Fiscal stimulus packages to COVID-19: The role of informality

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Abstract
In this paper, we use a novel cross-country dataset to investigate the relationship between the prevalence of the shadow economy and fiscal policy responses to the economic crisis induced by the pandemic. The finding is that countries with a relatively larger shadow economy before the pandemic have adopted a smaller fiscal policy package. The results are robust to different econometric specifications, including an instrumental variable estimation. This reinforces the wider literature that countries (especially those with larger shadow economies) generally follow a procyclical policy as opposed to the optimal and countercyclical one.

KEYWORDS
COVID-19, fiscal policy, informal sector, pandemic, shadow economy

1 INTRODUCTION

The coronavirus (COVID-19) outbreak emerged in Wuhan, China, in December 2019 and spread to almost every country and territory in the world causing about 260 million cases and about 5.2 million deaths as of late November 2021 (Roser et al., 2021). In addition to the human suffering and loss of lives, the pandemic generated a major global economic downturn globally, affecting every economy to different degrees (Baldwin & Weder di Mauro, 2020). To decrease the transmission rate of COVID-19 and reduce the burden on health care systems, governments adopted a wide range of stringent public health measures including school and business closures, travel restrictions, and city lockdowns (Atkeson, 2020). These measures have effectively slowed the growth of new infections and allowing health care systems to better manage the flow of positive cases (Anderson et al., 2020). However, these nonpharmaceutical measures have also distorted economic activity by limiting human mobility and business operations which in turn has led to mass layoffs (Eichenbaum et al., 2020).
et al., 2020). For instance, there have been more than 40 million unemployment claims in the United States since the start of the pandemic. It is estimated that more than 5 billion people in the world will be affected, with a significant impact on 1.6 million informal workers (ILO, 2020). Informal workers are in a much more disadvantageous position since they predominantly work in sectors that are hit most by the pandemic and they lack the opportunity of receiving the short-term financial support that has been made available by governments.

To mitigate the adverse effects of public health controls on the economy and to sustain public welfare, governments have generally adopted expansionary economic packages, including fiscal, monetary/financial, and exchange rate policy measures (Elgin et al., 2020; Gourinchas, 2020). These economic measures targeting households, firms, health systems, and banks significantly vary across countries in their type, breadth and scope (Weder di Mauro, 2020); however, overall, according to Elgin et al. (2020), the average size of the packages is unprecedented in the economic history of the world. Similarly, the decline in national GDPs in 2020 is also unprecedented for many countries (International Monetary Fund [IMF], 2021a). For example, according to the last figures, the fiscal stimulus measure adopted by Japan exceeds 50% of its GDP (IMF, 2021b). Moreover, there is also preliminary evidence that the overall size of these measures was key in determining the recovery path of national economies (IMF, 2021a). In this regard, we believe that it is crucial to understand factors that are associated with the size of these measures.

In order to understand and explain the variation in the size of the fiscal stimulus measures, in this paper, the aim is to investigate whether the presence of a relatively large shadow economy plays a role in determining the size of the fiscal responses to the pandemic. We believe that this is an important empirical question to address. Our main topic of investigation in this paper to be tested is not what happens to the shadow economy during or after the pandemic (although this could also be an important topic to be researched later on when new data pours in) but instead whether countries that have a larger prepandemic level of shadow economy (as measured by its level in 2019) responded differently to the pandemic. This is a novel question and to the best of our knowledge considering the existing literature it is investigated for the first time in this paper. We also believe that the pandemic induced crisis as well as the policy responses to the pandemic are unprecedented and were not examined by previous researchers. Notice that, here, we do not investigate the relationship between ordinary fiscal policy and shadow economy size. We look at the impact of the prepandemic level of the shadow economy on stimulus measures adopted by the pandemic.

On the one hand, countries with high informality need to introduce larger economic packages since their business activities are more fragile and they have more citizens who are in need (Elgin, 2020). On the other hand, these countries’ negative characteristics, such as lack of resources and institutional ineffectiveness, prevent the introduction of sizable stimulus packages (Elgin, 2020; Huynh & Nguyen, 2020). In this paper, specifically, a novel dataset is used to study governments’ different policy responses to the COVID-19 pandemic. This will reveal that (i) the size of the fiscal stimulus packages (as a % of GDP) is significantly smaller in countries with relatively large shadow economies. This relationship is robust to the inclusion of several control variables including GDP per-capita; (ii) the relationship between the shadow economy and the size of the fiscal policy package is strongly robust as shown by using several instrumental variable (IV) estimations; (iii) system estimations indicate that several policy tools, such as corruption control and law enforcement, might mitigate the effect of the shadow economy on the inability to give strong fiscal responses to the pandemic. The resultant argument is that understanding the role of the informality on policy, and especially on fiscal policy, during a pandemic is crucial not only for short-term recovery prospects but also for long-term developmental goals.

The rest of the paper is organized as follows. The next section provides a review of the related literature and builds our hypothesis upon it. Section 3 includes a description of the data sources and the estimation methodology used. Section 4 presents benchmark regression results. Building upon these benchmark results, Section 5 runs systems estimations that provide useful insights for policy recommendations. Finally, Section 6 draws together the implications of the findings.
2 | LITERATURE AND CONTRIBUTION

The size of the shadow economy creates a barrier for countries’ sustainable development. It is related to adverse labor market conditions, such as low-quality jobs and unprotected workers (Colombo et al., 2019) and harsh living conditions, including poverty (Gulyani & Talukdar, 2010). Elgin, Elveren, et al. (2021) studied the relationship between informality and various indicators, including health-related, economic, environmental, education, and social variables. They find that the size of the shadow economy is negatively associated with GDP per capita, carbon dioxide emissions per capita, education, educational attainment, life expectancy, and access to safe drinking water, and positively related to female labor force participation rate, poverty rates, mortality rates, and air pollution. They argue that these empirical associations significantly interact with GDP per capita, indicating that the effect of larger shadow economy size is more substantial in less developed economies. When combining the findings from the previous studies with the results of this study, the shadow economy may have adverse longer term development effects, which the global pandemic might further exacerbate.

There is also a vast literature examining the fiscal policy implications of the shadow economy. For example, Dellas et al. (2017) provide a model of fiscal policy under the presence of shadow economy in Greece and show that it has been a crucial determinant in Greece’s inability for debt consolidation. Moreover, in other papers that investigate the fiscal policy-shadow economy nexus, Teobaldelli (2011) emphasizes the role of federalism, Charlot et al. (2015) provide a role for regulation, and finally, Huynh and Tran (2021) look at the effect of corruption in shaping this nexus. Moreover, even though there are some disagreements in the literature, economic theory, Keynesian or neoclassical, generally suggests that optimal economic (monetary or fiscal) policy should follow a counter-cyclical pattern with respect to business cycles. Namely, if a government respected these prescriptions, the optimal policy should be expansionary in “bad” times and contractionary in “good” times. However, contrary to the theory, numerous recent contributions have found evidence that even though fiscal policy in most high-income countries is counter-cyclical, in many developing countries, it is acyclical or procyclical. A similar observation is also made for monetary policy differences across countries (Kaminsky et al., 2004; Ocampo, 2003) that is said to be countercyclical in advanced economies but procyclical in developing ones. Even though the differences in the cyclicality of economic policy is generally well documented, there is no consensus on what might be driving this specific difference across countries. For fiscal policy, on the one hand, Lane and Tornell (1999), Talvi and Vegh (2005), and Alesina et al. (2008) attribute this difference to differences in the degree of political pressures and control of corruption, whereas Ilzetzki and Vegh (2008) claims that the varying degree of political stability among countries is the cause. On the other hand, Aizenman et al. (1996), Gavin and Perotti (1997), and Riascos and Vegh (2003) claim that the fact that most of the developing countries lose access to international credit markets in “bad times” and other types of borrowing constraints and credit market imperfections provide the key. Closely related to the current research, Cicek and Elgin (2012) argue that the shadow economy might be one of the factors behind governments’ inability to pursue countercyclical policy. As for the effects of informality on fiscal policy, the authors run estimations using cross-sectional and panel data sets for 78 countries to show that fiscal policy procyclicality is more pronounced in countries with a larger informal economy. The authors also lay out several theoretical justifications behind this result. Particularly, they emphasize that the presence of a relatively large shadow economy reduces the tax base and public saving opportunities during booms and thereby leaves less to spend during downturns. As the presence of a large shadow economy is actually a symptom of different underlying and structural issues, this is further exacerbated by the determinants of shadow economy size such as bureaucracy quality, corruption, and the extent of law enforcement.

Considering that the optimal fiscal policy should be countercyclical or at least acyclical, this indicates that informality hinders the implementation of optimal fiscal policy designs over the business cycle. More recently, Elgin and Uras (2013) use different econometric specifications to demonstrate that a larger shadow economy is associated

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1Some of the recent studies are Riascos and Vegh (2003), Kaminsky et al. (2004), Talvi and Vegh (2005), and Alesina et al. (2008).
with higher public debt and probability of sovereign default. Similar results are also obtained for monetary policy (Duncan, 2014; Kaminsky et al., 2004; Kim, 2006; Ocampo, 2003; Plessis et al., 2007) where both theory and practice dictate counter-cyclical policy to be optimal. However, several countries still suffer from an inability to conduct expansionary policy in recessions due to several different reasons, such as the decline in capital inflows, exchange rate, and balance of payment considerations or the presence of structural inflation.

Given the extensive literature above, an investigation of the size of the shadow economy and the economic response given by governments during economic downturns is very much needed. In this regard, the pandemic allows for a laboratory-type environment where the policy responses of governments during a major economic downturn (IMF, 2021b) induced by the pandemic can be studied. Given the already existing results in the literature and the theoretical considerations (as summarized above), in this paper, we hypothesize and test that countries that had a larger prepandemic level of shadow economy size (as measures by the shadow economy as % of GDP in 2019) adopted significantly smaller fiscal stimulus measures during the pandemic. Moreover, we also test the applicability of several policy recommendations that also provide some information about the mechanism of the relationship between shadow economy and fiscal stimulus measures. Notably, we hypothesize whether from a long-run perspective, several policy tools can be recommended that could have reduced the shadow economy size, which could then lead to more appropriate and expansionary fiscal stimulus during the pandemic. To be more specific we postulate and test the following main hypothesis here.

**Hypothesis 1.** Controlling for different factors that might potentially be associated with fiscal stimulus, the larger the prepandemic level of shadow economy size the smaller is the fiscal stimulus package size (both variables measured as a percent of GDP).

In this respect, we expect the sign of the estimated coefficient of the prepandemic level of shadow economy size to be negative. We also postulate and test whether this relationship is robust to using different measures of shadow economy size as well as to the use of different estimation methods. Furthermore, we test whether and if yes how, different policy tools such as the level of prepandemic level of corruption control, law and order, and government spending (as a percent of GDP) influence the relationship between the prepandemic level of shadow economy size and fiscal stimulus packages. This brings us to the second tested hypothesis as follows:

**Hypothesis 2.** Controlling for different factors that might potentially be associated with fiscal stimulus, we expect higher institutional quality as manifested by higher levels of corruption control and law and order variables as well as a higher level of government spending incentivizing formal sector activities be associated with smaller shadow economy size and then in turn a larger shadow economy size be associated with smaller fiscal stimulus packages.

In this respect, we expect the sign of the estimated coefficient of the prepandemic level of shadow economy size to be negative in a system estimation when fiscal stimulus is regressed on it. Concurrently, when the size of the shadow economy is regressed on them, we expect the signs of the estimated coefficients of corruption control, law and order and government spending (as a percent of GDP) to be negative as well.

### 3 | DATA AND METHODOLOGY

#### 3.1 | Data sources

A relatively large cross-country dataset is here used. To construct a comprehensive database of countries’ policy measures, Elgin et al. (2020) use the information provided by the IMF (2021b). To improve data validity, they also cross-check this information using different sources. When the reported information was not up-to-date, it is
replaced with the most recent information gathered from various sources such as the ILO Policy Tracker, news channels or central bank and government websites. The economic policy package database used in this paper includes a measure of the fiscal stimulus package denominated as a percentage of GDP, including all adopted on- and off-budget fiscal measures taken towards mitigating the adverse economic impact of the pandemic. These are not regular components of fiscal policy, but instead, here, the stimulus is defined as extra spending on top of the already projected in the budget before the pandemic. The first version of the whole dataset was reported in Elgin et al. (2020) in early April 2020. As governments announced revised or new packages in due course, the current version of our dataset in this paper uses all available information by February 2021. The dataset covers 168 economies and has 15 different versions reported on different dates, the first version on 25 March 2020 and the 15th version on 5 February 2021. In the empirical analysis, in different estimations, panel and cross-country versions of these data series are used.

As the relevant measure of the prepandemic level of the shadow economy, our benchmark estimations use dynamic general equilibrium (DGE) estimates of shadow economy size as a % of GDP of Elgin, Kose, et al. (2021). In this paper, the authors report an annual cross-country panel dataset of shadow economy estimates. For the current paper, the estimate from the most-recent year is used, that is, the year 2019. However, robustness checks are also run using three different data sources, specifically shadow economy size as % of GDP as given by Medina and Schneider (2018) and self-employment (measured as % of total employment), and pension coverage (% of labor force). Medina and Schneider (2018) measure the size of the shadow economy (again as a % of GDP) using a multiple-indicators-multiple-causes (MIMIC) model, which is very different from the DGE estimates of Elgin, Kose, et al. (2021). Here, we use the re-constructed MIMIC estimates of Elgin, Kose, et al. (2021) who use the same methodology as in Medina and Schneider (2018). However, the correlation between the two series is very high. Moreover, we also use an employment-based measure, namely, self-employment (De Soto, 1989; La Porta & Shleifer, 2014 and Maloney, 2004) as another measure of the extent of shadow activities. As defined by the 1993 International Classification of Status in Employment, self-employed workers include four subcategories of jobs (as classified in WDI and ILO): employers, own-account workers, members of producers’ cooperatives, and contributing family workers and are generally seen as an indicator of informality. Finally, we also use the pension coverage as an inverse measure of shadow economy. The measure is defined as the fraction of the labor force that contributes to a retirement pension scheme (Loayza et al., 2010) and is generally suitable for analysing social security issues related to informality.

Anticipating that the size of the shadow economy is not the only factor associated with policy responses, we control for several variables that might be associated with the size of the fiscal stimulus. These are infection rate (defined by the ratio of total COVID-19 cases to population), fatality rate (the ratio of confirmed COVID-19 deaths to total cases), total health expenditures (as % of GDP), real GDP per-capita in 2019, total public debt (as % of GDP), trade openness (defined as the percentage ratio of the sum of exports and imports to GDP), level of democracy (obtained from the Polity V), 2020 growth forecast of the IMF (forecast made in April 2020 by the World Economic Outlook), as well as dummies for six different country groups, namely OECD-EU, Latin American and Caribbean, MENA, Sub-Saharan Africa, post-socialist transition economies and Australia & Asia. Finally, we also control for the degree of stringency measures (such as curfews and school closures) taken by the governments. Hale et al. (2021) provide such a measure that is updated weekly since the beginning of the pandemic.

Moreover, considering that several independent variables, most importantly, real GDP per-capita and shadow economy size might be endogenous, in addition to the benchmark estimations we also adopt an instrumental variable (IV) estimation strategy. To this end, following Estrin and Mickiewicz (2012) we assume that the shadow economy, as an embedded institution, is an outcome of a long-run equilibrium. This necessitates using

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2See https://www.ilo.org/global/topics/coronavirus/regional-country/country-responses/lang–en/index.htm.

3The cross-country correlation is 0.95 in our dataset.
instruments that can explain variation in the longer term institutions but uncorrelated with the short-run policy responses to the pandemic. A similar argument can also be made for cross-country income differences. That is why as instruments for informality we use an indicator of the number of procedures required to start a business and durability of democracy, measured by the number of years a country spent without a political regime change (similar to Estrin & Mickiewicz, 2012), as well as latitude, legal regime type (French, British, German, Scandinavian, and Post-Socialist) and the type of the political regime (presidential, semipresidential vs. parliamentarian). We test for the relevancy and exogeneity of the instruments using a number of tests when reporting the results of the IV regressions.

Finally, in systems estimation, we use three variables that are frequently used in the related literature as determinants of the shadow economy. These are current government spending (as % of GDP, obtained from the Penn World Tables 10.0) the law and order and the corruption control indices obtained from the International Country Risk Guide (ICRG). The first of these measures the strength and impartiality of the legal system as well an assessment of the popular observance of the law. The latter measures the degree to which corruption is controlled. In both cases, higher values imply better institutions.

Table 1 presents descriptive summary statistics of all variables used in the empirical analysis as well as their sources. For all the variables, we use the most-recent annual data.

3.2 | Methodology

In our benchmark cross-country regressions, we estimate the following equation using heteroskedasticity-consistent ordinary least squares estimator:

$$\text{Policy}_i = \beta_0 + \beta_1 \text{Shadow}_i + \beta_k \sum_{k=2} X_{ki} + \epsilon_i.$$  

Here, for country $i$, Policy$_i$ denotes the most recent (or the average between March 2020 and February 2021) fiscal stimulus measure (as of February 2021), Shadow$_i$ denotes the measure for shadow economy size (2019, prepandemic level$^a$), $X_{ki}$ denotes other control variables, and $\epsilon_i$ is the error term.

Utilizing the panel nature of our fiscal stimulus data series (dependent variable), we also have run some panel regressions in the following form:

$$\text{Policy}_{it} = \alpha_0 + \alpha_1 \text{Shadow}_i + \alpha_k \sum_{k=2} X_{ki} + \alpha_j \sum_{j=1} Z_{ji} + \gamma_t + \epsilon_{it}.$$  

Here, different than the cross-country regressions, $X_{ki}$ and $Z_{ji}$ denote the control variables available as a panel and cross-sectional data, respectively. $\gamma_t$ stand for the version fixed effects.

We should note here that the main independent variable, the shadow economy size is available in a cross-sectional form only; however, additionally, we can still use various variables available in panel or cross-sectional format.

A priori, we expect to have a negative value for the estimate of $\beta_1$ as well as for $\alpha_1$. On top of our benchmark regressions, we also use an IV estimation strategy to control for the potential endogeneity of shadow economy size and GDP per-capita. In this regard, we use the two-stage least squares estimator. For all IV estimations, we also report the results of the underidentification (using the Kleibergen–Paap rk LM statistic), weak identification (Cragg–Donald Wald $F$ statistic), overidentification tests (Hansen J statistic), as well as the $F$ test of the first-stage regressions. We report IV estimations both using cross-country and panel data.

$^a$Because we use the prepandemic level of the shadow economy size as the relevant independent variable here, we assume that there is no issue of a reverse-causality here.
| TABLE 1 | Descriptive summary statistics |
|---------|-------------------------------|
|         | Mean  | Std. dev | Min. | Max. | Source                     | Obs. |
| **Shadow economy measures** |       |         |      |      |                            |      |
| Shadow economy (% GDP)       | 26.41 | 11.67    | 5.00 | 58.00| Elgin, Kose, et al. (2021) | 145  |
| Shadow economy (% GDP)       | 27.99 | 11.86    | 5.40 | 58.20| Elgin, Kose, et al. (2021) using the methodology by Medina and Schneider (2018) | 145  |
| Self-employment (% employment) | 40.24 | 27.21    | 0.42 | 94.65| World Development Indicators | 165  |
| Pension coverage (% Workforce)| 45.83 | 33.83    | 0.00 | 1.00 | World Bank Pensions Data   | 127  |
| **Policy measures**          |       |         |      |      |                            |      |
| Fiscal stimulus (average) (% GDP) | 4.68  | 5.10    | −4.83| 31.97| Elgin et al. (2020)        | 168  |
| Fiscal stimulus (panel) (% GDP)| 4.68  | 5.76    | −12.80| 54.90| Elgin et al. (2020)        | 2,518|
| Fiscal stimulus V15-latest version (% GDP) | 6.76  | 7.57    | −5.00| 54.90| Elgin et al. (2020)        | 168  |
| **Control variables**        |       |         |      |      |                            |      |
| Real GDP per-capita (000 USD) | 14.77 | 20.01   | 0.02 | 110.74| World Development Indicators | 164  |
| Health expenditures          | 6.50  | 2.51    | 2.27 | 17.06| World Development Indicators | 162  |
| Government stringency        | 84.48 | 13.62   | 20.00| 97.00| Hale et al. (2021)         | 149  |
| Infection rate V15 (%)       | 1.06  | 0.30    | 0.00 | 22.85| John Hopkins University    | 164  |
| Fatality rate V15 (%)        | 2.12  | 2.53    | 0.00 | 28.98| John Hopkins University    | 164  |
| Public debt (% GDP)          | 57.64 | 33.49   | 2.50 | 237.10| World Development Indicators | 164  |
| Trade openness (% GDP)        | 88.32 | 60.33   | 0.00 | 387.10| Penn World Tables 10.0     | 168  |
| Democracy score              | 6.04  | 3.69    | 0.00 | 10.00| Polity V                    | 154  |
| **Instruments**              |       |         |      |      |                            |      |
| Procedures to start a business | 6.46  | 2.86    | 1.00 | 16.00| World Bank Doing Business Index | 166  |
| Democratic durability         | 32.25 | 33.40   | 0.00 | 209.00| Polity V Project            | 155  |
| Latitude                      | 19.95 | 24.08   | −41.28| 64.09| CIA, The World Factbook    | 168  |
| French legal dummy           | 0.55  | 0.50    | 0.00 | 1.00 | La Porta et al. (2008)     | 162  |
| British legal dummy          | 0.30  | 0.17    | 0.00 | 1.00 | La Porta et al. (2008)     | 162  |
| Scandinavian legal dummy     | 0.03  | 0.17    | 0.00 | 1.00 | La Porta et al. (2008)     | 162  |
| German legal dummy           | 0.12  | 0.32    | 0.00 | 1.00 | La Porta et al. (2008)     | 162  |

(Continues)
Moreover, to see whether several policy tools can be used to reduce the adverse effect of the shadow economy on countercyclical policy, we estimate the following system of equations using a three-stage least squares estimator:

\[
\text{Policy}_i = a_0 + \alpha_1 \text{Shadow}_i + u_i,
\]

\[
\text{Shadow}_i = b_0 + b_1 \text{Tools}_i + v_i.
\]

Here, \(\text{Policy}_i\) and \(\text{Shadow}_i\) are again defined similar to above; \(\text{Tools}_i\) refer to the policy tools (government spending, law and order, and corruption control) that may potentially affect the size of the shadow economy. Finally, \(u_i\) and \(v_i\) are the error terms.

### 4 Benchmark Results

Before proceeding with the estimation results, two visualizations of our data series are presented. Figure 1 illustrates the simple correlation between the fiscal policy size and prepandemic level of shadow economy size (both in % GDP). Here, the most recent fiscal policy package is used (as of February 2021) and the correlation between the two series is \(-0.53\). With different versions of the fiscal package series, this correlation varies between 0.48 and 0.55 from version 1 to version 15. The figure is included here to provide a visual illustration of the negative correlation that will be complemented with a fully fledged empirical analysis below.

Meanwhile, Figure 2 presents the evolution of three series between March 2020 and February 2021. These are the average GDP-weighted fiscal policy package of the whole data series for 168 countries and then two additional series that report the GDP-weighted fiscal policy package for countries having a prepandemic shadow economy size above (high-informality) and below (low-informality) the median of all countries (26% of GDP). As Figure 2 reveals, countries with a below median shadow economy size have not only announced larger packages in the beginning of the pandemic but the difference between them and countries with larger shadow economies got even wider through the course of the pandemic.

Next, Table 2 presents the benchmark cross-country regressions with the size of the fiscal package as the dependent variable. Here, we report eight regressions in total, where we stepwise add additional control variables.
on top of the shadow economy size. The first four regressions use the most recent (February 2021) version-15 of the policy package series as the dependent variable, whereas the last four use the average (between March 2020 and February 2021) across all versions. In all the regressions, the estimated coefficient of shadow economy size is significantly negative, albeit the level of the coefficient changes significantly across different regressions. A one-

**FIGURE 1** Fiscal Stimulus vs. Shadow Economy Size. Source: Informal sector size data is the DGE series (from the year 2019) from Elgin, Kose, et al. (2021). The fiscal stimulus package is from the most recent version (February 2021) of the stimulus data.

**FIGURE 2** Evolution of the Fiscal Stimulus Package. Source: Informal sector size data is the DGE series (from the year 2019) from Elgin, Kose, et al. (2021). The fiscal stimulus package is from the most recent version (February 2021) of the stimulus data.
## Table 2: Benchmark regressions of fiscal stimulus

| Variables | V15 | V15 | V15 | Avg | Avg | Avg | Avg | Avg | Avg |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| IS/C0     | 33.62*** (5.81) | 24.46*** (7.28) | 24.06*** (7.49) | 11.81** (5.04) | 24.39*** (3.84) | 15.67*** (4.54) | 12.96*** (4.64) | 6.72* (3.42) |
| Infection rate/C0 | 0.04 (0.17) | 0.20 (0.28) | 0.04*** (0.01) | 0.04*** (0.01) |
| Fatality rate | 8.03 (30.24) | 9.98 (28.15) | 2.59 (13.26) | 9.80 (14.32) |
| Public debt/GDP | 0.08* (0.04) | 0.03 (0.02) |
| Growth forecast | 0.50*** (0.15) |
| Openness | 0.01 (0.01) |
| Democracy | 0.19 (0.14) | 0.16 (0.11) |
| Stringency | 0.03 (0.03) |
| Health exp | 0.63** (0.25) | 0.35** (0.18) |
| Observations | 145 | 145 | 135 | 119 | 145 | 145 | 139 | 126 |
| R² | 0.28 | 0.42 | 0.42 | 0.64 | 0.29 | 0.45 | 0.48 | 0.61 |
| F-test | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Region dummy | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes |

Note: Robust standard errors are reported in parentheses. The dependent variable is the most recent (February 2021) version (V15) of the fiscal policy package in the first four regressions, and the average (Avg.) fiscal policy package (average of all versions between March 2020 and February 2021) in the remaining six regressions. Unless otherwise noted, regional dummies for the following regions: Australia-Asia, Latin America and Caribbean Economies, Middle East and North Africa, OECD-EU, and Post-Socialist transition economies, respectively. IS is shadow economy size (% GDP) as given by Elgin, Kose et al. (2021). Infection rate is the COVID-19 infection rate in %, fatality rate is the % case-fatality rate from COVID-19, growth forecast is the 2020 growth forecast of the IMF made in April 2020, public debt is the total level of government as % GDP. All regressions include a constant term. **p < 0.01, *p < 0.05, *p < 0.1.
percentage point increase in shadow economy size (as a % of GDP) is associated with a reduction of 0.67 to 3.3 percentage points in the size of the fiscal stimulus policy package.

In addition to the shadow economy size, two other variables that consistently have a significant coefficient are current health spending and the growth forecast of the IMF. Accordingly, countries with a higher level of prepandemic health care spending and those who in April 2020 were expected to be affected more adversely by the pandemic (according to the IMF) have announced large fiscal stimulus packages. Health care spending (as of 2019), which is mostly public spending in a large fraction of economies, is both an indicator of the level of income as well as government capacity. The positive coefficient of this variable suggests that countries that were spending more on health care before the pandemic could continue to afford spending more during the pandemic. Moreover, the negative coefficient of the growth forecast of the IMF suggests that, economies that were predicted to experience a larger negative impact, have responded to this prediction and announced larger packages.

In two regressions, where we use the average policy package size as the dependent variables, the finding is that countries with a higher infection rate are associated with a larger fiscal package, most likely because the economic crisis during the pandemic very much depends on the extent of the public health crisis. However, when the version 15 package size is used, this relationship becomes insignificant, likely because almost 1 year

### TABLE 3  Regressions with other informality measures

| Variables                  | V15  | V15  | V15  | V15  | V15  | V15  |
|----------------------------|------|------|------|------|------|------|
| IS (MIMIC)                 | −0.26*** (0.07) | −0.18*** (0.05) |      |      |      |      |
| Self-employed              |      |      |      | −0.09*** (0.03) | −0.05* (0.02) |      |
| Pension coverage           |      |      |      |      |      |      |
| Infection rate             | 0.13 (0.23) | 0.23 (0.24) | 0.20 (0.25) |      |      |      |
| Fatality rate              | −7.64 (27.70) | 3.75 (7.00) | 4.68 (7.50) |      |      |      |
| Growth forecast            | −0.34** (0.16) | −0.31* (0.16) | −0.33* (0.18) |      |      |      |
| Public debt                | 0.07* (0.04) | 0.08** (0.04) | 0.09** (0.04) |      |      |      |
| Health exp                 | 0.61** (0.29) | 0.81*** (0.28) | 0.70** (0.30) |      |      |      |
| Observations               | 145  | 129  | 165  | 138  | 127  | 109  |
| R²                         | 0.43 | 0.59 | 0.31 | 0.58 | 0.35 | 0.60 |
| F test                     | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Region dummy               | Yes  | Yes  | Yes  | Yes  | Yes  | Yes  |

Note: Robust standard errors are reported in parentheses. The dependent variable is the latest (February 2021) version (V15) size of the fiscal stimulus packages (% GDP). All regressions include a constant and dummies for the following regions: Australia-Asia, Latin America and Caribbean Economies, Middle East and North Africa, OECD-EU and Post-Socialist transition economies, respectively. IS (MIMIC) is shadow economy size (% GDP) as given by Elgin, Kose, et al. (2021) using the MIMIC method of the Medina and Schneider (2018), infection rate is the COVID-19 infection rate in %, fatality rate is the % case-fatality rate from COVID-19, growth forecast is the 2020 growth forecast of the IMF made in April 2020, public debt is the total level of government as % GDP, Health Exp. is current health expenditures in % GDP, Self-employed is the self-employment rate in % and finally, pension coverage is reported as % of workforce.

*** p < 0.01.
** p < 0.05.
* p < 0.1.
after the pandemic, several other factors in addition to the infection rate started to play a role in stimulus package size.

Table 3 repeats the regressions two and four of Table 2 with significant independent variables from Table 2 and alternative proxies of shadow economic activity, particularly with shadow economy size (as % of GDP) obtained from Elgin, Kose, et al. (2021) using the MIMIC method of Medina and Schneider (2018), self-employment and pension coverage. 5

Strikingly similar results are observed in line with the ones reported in Table 2. Particularly, countries with a larger shadow economy size, more (less) prevalent self-employment, and pension coverage have smaller fiscal stimulus packages. Other than these variables, the growth forecast of the IMF, and current health spending, have similarly significant coefficients here. Again, these coefficients are interpreted in a similar fashion to Table 2. Additionally, yet another coefficient that is consistently significant here is public debt. Somewhat surprisingly, the estimated coefficient is positive in all regressions, suggesting that countries with larger outstanding debt, could announce larger policy packages. We interpret this result with the high level of borrowing capacity, especially the ones of the European Monetary Union, of these economies.

Next, Table 4 reports results of five panel regressions. As mentioned earlier, here, the panel data version of the fiscal policy package series is used as the dependent variable.

| Variables          | (1)         | (2)         | (3)         | (4)         | (5)         |
|--------------------|-------------|-------------|-------------|-------------|-------------|
| IS                 | −24.39*** (1.10) | −15.66*** (1.27) | −15.04*** (1.28) | −14.74*** (1.25) | −8.81*** (0.98) |
| Infection rate     | 0.17*** (0.05) | 0.17*** (0.05) | 0.40*** (0.06) |             |             |
| Fatality rate      | −4.59* (2.62)  | −4.87* (2.61)  | −12.57*** (2.83) |             |             |
| Stringency         | −0.02*** (0.01) |             |             |             |             |
| Public debt        |             | 0.04*** (0.01) |             |             |             |
| Growth forecast    | −0.38*** (0.03) |             |             |             |             |
| Openness           |             | 0.01*** (0.00) |             |             |             |
| Democracy          |             |             | 0.09*** (0.03) |             |             |
| Health exp         |             |             |             | 0.36*** (0.06) |             |
| Observations       | 2174        | 2174        | 2052        | 2048        | 1854        |
| $R^2$              | 0.24        | 0.42        | 0.42        | 0.42        | 0.54        |
| F test             | 0.00        | 0.00        | 0.00        | 0.00        | 0.00        |
| Region dummy       | No          | Yes         | Yes         | Yes         | Yes         |
| Version dummy      | No          | Yes         | Yes         | Yes         | Yes         |

Note: Robust standard errors are reported in parentheses. The dependent variable is the size of the fiscal stimulus packages (% GDP). In all regressions, except the first one we control for regional dummies for Australia-Asia, Latin America and Caribbean Economies, Middle East and North Africa, OECD-EU and Post-Socialist transition economies, as well as version dummies. IS is the shadow economy size (% GDP, using the DGE method) as given by Elgin, Kose, et al. (2021), infection rate is the COVID-19 infection rate in %, fatality rate is the % case-fatality rate from COVID-19, growth forecast is the 2020 growth forecast of the IMF made in April 2020, public debt is the total level of government as % GDP, openness refers to trade openness (as % GDP), democracy is the Policy V democracy score, stringency refers to the government stringency index (quantifying stringency measures towards COVID-19), and Health Exp. is current health expenditures in % GDP.

*** p < 0.01.
** p < 0.05.
* p < 0.1.

5We only report results with the most-recent version of the policy series here, but estimations with the average policy size are highly similar.
| Variables  | V15 | V15 | V15 | V15 | Panel |
|-----------|-----|-----|-----|-----|-------|
| IS        | -44.48*** (7.21) | -34.67** (15.74) | -20.56** (10.40) | -16.04*** (5.18) | -15.80*** (5.18) |
| GDP cap.  | -42.33** (20.03) | -17.56 (13.48) | -12.16*** (2.96) | -12.00*** (2.96) | -12.00*** (2.96) |
| Infection rate | -0.56 (0.24) | 0.25 (0.20) | -0.004 (0.04) | 0.05 (0.03) | 0.05 (0.03) |
| Fatality rate  | 21.72 (38.03) | 21.56 (38.03) | 17.56 (38.03) | 17.56 (38.03) | 17.56 (38.03) |
| Growth forecast | -0.004 (0.04) | 0.05 (0.03) | 0.05 (0.03) | 0.05 (0.03) | 0.05 (0.03) |
| Stringency  | 13.7 | 13.0 | 12.0 | 11.7 | 11.7 |
| Observations | 0.25 | 0.38 | 0.47 | 0.45 | 0.45 |
| R²         | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 |
| Under-id. test | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 |
| Weak-id. test | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Version dummy | No | Yes | Yes | Yes | Yes |
| First stage F test (p-value) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Note: Robust standard errors are reported in parentheses. The dependent variable is the size of the fiscal stimulus packages (% GDP). The first four regressions use the latest version (February 2021) of the stimulus measure (V15). The fifth regression uses the average fiscal stimulus measure (Avg.) in between March 2020 and February 2021, and in the last regression, we present a panel-IV estimation using the whole panel fiscal stimulus series. IS is shadow economy size (% GDP using the DGE method), GDP-cap is real GDP per capita, infection rate is the COVID-19 infection rate, fatality rate is the % case-fatality rate from COVID-19, growth forecast is the 2020 growth forecast of the IMF made in April 2020, and stringency refers to the government stringency index (quantifying strictness measures towards COVID-19). We also report the results of the underidentification (using the Kleibergen-Paap rk LM statistic), weak identification (Cragg-Donald Wald F statistic), overidentification tests (Hansen J statistic), as well as the F test of the first-stage regressions. *p < 0.1, **p < 0.05, ***p < 0.01.
Here, on the right-hand side of the regression equation, three variables—namely, infection rate, fatality rate, and stringency index—are also available in panel format. On the other hand, shadow economy size, public debt, growth forecast, trade openness, democracy, and health spending are available only in cross-country form. Moreover, we also use regional dummies and version fixed effects in four out of five regressions. The estimations presented in Table 4, with respect to the coefficient of the shadow economy size, are similar to the previous results. The consistent significant coefficient of the shadow economy size in all five regressions indicate that a one-percentage point increase in shadow economy size (as % of GDP) is associated with a reduction of 0.88 to 2.44 percentage points in the fiscal package size.

Moreover, several other variables are also significant in the panel regressions. Particularly, we observe that countries with a higher infection rate, more expected adverse impact on growth, public debt to GDP ratio, trade openness, democracy score, and health spending have announced larger packages. On the other hand, the estimated coefficient of the case-fatality rate is negative.

We already provided some mechanism for the coefficients of public debt, growth forecast and health spending earlier. Furthermore, as for the findings of panel regressions, a higher infection rate suggests a higher exposure to the pandemic and we interpret the positive coefficient of this variable as an appropriate response of the governments to the pandemic. Furthermore, countries that are more open to international trade have announced larger packages. As for the coefficient of the democracy, Elgin, Yalaman, et al. (2021) indicate that more democratic countries adopted a larger fiscal package and this relation got stronger over time and argue that stronger media freedom in democracies can provide an explanation for this relationship. Finally, a higher (case) fatality rate, defined as the fraction of deaths out of confirmed cases, can be a proxy for the quality of the health care industry as well as the public health system in a country. The negative coefficient of this variable suggests that countries with a lower such capacity and institutional quality have announced smaller packages.

Table 5 reports the IV regressions with fiscal stimulus package as the dependent variable. It presents a total of six regressions. The first four of these use the latest (February 2021) version 15 fiscal package series as the dependent variable. The fifth one uses the average fiscal package size across all versions between March 2020 and February 202, and finally, the last one is a panel IV regression. Here, we use several different instruments for shadow economy size. We argue that our instruments for shadow economy size are highly correlated with a country’s current level of shadow economy, but it does not have a direct effect on the country’s fiscal policy response to COVID-19. Similarly, our assumption is that a country’s latitude and legal origin are associated with the country’s GDP per-capita but do not have a direct effect on its fiscal-policy response to COVID-19. In addition to these two variables, we only control for variables that are potentially exogenous by nature. These are the pandemic related variables, that is, the infection and case-fatality rates, the growth forecast of the IMF, and the government stringency measures. For all regressions, we report results of weak, underidentification, and overidentification tests, as well as the F test associated with the first stage regressions. Overall, all these tests provide support for the relevancy and exogeneity of our instruments.

In all the IV regressions, the estimated coefficient of shadow economy size is significantly negative. However, no other variable is consistently significant across all regressions. Out of the six regressions, panel-IV regression results are strikingly similar to results reported in Table 4, with a positive coefficient for the infection rate and negative coefficients for shadow economy size, fatality rate, and the growth forecast of the IMF.

5 | POLICY RECOMMENDATIONS

Results of our systems estimations provide some insights about different policy recommendations. Moreover, it also provides some ideas about the mechanism through which the size of the shadow economy is associated with stimulus measures. Particularly, we use the Law and Order and Corruption Control indices that are potentially relevant policy tools in this regard.
| Variables       | Fiscal V15       | IS   | Fiscal V15       | IS   | Fiscal V15       | IS   |
|-----------------|------------------|------|------------------|------|------------------|------|
| IS              | −44.99*** (10.39)|      | −45.74*** (11.34)|      | −36.34*** (12.28)|     |
| Infection rate  | −0.09 (0.21)     | 0.20 (0.23) |
| Fatality rate   | 25.61 (45.48)    | 3.09 (37.20) |
| Stringency      | 0.02 (0.04)      | 0.01 (0.03)  |
| Corruption      | −0.04*** (0.01)  |      | −0.04*** (0.01)  |      | −0.05*** (0.01)  |
| Law & order     | −0.04*** (0.01)  |      | −0.04*** (0.01)  |      | −0.04*** (0.01)  |
| Gov. Sp.        | −0.001 (0.002)   |      | −0.001 (0.002)   |      | −0.001 (0.001)   |
| Health exp      |                  | 0.28 (0.30) |
| Openness        |                  | 0.008 (0.01) |
| Democracy       |                  | 0.05 (0.20)  |
| Public debt     |                  | 0.10*** (0.02) |
| Growth forecast |                  | −0.57*** (0.22) |
| Region dummies  | Yes              | Yes  | Yes              | Yes  | Yes              | Yes  |
| Observations    | 120              | 120  | 111              | 111  | 103              | 103  |
| R²              | 0.40             | 0.61 | 0.40             | 0.61 | 0.64             | 0.59 |

Note: Robust standard errors are reported in parentheses. Fiscal V15 is latest (February 2021) version of the fiscal stimulus packages (% GDP) and IS is shadow economy size (% GDP) as reported by Elgin, Kose, et al. (2021). All regressions include a constant and regional dummies for the following regions: Australia-Asia, Latin America and Caribbean Economies, Middle East and North Africa, OECD-EU and Post-Socialist transition economies, respectively. Infection Rate is the COVID-19 infection rate in %, fatality rate is the % case-fatality rate from COVID-19, growth forecast is the 2020 growth forecast of the IMF made in April 2020, public debt is the total level of government as % GDP, openness refers to trade openness (as % GDP), democracy is the Policy V democracy score, stringency refers to the government stringency index (quantifying stringency measures towards COVID-19), and Health Exp. is current health expenditures in % GDP.

*** p < 0.01.
** p < 0.05.
* p < 0.1.
We report the results of the benchmark systems estimations in Table 6. This table reports estimations of three systems, which provide highly similar implications. In the first panel, fiscal policy package size is regressed on shadow economy size and a constant and simultaneously the prepandemic level of shadow economy size is regressed on government consumption, corruption control, and law and order indices. Here, we observe that better control for corruption and enforcement of law are associated with a smaller shadow economy size, which is in turn associated with a larger fiscal package. A similar result is obtained when we control for infection and fatality rates as well government stringency in the second system as well as heath spending, openness, democracy, public debt, and 2020 growth forecast of the IMF in the third system.

When interpreted together, overall, these results imply that governments concerned with the relationship between the shadow economy size and fiscal responses may adopt measures to control corruption, to increase the quality of the judicial system, and to enhance law enforcement. These results are also not surprising controlling for the literature on the determinants of informality as summarized by Elgin et al. (2020).

6 | CONCLUDING REMARKS

The COVID-19 pandemic has direct adverse effects on the economy in several different ways. Infected workers who are isolated or hospitalized cannot join the workforce, which has several supply and demand-side implications. Furthermore, the psychological effect of the pandemic leads to withdrawal from economic activity by agents who prefer to adopt the “wait and see” approach. Elgin et al. (2020) conducted a comprehensive review of different economic policy measures adopted by 166 countries in response to the COVID-19 pandemic and created a large database including fiscal, monetary, and exchange rate measures.

In this paper, the aim has been to investigate the relationship between the size of the informal economy and fiscal policy responses to the economic crisis induced by the COVID-19 pandemic. The results show that countries with a relatively larger shadow economy size adopted a substantially smaller fiscal policy package. Moreover, the instrumental variable estimations also support a robust relationship between a larger informal sector and a smaller fiscal stimulus package size. This suggests that the presence of a shadow economy constitutes a strong factor for governments' (in)ability to conduct countercyclical economic policy.

The shadow economy is characterized by insecure and fragile forms of economic activity. As a result, the size of the shadow economy in a country can exacerbate the devastating effects of the pandemic and make it harder to recover after the pandemic ends. The reactions of governments in the form of stimulus packages heavily depend on the size of informality. To mitigate the adverse effects of the pandemic in countries with larger shadow economies, law and order enforcements are very much needed.

Even though robust results are provided with respect to the effect of the informality on economic policy, as it is, this paper is silent about the exact mechanisms leading to this result. However, we believe that there might be different reasons behind this observation. First, countries with a large shadow economy generally suffer more from tax evasion. This leaves significantly less revenue for governments and limits their ability to spend in bad times. Second, even if the government may design appropriate fiscal policies, these are hard to implement when facing a large shadow economy. Informal workers or enterprises are by definition not registered with the relevant government authorities, and therefore, it is very difficult (if not impossible) to target them with appropriate policies. These are both testable explanations for our reported results, provided that one can find the relevant data series. We intend to investigate this further in future research. Moreover, we should also emphasize here that this study does not investigate the behaviour of the shadow economy size during the pandemic. Here, our main purpose is to see whether the prepandemic level of the shadow economy size has an impact on the extra stimulus measures adopted during the pandemic. But again, this could well be a potential research topic for a new paper, once more measures of the shadow economy size during and after pandemic become available.
LIST OF COUNTRIES

Afghanistan, Albania, Algeria, Angola, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei, Bulgaria, Burkina Faso, Cabo Verde, Cambodia, Cameroon, Canada, Central African Republic, Chad, Chile, China, Colombia, Democratic Republic of Congo, Republic of Congo, Costa Rica, Cote d’Ivoire, Croatia, Cyprus, Czech Republic, Denmark, Djibouti, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Estonia, Eswatini, Ethiopia, Fiji, Finland, France, Gabon, Gambia, Georgia, Ghana, Greece, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hong Kong, Hungary, Iceland, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kosovo, Kuwait, Kyrgyzstan, Laos, Latvia, Lebanon, Lesotho, Liberia, Libya, Lithuania, Luxembourg, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Montenegro, Morocco, Mozambique, Myanmar, North Macedonia, Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Rwanda, Saudi Arabia, Senegal, Serbia, Seychelles, Sierra Leone, Singapore, Slovak Republic, Slovenia, South Africa, South Korea, Spain, Sri Lanka, Sudan, Suriname, Sweden, Switzerland, Tajikistan, Tanzania, Thailand, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, United Arab Emirates, United Kingdom, Uganda, Ukraine, United States, Uruguay, Uzbekistan, Vietnam, Yemen, Zambia, Zimbabwe.

DATA AVAILABILITY STATEMENT

The data used to support the findings of this study are available from the corresponding author upon request.

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