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Governments' accounts and pandemics

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Abstract

Purpose – Early evidence suggests that coronavirus disease 2019 (COVID-19) caused a sharp deterioration in fiscal accounts worldwide. This paper empirically assesses the fiscal impact of previous pandemics and epidemics.

Design/methodology/approach – Using a large sample of 170 countries from 2000 to 2018, this study relies on Jordà's (2005) local projection method to trace pandemics' short- to medium-term dynamic impact on several fiscal aggregates.

Findings – This paper shows that (qualitatively) similar responses to those observed more recently with COVID-19 have characterized the effects of previous pandemics. While the fiscal effect has been economically and statistically significant and persistent, it varies; pandemics affect government expenditures more strongly than revenues in advanced economies, while the converse applies to developing countries. The author also finds that asymmetric responses depend on whether a country is characterized as a chronic fiscal surplus or deficit type. Another factor that generates an asymmetric fiscal response is the prevailing phase of the business cycle the economy was in when the pandemic shock hits.

Research limitations/implications – This paper's findings provide a lower bound to what the current COVID-19 pandemic will inflict on countries' fiscal situation. That said, the set of pandemics and epidemics used in this paper are geographically more concentrated and did not affect all countries in such a systemic and synchronized manner as did COVID-19 more recently.

Originality/value – This is the first paper to explore the fiscal side of this type of health-related shocks, as most of the literature has focused on the more traditional macroeconomic effects.

Keywords Fiscal policy, Pandemics, Debt, Budget balance, Local projection, Impulse response functions, Non-linearities

Paper type Research paper

1. Introduction

The COVID-19 pandemic cost lives and disrupted economic activities worldwide. As with previous pandemics and epidemics – though of different types and severity levels – higher rates of illness and death tested the capacities of health systems. Governments were called upon to fulfill one of their Musgravian roles and use its main instrument, fiscal policy, to help

JEL Classification — C33, C36, E32, E62, H20

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counteract the negative consequences (from a health, economic and social standpoint) of such a shock. According to the standard Keynesian logic, fiscal stimulus in a crisis, either by increasing government spending or cutting taxes, has been found to speed up economic recovery (see Gourinchas, 2020). More generally, fiscal policy has been proposed as an effective way to address crises, such as during the zero-lower bound period and in times of secular stagnation (see Eggertsson, 2011; Eggertsson and Krugman, 2012; Eggertsson *et al.*, 2016; Fatas and Summers, 2018; Fornaro and Wolf, 2020).

In contrast with previous pandemics such as SARS or Zika, in the COVID-19 pandemic – given its speed and systemic nature – confinement measures to control the spread of the virus disrupted trade between and within countries. The closure of schools and childcare services affected the ability of parents to work. Production and employment consequently fell in most countries. Governments imposed lockdowns with varying degrees of stringency to prevent the spread of the virus. The general population also sought to reduce exposure to the virus through voluntary social distancing. The result was a dramatic contraction in economic activities in 2020, with global GDP estimated to have declined by 3.5% (IMF, 2021). In many advanced and developing economies, the rebound in 2021 did not restore the pre-crisis GDP in 2019.

At the same time, private and public debt levels were already at record highs before the COVID-19 pandemic and surged further in 2020. According to IMF (2021), global public debt rose by about 19 percentage points of GDP in 2020 among advanced economies. The increase reflected the deficit rise due to the automatic stabilizers as economic growth collapsed and the discretionary policy measures governments undertook to respond to the health crisis.

Against this background, while previous literature has been fueled to explore the macroeconomic consequences of pandemics (by looking at the impact on output, its components, inflation or labor market variables), the fiscal dimension has received less attention, which is a gap we aim to bridge with this paper. In an environment where most countries faced – until very recently – meagre interest rates (so monetary policy lacked effectiveness), fiscal policy retains a crucial role in mitigating a pandemic's overall economic (and social) impact and promoting a quick recovery afterward. The drawback of this is the inevitable upward pressure on government finances, which tends to be negatively reflected immediately and significant (as revenue falls due to contraction in tax bases and expenditure expands to capacitate public health services and other public services). Hence, understanding empirically how specific fiscal aggregates were affected by past pandemics is vital for policymakers and could inform what is likely to unfold following COVID-19 (even if as a lower bound). In this paper, we specifically study the short- to the medium-term fiscal impact of the last five pandemics in 170 countries between 2000 and 2018 using local projections. This paper relates to the literature on the economic effects of pandemics and epidemics (e.g. Brainerd and Siegler, 2003; Jonung and Roeger, 2006 or, more recently, Barro *et al.*, 2020; Eichenbaum *et al.*, 2020; Ma *et al.*, 2020; Jordà *et al.*, 2022) and on the role of crises and recessions in affecting fiscal variables (European Commission (2009a) [1].

Our key results can be summarized as follows. The short to the medium-term fiscal impact of pandemics is significant and persistent in our sample of 170 countries during the 2000–2018 period. Public debt rises close to 4 percentage points of GDP in the first year after the pandemic, and the impact's magnitude increases over time and is long-lasting. The long-lasting negative toll pandemics have on the budget is explained mainly by a significant fall in revenues in the case of developing countries. This contrasts with the situation in advanced economies where revenues are not statistically significantly affected as much, but expenditures do rise. We also find that asymmetric responses depend on whether a country is characterized as a chronic fiscal surplus or deficit type. Another factor that generates an asymmetric fiscal response is the prevailing phase of the business cycle the economy was in when the pandemic shock hits. Our results are robust to several robustness checks.

The remainder of the paper is structured as follows. Section 2 discusses the relevant literature. Section 3 presents the empirical strategy followed to study the dynamic response of fiscal variables to past pandemic shocks and presents the data together with key stylized facts. Section 4 discusses our empirical results. Section 5 concludes and elaborates on the policy implications.

2. Literature review

This paper relates to two main strands of literature.

The first is the literature on the economic effects of pandemics. Studies of past pandemics' macroeconomic impact and other major diseases (such as SARS and HIV/AIDs) have typically quantified the resulting short-term loss in output and growth [2], [3]. However, there is little consensus on the economic consequences of pandemics. Results critically depend on the models used and on the availability of data (Bell and Lewis, 2004). Brainerd and Siegler (2003), studying the economic effects of the Spanish flu, suggested that the 1918/19 pandemic in the US increased growth in the 1920s.

In contrast, Almond and Mazumber (2005) argued that the Spanish flu had long-term adverse effects through its impact on fetal health. Using a theoretical model, Young (2005) argued that the AIDS epidemic in South Africa would increase net future per capita consumption, while Bell *et al.* (2006) found strong adverse effects. Jonung and Roeger (2006) estimated the macroeconomic effects of a pandemic using a quarterly macro-model constructed and calibrated for the EU-25 as a single economic entity. The recent literature on this topic, motivated by the COVID-19 pandemic, provides evidence of significant and persistent effects on economic activity (e.g. Atkeson, 2020; Barro *et al.*, 2020; Eichenbaum *et al.*, 2020). Ma *et al.* (2020), in an empirical analysis of the economic effects of past pandemics, found that real GDP is 2.6% lower on average across 210 countries in the year the outbreak is officially declared and remains 3% below pre-shock level five years later. Moreover, according to Jordà *et al.* (2022), significant macroeconomic after-effects of pandemics persist for decades, with real rates of return substantially depressed. Pandemics induce relative labor scarcity in some areas and/or a shift to more significant precautionary savings.

The second strand of the literature is on the role of crises and recessions in affecting fiscal variables (European Commission, 2009a). Financial crises have induced governments around the globe to take decisive action to sustain economic activity and prevent the meltdown of the financial sector. These actions had direct and indirect fiscal costs. Direct fiscal costs from actions from financial system rescue packages (such as capital injections, purchases of toxic assets, subsidies, and payments of called-upon guarantees) resulted in permanent decreases in the government's net worth (such interventions result in higher public debt, which either show up as an increase in stock flow debt-deficit adjustments or as higher deficits) (Attinasi *et al.*, 2010; European Commission, 2009b). There also are indirect fiscal costs, i.e. due to the feedback loop from the crisis to economic activity. These involve lower revenues due to falling profits and asset prices, higher expenditure to counter the impact of the crisis, as well as interest rate and exchange rate effects due to market reactions (European Commission, 2009b). European Commission (2009b), building on fiscal reaction functions in the spirit of Gali and Perotti (2003), found that the bulk of the effect of crises on debt changes takes place during the first two years.

Moreover, the impact of financial crises on debt was more significant in emerging market economies than in the EU or other OECD countries. Building on a banking crises dataset by Laeven and Valencia (2008), several empirical studies have investigated the effect of crises on the debt-to-GDP ratio and GDP growth (Furceri and Zdzienicka, 2012a, 2012b; Reinhart and Rogoff, 2009). Furceri and Zdzienicka (2012a), using a panel of 154 countries from 1980–2006, showed that banking crises are associated with a significant and long-lasting increase in government debt and that such increase is a positive function of higher initial indebtedness levels – so initial conditions matter. Employing different modeling techniques, Tagkalakis (2013) found

significant econometric evidence that fiscal positions deteriorated during financial crises in 20 OECD countries over the 1990–2010 period. Several other studies investigated the direct financial implications of past banking system support schemes (Honoghan and Klingebiel, 2003), the determinants of fiscal recovery rates (European Commission, 2009b), as well as whether costly fiscal interventions reduced output loss (Claessens *et al.*, 2005; Detragiache and Ho, 2010) [4].

3. Empirical methodology and data

3.1 Empirical approach

To estimate the response of fiscal variables to major pandemic shocks, we follow Jordà's (2005) local projection method [5]. This approach to estimating impulse-response functions has been advocated by Auerbach and Gorodnichenko (2013) and Romer and Romer (2019) as a flexible alternative to vector autoregressions and autoregressive distributed models, better suited to estimating non-linear effects – such as, in our context, those associated with the interactions between pandemics and macroeconomic conditions [6]. The baseline specification takes the form:

$$y_{t+k,i} - y_{t-1,i} = \alpha_i + \beta_k pand_{i,t} + \theta X_{i,t} + \varepsilon_{i,t} \quad (1)$$

i denotes the cross-sectional unit, i.e. the number of countries, and t denotes the time in years. y is the dependent fiscal variable of interest, in particular public gross debt, total government revenues, total government expenditures, overall budget balance, public consumption expenditure, public investment expenditure, social spending, direct taxes, indirect taxes and non-tax revenue (all expressed in percent of GDP); β_k denotes the (cumulative) response of the variable of interest in each k year after the pandemic shock; α_i are country fixed effects, included to take account for cross-country heterogeneity; $pand_{i,t}$ denotes the pandemic shock from Ma *et al.* (2020). All pandemic shocks featured in our analysis are country-wide shocks. Pandemic shocks are treated as exogenous events as they cannot be anticipated nor correlated with past changes in economic activity. In large-scale epidemics, effects will be felt across whole economies or wider regions for two reasons: widespread infection or trade/market integration eventually propagate the economic shock across borders. $X_{i,t}$ is a set of control variables, including two lags of pandemic shocks, two lags of real GDP growth, two lags of CPI inflation rate and two lags of the relevant fiscal dependent variable.

Equation (1) is estimated using OLS with robust standard errors clustered at the country level. Impulse response functions (IRFs) are then obtained by plotting the estimated β_k for k = 0,1,..,5 with 90 (68) percent confidence bands computed using the standard deviations associated with the estimated coefficients β_k. This relates to Figure 2 and subsequent ones.

We also explore whether initial economic conditions at the time of the pandemic shock influence its effect on fiscal outcomes. We implement this by allowing the response to varying as follows:

$$y_{i,t+k} - y_{i,t-1} = \alpha_i + \beta_k^L F(z_{i,t}) pand_{i,t} + \beta_k^H (1 - F(z_{i,t})) pand_{i,t} + \boldsymbol{\theta}' \boldsymbol{X}_{i,t} + \varepsilon_{i,t} \quad (2)$$

with $F(z_{it}) = \frac{\exp(-\gamma z_{it})}{1+\exp(-\gamma z_{it})}, \gamma > 0$

in which z_{it} is an indicator of economic activity (proxied by the output gap) normalized to have zero mean and unit variance [7]. The coefficients β_L^k and β_H^k capture the fiscal impact of pandemics at each horizon k in cases of recessions ($F(z_{it}) \approx 1$ when z goes to minus infinity) and expansions ($1 - F(z_{it}) \approx 1$ when z goes to plus infinity), respectively. We choose $\gamma = 1.5$ [8]. Despite substantial progress in methodologies to calculate potential output, there is still not a widely accepted approach (Borio *et al.*, 2013). Mindful of the criticisms surrounding the

use of the Hodrick–Prescott (HP) filter (such as the identification of spurious cycles – Cogley and Nason, 1995), the state of the economy is measured by the output gap computed via the recent Hamilton (2018) filter to maximize the coverage since the IMF WEO output gap is relatively limited for developing countries.

As discussed in Auerbach and Gorodnichenko (2012, 2013), the local projection approach to estimating non-linear effects is equivalent to the smooth transition autoregressive (STAR) model developed by Granger and Teräsvirta (1993). The advantage of this approach is twofold. First, compared with a model in which each dependent variable would interact with a measure of the business cycle position, it permits a direct test of whether pandemics' effect varies across regimes such as recessions and expansions. Second, compared with estimating structural vector autoregressions for each regime, it allows the effect of pandemic shocks to change smoothly between recessions and expansions by considering a continuum of states to compute the IRFs, thus making the response more stable and precise.

3.2 Data and stylized facts

We employed a heterogeneous unbalanced sample of 170 countries from 2000 to 2018. The key regressor in the study of fiscal consequences of pandemics is taken from the dataset on pandemics/epidemics put together by Ma *et al.* (2020); this dataset starts in 2000 and covers SARS in 2003; H1N1 in 2009; MERS in 2012; Ebola in 2014 and Zika in 2016. We constructed a dummy variable, the pandemic event or shock, which takes the value 1 when the World Health Organization declares a pandemic for the country and zero otherwise. The list of countries that are affected by each event is given in Table 1.

Fiscal and macroeconomic variables come from the IMF's World Economic Outlook (WEO) database. Specifically, the following variables were compiled from this source: real GDP growth (in percent), CPI inflation rate (in percent), gross public debt, total government revenues, total government expenditures, overall budget balance, public consumption

Starting year	Event name	Affected countries	Number of countries
2003	SARS	AUS, CAN, CHE, CHN, DEU, ESP, FRA, GBR, HKG, IDN, IND, IRL, ITA, KOR, MNG, MYS, NZL, PHL, ROU, RUS, SGP, SWE, THA, TWN, USA, VNM, ZAF	27
2009	N1H1	AFG, AGO, ALB, ARG, ARM, AUS, AUT, BDI, BEL, BGD, BGR, BHS, BIH, BLR, BLZ, BOL, BRA, BRB, BTN, BWA, CAN, CHE, CHL, CHN,CIV, CMR, COD, COG, COL, CPV, CRI, CYP, CZE, DEU, DJI, DMA, DNK, DOM, DZA, ECU, EGY, ESP, EST, ETH, FIN, FJI, FRA, FSM, GAB, GBR, GEO, GHA, GRC, GTM, HND, HRV, HTI, HUN, IDN, IND, IRL, IRN, IRQ, ISL, ISR, ITA, JAM, JOR, JPN, KAZ, KEN, KHM, KNA, KOR, LAO, LBN, LCA, LKA, LSO, LTU, LUX, LVA, MAR, MDA,MDG, MDV, MEX, MKD, MLI, MLT, MNE, MNG, MOZ, MUS, MWI, MYS, NAM, NGA, NIC, NLD, NOR, NPL, NZL, PAK,PAN, PER, PHL, PLW, PNG, POL, PRI, PRT, PRY, QAT, ROU, RUS, RWA, SAU, SDN, SGP, SLB, SLV, STP, SVK, SVN, SWE, SWZ, SYC, TCD, THA, TJK, TON, TUN, TUR, TUV, TZA, UGA, UKR, URY, USA, VEN, VNM, VUT, WSM, YEM, ZAF, ZMB, ZWE	148
2012	MERS	AUT, CHN, DEU, EGY, FRA, GBR, GRC, IRN, ITA, JOR, KOR, LBN, MYS, NLD, PHL, QAT, SAU, THA, TUN, TUR, USA, YEM	22
2014	Ebola	ESP, GBR, ITA, LBR, USA	5
2016	Zika	ARG, BOL, BRA, CAN, CHL, COL, CRI, DOM, ECU, HND, LCA, PAN, PER, PRI, PRY, SLV, URY, USA	18
		Total Pandemic and Epidemic Events	220

Source(s): Based on Ma *et al.* (2020)

Table 1.
List of pandemic and epidemic episodes, 2000–2018

expenditure, public investment expenditure, social spending, direct taxes, indirect taxes and non-tax revenue (fiscal variables expressed in percent of GDP).

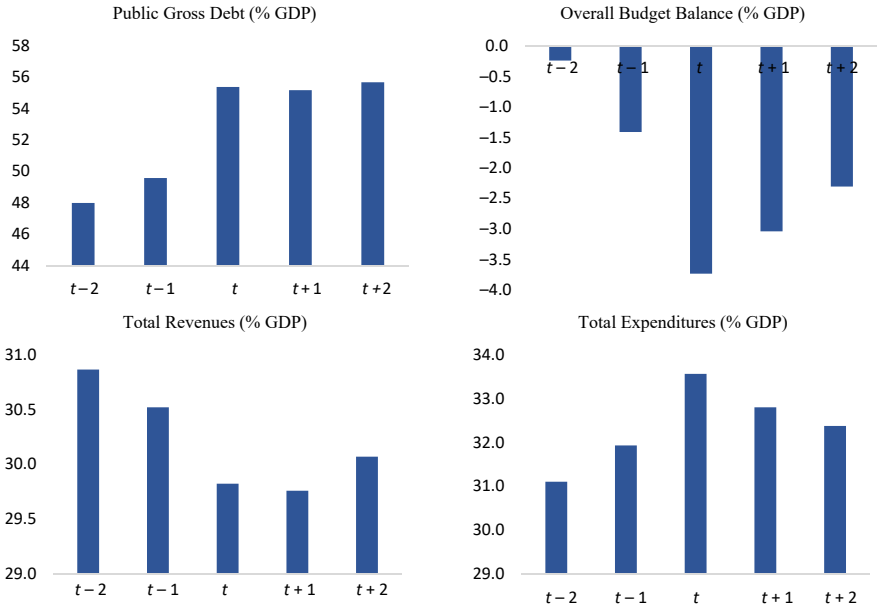
Figure 1 plots the unconditional evolution of key fiscal aggregates before, during and after the pandemic shock. Note that this exercise is a simple event-study type of graphical depiction of the dynamics of the debt, overall balance, expenditures and revenues before and after a pandemic shock hit; it is not the result of estimating Equations (1) or (2). We observe from this unconditional association that economic growth goes down while debt goes up, and the overall fiscal balance deteriorates due to both a revenue fall and an expenditure increase. These movements are somewhat persistent over time.

4. Empirical results

4.1 The fiscal consequences of pandemics

Figure 2 shows the results of estimating Equation (1) for alternative fiscal dependent variables. The 90 and 68 percent confidence bands are shown together with the fiscal response [9]. We see that public debt rises close to 4 percentage points of GDP in the first year after the pandemic event and reaches a cumulative of close to 8 percentage points of GDP after five years, meaning that the pandemic impact is non-negligible and long-lasting. This is *a priori*, not a surprise since debt is a stock variable resulting from budget deficit accumulations. As with the case of COVID-19, more recently, the level of fiscal stimulus is significant in the face of such shocks (IMF, 2021; Romer, 2021). This is confirmed by the IRF of the budget balance, which deteriorates immediately, reaching a deficit of 2.4% of GDP in the first year to start improving slowly later until it stabilizes at a level worse off than before the pandemic – at about −1.3% of GDP.

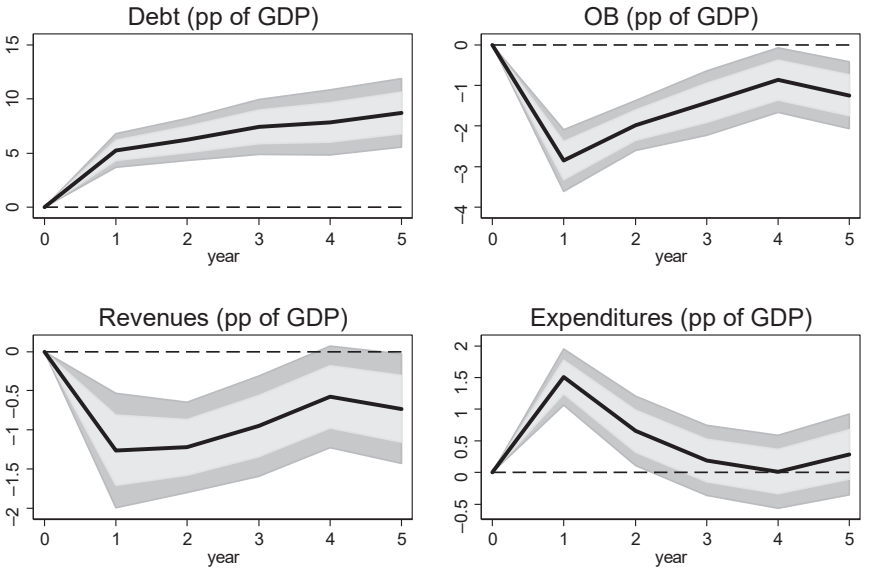
This deterioration in the budgetary position reflects a combined effect of a revenue fall and an increase in expenditure of about 1% of GDP. The natural operation of automatic stabilizers



Note(s): *x*-axis in years; $t = 0$ is the year of the pandemic shock

Source(s): Author's calculations

Figure 1.
Evolution of fiscal variables around pandemics



Note(s): x-axis in years; $t = 0$ is the year of the pandemic shock; $t = 1$ is the first year of impact. Solid black lines denote the response to a pandemic shock, a dark grey area denotes 90% confidence bands, while a light gray areadenotes 68% confidence bands based on standard errors clustered at the country level. How to read:when the response (solid black line) is all positive or negative together with top and bottom confidence bands, the effect is said to be statistically significantly different from zero

Figure 2.
Impact of pandemics on fiscal variables (% GDP)

and discretionary fiscal policy actions are sufficient reasons to explain these dynamics. Due to more limited production and consumption activities, tax bases are eroded and tax collection is reduced. At the same time, expenditure rises to support increasing needs from the public health sector and address social problems (related to unemployment or subsistence assistance). The effect on expenditure dissipates from the third year onwards, while for revenues, it takes about five years for the negative impact to become statistically not different from zero.

Splitting the sample of 170 countries between advanced and developing economies yields results shown in Figure 3 [10]. The negative toll pandemics have on the budget is long-lasting in the case of developing countries, explained mainly by a significant revenue fall. This contrasts with advanced economies where revenues are not affected as much but expenditures increase owing to the natural operation of automatic stabilizers, which are more prominent in this group of countries. While the shape can be similar in the cases of debt, overall balance and expenditure, the magnitudes are different. This relates to different initial fiscal conditions, as typically, the state is smaller in developing countries, and tax systems are underdeveloped (many do not even have VAT, for instance). Also, in advanced economies, public sector efficiency, governance and fiscal institutions provide different anchors for more effective fiscal management, aspects typically insipient in other parts of the world [11]. Appendix Figure A1 provides results for additional regional splits and alternative country groupings [12]. We observe that the negative fiscal effect of pandemics is the largest in low-income countries, mainly driven by countries in the Sub-Saharan Africa region: the debt ratio rises close to 20 pp of GDP 5 years after the shock. This is where the ability to countercyclical

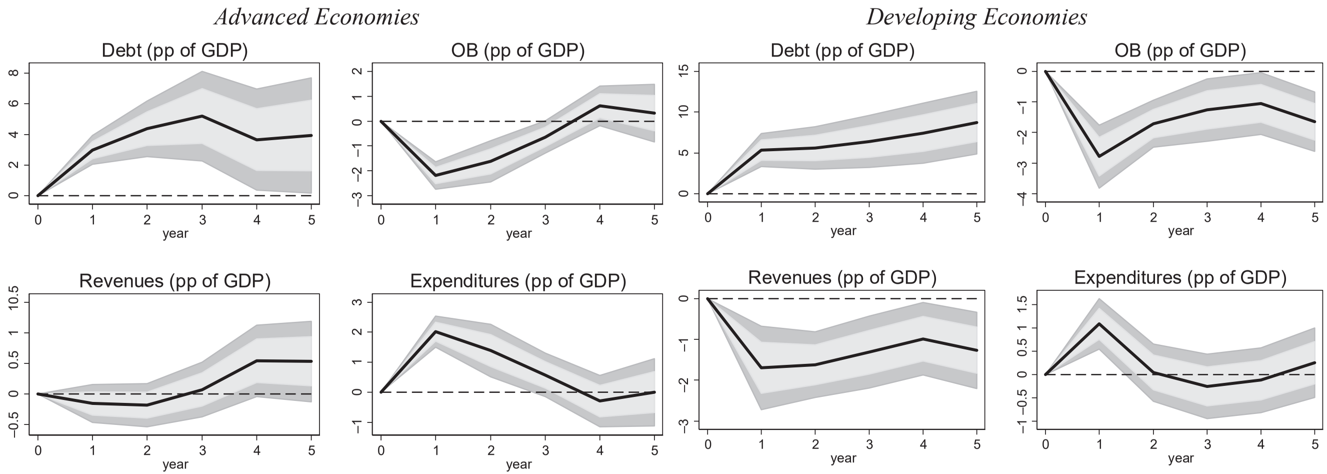


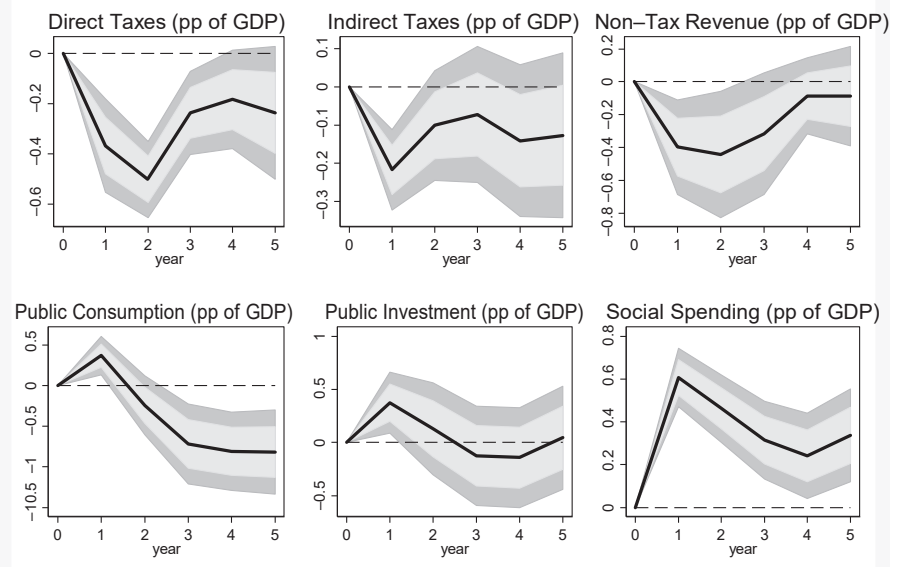
Figure 3. Impact of pandemics on fiscal variables across income groups (% GDP)

Note(s): x-axis in years; $t = 0$ is the year of the pandemic shock; $t = 1$ is the first year of impact. Solid black lines denote the response to a pandemic shock, a dark grey area denotes 90% confidence bands, while a light gray area denotes 68% confidence bands based on standard errors clustered at the country level. How to read: when the response (solid black line) is all positive or negative together with top and bottom confidence bands, the effect is said to be statistically significantly different from zero

Source(s): Author's calculations

fiscal policy is more limited – in contrast with advanced economies – as fiscal frameworks and institutions are less developed. The significant increase will likely reflect discretionary fiscal actions above the line. This effect is roughly halved for the same five years for commodity exporters, while indebtedness is not affected in fragile states. There are also some differences with respect to the budgetary components: for instance, revenues fall in Sub-Saharan Africa by 5 pp of GDP one year after the shock, but there is statistically no impact in the case of fragile states; the reverse effect is actual for expenditures that rise 3 pp of GDP in fragile states one year after the pandemic shock but remain quantitatively not different from zero in Sub-Saharan Africa.

A relevant question is whether a particular component of revenues and expenditures is driving the effect on the budget. In this regard, we decompose revenues into direct taxes, indirect taxes, and non-tax revenues and expenditures into public consumption, public investment and social spending (all expressed in percent of GDP). Looking at Figure 4 – for the entire sample – we observe that the fall in revenue is mainly driven by a drop in direct taxes followed by a decline in non-tax revenues (such as grants). The elasticity of tax revenues to GDP likely matters, and it is typically more significant for PIT and CIT (see Gupta *et al.*, 2022). The expenditure increase, in turn, is mainly the result of the operation of automatic stabilizers, that is, the jump in the social spending envelope. This effect is larger in magnitude, the bigger the size of government. Stabilizers are more prominent in recessions or crises – such as a pandemic (see Furceri and Jalles, 2018; Jalles, 2020).



Note(s): *x*-axis in years; $t = 0$ is the year of the pandemic shock; $t = 1$ is the first year of impact. Solid black lines denote the response to a pandemic shock, a dark grey area denotes 90% confidence bands, while a light gray area denotes 68% confidence bands based on standard errors clustered at the country level. How to read: when the response (solid black line) is all positive or negative together with top and bottom confidence bands, the effect is saidto be statistically significantly different from zero

Source: Author's calculations

Figure 4.
Impact of pandemics on revenue and expenditure components (% GDP), all countries

4.2 Robustness and extensions

Several sensitivity exercises and robustness checks were conducted.

The first consisted of separating the five pandemics/epidemics and evaluating their effects. Results in Appendix Figure A2 in the Appendix show that N1H1 is the past pandemic that contributes most of the rise in debt. It is also the one that affected more countries (148, according to Table 1).

4.2.1 Controlling for additional short-term drivers of fiscal variables. Secondly, a possible concern regarding the analysis is that the results may suffer from omitted variable bias. To address this issue, we expand the set of controls to include other macroeconomic variables typically found to affect fiscal outcomes. In particular, we include (lagged): (1) trade openness (% GDP); (2) real effective exchange rate; (3) fiscal rules index and (4) the Chinn-Ito index of capital controls [13]. The results obtained with this analysis are shown in Figure 5 (panel a) and are very similar to, and not statistically different from, those obtained in the baseline specification, suggesting that this source of omitted variable bias is likely to be negligible in our setting.

4.2.2 Cross-sectional dependencies. Third, we re-estimated equation (1) with a Driscoll-Kraay (1998) robust standard error to mitigate cross-sectional dependency concerns. This non-parametric technique assumes the error structure to be heteroskedastic, autocorrelated to some lag, and possibly correlated between the groups. Results – shown in Figure 5 (panel b) – are qualitatively similar, suggesting cross-sectional dependence is not a major issue in our setting.

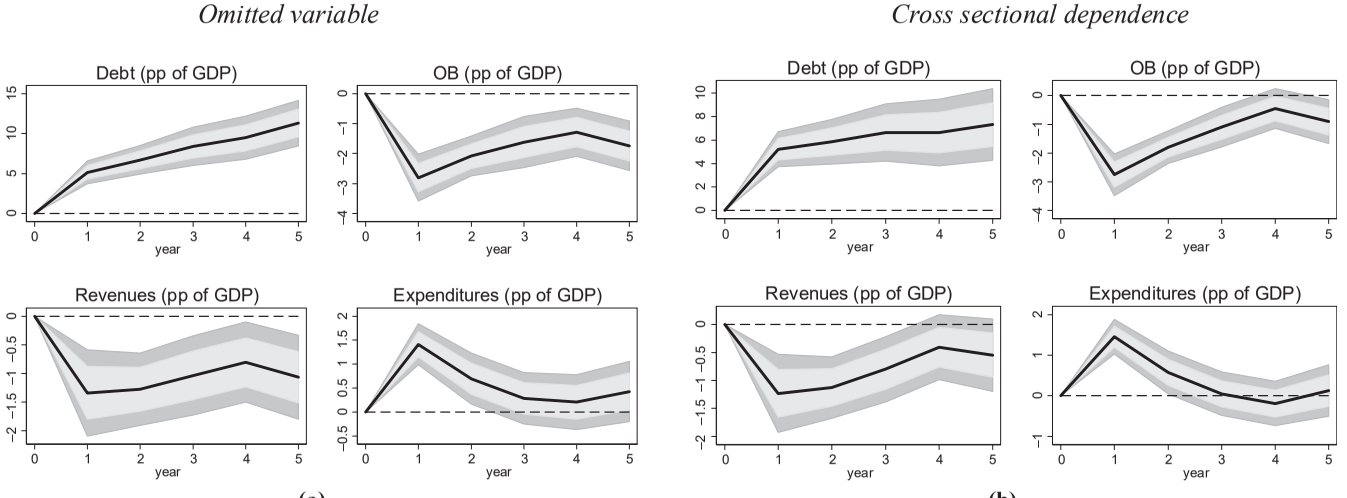
As far as extensions are concerned, we explored two aspects, namely whether different fiscal responses depend on the fiscal track record of a country, that is, being chronically a surplus or deficit country, and second, if the position of the economy in the cycle matters for the fiscal response after a pandemic shock.

4.2.3 Chronic surplus vs chronic deficit countries. In addition to distinguishing between advanced and emerging markets and developing economies, we tried another way to introduce heterogeneity, splitting the sample between countries that have run chronic fiscal surpluses versus chronic fiscal deficits. The results are shown in Figure 6 and illustrate a sharp asymmetry between the responses of the two groups of countries. A pandemic shock raises the debt level more in deficit economies (statistically significantly one year after the shock fades away) than in surplus countries (statistically significantly throughout the horizon period). In deficit countries, revenues fall by much more following a pandemic shock, while in surplus countries, the effect is statistically not different from zero. All in all, this particular asymmetric response implies that a pandemic exacerbates any existing fiscal imbalances.

4.2.4 The role of the business cycle. Our final exercise examines the role played by initial conditions during the pandemic shock related to the business cycle phase – Figure 7. In bad times, pandemics seem to have a less damaging effect on debt than in expansionary times. However, some caution is needed as the magnitude of these results may depend on the definition of recession used. As a final robustness check, we also considered recessions identified: (1) a binary variable taking the value one in years with negative real GDP growth; (2) those produced by the Harding and Pagan (2002) algorithm to identify economic turning points. The latter is meant to capture severe or deep recessions, as Blanchard *et al.* (2015) labeled. As seen in Appendix Figure A3, the rise in debt in good times is still smaller in magnitude than that in bad times using either of the alternative approaches. However, in bad times and contrast with the result in Figure 7, the conditional IRFs are above the unconditional ones, suggesting a more significant financial impact during recessions following a pandemic. What is unambiguous across all approaches is that debt rises following a pandemic shock in both cases (recessions or expansions).

Still inspecting Figure 7, the overall balance conditional effect is not statistically different from the baseline result. However, this fiscal aggregate masks some differentiated effects in its components, namely that in good times, expenditures seem to fall following a pandemic shock (contrary to the baseline), but a great deal of uncertainty surrounds the effect.

Figure 5.
Robustness: Impact of pandemics on fiscal variables (% GDP)



Note(s): *x*-axis in years; $t = 0$ is the year of the pandemic shock; $t = 1$ is the first year of impact. Solid black lines denote the response to a pandemic shock, a dark grey area denotes 90% confidence bands, while a light gray area denotes 68% confidence bands based on standard errors clustered at the country level. How to read: when the response (solid black line) is all positive or negative together with top and bottom confidence bands, the effect is said to be statistically significantly different from zero

Source(s): Author's calculations

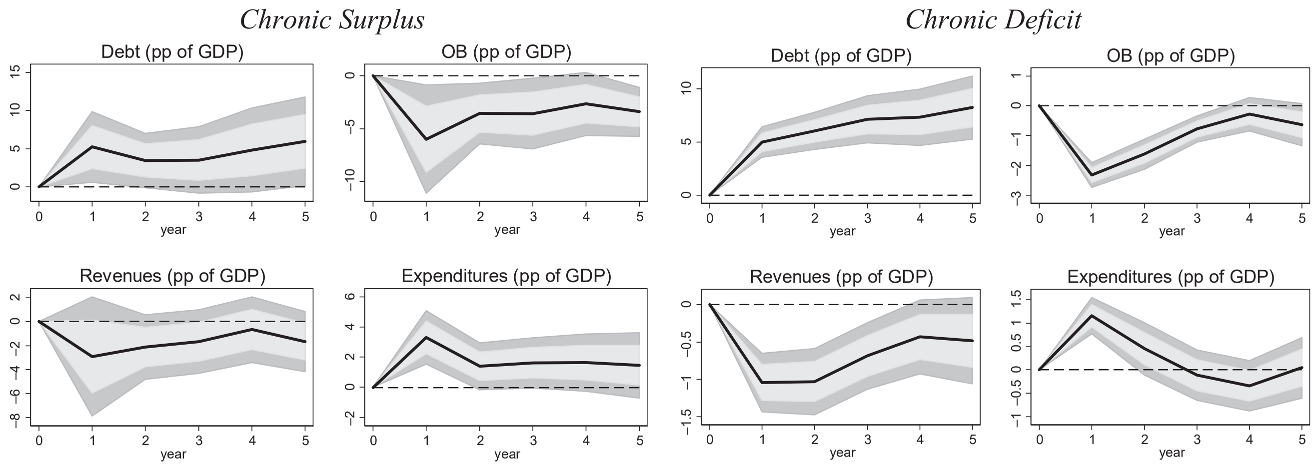
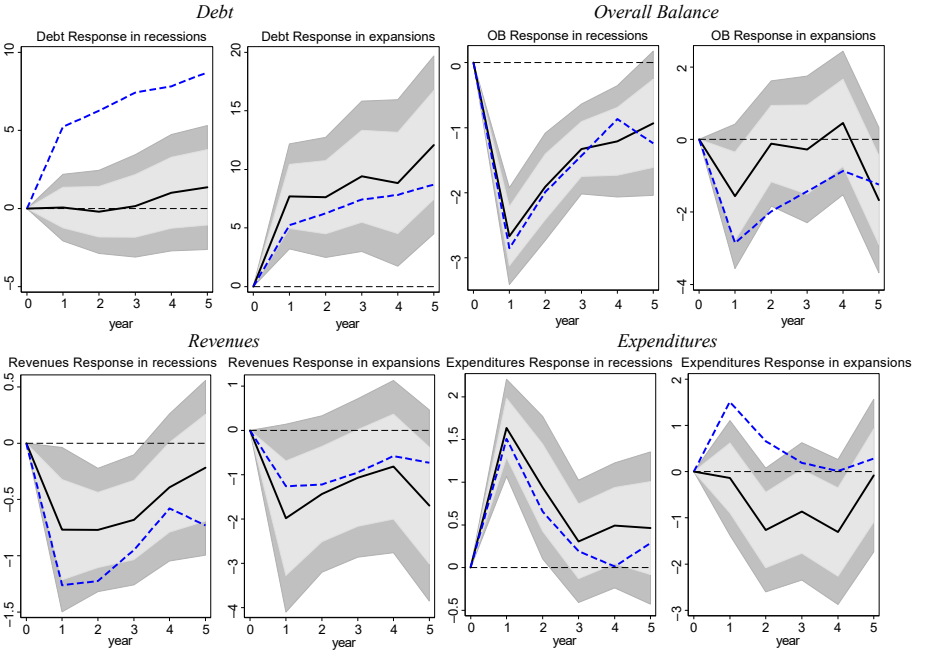


Figure 6.
Impact of pandemics on fiscal variables in chronic surplus vs chronic deficit countries (% GDP), all countries

Note(s): x-axis in years; $t = 0$ is the year of the pandemic shock; $t = 1$ is the first year of impact. Solid black lines denote the response to a pandemic shock; a dark grey area denotes 90% confidence bands, while a light gray area denotes 68% confidence bands based on standard errors clustered at the country level. How to read: when the response (solid black line) is all positive or negative together with top and bottom confidence bands, the effect is said to be statistically significantly different from zero

Source(s): Author's calculations



Note(s): *x*-axis in years; $t = 0$ is the year of the fiscal consolidation shock; $t = 1$ is the first year of impact.Solid blacklines denote the response to a pandemic shock, a dark grey area denotes 90% confidence bands, while a light gray area denotes 68% confidence bands based on standard errors clustered at the country level. The blue line denotes the unconditional baseline result. How to read: when the response (solid black line) is all positive or negative together with top and bottom confidence bands, the effect is said to be statistically significantly different from zero

Source(s): Author's calculations

Figure 7.
Impact of pandemics on fiscal variables: the role of the business cycle (% GDP), all countries

5. Conclusion

The outpouring of research has greatly advanced our understanding of the economic effects of pandemics in this area following the COVID-19 global shock. However, one area that remains relatively unexplored is how such shocks directly affect fiscal variables. The present paper attempted to provide additional insights on this issue.

Using data from 170 countries, we estimated the short- and medium-term fiscal effects of five (pre-COVID-19) 21st-century major global pandemic/epidemic shocks using the local projection method. Our results suggest that the fiscal landscape of countries is likely to alter due to the COVID-19 pandemic. We believe that this paper's findings provide a lower bound to what the current pandemic is likely to inflict on countries. The paper showed that the fiscal effect varies, with pandemics affecting government expenditures more than revenues in advanced economies, while the converse applies to emerging markets and developing countries. The two sources of revenue that are affected the most are direct taxes and non-tax revenues. The former plays a more significant role in advanced and the latter in emerging markets and developing economies. We also find that asymmetric responses depend on whether a country is characterized as chronic fiscal surplus or deficit type, namely that a pandemic exacerbates any pre-existing fiscal imbalances. This pattern is consistent with the

widening of fiscal imbalances observed after COVID-19, even though our data do not include that recent episode. In that sense, the fiscal effects of COVID-19 appear to be qualitatively similar to those of the previous shocks we study, and this paper could be seen as providing lower-bound results of what COVID-19 is expected to inflict. Our results also showed that another factor that generated an asymmetric response was the prevailing phase of the business cycle the economy was in when the shock hit. Specifically, the business cycle seems to matter, with debt not rising in bad times following a pandemic shock.

While generally justified, the necessary fiscal impulse in many countries following a pandemic shock can limit fiscal space and future fiscal actions if anti-debt sentiment emerges or reemerges (Romer, 2021). This is particularly sensitive in the case of developing countries where fiscal credibility effects seem to matter more. Given the large leverage COVID-19 generated, this fiscal room for maneuver is even more limited nowadays. Hence, going forward, policymakers should reconsider their revenue-raising strategy in favor of an approach that embraces a comprehensive (tax) reform package, including policies that have encountered political opposition in the past. For developing countries, this is even more pressing in the face of heightened challenges to fulfill the Sustainable Development Goals (SDGs). Mobilizing public and private resources in financing the SDGs is essential for the socio-economic recovery from COVID-19 and long-term development (ADB, 2021). Moreover, as it disproportionately affects the poor and vulnerable, policymakers should work towards more progressive tax systems.

We believe our findings provide fertile ground for future research. Such work could consider exploring more closely the role of fiscal space and fiscal institutions (fiscal rules and their design features) in affecting the magnitude of responses to this or other types of exogenous shocks. The role of monetary conditions could also be explored as an essential factor insofar as the monetary–fiscal nexus could dictate having a more active or passive fiscal response. Finally, an area that could benefit attention is the role of pandemics in affecting the degree of fiscal decentralization to better reach people in need.

Notes

1. Note that there is little consensus on economic consequences of pandemics. Results critically depend on the models used and on the availability of data (Bell and Lewis, 2004). See section 2 for further discussion.
2. Even then, direct measures based on data from past episodes are not generally available (e.g. in the US, see Meltzer *et al.*, 1999). An alternative would be to look at microeconomic outcomes for a given population in response to episodes for which high-quality administrative data are available (e.g. in Sweden Karlsson *et al.*, 2014). Absent such data, economic historians have to use more aggregated data at the regional or national level to study the relationship between pandemic incidence and economic outcomes (e.g. the 1918 flu epidemic across the US states, see Brainerd and Siegler, 2003).
3. For a historic view of pandemics, see Kenny (2021).
4. Claessens *et al.* (2005) explored the relationship between intervention policies and the economic and fiscal costs of crises. Costs were measured by the output loss relative to trend during the crisis episode. Detragiache and Ho (2010) found that crisis response strategies that commit more fiscal resources did not lower the economic costs of crises, and in some cases, they led to worse post crisis performance.
5. The local projection method has been used to study the dynamic impact of macroeconomic shocks, such as financial crises (Romer and Romer, 2017) or fiscal shocks (Jordà and Taylor, 2016).
6. Plagborg-Moller and Wolf (2021) discuss the properties of local projections, as well as the relationship between local projection and VAR estimation of impulse responses.
7. The weights assigned to each regime vary between 0 and 1 according to the weighting function $F(.)$, so that $F(z_{it})$ can be interpreted as the probability of being in a given economic space state, recession or boom.

8. This was calibrated by Auerbach and Gorodnichenko (2012) so that an economy spends about 20% of time in a recession regime as it has been the case for advanced economies in the last few decades. Our results hardly change when using alternative values of the parameter γ, between 1 and 4.
9. The coefficient estimates for each horizon k are shown in Appendix Table A1 for the case of debt as dependent variable for completeness. Other results omitted for reasons of parsimony.
10. The income group classification comes from the World Bank.
11. Note that discussing these issues go beyond the scope of the paper. For a discussion on public sector efficiency, see Afonso *et al.* (2021).
12. Appendix includes also the country listing for the groups displayed in Figure A1.
13. The series (1)–(3) are taken from the IMF World Economic Outlook database and Fiscal Rules Database. The Chinn-Ito index is taken from http://web.pdx.edu/~ito/Chinn-Ito_website.htm

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Appendix

Country list by groups

SSA: South Africa, Angola, Botswana, Burundi, Cameroon, Cabo Verde, Central African Republic, Chad, Comoros, Congo, Republic of, Congo, Democratic Republic of the, Benin, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, The, Ghana, Guinea-Bissau, Guinea, Côte d'Ivoire, Kenya, Lesotho, Liberia, Madagascar, Malawi, Maali, Mauritania, Mauritius, Mozambique, Niger, Nigeria, Zimbabwe, Rwanda, São Tomé and Príncipe, Seychelles, Senegal, Sierra Leone, Somalia, Namibia, Sudan, South Sudan, Eswatini, Tanzania, Togo, Uganda, Burkina Faso, Zambia.

LAC: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, Venezuela, Antigua and Barbuda, Bahamas, The, Barbados, Dominica, Grenada, Guyana, Belize, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago.

Fragile States: Haiti, Venezuela, Iraq, Lebanon, Syria, Yemen, Afghanistan, Myanmar, Timor-Leste, Burundi, Cameroon, Central African Republic, Chad, Comoros, Congo, Republic of, Congo, Democratic Republic of the, Eritrea, Ethiopia, Guinea-Bissau, Libya, Maali, Mozambique, Niger, Nigeria, Zimbabwe, Somalia, Sudan, South Sudan, Burkina Faso, Solomon Islands, Kiribati, Papua New Guinea, Marshall Islands, Micronesia, Tuvalu, Armenia, Azerbaijan, Kosovo.

Commodity Exporters: South Africa, Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, Nicaragua, Paraguay, Peru, Uruguay, Venezuela, Guyana, Belize, Suriname, Trinidad and Tobago, Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, Yemen, Brunei Darussalam, Myanmar, Indonesia, Timor-Leste, Lao PDR, Algeria, Angola, Botswana, Burundi, Cameroon, Cabo Verde, Central African Republic, Chad, Comoros, Congo, Republic of, Congo, Democratic Republic of the, Benin, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, The, Ghana, Guinea-Bissau, Guinea, Côte d'Ivoire, Kenya, Liberia, Libya, Madagascar, Malawi, Maali, Mauritania, Mozambique, Niger, Nigeria, Zimbabwe, Rwanda, São Tomé and Príncipe, Seychelles, Senegal, Sierra Leone, Namibia, Sudan, South Sudan, Tanzania, Togo, Uganda, Burkina Faso, Zambia, Solomon Islands, Fiji, Papua New Guinea, Armenia, Azerbaijan, Kazakhstan, Kyrgyz Republic, Russia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, Mongolia, Kosovo.

Regressor\horizon	1	2	3	4	5
Shock	5.240*** (0.943)	6.249*** (1.194)	7.425*** (1.556)	7.826*** (1.826)	8.715*** (1.935)
Shock $t-1$	0.485 (0.782)	1.71 (1.159)	3.275** (1.464)	5.779*** (81.692)	6.553*** (1.814)
Shock $t-2$	1.041 (0.740)	2.251** (0.095)	4.761*** (1.348)	5.627*** (1.611)	8.411*** (1.776)
Debt $t-1$	0.058 (0.081)	0.097 (0.120)	0.034 (0.156)	0.060 (0.167)	0.023 (0.175)
Debt $t-2$	0.076 (0.075)	0.020 (0.094)	0.062 (0.125)	0.047 (0.127)	0.025 (0.132)
Growth $t-1$	-0.207 (0.129)	-0.205 (0.169)	-0.259 (0.211)	-0.011 (0.226)	0.047 (0.243)
Growth $t-2$	-0.070 (0.077)	-0.076 (0.194)	0.187 (0.214)	0.320 (0.218)	0.521* (0.249)
Inflation $t-1$	-0.321*** (0.112)	-0.397*** (0.121)	-0.426*** (0.149)	-0.355** (0.147)	-0.288* (0.175)
Inflation $t-2$	-0.017 (0.077)	-0.031 (0.096)	-0.021 (0.107)	-0.038 (0.102)	-0.038 (0.116)
R2	0.22	0.27	0.31	0.35	0.37
Observations	2668	2668	2668	2668	2667

Note(s): Estimation of Equation (1) for debt as dependent variable. Robust standard errors clustered at the country level in parenthesis. *, **, *** denote statistical significance at the 10, 5 and 1 percent levels, respectively. Constant term and fixed effects included but omitted

Source(s): Author's calculations

Table A1. Coefficient Estimates of Equation (1) for debt at each horizon

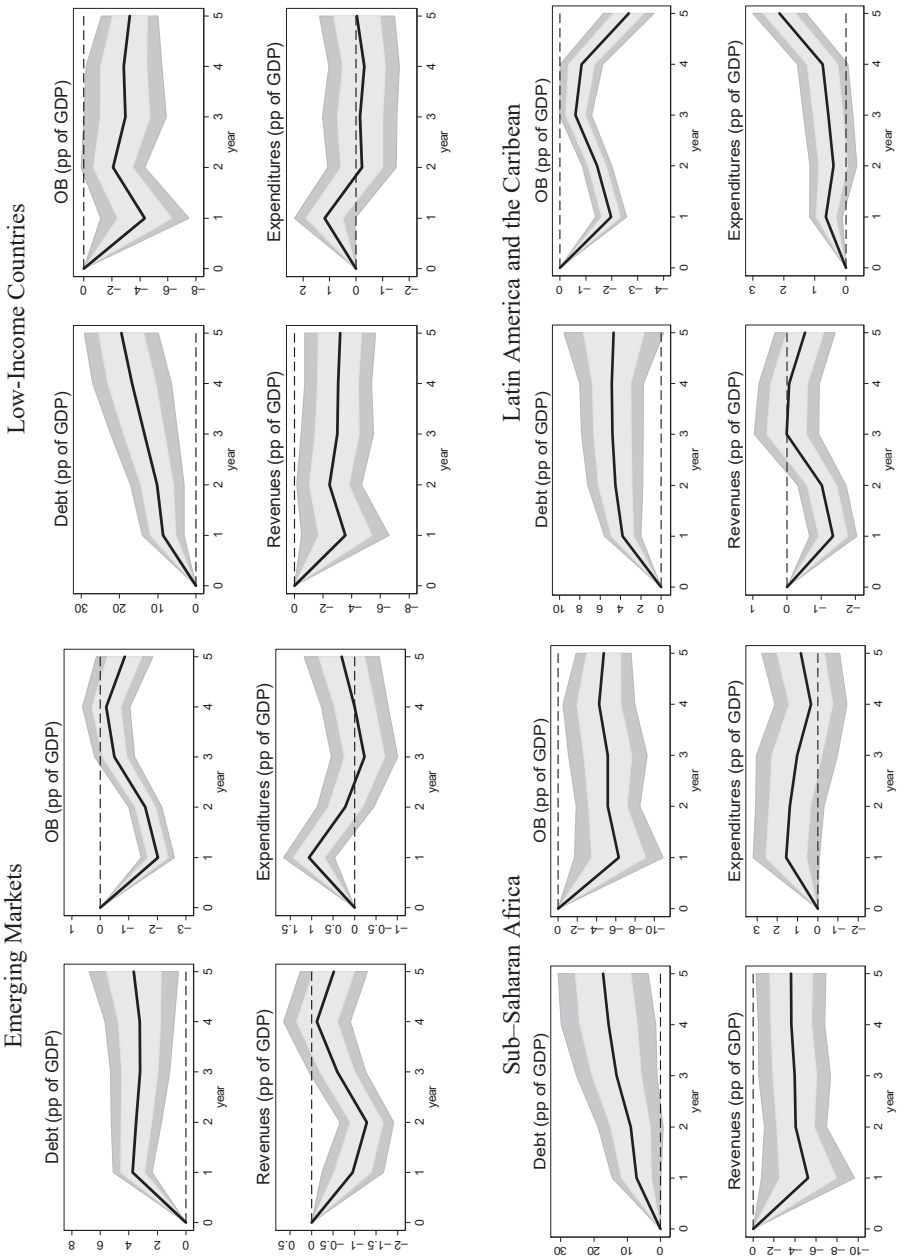
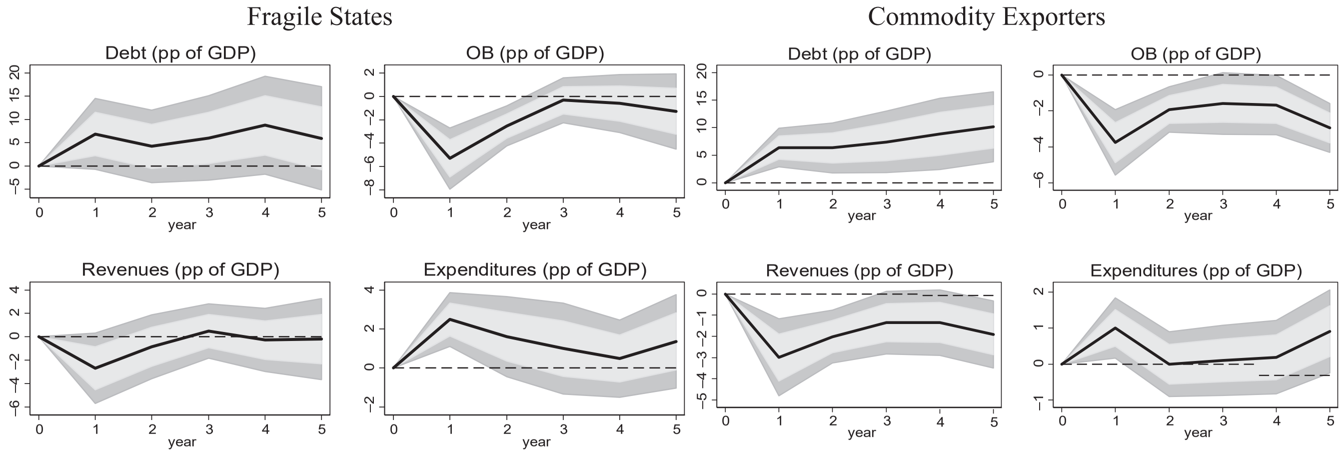


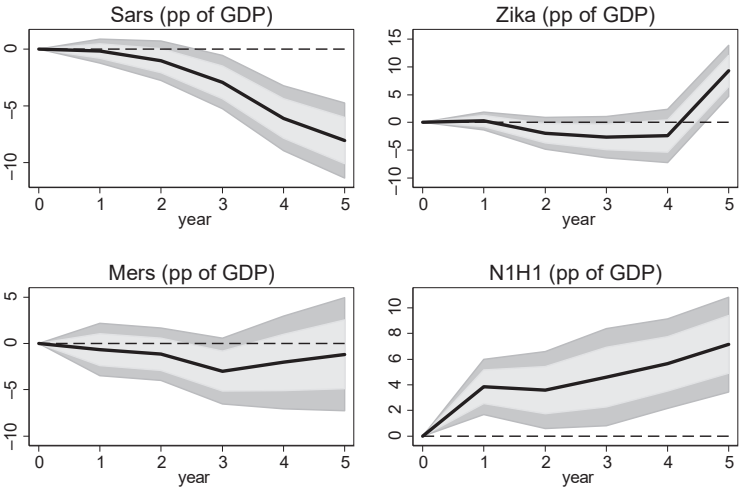
Figure A1.
Impact of pandemics on fiscal variables across alternative regions and groupings (% GDP)



Note(s): x-axis in years; $t = 0$ is the year of the pandemic shock; $t = 1$ is the first year of impact. Solid black lines denote the response to a pandemic shock, dark grey area denotes 90% confidence bands while light gray area denotes 68% confidence bands, based on standard errors clustered at country level. How to read: when the response (solid black line) is all positive or negative together with top and bottom confidence bands, the effect is said to be statistically significant different from zero

Source(s): Author's calculations

Figure A1

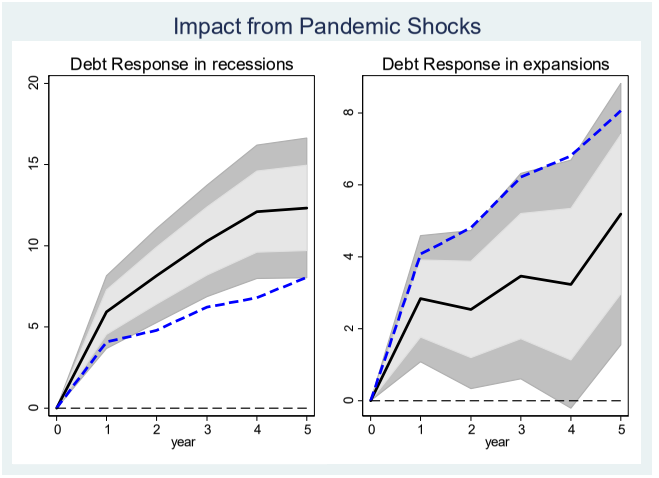


Note(s): *x*-axis in years; $t = 0$ is the year of the pandemic shock; $t = 1$ is the first year of impact. Solid black lines denote the response to a pandemic shock, dark grey area denotes 90% confidence bands while light gray area denotes 68% confidence bands, based on standard errors clustered at country level.
How to read: when the response (solid black line) is all positive or negative together with top and bottom confidence bands, the effect is said to bestatistically significant different from zero

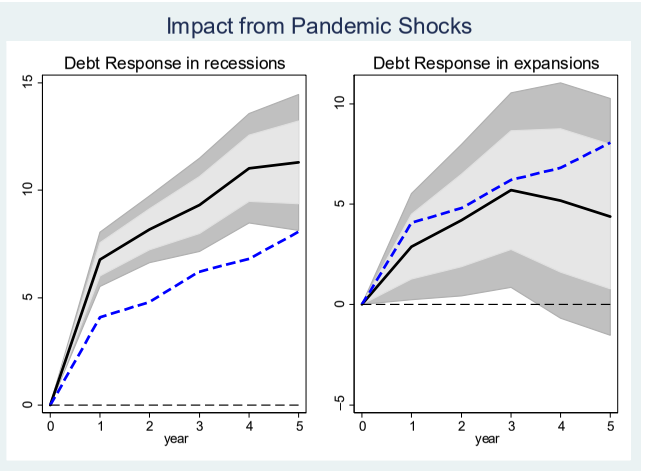
Source(s): Author's calculations

Figure A2.
Individual impact of each pandemic on debt (% GDP)

Binary method using negative growth



Harding Pagan



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Source(s): Author's calculations

Figure A3. Robustness on the impact of pandemics on debt: the role of the business cycle (% GDP), all countries