applies to the three proxies for income inequality, although these exert a positive influence on shadow economy size.

The main takeaway from this robustness assessment concerns the direct and indirect effects generated by specific taxes, income effects on self-employment and substitution effects on shadow economic activity associated with business cycle fluctuations, and the crucial importance of some institutional quality variables, income inequality and other economic conditions in driving the extent of the informal economy. Now, let us consider how tax policy is determined by informality, the business cycle and several control variables.

4.1.2 Robust determinants of tax policy

To consider the determinants of tax policy, we include five additional control variables in the OLS regressions. These variables correspond to democratic accountability, political constraints (Constraints on the executive, Checks and balances), investment profile, financial conditions (Chinn-Ito index, Liquid liabilities to GDP), and output volatility. These additional variables

[10] As regards the effect of corruption control, this result might be consistent with corruption and the informal economy behaving as substitutes and with the intuition that greater corruption lowers self-employment by acting as a tax or transaction cost of operating in the shadows. See note 3.

amount to two alternative proxies for five control variables (business cycle, political stability, democracy, political constraints and financial conditions) and three different indicators for two control variables (corruption control and income inequality). Thus, 288 model combinations are estimated in total for each dimension of the informal economy and tax policy instrument. The results, reported in Table 2, are organized into three panels, each for a dependent variable; in turn, every panel has two divisions corresponding to each informality measure and for which computations are referred to under the so-called "informality" regressor.

These results show the effect of self-employment on tax policy to be significant in over 60 percent of the 288 models estimated for all possible combinations of control variables. While the influence of self-employment is positive regarding direct taxation (see leftmost columns of panels (a) and (b)), it is negative as to the value-added tax rate. Somewhat similarly, shadow economy size exerts a positive and significant effect on the corporate tax rate (rightmost columns of panel (a)) but a strongly negative and significant influence on the personal income tax. Indirect taxation does not seem to be much affected by this dimension of informality. These findings are consistent with the normative literature stating that the optimal tax structure for countries where informality is prevalent includes high capital income taxes and, more generally, that the informal economy should affect the conduct of tax policy. However, these findings require caution as they might point at simultaneity issues that we address further on.

As regards the business cycle, it is worth noting that only the value-added tax rate appears to be strongly procyclical. Indeed, the influence of both GDP cycle and GDP growth is shown to be negative and significant in 75 percent or more of the 288 models estimated for every informality dimension and all possible combinations of control variables (see panel (c)). In contrast, the personal income tax seems to be countercyclical as the effect of GDP growth is positive and weakly robust for all possible controls. Corporate taxation does not look as if it were much affected by the business cycle. These findings are fairly consistent with those of Vegh and Vuletin (2015), who provide evidence that procyclicality dominates the behavior of tax policy in developing countries at the individual tax level, with the exception of personal income taxation, and that tax policy is acyclical in industrial countries for both personal and corporate income taxes but not for the value-added tax.[11]

[11]These results also are somewhat in line with the ones of Aizenman et al. (2019). These authors have found that OECD countries are procyclical in the value-added tax but countercyclical in corporate and personal income taxes, whereas non-OECD countries are acyclical in the value-added tax and associated with procyclicality in corporate and

Table 2: Robust determinants of tax policy

(a) Dependent variable: corporate income tax rate

	Self-employment				**Shadow economy size**			
	Mean beta	**Positive & Significant (%)**	**Negative & Significant (%)**	**Mean R2**	**Mean beta**	**Positive & Significant (%)**	**Negative & Significant (%)**	**Mean R2**
Informality	**0.384**	**100**	**0**	**0.304**	**0.168**	**74**	**0**	**0.297**
GDP cycle	-9.430	0	35	0.293	-9.901	0	31	0.297
GDP growth	0.087	21	0	0.265	0.097	33	0	0.272
Corruption ICRG	**0.636**	**96**	**0**	**0.341**	**0.732**	**100**	**0**	**0.342**
Control of corruption	-1.648	0	10	0.262	-1.817	1	33	0.273
Government integrity	*NA*	0	0	*NA*	*NA*	0	0	*NA*
Bureaucratic quality	0.852	19	0	0.328	1.043	28	0	0.308
Law and order	-0.305	7	26	0.334	0.580	37	0	0.294
Democratic accountability	-0.481	0	10	0.263	0.431	4	1	0.284
Constraints on the executive	1.711	35	0	0.346	1.609	37	0	0.344
Checks and balances	**-0.226**	**0**	**50**	**0.316**	-0.288	0	33	0.290
Government stability	**0.322**	**85**	**0**	**0.303**	**0.355**	**91**	**0**	**0.309**
Political stability	*NA*	0	0	*NA*	0.068	7	0	0.263
Investment profile	**-0.340**	**0**	**100**	**0.301**	**-0.289**	**0**	**95**	**0.301**
Polity2	-0.504	0	25	0.342	-0.484	0	24	0.344
Democracy	-0.647	0	34	0.339	-0.664	1	33	0.340
Gini WIID	**-0.194**	**0**	**100**	**0.309**	**-0.210**	**0**	**100**	**0.297**
Median Gini market SWIID	**-31.652**	**0**	**100**	**0.301**	**-40.023**	**0**	**100**	**0.305**
Mean Gini market SWIID	**-41.180**	**0**	**100**	**0.302**	**-54.661**	**0**	**100**	**0.309**
Chinn-Ito index	-0.366	0	29	0.325	**-0.399**	**0**	**54**	**0.323**
Liquid liabilities to GDP	**-0.051**	**0**	**100**	**0.306**	**-0.060**	**0**	**100**	**0.309**
Output volatility	*NA*	0	0	*NA*	*NA*	0	0	*NA*
GDP per capita	**-3.646**	**0**	**91**	**0.306**	**-5.390**	**0**	**96**	**0.304**
Trade openness	**-0.043**	**0**	**96**	**0.305**	**-0.044**	**0**	**73**	**0.313**

Note: analysis based on 288 models estimated for each dimension of informality. NA: not available.

(b) Dependent variable: personal income tax rate

	Self-employment				Shadow economy size			
	Mean beta	**Positive & Significant (%)**	**Negative & Significant (%)**	**Mean R2**	**Mean beta**	**Positive & Significant (%)**	**Negative & Significant (%)**	**Mean R2**
Informality	**0.225**	**66**	**0**	**0.148**	**-0.460**	**0**	**100**	**0.213**
GDP cycle	*NA*	0	0	*NA*	-9.994	0	6	0.227
GDP growth	**0.129**	**71**	**0**	**0.154**	**0.11**	**55**	**0**	**0.219**
Corruption ICRG	0.541	32	0	0.165	0.505	29	0	0.222
Control of corruption	**2.605**	**95**	**0**	**0.148**	2.464	22	0	0.225
Government integrity	**0.052**	**100**	**0**	**0.155**	**0.046**	**100**	**0**	**0.221**
Bureaucratic quality	1.916	35	0	0.155	1.495	33	0	0.207
Law and order	-0.442	2	13	0.164	0.652	12	0	0.234
Democratic accountability	**-1.014**	**0**	**84**	**0.149**	**-1.064**	**0**	**98**	**0.213**
Constraints on the executive	**-1.676**	**0**	**91**	**0.162**	**-2.113**	**0**	**88**	**0.228**
Checks and balances	0.27	11	0	0.166	0.307	11	0	0.219
Government stability	-0.273	0	47	0.165	-0.242	0	24	0.224
Political stability	*NA*	0	0	*NA*	*NA*	0	0	*NA*
Investment profile	0.262	26	0	0.164	**0.274**	**63**	**0**	**0.217**
Polity2	-0.240	2	44	0.148	**0.026**	**33**	**50**	**0.213**
Democracy	**0.425**	**72**	**0**	**0.152**	**0.566**	**51**	**0**	**0.218**
Gini WIID	**-0.180**	**0**	**71**	**0.169**	-0.115	0	2	0.250
Median Gini market SWIID	**-20.718**	**0**	**76**	**0.134**	-17.632	0	42	0.213
Mean Gini market SWIID	**-53.141**	**0**	**100**	**0.158**	**-57.321**	**0**	**100**	**0.224**
Chinn-Ito index	**-0.854**	**0**	**100**	**0.153**	**-1.211**	**0**	**100**	**0.213**
Liquid liabilities to GDP	0.032	3	0	0.163	0.031	3	0	0.238
Output volatility	-93.099	0	8	0.123	-87.520	0	0	0.189
GDP per capita	-3.635	0	31	0.163	**-9.902**	**0**	**100**	**0.213**
Trade openness	**-0.067**	**0**	**100**	**0.153**	**-0.086**	**0**	**100**	**0.213**

Note: analysis based on 288 models estimated for each dimension of informality. NA: not available.

(c) Dependent variable: value-added tax rate

	Self-employment				Shadow economy size			
	Mean beta	**Positive & Significant (%)**	**Negative & Significant (%)**	**Mean R2**	**Mean beta**	**Positive & Significant (%)**	**Negative & Significant (%)**	**Mean R2**
Informality	**-0.060**	**0**	**76**	**0.188**	-0.048	0	25	0.190
GDP cycle	**-11.173**	**0**	**100**	**0.216**	**-11.876**	**0**	**100**	**0.227**
GDP growth	**-0.033**	**0**	**75**	**0.155**	**-0.036**	**0**	**90**	**0.157**
Corruption ICRG	**-0.287**	**0**	**100**	**0.221**	**-0.308**	**0**	**100**	**0.226**
Control of corruption	**-1.027**	**0**	**100**	**0.167**	**-0.957**	**0**	**100**	**0.177**
Government integrity	*NA*	0	0	*NA*	*NA*	0	0	*NA*
Bureaucratic quality	-0.367	0	21	0.158	-0.371	0	21	0.168
Law and order	0.043	16	11	0.184	-0.045	8	13	0.179
Democratic accountability	**0.358**	**100**	**0**	**0.183**	**0.348**	**100**	**0**	**0.191**
Constraints on the executive	*NA*	0	0	*NA*	0.283	1	0	0.153
Checks and balances	0.069	6	0	0.205	0.073	20	0	0.221
Government stability	0.034	31	11	0.202	0.037	31	10	0.211
Political stability	*NA*	0	0	*NA*	*NA*	0	0	*NA*
Investment profile	-0.079	0	49	0.152	**-0.084**	**0**	**58**	**0.168**
Polity2	-0.053	0	9	0.225	-0.052	0	10	0.238
Democracy	0.189	1	0	0.119	*NA*	0	0	*NA*
Gini WIID	0.031	21	0	0.209	0.035	27	0	0.206
Median Gini market SWIID	**10.903**	**100**	**0**	**0.186**	**11.648**	**100**	**0**	**0.199**
Mean Gini market SWIID	**10.350**	**100**	**0**	**0.178**	**11.181**	**100**	**0**	**0.190**
Chinn-Ito index	**0.303**	**100**	**0**	**0.183**	**0.292**	**100**	**0**	**0.191**
Liquid liabilities to GDP	-0.006	0	1	0.268	*NA*	0	0	*NA*
Output volatility	-24.244	0	6	0.128	-29.970	0	13	0.140
GDP per capita	**1.379**	**68**	**0**	**0.207**	**1.660**	**88**	**0**	**0.198**
Trade openness	-0.010	0	37	0.217	-0.010	0	34	0.224

Note: analysis based on 288 models estimated for each dimension of informality. NA: not available.

Examining the results for the rest of the control variables in this table, the only other variables exceeding the 50 percent significance threshold are, in regard to the corporate income tax rate, corruption control (Corruption ICRG), political constraints (Checks and balances), government stability, investment profile, income inequality, financial conditions, GDP per capita and trade openness. Notice that two of the institutional variables just mentioned (corruption control and government stability) have a positive and significant effect on corporate taxation regardless of the informality dimension used as regressor. Income inequality, financial openness and depth, and the economic conditions mentioned have a negative and significant influence on the corporate tax throughout all dimensions of informality.

As for the personal income tax rate, the other variables exceeding the 50 percent significance threshold are corruption control (Control of corruption, Government integrity), democratic accountability, political constraints (Constraints on the executive), investment profile, democracy (Polity2, Democracy), income inequality (Gini WIID, Median Gini market SWIID, Mean Gini market SWIID), financial openness, GDP per capita and trade openness. In this case, three of the institutional quality variables just mentioned (corruption control, investment profile and democracy) have a positive and significant effect on personal income taxation. Further, the influence of income inequality (Mean Gini market SWIID), financial openness and the economic conditions mentioned is significantly negative in 100 percent of the models.

Lastly, regarding the value-added tax rate, the other control variables exceeding the 50 percent significance threshold are corruption control (Corruption ICRG, Control of corruption), democratic accountability, investment profile, income inequality (Median Gini market SWIID, Mean Gini market SWIID), financial openness and GDP per capita. Notice that democratic accountability, income inequality and financial openness have a positive and significant effect on value-added taxation in 100 percent of the models regardless of the informality dimension used as regressor. The influence of GDP per capita is of the same sign but weakly robust.

The positive and significant effect of corruption control and other institutional quality variables on tax policy may seem counterintuitive. However, a plausible interpretation could be that more transparent societies have the possibility of taxing more given the effective context for government activities and the chance of providing more and better public goods, which is compatible with the indirect effect of taxation on the informal economy (see Friedman et al., 2000). Likewise, our findings on income inequality being negatively

personal income taxes.

and significantly related to corporate and personal income tax rates while influencing value-added taxation in a positive manner is consistent with the evidence that more unequal societies have lower direct, progressive taxes, along with higher indirect, regressive taxes.

Moreover, it is worth noting that bureaucratic quality, law and order and output volatility do not appear to be robust determinants of any of the tax policy instruments considered in this study. These findings do not support Frankel et al.'s (2013) and Vegh and Vuletin's (2015) choice of the former two variables for inclusion in constructing an index of institutional quality. Also, these results do not seem to lend much credence to Talvi and Végh's (2005) implication that, in the presence of political distortions, the larger the variability of the tax base the more procyclical is fiscal policy, as policymakers try to reduce the budget surplus in good times to prevent wasteful spending.

In sum, the results of Table 2 generally support recent studies highlighting the qualitative differences across tax policy instruments and emphasizing the effects of the business cycle. These results are noteworthy in the sense that while political distortions and imperfect access to credit markets have been traditionally believed to be drivers of tax policy procyclicality, these show that informality and other factors such as income inequality and trade openness also play a non-negligible role. In this sense, the robustness assessment above has allowed us to identify an adequate set of variables to include in regressions of both the informal economy and tax policy, thus laying the basis for the instrumental variable approach to be performed next.

4.2 Instrumental variables

Table 3 reports the results for Equation (2) with the different measures of the conceivably endogenous variables interchanged. For these instrumental variable regressions, we consider as controls those that have passed the 50 percent significance threshold in the robustness assessment above (Table 2) and appear to be the most robust across all tax policy instruments and alternative proxies. And, as mentioned before, we use terms of trade and one-year Treasury constant maturity rate as instruments for variables representing the effect of the business cycle, namely, GDP cycle and GDP growth.

In Table 3, self-employment and shadow economy size alternately serve as instrumented variables that account for the influence of the informal economy. Notice that our approach takes advantage of the robustness assessment above in order to ascertain appropriate instruments for these two variables. This assessment specifically suggests that two robust determinants of informality that do not significantly influence tax policy are bureaucratic quality and law and order. Accordingly, these two institutional variables are chosen

Table 3: Effect of the business cycle and informality on tax policy

(a) Dependent variable: corporate income tax rate

Instrumented variable	(1) GDP growth	(2) GDP cycle	(3) Self-employment	(4) Shadow economy size
GDP growth	0.742***		-0.0181	-0.0807
	(0.28)		(0.05)	(0.05)
GDP cycle		24.85***		
		(8.07)		
Shadow economy size				-0.463
				(0.4)
Self-employment	0.573***	0.510***	-0.887	
	(0.1)	(0.08)	(0.83)	
Corruption ICRG	0.249	0.0701	1.049**	0.576**
	(0.26)	(0.24)	(0.42)	(0.23)
Democratic accountability	-0.0246	-0.183	-0.0888	-0.324
	(0.29)	(0.26)	(0.33)	(0.28)
Government stability	0.0671	0.178*	0.237***	0.288***
	(0.12)	(0.1)	(0.09)	(0.09)
Investment profile	-0.258**	-0.330***	-0.307***	-0.301***
	(0.12)	(0.1)	(0.08)	(0.08)
Democracy	-1.061***	-0.831***	-1.173***	-1.135***
	(0.33)	(0.26)	(0.36)	(0.35)
Constraints on the executive	1.285**	1.237***	1.821***	1.600***
	(0.54)	(0.44)	(0.62)	(0.53)
Mean Gini market SWIID	-36.21***	-36.08***	-10.75	-23.29
	(9.88)	(8.55)	(20.07)	(19.81)
Chinn-Ito index	-0.152	-0.268	-0.031	-0.483***
	(0.23)	(0.18)	(0.32)	(0.17)
Liquid liabilities to GDP	0.0572*	0.0024	-0.0799**	-0.0372***
	(0.03)	(0.02)	(0.03)	(0.01)
GDP per capita	-5.291***	-4.433***	-11.38*	-11.81**
	(1.62)	(1.26)	(6.24)	(5.51)
Trade openness	-0.0511***	-0.0240*	-0.0778***	-0.0727***
	(0.02)	(0.01)	(0.02)	(0.02)
Observations	1,054	1,054	1,288	1,310
R-squared	-0.042	0.26	0.131	0.326
Number of countries	56	56	58	59
Kleibergen-Paap rk Wald F statistic	11.87	83.68	6.712	14.84
Kleibergen-Paap rk LM statistic	21.73	115.9	13.71	26.47
	[0.000]	[0.000]	[0.001]	[0.000]
Hansen's J statistic	0.302	0.668	1.886	0.588
	[0.582]	[0.414]	[0.170]	[0.443]

Notes: Constants are included but not reported. Robust standard errors are in parentheses and probability values are in brackets. Asterisks denote the following significance levels: ***p $<$ 0.01, **p $<$ 0.05, *p $<$ 0.1. Excluded instruments for GDP growth and GDP cycle are terms of trade and 1-year Treasury constant maturity rates; for self-employment and shadow economy size are bureaucratic quality and law and order.

(b) Dependent variable: personal income tax rate

Instrumented variable	(1) GDP growth	(2) GDP cycle	(3) Self-employment	(4) Shadow economy size
GDP growth	0.58		0.0617	-0.0981
	(0.37)		(0.06)	(0.08)
GDP cycle		22.65**		
		(10.99)		
Shadow economy size				-1.912***
				(0.66)
Self-employment	0.298**	0.268**	-0.3	
	(0.12)	(0.12)	(0.75)	
Corruption ICRG	0.725***	0.545**	0.967**	0.284
	(0.27)	(0.27)	(0.4)	(0.36)
Democratic accountability	-0.591*	-0.695**	-0.731**	-1.359***
	(0.35)	(0.32)	(0.31)	(0.42)
Government stability	-0.491***	-0.413***	-0.295**	-0.211
	(0.16)	(0.14)	(0.13)	(0.16)
Investment profile	-0.195	-0.231*	0.411***	0.380**
	(0.14)	(0.14)	(0.13)	(0.17)
Democracy	0.609*	0.853***	0.421	-0.0925
	(0.32)	(0.29)	(0.37)	(0.46)
Constraints on the executive	-1.921***	-2.097***	-1.447**	-1.341*
	(0.62)	(0.57)	(0.71)	(0.74)
Mean Gini market SWIID	-75.66***	-75.35***	-38.07*	19.01
	(12.85)	(12.51)	(19.82)	(32.53)
Chinn-Ito index	-0.707***	-0.793***	-0.796**	-1.122***
	(0.24)	(0.22)	(0.32)	(0.29)
Liquid liabilities to GDP	0.0605	0.0215	-0.00844	0.0256
	(0.05)	(0.02)	(0.03)	(0.02)
GDP per capita	-6.393**	-5.915**	-7.036	-32.77***
	(3.05)	(2.46)	(5.99)	(9.26)
Trade openness	-0.0506***	-0.0291	-0.0669***	-0.111***
	(0.02)	(0.02)	(0.02)	(0.03)
Observations	1,042	1,042	1,272	1,293
R-squared	0.148	0.208	0.151	-0.069
Number of countries	56	56	58	59
Kleibergen-Paap rk Wald F statistic	10.51	86.02	6.584	14.65
Kleibergen-Paap rk LM statistic	19.45	117.5	13.45	26.14
	[0.000]	[0.000]	[0.001]	[0.000]
Hansen's J statistic	1.845	0.331	10.25	0.31
	[0.174]	[0.565]	[0.001]	[0.578]

Notes: Constants are included but not reported. Robust standard errors are in parentheses and probability values are in brackets. Asterisks denote the following significance levels: ***p < 0.01, **p < 0.05, *p < 0.1. Excluded instruments for GDP growth and GDP cycle are terms of trade and 1-year Treasury constant maturity rates; for self-employment and shadow economy size are bureaucratic quality and law and order.

(c) Dependent variable: value-added tax rate

Instrumented variable	(1) GDP growth	(2) GDP cycle	(3) Self-employment	(4) Shadow economy size
GDP growth	-0.379***		-0.0399***	-0.0377*
	(0.11)		(0.02)	(0.02)
GDP cycle		-15.92***		
		(2.73)		
Shadow economy size				0.0802
				(0.17)
Self-employment	-0.053	-0.0194	-0.275	
	(0.04)	(0.03)	(0.23)	
Corruption ICRG	-0.227**	-0.176*	-0.135	-0.228**
	(0.11)	(0.1)	(0.13)	(0.1)
Democratic accountability	0.204	0.335***	0.339***	0.405***
	(0.13)	(0.09)	(0.09)	(0.1)
Government stability	0.067	0.0457	0.0652*	0.0702**
	(0.06)	(0.04)	(0.04)	(0.04)
Investment profile	-0.133**	-0.0819**	-0.0325	-0.0404
	(0.06)	(0.04)	(0.03)	(0.03)
Democracy	0.0752	-0.0694	-0.101	0.0491
	(0.13)	(0.09)	(0.12)	(0.15)
Constraints on the executive	0.0187	0.0489	0.177	-0.0709
	(0.19)	(0.15)	(0.21)	(0.19)
Mean Gini market SWIID	7.493*	8.287**	14.41***	7.009
	(4.2)	(3.48)	(4.84)	(8.2)
Chinn-Ito index	0.280***	0.355***	0.410***	0.291***
	(0.1)	(0.08)	(0.12)	(0.08)
Liquid liabilities to GDP	-0.0401***	-0.0140**	-0.00572	0.00368
	(0.01)	(0.01)	(0.01)	(0)
GDP per capita	2.696***	2.852***	-0.679	2.558
	(0.74)	(0.6)	(1.75)	(2.4)
Trade openness	0.00876	-0.00772*	-0.0128*	-0.00481
	(0.01)	(0)	(0.01)	(0.01)
Observations	945	945	1,163	1,184
R-squared	-0.511	0.202	0.121	0.149
Number of countries	55	55	57	58
Kleibergen-Paap rk Wald F statistic	12.84	84.71	5.427	8.38
Kleibergen-Paap rk LM statistic	23.23	112.9	11.14	14.98
	[0.000]	[0.000]	[0.004]	[0.001]
Hansen's J statistic	6.96	1.341	0.102	2.131
	[0.008]	[0.247]	[0.749]	[0.144]

Notes: Constants are included but not reported. Robust standard errors are in parentheses and probability values are in brackets. Asterisks denote the following significance levels: ***p < 0.01, **p < 0.05, *p < 0.1. Excluded instruments for GDP growth and GDP cycle are terms of trade and 1-year Treasury constant maturity rates; for self-employment and shadow economy size are bureaucratic quality and law and order.

as suitable instruments.

Focusing on the effect of the business cycle on tax policy, the coefficient on GDP cycle is positive and significant for corporate and personal income tax rates (see panels (a) and (b)) and negative and significant for value-added tax rate (panel (c)). The coefficient on GDP growth have similar signs but is insignificant regarding personal income taxation. These results corroborate those found in recent studies (see Vegh and Vuletin, 2015; Aizenman et al., 2019) and suggest that, even after controlling for the endogeneity of the output gap or the growth rate, direct taxes seem to be acyclical or countercyclical while indirect taxes continue to be strongly procyclical.

Turning to the effect of informality on taxation, the coefficients on self-employment and shadow economy size are negative across all tax policy instruments, except for Model 4 in panels (b) and (c). In the first exception, the coefficient is negative and statistically significant, whereas it is positive and insignificant in the last panel. Thus, once possible endogeneity issues are accounted for, our results imply that the informal economy may affect the tax policy conduct in the way suggested by some normative frameworks (see Cerda and Saravia, 2013; Espino and Gonzalez-Rozada, 2013), but only in the case of the personal income tax is a strong determinant.

The control variables remain largely in agreement with the robustness assessment across the three tax policy instruments, thereby reinforcing our interpretation on how institutional quality may affect tax design and that more unequal societies rely more on indirect taxation. With the exception of Model 3 in panel (b) and Model 1 in panel (c), the diagnostic tests allow us to conclude that the instruments are valid and relevant.

5 Concluding remarks

Despite the worldwide prevalence of informality, consensus on a reliable and consistent set of drivers and consequences of informal activity has been elusive to both researchers and policymakers. This study partly addresses this shortcoming by exploring the interactions between informality and taxation and how these are shaped by business cycle fluctuations. To this end, we identify robust determinants of both the informal economy and tax policy by means of an econometric analysis that employs qualitatively different measures of these two phenomena and accounts for bi-directional causality.

Informality and taxation entail potential feedback effects that in turn make selection of key determinants a cumbersome process. To address this issue, we propose a two-pronged approach and use multiple indicators for each explanatory variable. Our robustness assessment, in particular, provides ev-

idence on the most relevant variables explaining the relation between tax policy and the informal economy. Then, instrumental variable regressions allow us to correct for potential endogeneity in ascertaining the factors driving actual tax design.

Using panel data methods and considering dozens of model variations in the determinants of informality and tax policy, our approach reveals the existence of a bi-directional relationship between these two phenomena, although the significance depends on the tax instrument. Thus, for instance, specific taxes give rise to direct (increasing) and indirect (decreasing) effects on informal activity (see Friedman et al., 2000); but informality, in turn, may influence tax design, especially as regards direct taxation.

Furthermore, our findings support the distinctive influences that explanatory factors may have on alternative dimensions of the informal economy and tax policy. This is especially the case of business cycle fluctuations, which entail income effects on self-employment and substitution effects on shadow economic activity. Likewise, direct taxes appear to be acyclical or countercyclical while indirect taxes are strongly procyclical.

In other influences, some institutional quality variables, income inequality and other economic and financial conditions play a crucial role in driving the extent of informality and the cyclical conduct of tax policy. This suggests that less bureaucracy and corruption and a strong legal environment better enable individuals to find opportunities that keep them away from informal activities. And, at the same time, more prosperous and inclusive societies constrain politicians in their policy space and make them hold accountable to the public, thus preventing policy discretion and limiting fiscal procyclicality.

Notice that the observed bi-directional relationship highlights the potential implications of how the business cycle influences informality and taxation. Hence our results substantiate evidence that recessions may lead to a larger share of informal economic activity and thereby trigger a sharper depletion of public coffers, which, with compounding financial restrictions, leaves governments with no choice but to engage in destabilizing fiscal policies. Disentangling the mechanisms underlying our findings through optimal policy frameworks thus stands as a worthy avenue to pursue in future studies.

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