INFER
INTERNATIONAL NETWORK FOR ECONOMIC RESEARCH

INFER WORKING PAPER SERIES

INTERNATIONAL NETWORK FOR ECONOMIC RESEARCH

No. 2 | 2023

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João Tovar Jalles *(Universidade de Lisboa)*

Website:
https://infer-research.eu/

Contact:
publications@infer.info

Pandemics and Economic Turmoil in the Short-Run: the role of Fiscal Space[1]

João Tovar Jalles[2]

Abstract

We estimate, by means of the local projection method, the short to medium-term economic impact of previous pandemics in a sample of 170 countries during the 2000-2018 period. We find that the output effect has been significant (reaching over -2 percent after 5 years) and persistent. The impact has varied across income groups, with pandemics affecting more developed countries through a big negative impact on investment. Moreover, we explored the relevance of fiscal space in affecting the negative economic impact of pandemics. To this end, we constructed new aggregate fiscal space variables based on a principal component analysis that combined several indicators. Results suggest that the initial fiscal landscape of countries was a key ingredient in softening the economic impact of past pandemics. We believe that these paper´s findings are useful to inform policy makers what can be expected in the new-normal that is following the recent COVID-19 pandemic particularly in a context of increasingly constrained fiscal space.

JEL: C33, C36, D63, E32, E62, H20
Keywords: aggregate demand; fiscal policy; pandemics; local projection; impulse response functions; fiscal space, nonlinearities

[1] The author thanks two anonymous referees for useful comments and suggestions. Thanks also go to participants of the 23rd INFER Annual Conference for comments and suggestions. The author acknowledges financial Support from FCT – Fundação para a Ciência e Tecnologia (Portugal), national funding through research grant UIDB/05069/2020. The usual disclaimer applies and any remaining errors are the author´s own responsibility.
[2] Instituto Superior de Economia e Gestão (ISEG), Universidade de Lisboa, Rua do Quelhas 6, 1200-781 Lisboa, Portugal. Research in Economics and Mathematics (REM) and Research Unit on Complexity and Economics (UECE), ISEG, Universidade de Lisboa, Rua Miguel Lupi 20, 1249-078 Lisbon, Portugal. Economics for Policy, Nova School of Business and Economics, Universidade Nova de Lisboa, Rua da Holanda 1, 2775-405 Carcavelos, Portugal. IPAG Business School, 184 Boulevard Saint-Germain, 75006 Paris, France. Email: joaojalles@gmail.com.

1. Introduction

The Covid-19 pandemic has cost lives and disrupted economic activity worldwide. To prevent the spread of the virus, governments have imposed lockdowns with varying degrees of stringency. The general population has also sought to reduce exposure to the virus through voluntary social distancing. The result has been a dramatic contraction in economic activity in 2020 with global GDP estimated to have declined by 3.5 percent (IMF, 2021). The projected rebound in 2021 is not expected to restore the pre-crisis GDP in 2019 in advanced, emerging and developing economies until 2022. The global reduction in work hours in the second quarter of 2020 compared with the fourth quarter of 2019 was equivalent to 400 million full-time jobs; already 155 million full-time jobs were lost in the first quarter (ILO, 2020).

In an environment where most countries still face near zero interest rates (so conventional monetary policy lacks effectiveness and even non-conventional instruments are at the brink of exhaustion), fiscal policy has a crucial role in mitigating the pandemic´s overall economic impact and promoting a quick recovery, but fiscal space matters.[3] To counter income losses arising from the pandemic, countries have taken steps to help households and firms by implementing discretionary revenue and spending measures. In addition, they have provided liquidity support to the economy in the form of equity injections, asset purchases, loans, and credit guarantees. Together with lower projected output growth, these measures would reduce revenues in relation to GDP in 2020 and possibly beyond with important implications for public spending at a time when the overall spending has been scaled up. These developments are resulting in larger budget deficits and rising debt-to-GDP ratios in the foreseeable future.

Understanding empirically how certain macroeconomic aggregates are affected by past pandemics and how their reaction is affected by available fiscal space is, therefore, important for policy makers notably once the unwinding of economic support measures begin and the "new-

[3] Fiscal space can matter for policy responses which typically aim to be counter-cyclical to enhance macro stabilization. For instance, Jordà et al. (2016) and Romer and Romer (2018) both find that the aftermaths of crises are far worse in countries with high levels of government debt (which one can take as a proxy for lack of fiscal space – mindful that not all public debt is created equal (e.g. the cases of Greece vs Japan)). Moreover, Romer and Romer (2018) find that a likely mechanism behind such a link is that the policy response is far more contractionary in highly indebted countries.

normal" is attained. In this paper, we specifically study the short to medium-term economic impact of past pandemics in a large sample of 170 countries between 2000 and 2018.

This paper relates to the literature on the economic effects of pandemics and epidemics. Studies of the macroeconomic impact of past pandemics and of other major diseases (such as SARS and HIV/AIDs) have typically quantified the resulting short-term loss in output and growth.[4][5] However, 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). A study by Brainerd and Siegler (2003), one of the few on the economic effects of the Spanish flu, suggested that the 1918/19 pandemic in the US actually increased growth in the 1920s. In contrast, Almond and Mazumber (2005) argued that the Spanish flu had long-term negative effects through its impact on fetal health. Using a theoretical model, Young (2004) argued that the AIDS epidemic in South Africa would increase net future per capita consumption, while Bell and Gersbach (2004) found strong negative 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 large and persistent effects on economic activity (see e.g. Atkeson, 2020; Barro et al., 2020; Eichenbaum et al., 2020). In fact, Ma et al. (2020) in an empirical analysis of the economic effects of past pandemics, found that real GDP is 2.6 percent lower on average across 210 countries in the year the outbreak is officially declared and remains 3 percent below pre-shock level five years later. Moreover, according to Jorda et al. (2020), 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 greater precautionary savings.

While the macroeconomic effects of pandemics have been studied, a deeper and more disaggregated assessment is lacking on the channels conditioned on the available fiscal space is lacking. The need for support to economic activity in the aftermath of the Covid-led-crisis presented a painful reminder of the importance of a government´s ability to implement effective

[4] Even then, direct measures based on data from past episodes are not generally available (e.g. in the US, see Meltzer, Cox and Fukuda, 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, Nilsson and Pichler, 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).

[5] For a historic view of pandemics, see Kenny (2021).

fiscal stimulus. This ability is ultimately predicated on the availability of fiscal space. Ample fiscal space provides a government with the necessary budgetary resources to stimulate activity. Just as important, it provides credibility about the sustainability of the budget, and thereby helps to ensure that fiscal stimulus is effective in promoting growth.[6] This paper looks in more detail on what happens to GDP components conditioned on alternative fiscal-space proxies. Although there is no single definition, a core aspect of fiscal space is "the ability of a government to service its debt." (Kose et al., 2017). Using a dataset put together by Ma et al. (2020), we first estimate the short to medium-term response of macroeconomic variables to major pandemic shocks.[7] As Ma et al. (2020) conclude, the impact of pandemic events on economic activity is likely to vary across episodes and countries´ initial conditions. We will explore particularly the fiscal area in four distinct but related dimensions relying on Kose et al. (2017) dataset: i) government debt sustainability; ii) balance sheet composition; iii) external and private sector debt; and iv) market perception. These are aggregated by means of a factor analysis (principal components) that combine several specific indicators.

This paper finds that the short to medium-term economic impact of pandemics is significant in our sample of 170 countries during the 2000-2018 period. This effect is mainly driven by a sizeable decline in investment while net exports have a slightly positive contribution to aggregate demand. Advanced economies and emerging markets seem to suffer the most economically from pandemics. More importantly, initial fiscal space conditions matter with those countries having more fiscal space to fight the ensuing crisis or recession being able to mitigate partly the adverse economic effect. Our results are robust to several robustness checks.

The remainder of the paper is structured as follows. Section 2 presents the empirical strategy followed to study the dynamic response of fiscal variables to past pandemic shocks and lays out the strategy to examine whether these fueled tax reforms. Section 3 presents the data and key

[6] Auerbach and Gorodnichenko (2013) and Huidrom et al. (2016) find that fiscal multipliers tend to be larger when fiscal space is wider.

[7] Historically, there were three influenza pandemics in the last century occurring in 1980 (A/H1N1), 1957 (A/H2N2) and 1968/69 (A/H3N2) (HPA, 2006). The most serious of these pandemics was A/H1N1 known as "Spanish flu", which occurred in 1918/19 causing serious illness and a high number of deaths (20-40 million worldwide). The other two pandemics were less severe and had less impact on those in prime age with mortality occurring mainly amongst the elderly. Because these pandemics occurred at a time when data quality and coverage was poor, this paper focuses on the last 30 years to maximize country coverage.

stylized facts. Section 4 discusses our empirical results while sensitivity and robustness checks are available in an online annex. Section 5 concludes and elaborates on the policy implications.

2. Econometric Methodology

In order to estimate the response of macroeconomic variables to major pandemic shocks, we follow the local projection method proposed by Jordà (2005) to estimate impulse-response functions. This approach has been advocated by Auerbach and Gorodnichenko (2013) and Romer and Romer (2019) as a flexible alternative, better suited to estimating a dynamic response—such as, in our context, interactions between pandemic shocks and macroeconomic conditions. The baseline specification is:

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

in which y is the dependent macroeconomic variable of interest; β_k denotes the (cumulative) response of the variable of interest in each *k* year after the pandemic event or shock (we use these concepts interchangeably); α_i, τ_i are country and time fixed effects, included to take account for cross-country heterogeneity and global factors (such as the world business cycle or oil price movements) and trends that can affect the evolution of the pandemic; $pand_{i,t}$ denotes the pandemic shock retrieved from Ma et al. (2020).[8] $X_{i,t}$ is a set a of control variables including two lags of pandemic shocks, two lags of real GDP growth and two lags of the relevant dependent variable.

Equation (1) is estimated using OLS.[9] 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—based on robust standard errors clustered at the country level. 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 across wider regions, for two reasons:

[8] All pandemic events featured in our analysis are country-wide shocks.

[9] Another advantage of the local projection method compared to vector autoregression (autoregressive distributed lag) specifications is that the computation of confidence bands does not require Monte Carlo simulations or asymptotic approximations. One limitation, however, is that confidence bands at longer horizons tend to be wider than those estimated in vector autoregression specifications.

either because the infection itself is widespread or because trade and market integration eventually propagate the economic shock across borders.

We also explore whether initial fiscal space conditions at the time of the pandemic affect economic outcomes.[10] That means the response is allowed to vary according to a continuous function $F(z_{it})$, as follows:

$$y_{i,t+k} - y_{i,t-1} = \alpha_i + \tau_i + \beta_k^L F(z_{i,t}) pand_{i,t} + \beta_k^H (1 - F(z_{i,t})) pand_{i,t} + \theta X_{i,t} + \varepsilon_{i,t} \qquad (2)$$

with

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

in which z_{it} is an indicator of the fiscal space (see below) normalized to have zero mean and unit variance.[11] The coefficients β_L^k and β_H^k capture the economic impact of pandemics at each horizon k in cases of lack of fiscal space ($F(z_{it}) \approx 1$ when z goes to minus infinity) and availability of fiscal space ($1 - F(z_{it}) \approx 1$ when z goes to plus infinity), respectively. [12]

3. Data

Our empirical analysis consists – as explained above –of two related but separate steps. The first makes use of a heterogeneous unbalanced sample of 170 countries from 2000-2018. The key regressor in the study – the pandemic event or shock - 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. Among the five events, the most widespread one is H1N1 (Swine Flu Influenza). 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 below.

[10] Auerbach and Gorodnichenko (2012, 2013) discuss the advantages of using the local projection approach to estimating non-linear effects.

[11] 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 fiscal space state.

[12] We choose $\gamma = 1.5$. Our results hardly change when using alternative values of the parameter γ, between 1 and 4.

Table 1. List of Pandemic and Epidemic Episodes

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: based on Ma et al. (2020)

The availability of fiscal space has also been at the center of recent debates on the deployment of fiscal policy to accelerate growth in advanced and developing economies (IMF 2017; World Bank 2017). Fiscal space is a complex concept as evident from multiple definitions and measures used in the literature. Some authors define fiscal space simply as the budgetary room to create and allocate funding for a certain purpose, such as smoothing the business cycle, or undertaking growth-enhancing investment projects, without threatening liquidity and sustainability of a sovereign's financial position (Heller 2005; Ley 2009). Perotti (2007) regards the notion of fiscal space as an alternative way of expressing a sovereign's intertemporal budget constraint. Others consider fiscal space as the difference between the current level of public debt and a country-specific debt limit (Ostry et al. 2010).

Recent research presents databases that include select indicators of fiscal space, including those associated with the debt service capacity of sovereigns (Abbas et al. 2011; Jaimovich and Panizza 2010; Panizza 2008; Mauro et al. 2015; Reinhart and Rogoff 2009). Although the literature contains multiple measures of fiscal space, before Kose et al. (2017) no database systematically brought together these measures for a large number of countries. Their database includes a wide range of 28 indicators for 200 countries between 1990-2016 that go beyond simple measures of

solvency: government debt sustainability, balance sheet composition, external and private sector debt, and market perception of sovereign risk. These aspects materially affect the availability of fiscal space.[13]

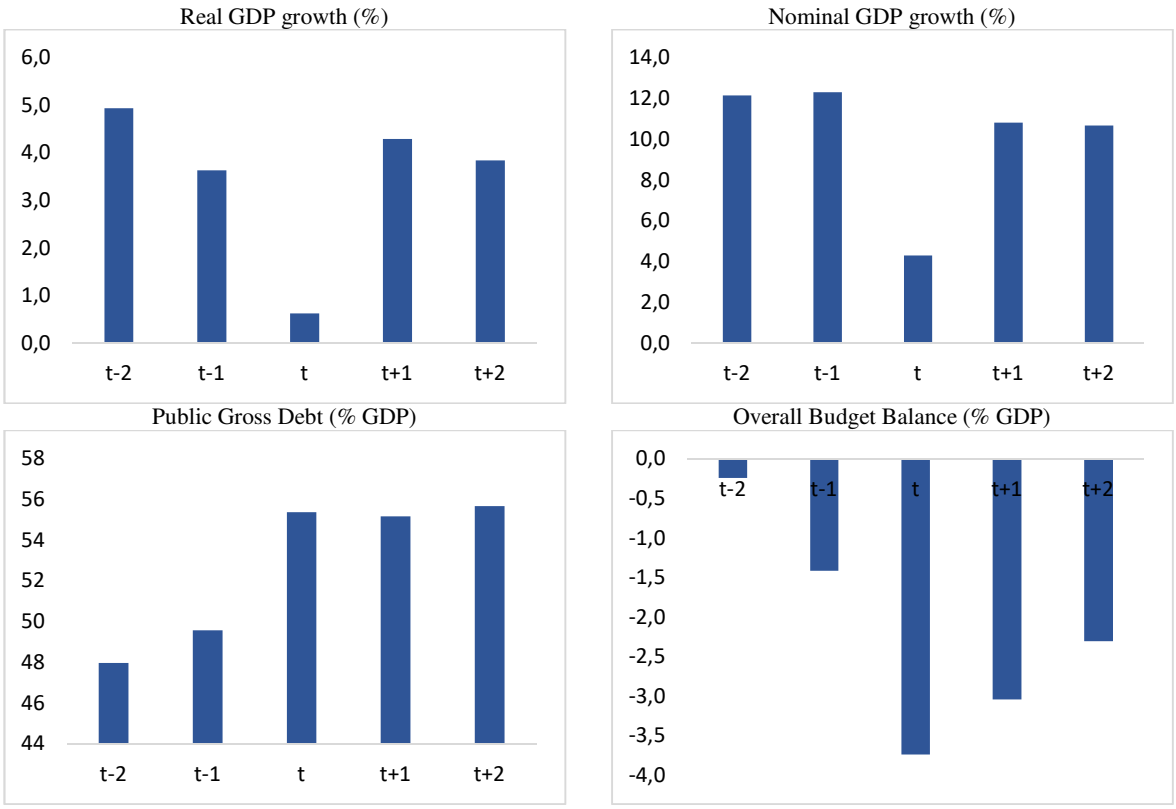
To test the role of these fiscal space indicators in conditioning the economic impact of pandemics, we propose an approach that relies on principal components analysis (PCA), with variables grouped around Kose et al. (2017) four dimensions. The resulting principal components indices are described in Table A1 in the Appendix, while Table A2 lists the corresponding factor loadings. We can interpret the principal components by focusing on the factor loadings and the uniqueness of each variable. Specifically, as regards government debt sustainability, uniqueness is relatively low for the first three variables, which implies that the factor appears to describe mostly these ones. As to balance sheet composition, the relatively low uniqueness of all three variables means that the factor is well described by the original variables. With respect to external and private sector debt, the factor is mainly driven by the role of total external debt stocks (% reserves). Finally, concerning market perception of sovereign risk, as it only combines two variables, the factor is equally explained by both.

Other macroeconomic and fiscal variables come from the IMF´s World Economic Outlook (WEO) database. Specifically, in addition to real and nominal GDP, the following variables are analyzed as main dependent variables: CPI index, employment (total) and key aggregate demand components: private consumption, public consumption, gross fixed capital formation, exports and imports (these expressed in real terms).

Figure 2 plots the evolution of key macro and fiscal aggregates before, during and after the pandemic shock. This unconditional association shows that economic growth goes down while debt goes up and the overall balance deteriorates. These movements are somewhat persistent over time.

[13] For example, a higher share of short-term and foreign currency debt could raise rollover and exchange rate risks, respectively. A high hare of nonresident holdings of government debt may imply liquidity risk as well as currency risk in the event of confidence losses among foreign investors. The maturity profile of debt is important since debt principal coming due often constitutes an important portion of an economy's upcoming financing needs, and a bunching of maturities can constrain fiscal space. Market participants´ perceptions of sovereign risk reflect and, in turn, influence an economy's ability to tap markets and service its obligations.

Figure 2. Evolution of key macro-fiscal variables around Pandemics



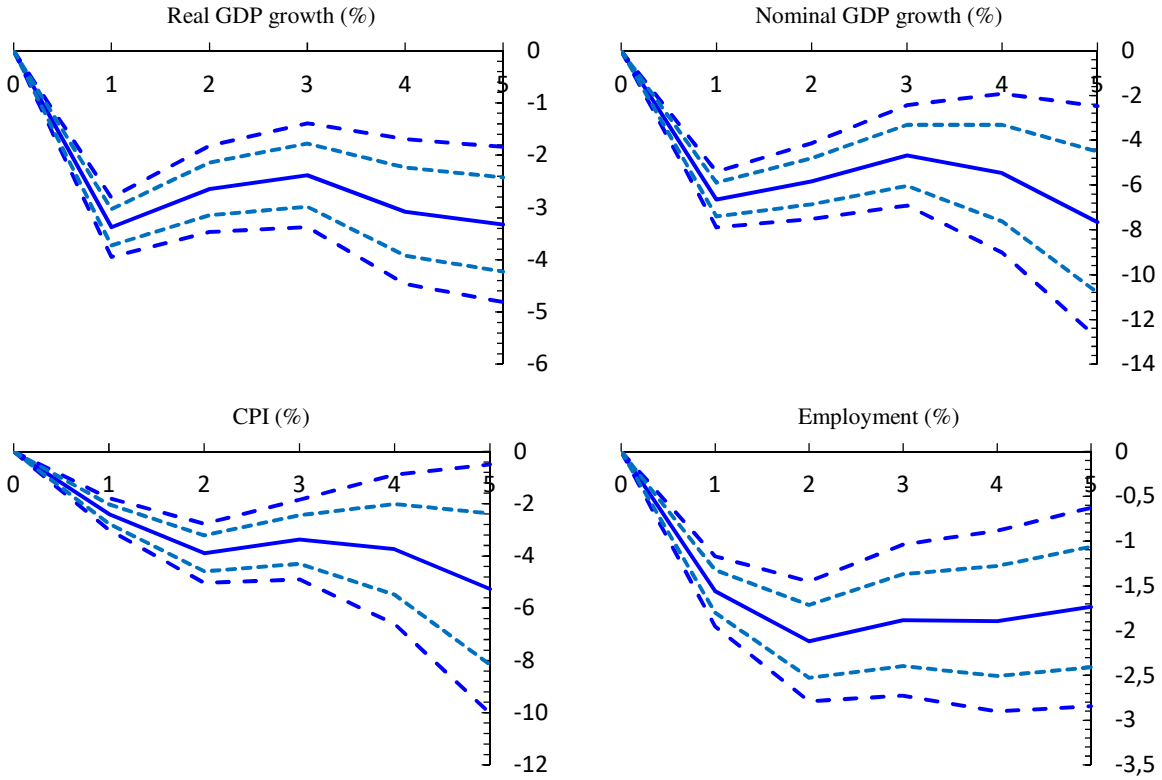
Note: x-axis in years; t=0 is the year of the pandemic shock.

4. Empirical Results

A. Economic Consequences of Pandemics

Figure 3 shows the results of estimating equation (1) for alternative macroeconomic dependent variables. Both the 90 and 68 percent confidence bands are shown together with the response. Real GDP drops to 3.7 percent in the first year after the pandemic shock, it then recovers slightly, but ends up reaching a cumulative of -3.2 percent after 5 years, meaning that the pandemic impact is non-negligible and long-lasting. At the same time, prices fall 2.7 percent in the first year and remained subdued in the medium term (falling over 5 percent 5 years after the pandemic shock). The labor market also suffers with a peak loss in employment 2 years after the shock at -2.2 percent. These effects do not dissipate quickly as observed by statistically significant confidence bands always below the horizontal axis.

Figure 3. Impact of Pandemics on Macro Variables, all countries (%)



Note: Impulse response functions are estimated using a sample of 170 countries over the period 2000-2018. The graph shows the response and both the 90 and 68 percent confidence bands. The x-axis shows years (k) after pandemic shocks; t = 0 is the year of the pandemic shock. Estimates based on equation 1. Standard errors in parentheses are clustered at the country level.

We then split the sample of 170 countries between advanced, emerging and low-income developing economies. We also perform some sample sensitivity with respect to countries´ characteristics such as being a fragile state (countries defined by the World Bank as having less good policy performance or institutions).[14]

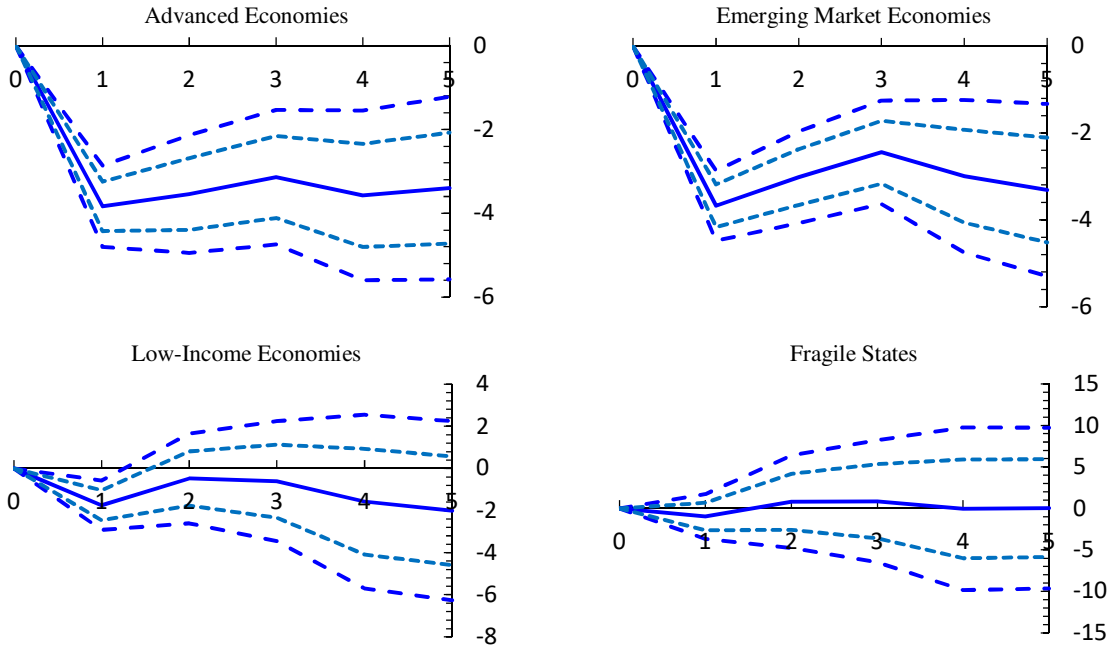
Results for real GDP are plotted in Figure 4.[15] We observe that pandemics´ effect on real GDP is non-statistically different from zero in the sub-sample of low-income or fragile states, despite being on the negative side (at least in the immediate aftermath of the pandemic shock). So the

[14] Analysis of this group of low-income countries, is important because, as far as fiscal space is concerned, in fragile states crises typically create a revenue shortfall for only some countries, because others already have very low revenue levels to start with. Moreover, in many countries fiscal deterioration results from ensuing spending increases.

[15] Figure A1 in the Appendix shows the results for the other key macroeconomic variables.

overall result is mostly driven by the negative and significant impact on advanced countries and emerging markets which show a relatively similar pattern.

Figure 4. Impact of Pandemics on real GDP by Group of countries (%)



Note: Impulse response functions are estimated using a sample of 170 countries over the period 2000-2018. The graph shows the response and both the 90 and 68 percent confidence bands. The x-axis shows years (k) after pandemic shocks; t = 0 is the year of the pandemic shock. Estimates based on equation 1. Standard errors in parentheses are clustered at the country level.

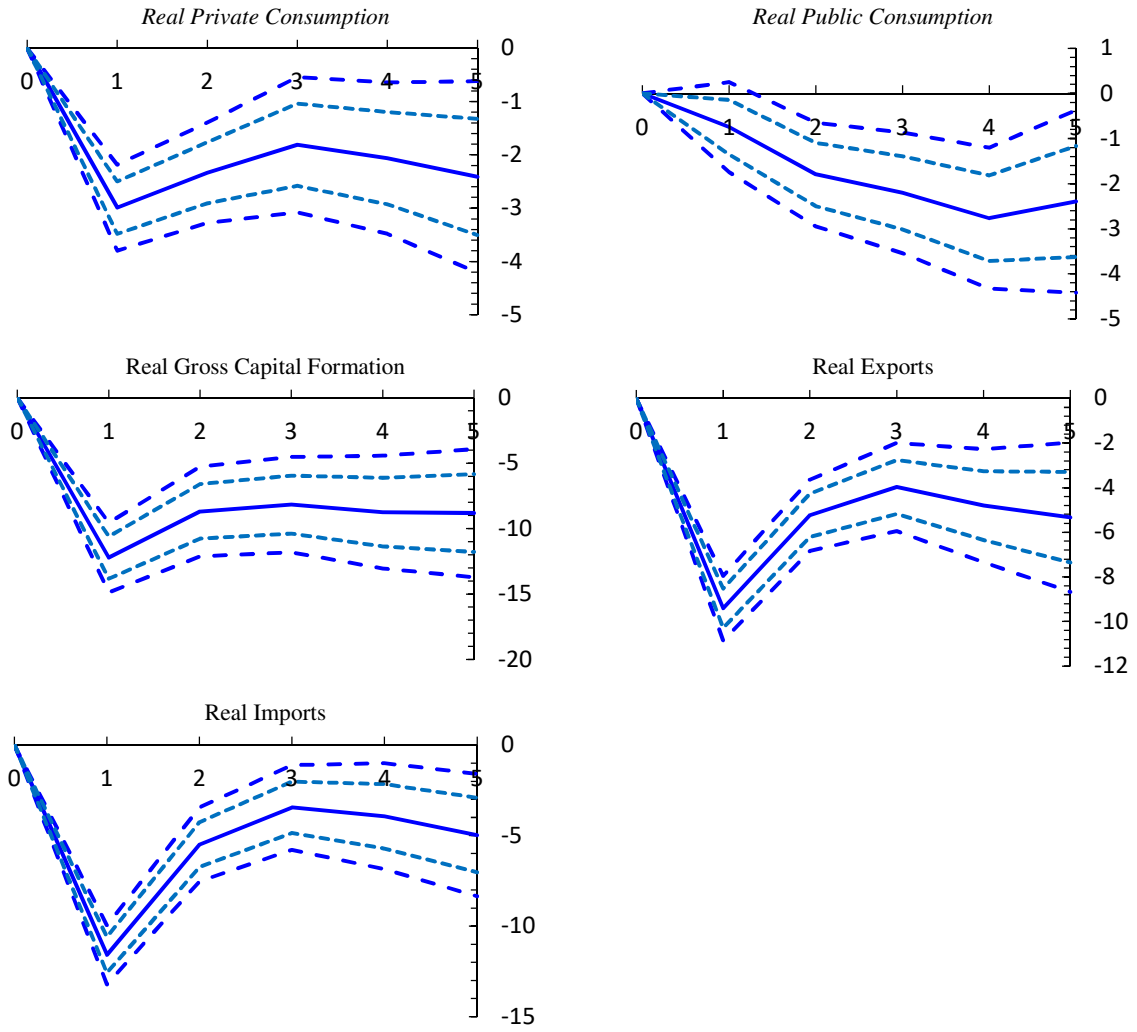
B. Channels

A relevant question is whether the effect on the real GDP is being driven by a particular component of aggregate demand. In this regard, we decompose real GDP into private and public consumption, gross capital formation, exports and imports. All these variables are expressed in real terms using the GDP deflator. Looking at Figure 5 – for the entire sample - we observe that the fall in real GDP is mostly driven by a drop in investment. Investment is well known to be the most volatile component of aggregate demand (relative to GDP) and highly procyclical. Moreover, investment depends on expectations and heightened uncertainty in the future caused by a pandemic shock has an effect of reducing investment today.[16] While private consumption falls more abruptly,

[16] For example, for greater details on the procyclicality of investment in Spain and in other European countries, see Álvarez, Gadea and Gómez-Loscos (2021).

public consumption has a smoother pattern but after 5 years both these variables show a cumulative negative impact over 2 percent.[17] While both exports and imports fall close to two digits, the decrease in the latter is larger, meaning that the net contribution of net exports is positive.

Figure 5. Impact of Pandemics on Aggregate Demand Components, all countries (%)



Note: Impulse response functions are estimated using a sample of 170 countries over the period 2000-2018. The graph shows the response and both the 90 and 68 percent confidence bands. The x-axis shows years (k) after pandemic shocks; t = 0 is the year of the pandemic shock. Estimates based on equation 1. Standard errors in parentheses are clustered at the country level.

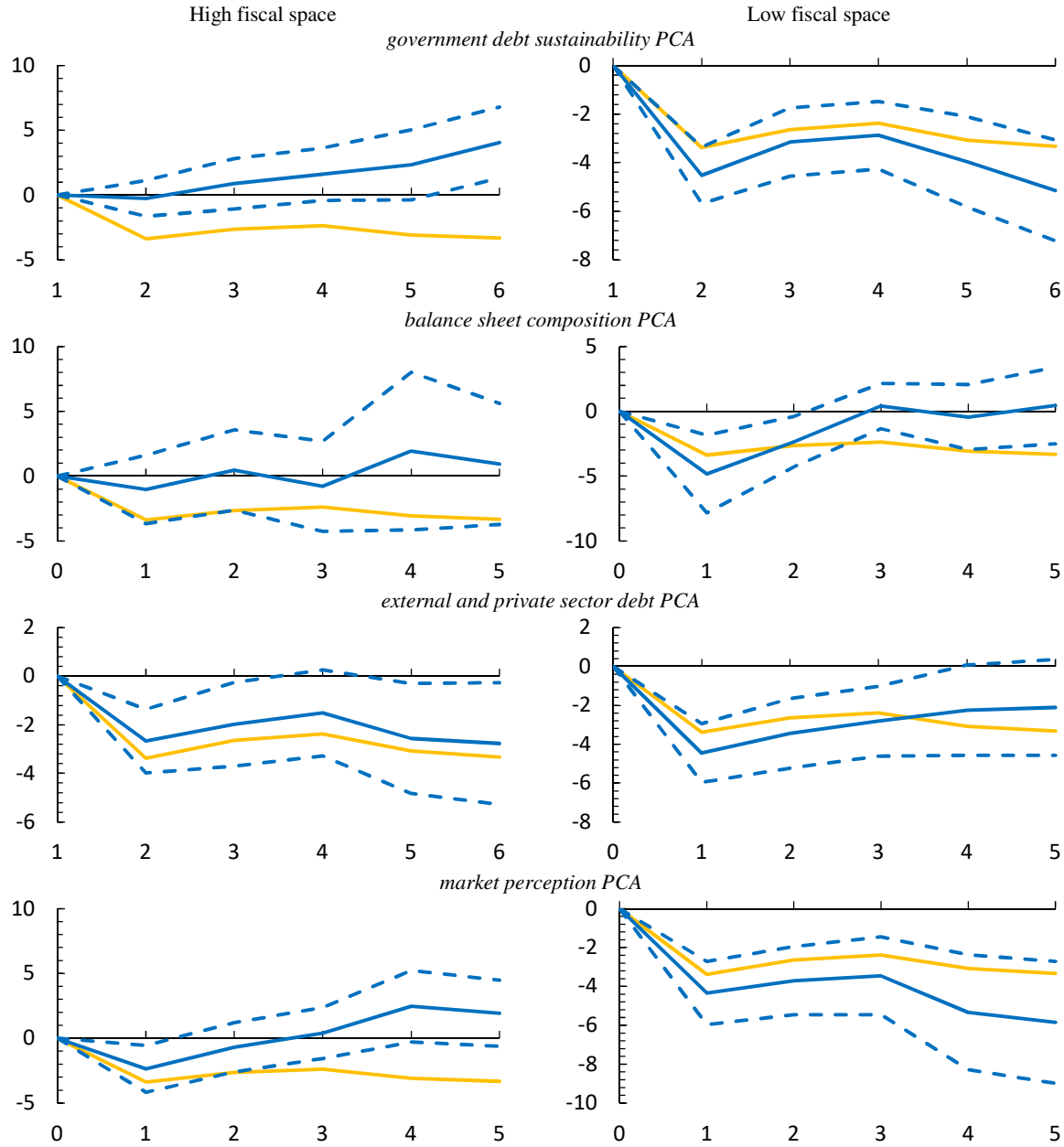
[17] Regarding private consumption, Barro et al. (2020) looking at the Spanish flu in the early 20th century, found real consumption per capita to fall cumulatively by 8%. In our exercise, it falls by about 3 percent but the degree of severity of the different pandemics is not comparable (plus we are not using dependent variables in per capita terms).

C. The Role of Fiscal Space

Now we focus on the non-linear specification described by equation 2. Results in Figure 6 suggest that the response of real GDP to pandemics does vary significantly with prevailing fiscal space conditions, but the exact proxy used to measure this concept matters. If fiscal space is best represented by the sustainability PCA or the market perception one, then having more fiscal space greatly minimizes the economic impact of pandemics. The ability to serve debt and the degree of fiscal policy credibility matter. These two dimensions are linked as market perception is typically closely related to longer-term sustainability, so it is not entirely surprising to have these two PCAs conveying a similar message. Contrarily, lack of fiscal space can make the negative impact more pronounced (but the effect is not statistically different from the baseline result in yellow). A narrowed fiscal space does not leave room for government to adopt counter-cyclical policy in period of pandemic. Meaning that the government has a really limited room to cushion the economic impact of the pandemic and support the economy, thus worsening the economic impact. Using alternative measures we do not uncover much difference in the results considering high and low fiscal space. In Figure A2 in the appendix we re-estimate equation (2) using instead in our argument of the function $F(z_{it})$ a overall combined fiscal space PCA.[18] As it can be observed, using this alternative measure, lack of fiscal space can still have a more negative impact comprared to the baseline unconditional result (but yet again the effect is not statistically different from the baseline).

[18] We thank an anonymous referee for suggesting this.

Figure 6. Nonlinear Regression: Impact from Pandemics on Real GDP conditional on the fiscal space (%)



Note: Impulse response functions are estimated using a sample of 170 countries over the period 2000-2018. Yellow solid lines correspond to the baseline result in Figure 3. The graph shows the response and the 90 confidence bands. The x-axis shows years (k) after pandemic shocks; t = 0 is the year of the pandemic shock. Estimates based on equation 1. Standard errors in parentheses are clustered at the country level.

D. Sensitivity and Robustness

We have carried out a couple of robustness checks.

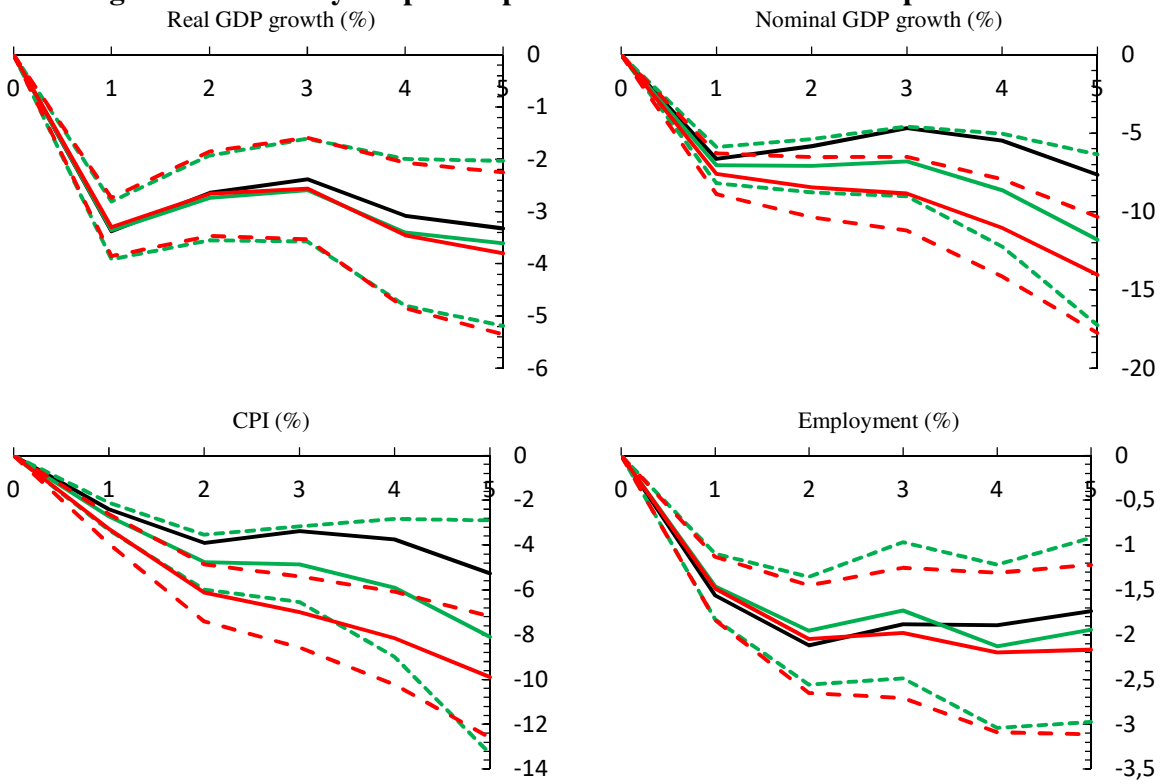
A possible bias from estimating equation (1) using country-fixed effects is that the error term may have a non-zero expected value, due to the interaction of fixed effects and country-specific developments (Tuelings and Zubanov, 2014). This would lead to a bias of the estimates that is a function of *k*. To address this issue, equation (1) was re-estimated by excluding country fixed effects from the analysis. Results in Figure 7 (green lines) suggest that this bias is negligible (perhaps less so in the case of inflation).

To try and estimate the causal impact of pandemics on economic outcomes, it is important to control for previous trends in dynamics of such variables. The baseline specification attempts to do this by controlling for up to two lags in the dependent variable.[19] To further mitigate this concern, we re-estimate equation (1) by including country-specific time trends as additional control variables. Results in Figure 7 (red lines) keep the main thrust of our previous findings (a larger departure from the baseline result is shown in the cases of nominal GDP and inflation).

Another possible concern regarding the analysis is that the results may suffer from omitted variable bias, as economic and fiscal policies may be carried out because of concerns regarding future evolution of economic activity. To address this issue, we control for the expected values in *t-1* of future real GDP growth and the overall fiscal balance over periods *t* to *t+k*—that is, the time horizon over which the impulse response functions are computed. These are taken from the fall issue of the IMF WEO for year *t-1*. Figure 8a and 8b shows the results from considering growth and fiscal expectations, respectively, in our baseline specification. We observe that these are in line with those presented in Figure 3 but in general the magnitude of the effect is smaller (in the case of Figure 8.b for inflation the effect becomes statistically not different from zero).

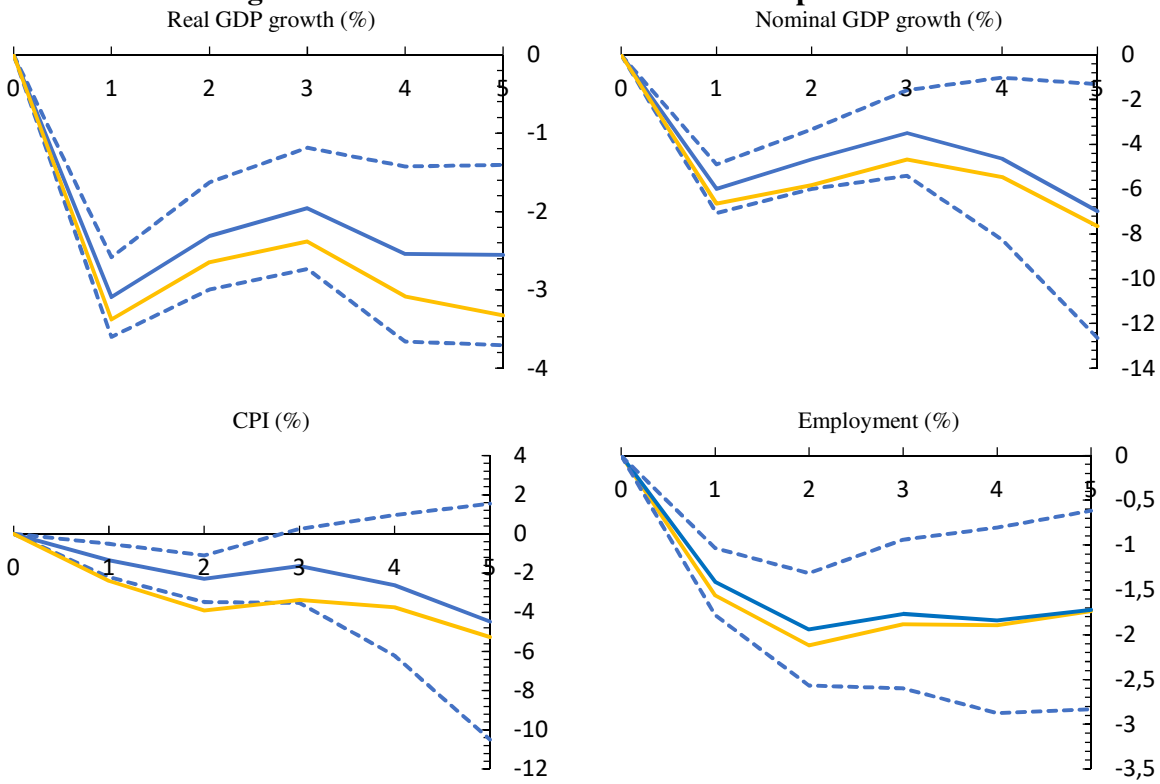
[19] Similar results are obtained when using alternative lag parametrizations. Results for zero, one and three lags (not shown) confirm that previous findings are not sensitive to the choice of the number of lags.

Figure 7. Sensitivity: Impact of pandemics under alternative specifications



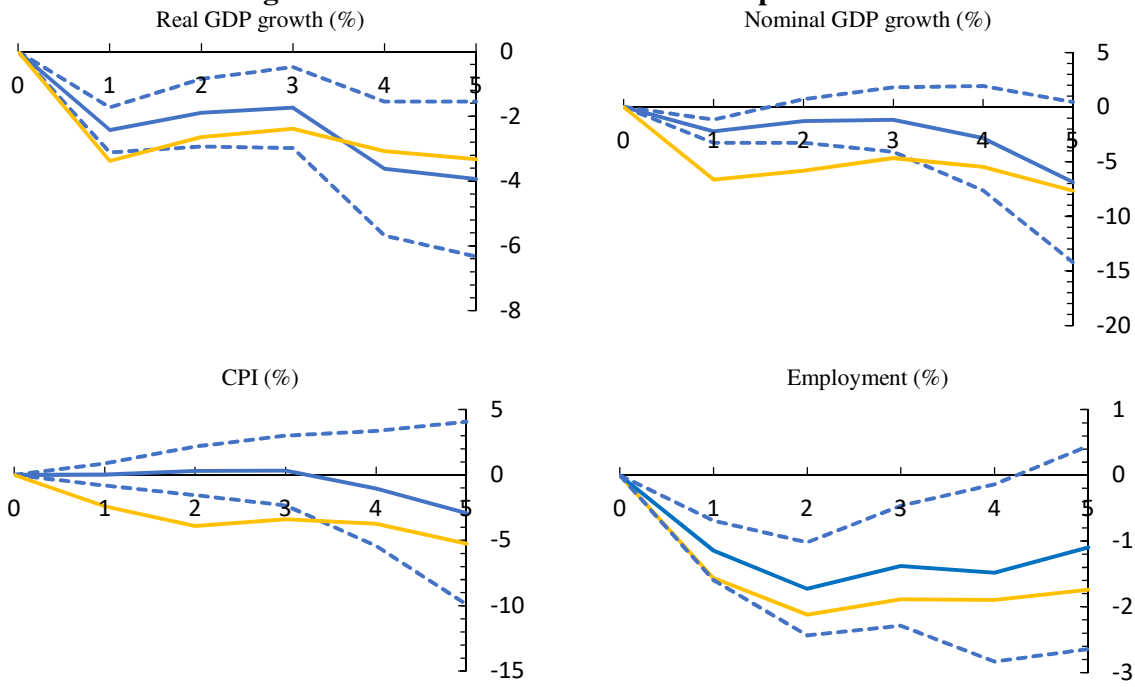
Note: Impulse response functions are estimated using a sample of 170 countries over the period 2000-2018. Black solid line corresponds to the baseline result in Figure 3. Green lines denote the exercise dropping country fixed effects. Red lines denote the exercise adding country time trends. The graph shows the response and the 90 confidence bands for the two exercises conducted. The x-axis shows years (k) after pandemic shocks; t = 0 is the year of the pandemic shock. Estimates based on equation 1. Standard errors in parentheses are clustered at the country level.

Figure 8.a Additional Control: economic expectations



Note: Impulse response functions are estimated using a sample of 170 countries over the period 2000-2018. Black solid line corresponds to the baseline result in Figure 3. Blue lines denote the exercise augmented with growth expectations. The graph shows the response and the 90 confidence bands for the two exercises conducted. The x-axis shows years (k) after pandemic shocks; t = 0 is the year of the pandemic shock. Estimates based on equation 1. Standard errors in parentheses are clustered at the country level.

Figure 8.b Additional Control: fiscal expectations



Note: Impulse response functions are estimated using a sample of 170 countries over the period 2000-2018. Black solid line corresponds to the baseline result in Figure 3. Blue lines denote the exercise augmented with growth expectations. The graph shows the response and the 90 confidence bands for the two exercises conducted. The x-axis shows years (k) after pandemic shocks; t = 0 is the year of the pandemic shock. Estimates based on equation 1. Standard errors in parentheses are clustered at the country level.

5. Conclusions

In this paper, we applied the local projection method on a large sample of countries between 2000-2018 to trace the short to medium-term economic impacts of pandemics. Two innovations consisted in: i) disentangling the channels being the general output effect; and ii) exploring the role of fiscal space in a nonlinear regression by constructing aggregate indicators based on principal component analyses. Results presented in this paper suggest that the initial fiscal landscape of countries is a key ingredient understand the economic impact of the more severe COVID-19 shock. We believe that this paper´s findings are useful to inform policy makers what can be expected in the new-normal that is following the recent COVID-19 pandemic particularly in a context of increasingly constrained fiscal space. The negative economic impact of pandemics is larger in more developed countries and it is persistent over time.

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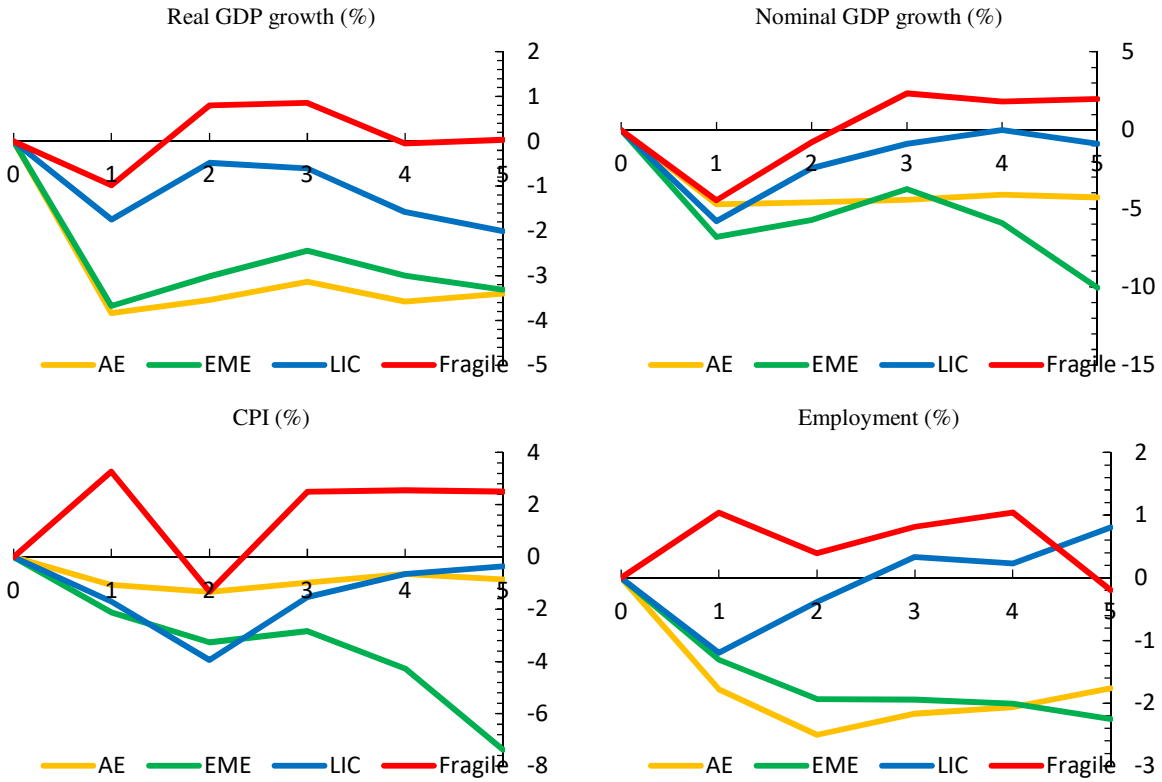
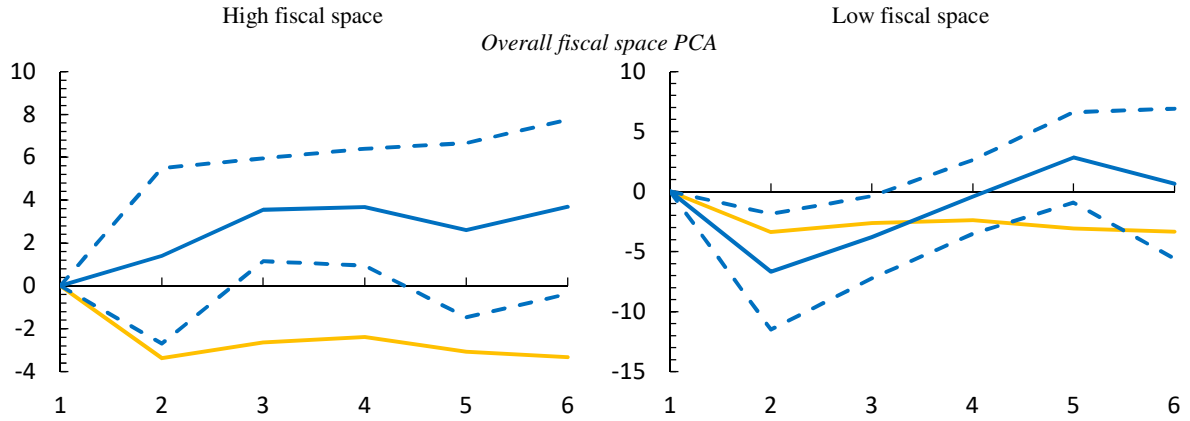
APPENDIX

Figure A1. Comparing the Impact of Pandemics on Macro Variables by Group of countries (%)



Note: Impulse response functions are estimated using a sample of 170 countries over the period 2000-2018. The graph shows the response. The x-axis shows years (k) after pandemic shocks; t = 0 is the year of the pandemic shock. Estimates based on equation 1. Standard errors in parentheses are clustered at the country level.

Figure A2. Nonlinear Regression: Impact from Pandemics on Real GDP conditional on an overall measure of fiscal space (%)



Note: Impulse response functions are estimated using a sample of 170 countries over the period 2000-2018. Yellow solid lines correspond to the baseline unconditional result. The graph shows the response and the 90 confidence bands. The x-axis shows years (k) after pandemic events; t = 0 is the year of the pandemic shock. Estimates based on equation 1. Standard errors in parentheses are clustered at the country level.

Table A1: Summary of Composite Fiscal Space Variables and Descriptive Statistics

Concept	Average	Standard deviation	Variables
government debt sustainability	0	1	Primary balance % GDP
			Cyclically adjusted primary balance % potential GDP
			Fiscal balance % GDP
			Fiscal balance % average tax revenues
balance sheet composition	0	1	General government debt held by nonresidents % of total
			Concessional external debt stocks, % government gross debt
			Average maturity of sovereign debt in years
external and private sector debt	0	1	Total external debt stocks % GDP
			Private external debt stocks % GDP
			Domestic credit to the private sector % GDP
			Short term external debt stocks % Total
			Short term external debt stocks % of reserves
			Total external debt stocks % reserves
			Total external debt stocks % reserves excluding gold
market perception of sovereign risk	0	1	5-year sovereign CDS spread basis points
			Foreign currency long-tern sovereign debt ratings 1-21 (worst)

Table A2: Factor Loadings and Uniqueness

Variables	Factors				Uniqueness
	government debt sustainability	balance sheet composition	external and private sector debt	market perception of sovereign risk	
Primary balance % GDP	0.98				0.04
Cyclically adjusted primary balance % potential GDP	0.96				0.07
Fiscal balance % GDP	0.99				0.03
Fiscal balance % average tax revenues	0.75				0.43
General government debt held by non residents % of total		0.91			0.10
Concessional external debt stocks, % government gross debt		0.82			0.12
Average maturity of sovereign debt in years		0.02			0.06
Total external debt stocks % GDP			0.88		0.15
Private external debt stocks % GDP			0.87		0.15
Domestic credit to the private sector % GDP			0.29		0.18
Short term external debt stocks % Total			0.01		0.18
Short term external debt stocks % of reserves			0.89		0.20
Total external debt stocks % reserves			0.97		0.03
Total external debt stocks % reserves excluding gold			0.87		0.23
5-year sovereign CDS spread basis points				0.78	0.38
Foreign currency long-tern sovereign debt ratings 1-21 (worst)				0.78	0.38
% explained	**0.86**	**0.50**	**0.59**	**0.62**	