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On the Determinants of the Fiscal Policy Response to COVID-19: Evidence from Robust Estimation and Country Outlier Detection

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Abstract

This paper analyzes the determinants of fiscal policies during the COVID-19 crisis. Using the robust regression MM-estimator for 180 countries we have found that GDP per capita, quantitative easing, debt to GDP ratio, trade openness and total revenue had a positive and a statistically significant impact on the fiscal policy responses, while unemployment rate and current account balance had a negative one. Furthermore, we have shown that the proportion of the population aged 65 and above had a positive influence on the size of fiscal packages. In contrast, factors such as political stability, absence of violence, and political ideology had no discernible impact on the allocation of fiscal aid. The outcomes of our findings carry substantial implications and offer valuable insights for authorities and policymakers.

Keywords

Fiscal Policy, COVID-19, Cross-Country, Comparative Analysis

1. Introduction

The COVID-19 pandemic has had profound global impacts, necessitating comprehensive policy responses to mitigate its effects on societies, economies, and public health systems. In response to the multifaceted challenges posed by the pandemic, governments worldwide have employed various policy tools, with fiscal policy playing a crucial role in alleviating the adverse effects of the crisis (Bergant & Forbes, 2023; Hinterlang et al., 2023). Understanding the determi-

nants that shape countries' fiscal policy responses is vital for effective crisis management and policy formulation.

The existing literature on the determinants of the fiscal policy responses to the pandemic is still rather limited. The most intensively explored factors are GDP per capita, followed by quantitative easing and share of population aged 65 and above. Indicatively, Alberola et al. (2021) and Benmelech and Tzur-Ilan (2020) provide statistical evidence that GDP per capita has a positive impact on the COVID-19 fiscal packages, while Aizenman et al. (2021) did the same for quantitative easing. Furthermore, Li and Lian (2021) found that the proportion of individuals aged 65 and above influences the extent of fiscal assistance provided. Finally, Azad et al. (2021) have shown that during the pandemic fiscal policy exhibited a higher level of engagement than monetary policy, with deficit spending playing a vital role in bolstering immediate economic activity in the short-run. Other factors, including the debt-to-GDP ratio and the trade openness, have generated mixed findings (Apeti et al., 2021; Benmelech & Tzur-Ilan, 2020; Bergant & Forbes, 2023; Elgin et al., 2022; Romer, 2021).

This research paper aims to analyze the determinants influencing the fiscal policy responses to COVID-19 across 180 countries. By examining a diverse set of nations, encompassing different geographical regions, economic structures, and political systems, this study seeks to identify macroeconomic and political factors that drive fiscal policy decisions during a global health crisis.

Overall, this research contributes to the existing literature on fiscal policy responses to crises by providing a comprehensive analysis of 180 countries. By using the robust regression MM-estimator derived by Yohai (1987), combining high breakdown value estimation and efficient estimation, we manage to address the issue of outliers. Thus far, and to the best of our knowledge, the issue of outliers has been addressed by excluding outlier countries from estimation. Furthermore, we apply 18 bivariate and multivariate models for 180 countries. Finally, instead of utilizing previous versions of the data, we have used the latest available version of the data on the fiscal responses, including fiscal measures for 2020-2021 and beyond.

The findings are expected to provide valuable insights for policymakers, international organizations, and researchers, aiding in the formulation of evidence-based strategies to navigate future crises effectively.

2. Data, Model Specification and Methodology

To detect the impact of various determinants on the fiscal support measures implemented in the aftermath of the COVID-19 outbreak, we consider the following cross-sectional regression model:

$$\begin{aligned}\text{Fiscal}_i = {} & \beta_0 + \beta_1 \text{GDPpc}_i + \beta_2 \text{QE}_i + \beta_3 \text{Debt}_i + \beta_4 \text{Curacbal}_i + \beta_5 \text{Trade}_i \\ & + \beta_6 \text{Totrev}_i + \beta_7 \text{Unem}_i + \beta_8 \text{Popageing}_i + \beta_9 \text{Polid}_i + \beta_{10} \text{Polstab}_i + u_i\end{aligned} \quad (1)$$

where Fiscal_i: Fiscal measures taken for 2020-2021 and beyond in response to

COVID-19 (%GDP); $GDPpc_i$: GDP per capita (constant 2015 US$); QE_i: a dummy variable for Quantitative Easing; $Debt_i$: Central Government Debt, (%GDP); $Curacbal_i$: Current Account Balance (%GDP); $Trade_i$: Trade Openness (%GDP); $Totrev_i$: Total Revenues (tax and non-tax revenues, %GDP); $Unem_i$: Unemployment rate, $Popageing_i$: share of Population aged 65 and above, $Polstab_i$: Political Stability and Absence of Violence (percentile rank), and $Polid_i$: Political Ideology Index ranging from 1 [right ideology] to 3 [left ideology]; 0 for other cases.

The data for all regressors correspond to 2019 values or to the latest available before 2019, except QE which is a dummy variable, receiving the value of 1 for the countries that applied a Quantitative Easing as a response to COVID-19, and 0 otherwise. The dataset consists of 180 countries and was built utilizing the following sources: 1) IMF's database of fiscal policy responses to COVID-19 (Fiscal), Global Debt Database (Debt), and Fiscal Monitor (Totrev), 2) World Development Indicators (GDPpc, Trade, Curacbal, Unem, Popageing and Polstab), 3) Database of Political Institutions (Polid) and 4) Global database on Centrals' Banks Monetary Responses to COVID-19 (QE).

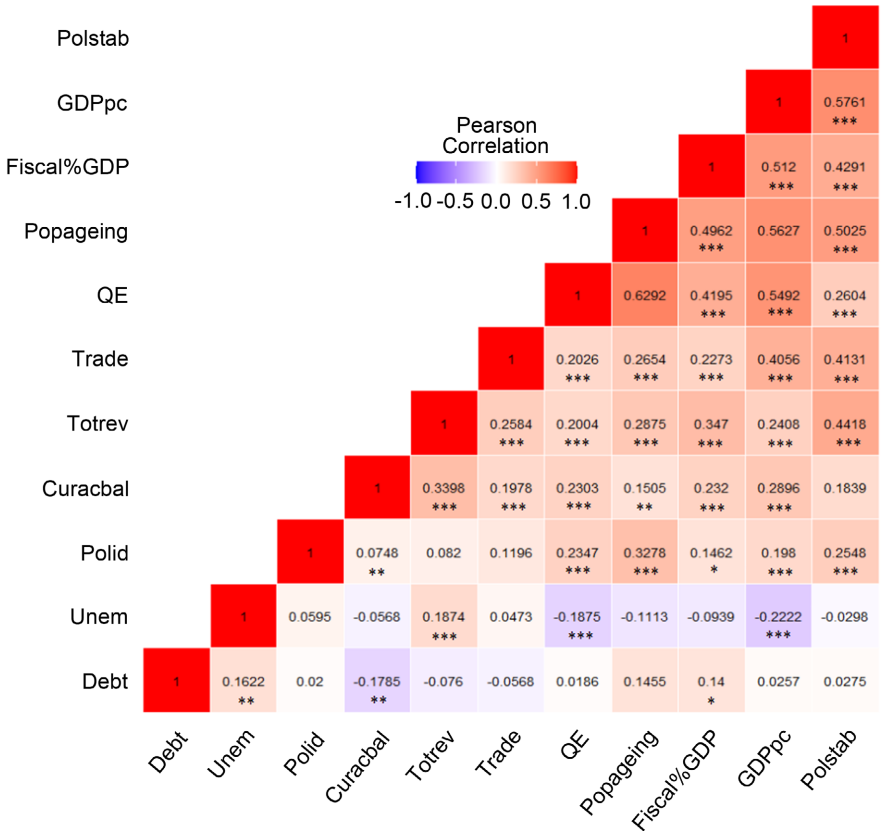
To address the presence of outliers in our dataset, Equation (1) is estimated using, apart from Ordinary Least Squares, a robust regression analysis in the spirit of Yohai's (1987) MM-estimator. This robust estimator combines high breakdown value estimation and efficient estimation and is obtained by minimizing a robust scale measure while achieving high efficiency, meaning that it manages to minimize a loss function that gives less importance to extreme residual values. Outlying values can affect the OLS estimates in various ways depending on their type. Vertical outliers affect OLS intercepts, good leverage points affect only statistical inference, and bad leverage points exert a significant impact on the estimated intercept and slope (Rousseeuw & Leroy, 2005).

To categorize the outliers according to their type, we adopt the graphical representation of Rousseeuw and van Zomeren (1990) which plots the robust standardized residuals versus a robust distance measure. In this context, values located right to the vertical limit of $\sqrt{\chi^2_{p,0.975}}$ but within the tolerance band [−2.5, 2.5] are regarded as good leverage points, while points right to the vertical limit and outside the tolerance band [−2.5, 2.5] signify bad leverage points. Finally, values left to the vertical limit, but outside the tolerance band, suggest regression outliers.

3. Presentation and Discussion of Results

Figure 1 depicts the degree of correlation between the variables employed. Overall, a positive relationship is the dominant pattern with the correlation coefficient values ranging from weak to moderate levels. In addition, the results from the OLS regression are presented in **Table 1**, while **Table 2** depicts the results from the MM-estimator. The latter is accompanied by **Figure A1** of the Appendix that depicts the graphs related to the detection of the different types of outliers. As it

can be seen, several outlying observations have probably distorted statistical inference and/or the OLS estimates.



Note: *, **, *** denote significance at 10%, 5% and 1% significance levels respectively.

Figure 1. Correlation Heatmap of the employed variables.

Table 1. OLS regression for fiscal support (% GDP).

Variables	1	2	3	4	5	6	7	8	9
GDPpc	0.1290*** (0.0307)	-	-	-	-	-	-	0.0843** (0.0389)	0.0611 (0.0422)
QE	-	4.3396*** (0.7994)	-	-	-	-	-	1.6921 (1.0694)	1.0068 (1.0750)
Debt	-	-	0.0206 (0.0160)	-	-	-	-	0.0241** (0.0121)	0.0199* (0.0114)
Curacbal	-	-	-	0.1211** (0.0535)	-	-	-	0.0212 (0.0493)	0.0316 (0.0500)
Trade	-	-	-	-	0.0196** (0.0075)	-	-	−0.0003 (0.0089)	−0.0019 (0.0092)
Totrev	-	-	-	-	-	0.0930*** (0.0224)	-	0.0652*** (0.0194)	0.0493*** (0.0172)

Continued

Unem	-	-	-	-	-	-	−0.0746 (0.0592)	−0.0465 (0.0444)	−0.0394 (0.0436)
Popageing	-	-	-	-	-	-	-	-	0.1345** (0.0622)
Polid	-	-	-	-	-	-	-	-	−0.0940 (0.2639)
Polstab	-	-	-	-	-	-	-	-	0.0160 (0.0156)
C	3.4817*** (0.3837)	3.9077*** (0.3442)	4.2296*** (0.8700)	5.5294*** (0.3946)	3.5380*** (0.7874)	2.5214*** (0.6682)	5.9050*** (0.6273)	0.7087 (0.9989)	0.2505 (0.9341)
R^2	0.2621	0.1759	0.0195	0.0538	0.0516	0.1204	0.0088	0.3362	0.3497
B.P.G.Test	36.2281 [0.0000]	3.5001 [0.0614]	1.7141 [0.1905]	9.4701 [0.0021]	0.0361 [0.8493]	2.7192 [0.0991]	0.8072 [0.3703]	48.1174 [0.0000]	45.7535 (0.000)

Notes: Standard errors and p-values in (.) and [.] respectively. For multivariate regressions adjusted R^2 is reported. *, **, *** denote significance at 10%, 5% and 1% respectively.

Table 2. Robust regression for fiscal support (%GDP).

Variables	1	2	3	4	5	6	7	8	9
GDPpc	0.1058*** (0.0122)	-	-	-	-	-	-	0.0278** (0.0137)	0.0002 (0.0155)
QE	-	3.2599*** (0.4964)	-	-	-	-	-	1.7980*** (0.5105)	1.1678** (0.5936)
Debt	-	-	0.0051 (0.0075)	-	-	-	-	0.0109* (0.0062)	0.0126** (0.0063)
Curacbal	-	-	-	0.0171 (0.0267)	-	-	-	−0.0502** (0.0236)	−0.0448* (0.0237)
Trade	-	-	-	-	0.0349*** (0.0038)	-	-	0.01154*** (0.0105)	0.0070* (0.0040)
Totrev	-	-	-	-	-	0.0768*** (0.0119)	-	0.0609*** (0.0123)	0.0587*** (0.0134)
Unem	-	-	-	-	-	-	−0.0418 (0.0402)	−0.0757** (0.0355)	−0.0679* (0.0357)
Popageing	-	-	-	-	-	-	-	-	0.1531*** (0.0461)
Polid	-	-	-	-	-	-	-	-	−0.1129 (0.1767)

Continued

Polstab	-	-	-	-	-	-	-	-	0.0049 (0.0102)
C	3.0702*** (0.2929)	3.2858*** (0.2842)	3.7852*** (0.4703)	4.0976*** (0.2525)	1.0927*** (0.4160)	1.8398*** (0.4220)	4.3796*** (0.3962)	0.1580 (0.6087)	−0.0590 (0.6329)
R_W^2	0.2848	0.2341	0.0028	0.0029	0.3329	0.2384	0.0084	0.4743	0.4845

Notes: R_W^2 refers to the Renaud and Victoria-Feser (2010) coefficient of determination. See notes of **Table 1** for the rest.

In **Table 1** and **Table 2**, Models (1)-(7) correspond to bivariate estimations, whereas the last two columns of the Tables present the results from two multivariate regressions. It has to be noted that the non-economic variables, i.e., Popageing (share of Population aged 65 and above), Polstab (Political Stability and Absence of Violence (percentile rank)), and Polid (Political Ideology Index), are added as control variables to enhance the robustness of the estimates. Moreover, in line indicatively with Alberola et al. (2021) and Benmelech and Tzur-Ilan (2020), GDPpc is an important determinant of the COVID-19 fiscal packages given its positive and statistically significant effect. An increase of $1,000 in GDPpc led to up to 0.13% higher fiscal stimulus.

Meanwhile, the favorable interest rate and reserve policies, lending operations, and asset purchases, were conducive to the fiscal aid. This is consistent with Aizenman et al. (2021), who also highlighted the vital role of QE policies in fiscal response to COVID-19. The bivariate OLS regression suggests that the QE programs were responsible for 4.34% increased fiscal response, with a corresponding effect of 3.26% in the Robust regression. In the multivariate context though only the latter yields statistically significant results as reflected on the respective coefficients.

Furthermore, Debt has a positive effect on recovery programs that is statistically significant in multivariate models, which is in line with Benmelech and Tzur-Ilan (2020). Thus, these findings challenge the conventional belief that countries with lower debt-to-GDP ratios employ more assertive fiscal policies during times of crises (Romer & Romer, 2018, 2019). Also, the presence of outlier countries, such as Japan and Greece, seems to have only affected the size of the relationship, as no additional differences are observed between OLS and Robust regression. This contrasts with previous similar studies in which the exclusion of outlier countries led to some changes in significance, and/or coefficient sign (Apeti et al., 2021; Benmelech & Tzur-Ilan, 2020; Romer, 2021).

Regarding Current account balance the evidence is conflicting. On the one hand, a positive and significant effect is established in the OLS regression. However, when accounting for outliers, its effect becomes insignificant in the bivariate case and negative and significant in the multivariate. Additionally, total revenues is positive and statistically significant in all estimated models. A 1% in-

crease in total revenues is associated with higher fiscal support between 0.04% and 0.09%. Besides, Trade openness is another significant determinant of fiscal response to COVID-19 but only in the bivariate OLS regression. In the Robust regressions, Trade retains its positive effect in the bivariate regression, albeit with a decrease in its coefficient value, whereas its impact switches to positive and becomes significant in the multivariate models.

Moreover, there is evidence of an adverse effect of Unemployment, which becomes significant, at least at a 10% significance level, in the multivariate regressions of the MM-estimator. As regards the rest explanatory variables, only the share of the population over 65 has an impact on fiscal support, implying the priority of governments to protect the elderly during the pandemic. The evidence is consistent with Li and Lian (2021), who also drew similar conclusions. According to the coefficient size, an increase of 1% in Popageing is related to 0.13% (in OLS), and 0.15% (in MM-estimator) higher fiscal aid. By contrast, none of the estimates suggest that Political ideology and Political stability were crucial in determining the size of the fiscal response.

Finally, the statistics accompanying the estimates reveal that the MM-estimator is superior to OLS in terms of the ability to interpret the variation of the dependent variable. Furthermore, the multivariate models (8)-(9) are having a higher explanatory power as reflected on the higher R-squared values. Besides, the residual diagnostics from the OLS, suggest that the estimated residuals are heteroscedastic. For that reason, Huber-White standard errors were applied to the estimates.

4. Conclusion

The fiscal policy response to COVID-19 encompasses a range of measures, including increased government spending, tax policy adjustments, and expansionary monetary policies amongst other factors. The determinants that influence these policy choices can vary based on a country's economic conditions, institutional frameworks, political considerations, and societal characteristics. By exploring and reflecting on these factors, this research has aimed to shed light on identifying the key drivers of fiscal policy responses to the pandemic.

Specifically, our study has examined the impact of various determinants on the effectiveness of fiscal policy measures in addressing the challenges posed by the pandemic. By analyzing the determinants of fiscal policies during the COVID-19 crisis, via the robust regression MM-estimator for 180 countries, we find that GDP per capita, quantitative easing, debt to GDP ratio, trade openness and total revenue had a positive and a statistically significant impact on the fiscal policy responses, while unemployment rate and current account balance had a negative one.

Our findings demonstrate, apart from the responsiveness of the fiscal policies to macroeconomic determinants, that the share of Population aged 65 and above boosted the fiscal packages. Furthermore, the ability to deploy fiscal policies

during the pandemic crisis was not affected by the political stability and the political ideology of the countries.

By evaluating the determinants of fiscal policy approaches to global pandemic, we have gained insights into the effectiveness of fiscal policy responses in stimulating economic recovery, safeguarding livelihoods, and promoting long-term sustainable development.

Finally, given that COVID-19 vaccination campaigns played a crucial role in managing the pandemic, Bellio et al. (2023) examined the success of these campaigns across different countries using Hofstede's cultural framework, identifying key factors for effectiveness. In the future, this domain demands ongoing scrutiny and focus.

Conflicts of Interest

The authors report there are no competing interests to declare.

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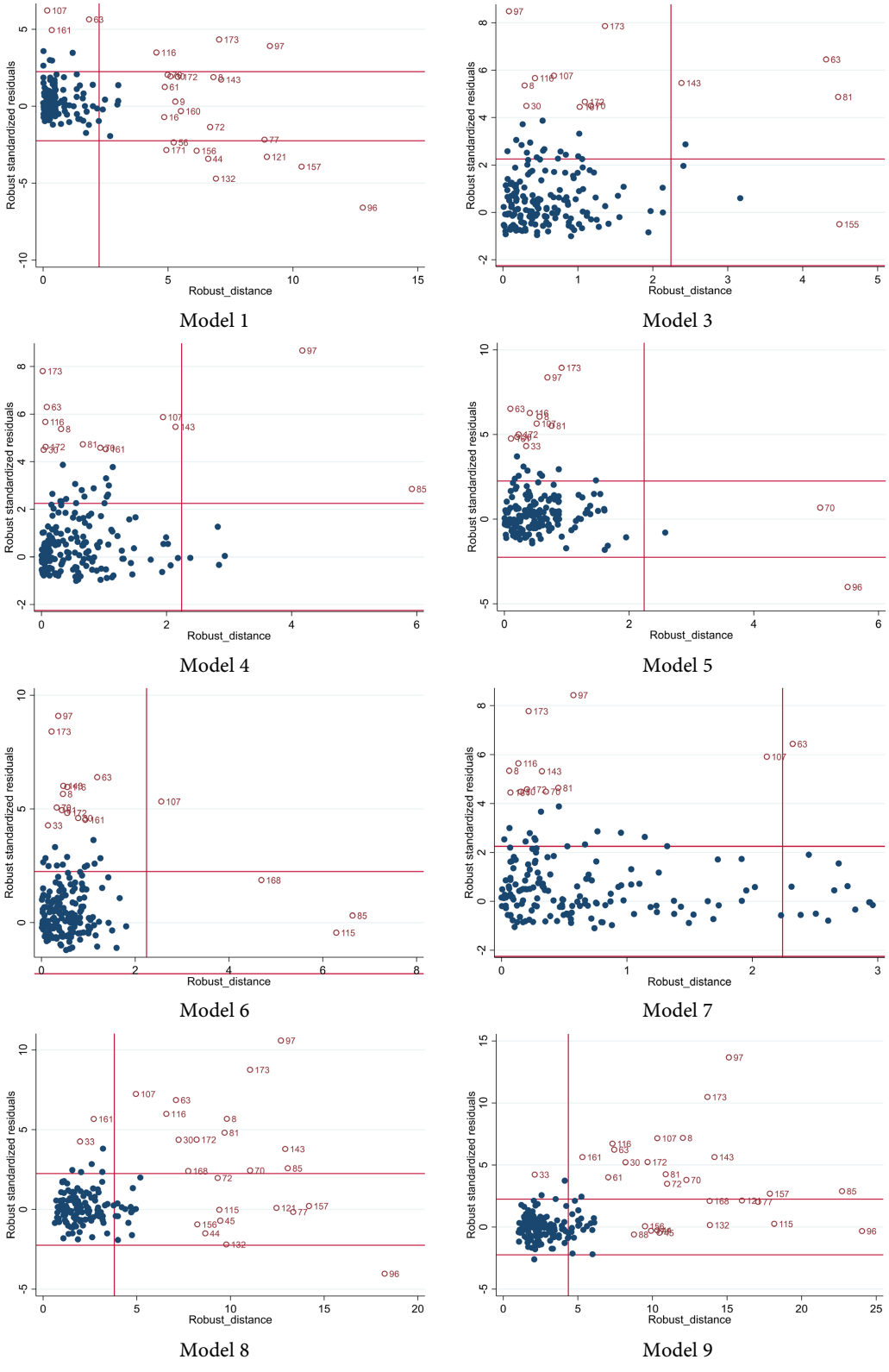
Appendix



Note: Robust distance cannot be estimated for Model 2.

Figure A1. Graphs of regression outliers according to their type.