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The Sooner (and the Smarter), the Better: COVID-19 Containment Measures and Fiscal Responses

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The Sooner (and the Smarter), the Better: COVID-19 Containment Measures and Fiscal Responses [1]

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Abstract

This paper finds empirical evidence that faster and smarter containment measures were associated with lower fiscal responses to the COVID-19 shock. We also find that initial conditions, such as fiscal space, income, health preparedness and budget transparency were important in shaping the amount and design of the COVID-19 fiscal response.

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I. INTRODUCTION AND CONTRIBUTION TO THE LITERATURE

COVID-19 is a health and economic shock. Since it was declared a global pandemic in early March 2020, many countries have seen more than one wave of infection outbreaks, and with it, waves of containment measures and central bank and government responses. This "Great Lockdown", as labeled by the IMF World Economic Outlook, is a supply and demand shock that has disrupted the cycle of production of goods and services, affecting households and businesses, big and small. Policymakers often struggled to balance their health and economic responses to the pandemic.

There is observational and empirical evidence that containment measures can reduce infections and fatalities. For example, Cowling et al (2020) in an observational study show that containment measures, or non-pharmaceutical interventions (NPIs), were effective in reducing the incidence of COVID-19 infections in Hong Kong between January and March 2020. IMF (2020), Deb et al (2020a) and Demirgüç-Kunt et al (2020) use empirical methods with high-frequency data to show that NPIs can be effective in reducing the number of infections and fatalities, especially when such measures were implemented faster.

A number of papers use the Susceptible, Infected and Recovered (SIR) epidemiology model and its variants to study the impact of hard/physical (quarantines) versus soft/smart[2] (testing) measures on health and economic outcomes. These models build on the original SIR epidemiology model by Kermack and McKendrick (1927) and adapt it to the economic literature. For example, Berger et al (2020) show that expanding testing in conjunction with targeted quarantine policies can dampen the economic fallout and reduce peak symptomatic infections – which is important for health infrastructure constraints. Acemoglu et al (2020), Brotherhood et al (2020) and Checo et al (2020) find similar results, focusing on targeted policies by age groups and high- versus low-risk individuals. Piguillem and Shi (2020) show that random testing can be a very close substitute for quarantines. Forslid and Herzing (2020) show that early quarantine essentially postpones, but does not alter, the course of infections at a cost that increases with the duration and extent of quarantine. They also model a trade-off between health and economic outcomes versus the duration of a quarantine. While their results imply that early quarantining may not be useful, lifting them earlier (potentially because of their success when implemented earlier) results in better health outcomes and less economic losses. Lattanzio and Palumbo (2020) emphasize the importance of soft containment measures, such as social distancing, wearing masks, sanitizing public and private spaces and generally increasing hygienic standards among others. Andrabi et al (2020) advocate the importance of smart real-time testing, contract tracing and community messaging. Cherif and Hasanov (2020) argue that implementing a universal testing strategy requires epidemiological

[2] Throughout the paper, "smart" containment measures refer to elements such as testing, contact tracing and public health information campaigns.

testing—sacrificing test accuracy for scalability, convenience, and speed—and industrial policy to ramp up production of tests.

A number of papers have used high-frequency indicators to study the economic impact of COVID-19 in real-time. Examples include proxies for economic activity such as electricity usage, nitrogen dioxide emissions, mobility trends and job postings as in Chen et al (2020), Deb et al (2020a; 2020b), Demirgüç-Kunt et al (2020) and IMF (2020), respectively. For example, Debt et al (2020b) show that containment measures have had, on average, an impact on economic activity equivalent to a loss of about 15 percent in industrial production. Deb et al (2020a) and Demirgüç-Kunt et al (2020) further show that early introduction of NPIs can limit the economic fallout of the pandemic. Cevik and Öztürkkal (2020) using daily data find that more infections are associated with higher sovereign credit default swap (CDS) spreads.

This paper empirically examines the determinants of countries' fiscal measures in response to COVID-19, focusing on the role of (speed and type of) containment measures. Specifically, we regress governments' fiscal measures in response to COVID-19 on the observed public health response time (or PHRT: the speed of introducing stringency measures, defined below) among other control variables. Importantly, when defining stringency, we differentiate between "hard/physical" lockdowns and "soft/smart" measures that also include elements such as testing, contact tracing and public health information campaigns. We also examine the role of other control variables including the average stringency over the sample period, as well as measures of income, fiscal space, budget transparency, economic outlook and health preparedness. The sample period covers daily data on stringency indices between January 1st and October 15th. Data on fiscal measures in response to COVID-19 covers 190 countries, by type (above-the-line and below-the-line)[3] and comes from the IMF October 2020 Fiscal Monitor.

The main finding is that faster and smarter containment measures were associated with lower fiscal responses. Specifically, the faster the PHRT, the better. Moreover, the type of containment measures matters – physical lockdowns alone are less effective than those accompanied by smart measures. We also find that swift introduction of (especially smart) measures may reduce or even nullify the need to maintain on average higher restrictions in place over time. This is in line with the growing literature on the importance of early and smart NPIs (Aum et al 2020; Berget el al 2020; Cherif and Hasanov (2020); Deb et al 2020a; Fotiou and Lagerborg 2021a; IMF 2020). This suggests that there need not be a trade-off between health and

[3] On budget "above-the-line" measures include additional spending (e.g. health spending, unemployment benefits, transfers) or forgone revenues (e.g. tax cuts and credits) provided through standard budget channels. Off-budget "below-the-line" measures include equity injections, asset purchases or loans, including through extra-budgetary funds. "Contingent liabilities" include government guarantees and other quasi-fiscal operations.

economic outcomes, and that the same measures that help save lives, can also save fiscal resources.

Other results highlight the important role of initial conditions in shaping the amount and design of the COVID-19 fiscal response. We find that fiscal space constrained the overall fiscal response, especially in non-health fiscal measures and in developing countries. We also find that fiscal packages were larger for higher-income countries, especially below-the-line measures, while lower-income countries spent more on health given their weaker initial health infrastructure and preparedness. Other health-related variables, such as cases per population and the share of elderly population, matter for the health fiscal response. Higher budget transparency is also found to be associated with a larger fiscal response, reflecting the importance of strong institutional and PFM capacity.

We contribute to the strand of the empirical literature on the economic impact of containment measures. Many of the above cited existing studies on the impact of the pandemic are model-based. This paper contributes to the small but rapidly expanding empirical literature on the topic as more data becomes available. We differentiate between physical and smart containment measures, emphasize the importance of the speed of enacting stringency measures, and study the impact of the type and speed of measures on government fiscal responses. Closest to our work is Fotiou and Lagerborg (2021a), but compared to that, we define "early" and "smart" containment measures in a way that more robustly captures the dynamics of governments' stringency responses (see below), use a more updated dataset (from Jan 1st till Oct 15th) on both stringency indices and fiscal measures, and control for more variables that can affect the size and composition of fiscal measures in response to COVID-19 in the empirical specifications. Fotiou and Lagerborg (2021b) study the impact of average and early containment, among other variables, on the WEO projection revisions of GDP growth, primary balance and debt-to-GDP. Balajee et al (2020) focus on the role of average stringency only and their measure of fiscal responses excludes below-the-line measures and tax deferrals and the sample period, over which average stringency is computed, stops on April 9th.

The rest of this paper is structured as follows. Section II presents stylized facts. Section III presents the empirical model and results. Finally, Section IV concludes.

II. AN INITIAL LOOK AT THE DATA

Fiscal measures in response to COVID-19 varied by income level and by region. We use the October 2020 Fiscal Monitor database on country fiscal measures in response to COVID-19.[4] The dataset includes announced fiscal measures, in almost all IMF member countries, and are classified into on-budget above-the-line (ATL) health and non-health measures, tax deferrals and off-budget below-the-line (BTL) and contingent labilities (CLs such as guarantees and quasi-fiscal operations). ATL measures include both forgone revenues and additional spending, mostly to provide support to households, while BTL-CL measures are mostly to support firms.

- By income level, reported fiscal responses were highest in AEs, followed by EMs and LIDCs. Health responses were smaller than non-health and other measures, on average. This may suggest that, while COVID-19 is primarily a health crisis, containment measures and disruptions to economic activity meant financial resources had to be devoted more to protecting incomes of vulnerable households and liquidity of stressed businesses. That said, additional spending on health as a share of overall fiscal response was most sizable in LIDCs, reflecting their weaker initial overall health infrastructure and preparedness. BTL-CL measures were more pronounced in AEs, potentially given their stronger fiscal institutions.
- By region, the median announced fiscal response was the highest in European (EUR) countries, at around 10 percent of GDP. Countries in Asian-Pacific (APD) and Western Hemisphere (WHD) followed. The median fiscal response in Middle East and Central Asia (MCD) and African (AFR) countries was relatively the smallest, potentially reflecting weaker fiscal space going into the crisis. This hypothesis will be tested below.

Figure 1. Fiscal Responses, by Income Level
(Jan. 1 – Oct. 15, 2020, in percent of GDP)

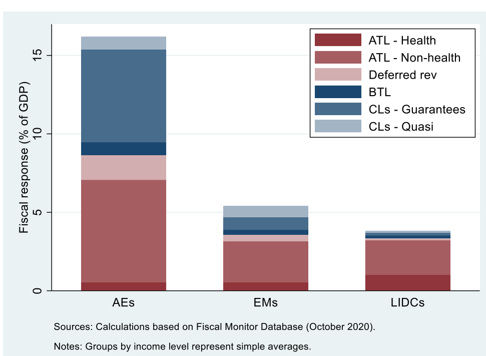
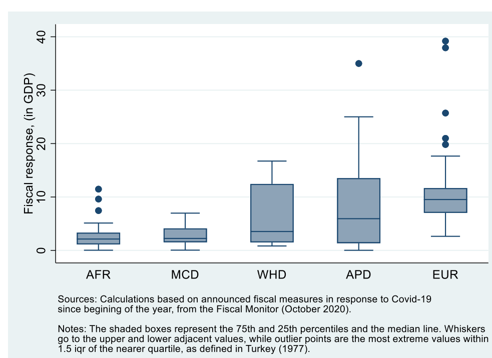


Figure 2. Fiscal Responses, by Region
(Jan. 1 – Oct. 15, 2020)



[4] Available at https://www.imf.org/en/Topics/imf-and-covid19/Fiscal-Policies-Database-in-Response-to-COVID-19. This is also reflected in the IMF Policy Tracker, available at https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19

We use data from Oxford's COVID-19 Government Response Tracker (OxCGRT) for containment measures (Hale et al 2020).[5] Specifically, we use both the stringency index and the containment health index. The OxCGRT "stringency index" collects information on government policy responses across eight dimensions, namely: school closures; workplace closures; public event cancellations; gathering restrictions; public transportation closures; stay-at-home orders; restrictions on internal movement; and international travel bans. The OxCGRT "containment and health index" includes all the above plus testing policy, contact tracing and public health information campaigns. We use both indices to distinguish between "hard/physical" lockdown measures alone versus those accompanied by "soft/smart" public health measures.

We use the concept of public health response time to study the speed of countries' response to COVID-19. Fotiou and Lagerborg (2021a; 2021b) define early stringency as the OxCGRT stringency index in place when the 100th case was reported. Deb et al (2020a) define public health response time (PHRT) as the number of days it takes for a country to tighten containment measures after a significant outbreak (defined as 100 confirmed cases), using all NPIs in the OxCGRT stringency index other than international travel restrictions. IMF (2020) calculates the number of days to reach maximum stringency after the first reported case, and use the median of that sample to split countries into fast versus slow tighteners. In this paper, we define PHRT as the number of days it takes a country to reach its maximum stringency (measured by both the stringency and containment health indices) after a significant outbreak. Compared to existing studies:

- As in Deb et al (2020a) and Fotiou and Lagerborg (2021a; 2021b), we define a significant outbreak as 100 confirmed cases. Baldwin and di Mauro (2020) also use this threshold.
- However, we differ in the following aspects. First, we define PHRT as the number of days for each country's OxCGRT index to reach its "maximum" level over the sample period, not just the days to "increase" the index after a major outbreak (as in Deb et 2020a), and not just the value of the stringency index at 100 cases (as in Fotiou and Lagerborg 2021a; 2021b). Consider the example of countries A, B and C; whereby country A was the most prudent and reached its maximum stringency before 100 confirmed cases, whereas countries B and C had similar stringencies when they hit 100 cases, but imposed restrictions thereafter at different speeds and reached their maximum stringency weeks or months apart. Deb el al (2020a) would likely penalize country A, while Fotiou and Lagerborg (2021a; 2021b) would not be able to differentiate between countries B and C. In fact, using our *phrt* (*phrt_smart*) definitions, the country A situation is observed in about 21 percent of the sample, while the countries B and C situation is observed in about 70[6]

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[5] Available at https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker#data

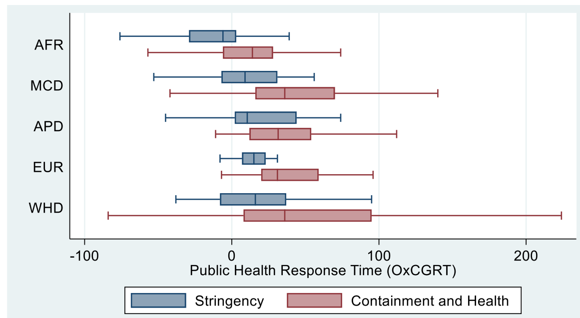
[6] This simply means that the example of countries B and C where two or more countries had about the same stringency index at 100 confirmed cases happened *collectively* in about 70 percent of the countries; *not* that 70 percent of the countries had the same stringency index at 100 confirmed cases.

percent of the sample. Second, we retain international travel restrictions in our measure of stringency (whereas Deb el al (2020a) drop it), as such restrictions have been shown to be effective (Chinazzi et al (2020) and Hsiang et al (2020)). Third, we use the containment and health index as is (whereas Fotiou and Lagerborg (2021a; 2021b) reconstruct it to separate out the health component).

Public health response times varied, by region and by type of restrictiveness. Using our definition of PHRT, AFR countries were the fastest to reach their maximum restrictiveness (using the OxCGRT stringency (blue bars) and the containment and health (red bars) indices). One reason for this could probably be because the COVID-19 wave reached AFR countries relatively late, allowing them to learn from the experiences of others and to put early stringency measures in place before infection cases reached a critical mass. Dispersion of the PHRT in WHD was the largest, suggesting a very heterogenous response at the country level, especially when using the containment and health index. While all regions were slower in enacting health and testing responses compared to lockdowns (median for red bars is uniformly higher than that of blue bars), the median PHRT for EUR improves, in comparison to other regions, suggesting they were relatively more aggressive on testing policies.

Figure 3. Public Health Response Time, by Region

(Jan. 1 – Oct. 15)



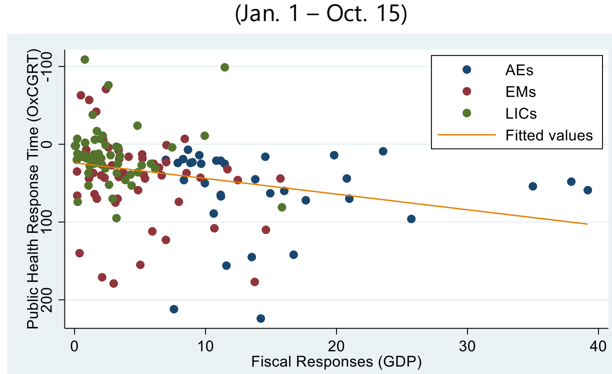
Sources: Calculations based on OxCGRT.

Notes: Public health response time (PHRT) is the numbers of days to reach the country's maximum restrictiveness (OxCGRT containment and health index) after a major outbreak (100 cases). The shaded boxes represent the 75th and 25th percentiles and the median line. Whiskers go to the upper and lower adjacent values, as defined in Turkey (1977).

Anecdotal evidence suggests that enacting containment and health measures faster is associated with lower fiscal responses. A visual examination of the data over the sample period suggests that faster PHRT is associated with lower fiscal responses in percent of GDP. We can also see that countries' income levels seem to be a relevant factor affecting the size of the fiscal response. The next section will empirically test this hypothesis, among other initial conditions and control variables to study the determinants of fiscal measures in response to COVID-19.

Figure 4. Speed of Containment Measures and Fiscal Response

(Jan. 1 – Oct. 15)



Sources: Calculations based on OxCGRT and Fiscal Monitor (October 2020).

Notes: (i) Public health response time (PHRT) is the numbers of days to reach the country's maximum restrictiveness (OxCGRT containment and health index) after a major outbreak (100 cases); and (ii) Fiscal response, in percent of GDP, are announced fiscal measures in response to Covid-19 since begining of the year, from the Fiscal Monitor.

III. THE EMPIRICAL MODEL AND RESULTS

The methodology used is a cross-sectional regression to study how containment measures may affect the size of announced fiscal responses, accounting for other factors that may affect fiscal responses.[7] Sample period starts in January and ends in mid-October. We use the following specification where the dependent variable is a measure of the fiscal response as a share of GDP. Our basic specification uses the total (ATL+BTL+CL) fiscal response, but we also use ATL health and BTL-CL fiscal measures separately.

$$fiscalresponse_i = \beta_0 + \beta_1 phrt_i + \beta_2 avg_i + \beta_3 lgdppc_i + \beta_4 X_i + \varepsilon$$

The main coefficient of interest is the PHRT variable which measures how the speed and type of containment relates to the fiscal response. As described above, *phrt* measures the speed at which countries implement stringency measures. We expect the estimated coefficient to be positive, indicating that faster containment response (lower PHRT) is associated with smaller fiscal responses. We use both the OxCGRT stringency index to capture the effect of physical lockdowns (*phrt*) and the OxCGRT containment and health index to also capture the effect of smart measures such as testing policy and contact tracing (*phrt_smart*).

We also include each country's average containment response. The *phrt* and *phrt_smart* variables measure the speed at which each country reaches its maximum stringency index over the sample period. To measure how strict such stringency has been on average, we use the *avg* and *avg_smart* variables, i.e. the average of the country's OxCGRT daily stringency index and containment and health index, respectively, over the sample period. The estimated coefficient could be positive (especially for *avg*, indicating that higher (lockdown) measures are costly given more disruptions to economic activity), or negative (especially for *avg_smart* indicating that higher (smart) measures on average are less costly given they can potentially limit infections and allow for safer resumption of activity), or statistically insignificant, including because a faster (and smarter) containment response – measured by PHRT – may more quickly contain the spread of infections and as a result lead to earlier easing of lockdown restrictions and resumption of economic activity, which could ultimately lower the required fiscal response.

Other control variables include the following:

- The (log of) **GDP per capita**, measured in real PPP terms from the October 2020 IMF WEO, to account for the role of income and the corresponding capacity of governments to issue fiscal support packages. The estimated coefficient could be positive for overall and BTL-CL fiscal

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[7] A panel methodology is not possible in this context, as time-series for the dependent variable (fiscal responses) is not available.

responses (as richer countries spent relatively more on these categories), but negative for health responses (as poorer countries spent relatively more on health).

- **Fiscal space.** Alon et al (2020) incorporate fiscal space constraints to model the effectiveness of government lockdown measures in developing countries. Closer to our work, Balajee et al (2020) use credit ratings, while Fotiou and Lagerborg (2021a) use public debt, fiscal balances, grants and commodity revenues as measures of fiscal space. One can argue that all such elements may in a way be reflected in countries' spreads, and as such we use the (log of) Emerging Markets Bond Index (EMBI) spreads as a summary measure of fiscal space in this paper. We expect the estimated coefficient to be negative, indicating that less fiscal space constrained the fiscal response.
- **Budget transparency.** We use the 2019 Open Budget Survey (OBS) index as a measure of budget transparency.[8] The index measures transparency (the extent to which the government releases timely, comprehensive and useful budget information) as well as public participation and oversight institutions. Higher values of the index imply higher budget transparency. As such, we expect the estimated coefficient to be positive, especially in the BTL-CL specification.
- **Health-related variables.** We control for the number of infected **cases per population**. Data on number of cases comes from OxCGRT while data on total population comes from the World Bank WDI. We also control for **population ages 65** and above, as a share of total population, from the WDI. We expect the estimated coefficients of these variables to be positive, especially in the ATL health specification. Finally, we use the 2019 Global Health Security **(GHS) index** as a measure of the overall health infrastructure and preparedness of a country prior to the pandemic.[9] The index covers prevention (e.g. immunizations), detection and reporting (e.g. laboratory systems), response (e.g. planning and operations), health system (e.g. healthcare capacity and access), compliance with international norms (e.eg. international agreements and commitments) and risk environment (e.g. infrastructure adequacy). Higher values of the index imply stronger initial health conditions. As such, we expect the estimated coefficient to be negative, especially in the ATL health specification.

Empirical results are subject to caveats. First, establishing causality in this context is difficult because countries' decisions to implement containment measures depend on the evolution of the pandemic, which in turn affects countries' fiscal responses, which in turn may depend on success of containment measures. Regression results presented show associations, and correlation does not imply causation. Second, the dependent variable is total announced fiscal measures, which may differ from actual implementation, may have been announced in stages and may include a mix of discretionary measures and automatic stabilizers. Third, coverage may differ between general or central government or public sector, blurring the difference between ATL and BTL-CL measures in some cases. Fourth, some countries where the pandemic hit

[8] Available at https://www.internationalbudget.org/open-budget-survey/
[9] Available at https://www.ghsindex.org/

relatively later might have been able to learn from others who were hit earlier, affecting countries' PHRT. Finally, the OxCGRT index neither captures voluntary social distancing, which may affect infections (IMF 2020) and fiscal responses, nor any potential gaps between officially imposed and actually implemented stringency measures or their effectiveness. In what follows, table 1 presents results using the total (ATL health and non-health and BTL-CL) fiscal response as the dependent variable. Table 2 focuses on the ATL health fiscal response only, while table 3 studies the determinants of the BTL-CL (BTL financing and CLs) fiscal response. Table 4 presents some robustness checks.

Our main result is that faster, and smarter, containment was associated with smaller fiscal responses. The coefficient attached to the *phrt_smart* variable is positive and statistically significant. This result is robust in all reported specifications with different control variables and whether the dependent variable is the total (models 1-3), ATL health (models 7-9), or BTL-CL (models 13-14) fiscal response. When looking at the *phrt* variable alone which considers physical lockdowns only, however, the coefficient is not statistically different from zero in 6 of the 8 specifications in tables 1-3. The simple average of statistically significant *phrt_smart* coefficients in tables 1-4 is around +0.03, indicating that a 10 percent decrease in mean PHRT is associated with a lower fiscal stimulus by 0.3 percent of GDP, holding all else constant.[10] This highlights the importance of not only acting fast, but also acting smart. It is consistent with the growing literature on the importance of smart measures. For example, Aum et al (2020), Berger et al (2020) and Cherif and Hasanov (2020) use variants of the SIR model to show that testing and tracking can more effectively reduce infections and disrupt the economy less than a blanket lockdown. Empirically, Deb et al (2020a) and IMF (2020) find evidence that countries with faster PHRT had a significant impact on infections and mortality. Focusing on economic outcomes, Fotiou and Lagerborg (2021b) find that countries that imposed strong and smart containment measures earlier suffered less downward revisions to their fiscal balance and GDP growth projections. Fotiou and Lagerborg (2021a) find that early and smart NPIs can lessen fiscal responses, although using different model specifications and definitions of stringency.

Table 1. Determinants of Total Fiscal Responses

VARIABLES	(1) Total	(2) Total	(3) Total	(4) Total	(5) Total	(6) Total
phrt_smart	0.016*	0.028**	0.046***			
	(0.008)	(0.011)	(0.012)			
avg_smart	-0.102*	-0.112*	-0.040			
	(0.057)	(0.063)	(0.045)			
phrt				0.016	0.020	0.031***

[10] In our sample, the mean of the *phrt_smart* variable is around 34 days, and 1 st dev is around 54 days.

VARIABLES	(1) Total	(2) Total	(3) Total	(4) Total	(5) Total	(6) Total
				(0.010)	(0.014)	(0.010)
avg				-0.097**	-0.093*	0.001
				(0.048)	(0.050)	(0.050)
lgdppc_rppp	2.948***	2.738***	-1.299	2.920***	2.852***	-0.619
	(0.426)	(0.761)	(0.840)	(0.404)	(0.746)	(1.005)
obsi2019		0.086***	0.052*		0.080**	0.044
		(0.029)	(0.031)		(0.030)	(0.037)
casespop		-0.853	1.017		-0.537	1.029
		(0.933)	(0.910)		(0.939)	(1.036)
lembi			-1.422**			-1.126
			(0.621)			(0.709)
Constant	-16.55***	-17.694***	22.042**	-16.07***	-18.725***	13.372
	(4.274)	(6.324)	(10.899)	(3.895)	(5.911)	(12.037)
Observations	147	105	56	147	105	56
R-squared	0.292	0.383	0.426	0.295	0.371	0.280

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Variable definitions: *phrt_smart* is PHRT measured using the OxCGRT containment and health index; *avg_smart* is the average OxCGRT containment and health index; *phrt* is PHRT measured using the OxCGRT stringency index; *avg* is the average OxCGRT stringency index; *lgdppc_rppp* is the (log of) GDP per capita in US dollar PPP terms; *obsi2019* is the 2019 OBS index measure of budget transparency; *casespop* is reported cases per population; *lembi* is the (log of) EMBI spreads.

Higher restrictiveness, on average, is not necessarily associated with lower fiscal responses. Estimated coefficients of *avg_smart* and *avg* variables are negative and statistically significant in only 5 of the 16 specifications (in tables 1, 2 and 3), including only once in the ATL health specification when including testing and contact tracing in the stringency definition (model 8). This could potentially be because the speed of introducing strict measures (*phrt_smart*) may contain the health and economic fallout earlier and as such lessen or nullify the need to maintain higher strict measures on average (*avg_smart*) over time. IMF (2020) reach a similar finding whereby early lockdowns, even if bearing short-term economic costs, may bring infections down faster and thus pave the way to a faster resumption of activity, possibly even leading to positive net effects on the economy. The simple average of statistically significant *avg* and *avg_smart* coefficients in tables 1-4 is around -0.08, indicating that a 10 percent increase in mean stringency is associated with a lower fiscal stimulus by 0.8 percent of GDP, holding all else constant.[11] Fotiou and Lagerborg (2021a) find similar, albeit weak, evidence. Balajee et al (2020), however, find that higher stringency, on average, is associated with more fiscal stimulus. This could be because their sample period ends in April which may have been rather short to capture the dynamics of stringency and fiscal reactions.

[11] In our sample, the mean of the *avg_smart* variable is around 48 (index goes from 0-100), and 1 st dev is around 10. A 10 percent increase in the mean is thus equivalent to around ½ st dev.

Fiscal space constrained the overall fiscal response. The estimated coefficient for EMBI spreads is negative as expected.[12] This is consistent with Balajee et al (2020) who find that lower credit ratings were associated with lower fiscal stimulus. The coefficient is statistically significant in the case of total fiscal response (table 1, model 3), but not other specifications. This could be because fiscal space was potentially not binding to the required health response (table 2), which was actually relatively higher in LIDCs –where fiscal space is most binding – both as a percent of GDP and as a share of total response. Fotiou and Lagerborg (2021a) also find that constrained access to finance was not a constraint in health spending. Similarly, fiscal space – although more limited in LIDCs and EMs than in AEs – may not have been a crucial factor in their BTL-CL response (table 3), given potential institutional constraints (see below) and their limited BTL-CL response overall. This suggests that fiscal space is potentially relevant to ATL non-health fiscal measures. We test this hypothesis in table 4 below.

Fiscal packages were larger for higher-income countries, especially BTL-CL measures, while lower-income countries spent more on health fiscal measures. As expected, higher fiscal responses are associated with higher GDP per capita. Balajee et al (2020) find similar evidence. However, this holds when using total (table 1) and BTL-CL fiscal measures (table 3) as the dependent variable. On the contrary, lower GDP per capita is associated with higher ATL health spending (table 2, models 8 and 11), as lower-income countries had weaker initial health infrastructure and preparedness overall going into the crisis, and as such had to spend relatively more on health measures in percent of GDP. Fotiou and Lagerborg (2021a) report similar results.

Health-related variables mattered for the health fiscal response. We find that the higher fiscal health response is associated with higher cases per population (table 2), but the relationship does not seem to hold in overall fiscal responses (table 1). Although not statistically significant, the GHS index is negative as expected (table 2), indicating that stronger health infrastructure is associated with less additional measures on health. Similarly, the coefficient on the share of population above 65 years of age is positive (table 2), although not statistically significant. Deb et al (2020a) use real-time data on COVID-19 confirmed cases and deaths and find that containment measures are more effective in countries with a relatively high share of elderly and those with a stronger GHS index. Aguirre and Hannan (2020) use state-level data from Mexico to show that age, pre-existing conditions and initial health capacity were important in controlling the fatality rate.

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[12] Specifications with EMBI spreads included as a control variable are, by definition, limited to a country sample of EMs and Frontier LIDCs. This issue is addressed in robustness checks in table 4.

Table 2. Determinants of the Health Fiscal Response

VARIABLES	(7) ATL_health	(8) ATL _health	(9) ATL _health	(10) ATL _health	(11) ATL _health	(12) ATL _health
phrt_smart	0.002*	0.002*	0.002*			
	(0.001)	(0.001)	(0.001)			
avg_smart	-0.007	-0.010**	-0.012			
	(0.006)	(0.005)	(0.013)			
phrt				0.001	0.001	0.002
				(0.002)	(0.002)	(0.002)
avg				-0.003	-0.007	-0.004
				(0.006)	(0.006)	(0.011)
lgdppc_rppp	-0.039	-0.149**	-0.103	-0.037	-0.157*	-0.062
	(0.053)	(0.070)	(0.186)	(0.054)	(0.081)	(0.177)
GHSI	-0.002	-0.002	-0.005	-0.000	-0.002	-0.007
	(0.004)	(0.005)	(0.006)	(0.005)	(0.004)	(0.006)
casespop		0.236***	0.200**		0.245***	0.189**
		(0.065)	(0.078)		(0.052)	(0.080)
Popages65		0.013	0.010		0.013	0.014
		(0.012)	(0.027)		(0.013)	(0.026)
lembi			-0.052			-0.030
			(0.082)			(0.091)
Constant	1.364**	2.318***	2.369	1.159*	2.219***	1.599
	(0.594)	(0.541)	(1.785)	(0.612)	(0.767)	(1.687)
Observations	128	128	58	128	128	58
R-squared	0.045	0.140	0.152	0.015	0.117	0.112

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Variable definitions: *phrt_smart* is PHRT measured using the OxCGRT containment and health index; *avg_smart* is the average OxCGRT containment and health index; *phrt* is PHRT measured using the OxCGRT stringency index; *avg* is the average OxCGRT stringency index; *lgdppc_rppp* is the (log of) GDP per capita in US dollar PPP terms; *GHSI* is the GHS index measure of health infrastructure and preparedness; *casespop* is reported cases per population; *Popages65* is the share of population aged 65 years and above; *lembi* is the (log of) EMBI spreads.

Higher budget transparency is associated with larger fiscal measures, especially BTL-CL measures. As expected, the estimated OBS index coefficient is positive and significant reflecting the importance of strong institutional and PFM capacity to respond with more BTL-CL measures (table 3, models 13 and 15). This also holds in the total fiscal response (table 1, models 2, 3 and 5), potentially because BTL-CL measures constituted the bulk of the overall fiscal response in AEs.

Table 3. Determinants of BTL and Contingent Liability (CL) Measures

VARIABLES	(13) BTL-CL	(14) BTL-CL	(15) BTL-CL	(16) BTL-CL
phrt_smart	0.028***	0.031**		
	(0.010)	(0.013)		
avg_smart	-0.062	-0.014		
	(0.047)	(0.042)		
phrt			0.027**	0.008
			(0.011)	(0.007)
avg			-0.053	0.024
			(0.039)	(0.043)
lgdppc_rppp		-0.109		0.454
		(0.473)		(0.695)
obsi2019	0.088***	0.024	0.086***	0.016
	(0.024)	(0.020)	(0.023)	(0.025)
lembi		-0.538		-0.411
		(0.405)		(0.533)
Constant	0.930	4.291	1.332	-2.400
	(2.220)	(5.721)	(1.851)	(7.953)
Observations	106	56	106	56
R-squared	0.179	0.305	0.163	0.121

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Variable definitions: *phrt_smart* is PHRT measured using the OxCGRT containment and health index; *avg_smart* is the average OxCGRT containment and health index; *phrt* is PHRT measured using the OxCGRT stringency index; *avg* is the average OxCGRT stringency index; *lgdppc_rppp* is the (log of) GDP per capita in US dollar PPP terms; *obsi2019* is the 2019 OBS index measure of budget transparency; *lembi* is the (log of) EMBI spreads.

The paper's main result on the role of fast and smart interventions holds under additional robustness checks (table 4). To further examine the robustness of the results, we use different measures of the dependent variable, namely ATL non-health (model 17) and total fiscal response including tax deferrals (model 18). Regarding independent variables, we first re-run the basic specification using a slightly different definition of PHRT (model 19). We also add revision to real GDP growth as a control variable to account for the impact of economic outlook (model 20), and experiment with alterative definitions of fiscal space (model 21). The paper's main result of a positive and significant *phrt_smart* coefficient continues to hold in all the specifications below. In all specifications, the *avg_smart* coefficient is insignificant, indicating that early strict interventions nullified the need to maintain high restrictions in average over time. Results (not shown) are mostly the same when using *phrt* and *avg* in place of *phrt_smart* and *avg_smart*.

In addition, we show that fiscal space mattered especially for ATL non-health measures and in developing countries, while worsening economic outlook mattered for the overall fiscal response. Specifically, robustness checks revealed the following additional results:

- **ATL non-health.** In this specification, the EMBI coefficient is negative and statistically significant, re-enforcing our view that fiscal space was binding especially for ATL non-health fiscal measures (model 17).
- **Tax deferrals.** Results on PHRT and EMBI spreads continue to hold when including tax deferrals as part of the overall fiscal response (model 18). In addition, stronger budget transparency is associated with a larger fiscal response.
- **Alternative PHRT definition.** Building on IMF (2020), we re-run the basic specification while defining PHRT as the number of days to reach maximum stringency after the 1st (not the 100th) case. Results (in model 19) hold. Further results (not shown) using *phrt* and *avg*, in place of *phrt_smart* and *avg_smart*, show that the relevant coefficient loses significance, re-enforcing the importance of smart, as opposed to only physical, containment measures.
- We control for the **revision to real GDP growth** by comparing growth rates from the IMF January 2020 WEO (before COVID-19) versus the October 2020 WEO (after COVID-19). This variable will have a negative value in most, if not all, countries.[13] The estimated coefficient is negative and significant suggesting that the worsening economic outlook prompted a larger overall fiscal response (model 20). This is in line with Fotiou and Lagerborg (2021a).
- **Alternative measures of fiscal space**. The baseline specifications use EMBI spreads as a summary measure of fiscal space. However, by definition, that leaves out AEs and most LIDCs. Alternatively, and building on Fotiou and Lagerborg (2021a), we use general government (GG) gross debt (in 2018), overall fiscal balance (average 2016-18) and a dummy for LIDCs. Results (in model 21) suggest that countries with higher debt (*GGdebt*) had larger fiscal packages. This potentially proxies for AEs capacity to carry debt. GG debt in developing countries (*GGdebtlidc*), however, constrained the fiscal response. Stronger initial fiscal balance positions (*GGfiscbal*) facilitated larger fiscal stimulus in response to COVID. These results are in line with Fotiou and Lagerborg (2021a).

[13] We expect the estimated coefficient to be negative in general implying that more downward GDP growth revisions were associated with a need for higher fiscal responses. That said, the causality could go in the other direction, where big fiscal responses could help smooth the revision in GDP growth rates, but we believe this to be minor as in general there would be a time lag between fiscal stimulus and the corresponding impact on economic activity.

Table 4. Robustness Checks

VARIABLES	(17) ATL_ nonhealth	(18) Total_ deff	(19) Total	(20) Total	(21) Total
phrt_smart	0.011*	0.054***	0.056***	0.025**	0.018**
	(0.006)	(0.013)	(0.016)	(0.011)	(0.009)
avg_smart	-0.008	-0.009	-0.050	-0.016	-0.082
	(0.033)	(0.054)	(0.049)	(0.065)	(0.051)
lgdppc_rppp	-0.689	-0.860	-1.230	-0.153	2.901***
	(0.420)	(0.725)	(0.859)	(0.712)	(0.652)
obsi2019	0.016	0.054*	0.047		
	(0.014)	(0.032)	(0.034)		
casespop	1.013**		1.361		
	(0.413)		(0.975)		
lembi	-0.811***	-1.546**	-1.567**	-0.958*	
	(0.299)	(0.649)	(0.695)	(0.569)	
revggw				-0.249*	
				(0.148)	
GGdebt					0.085***
					(0.026)
GGdebtlidc					-0.082***
					(0.027)
GGfiscbal					0.306**
					(0.150)
lidc					5.683**
					(2.237)
Constant	11.999**	17.756*	20.815*	11.191	-21.690***
	(5.235)	(9.912)	(11.424)	(9.113)	(7.538)
Observations	52	56	56	60	143
R-squared	0.341	0.421	0.404	0.206	0.416

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Variable definitions: *phrt_smart* is PHRT measured using the OxCGRT containment and health index; *avg_smart* is the average OxCGRT containment and health index; *lgdppc_rppp* is the (log of) GDP per capita in US dollar PPP terms; *obsi2019* is the 2019 OBS index measure of budget transparency; *casespop* is reported cases per population; *lembi* is the (log of) EMBI spreads; *revggw* is the revision in GDP growth rates in Jan vs Oct 2020 WEO; *GGdebt* is General Government gross debt in 2018; *GGdebtlidc* is GG gross debt in LIDC countries only; *GGfiscbal* is GG overall fiscal balance average 2016-18; *lidc* is a dummy variable that takes the value of 1 for LIDCs and 0 otherwise.

IV. CONCLUSION

The paper's main finding is that faster and smarter containment measures are associated with lower fiscal responses to COVID-19. The paper aims to study the determinants of countries' fiscal responses to COVID-19. This is done by regressing fiscal responses to COVID-19 (from the IMF Fiscal Monitor Database) on a measure of the speed of adopting strict containment measures (the public health response time), the degree of stringency measures (average OxCGRT stringency index from Jan 1st to October 15th), while controlling for other variables and initial conditions that may affect fiscal responses such as fiscal space, income, and health infrastructure among others. In measuring PHRT and average stringency, we differentiate between physical containment measures (such as lockdowns and travel restrictions) and smart containment measures (such as testing policies and contact tracing). The paper's main result – that faster and smarter containment measures are associated with lower fiscal measures in response to COVID-19 – is robust to different specifications including alternative measures of the dependent and independent variables.

Other results highlight that initial conditions shaped the amount and design of the COVID-19 fiscal response. We find that fiscal space constrained the overall fiscal response, especially in non-health fiscal measures and in developing countries. We also find that fiscal packages, especially below-the-line measures, were larger for higher-income countries, while lower-income countries spent more on health given their weaker initial health infrastructure and preparedness. Other health-related variables, such as cases per population and the share of elderly population, mattered for the health fiscal response. Higher budget transparency was also found to be associated with a larger fiscal response, reflecting the importance of strong institutional and PFM capacity. Results are robust to different specifications.

This paper's findings suggest that in the efforts to minimize health and economic losses, smart and rapid containment measures are essential. This is an important message for policymakers. Observational and empirical evidence in the literature suggest that quick and smart interventions may better and faster contain the spread of infections. Empirical evidence in this paper further suggest that the same quick and smart containment measures can also reduce the size of the fiscal response to the COVID-19 shock. This suggests that the same measures that help save lives, can also save fiscal resources.

Our results motivate future research in several aspects. Econometric improvements could include, first, a re-examination of the determinants of fiscal response to COVID-19 in a panel context, once time series data on countries' fiscal responses become available. Second, and contingent on having panel observations, an instrumental variable approach may be used to address potential endogeneity problems. Comparative country case studies could also be useful to help understand how countries used their fiscal space during the pandemic, including on the effectiveness and efficiency of the adopted fiscal measures.

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