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The economic reaction to non-pharmaceutical interventions during Covid-19



Agustí Segarra-Blasco, Mercedes Teruel*, Sebastiano Cattaruzzo

Universitat Rovira i Virgili, Department of Economics, Research Group of Industry and Territory, and ECO-SOS, Av. Universitat, 1, 43204 Reus, Spain

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ABSTRACT

Policy makers have implemented a set of non-pharmaceutical interventions (NPIs) to contain the spread of Covid-19 and reduce the burden on health systems. These restrictive measures have had adverse effects on economic activity; however, these negative impacts differ with respect to each country. Based on daily data, this article studies governmental economic responses to the application of NPIs for 59 countries. Furthermore, we assess if these economic responses differ according to the economic and sectoral context of the countries. By applying a counting model to the economic support intensity, our results quantify the average reaction of governments in counterbalancing the imposition of NPIs. We further re-estimate the base model by dividing the countries according to their GDP per capita, the intensity of their service sectors, and the expenditure by tourists. Our results show how each NPI implied a different level of economic support and how the structural characteristics considered were relevant to the decision-making process.

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1. Introduction

In order to reduce the spread of COVID-19 globally, governments have deployed a wide range of responses. These include efforts to prevent the spread of the virus by travel and work restrictions, quarantines, curfews, cancellations, the postponement of events, and facility closures (Cowling et al., 2020; Gössling et al., 2020). All such measures have been categorized as non-pharmaceutical interventions (NPIs) and, despite being considered as secondary in the fight against the Covid-19 pandemic (Capano et al., 2020), they have led to an unprecedented economic slump and a significant increase in the expectations of insolvency by families and firms (García et al., 2020; Eichenbaum et al., 2020).

In addition, policy makers have implemented a full set of economic policies designed, not only to slow down the spread of infections and the collapse of health systems, but also to sustain and promote welfare and the economic activity (Gourinchas et al., 2020; Elgin et al., 2020; Gentilini et al., 2020). These actions aim to mitigate the economic crisis arising from lockdowns that particularly affect vulnerable sectors and individuals. However, governmental responses to COVID-19 exhibit significant differences in their characteristics, their capacity to fight against an unpredictable health crisis, their ability to convince the population, and their ability to shoulder unforeseen expenses. The heterogeneous impact depends on the economic and social characteristics of those countries (Dosi et al., 2020; Gössling et al., 2020; Škare et al., 2021). Recent papers also highlight the role of cultural differences in the mitigation of the pandemic, Erdem (2020), Enghelhardt

* Corresponding author.

E-mail address: mercedes.teruel@urv.cat (M. Teruel).

et al. (2021) and Ashraf (2021) and Størdal et al. (2021) note a reduction in the adverse effects of the COVID-19 pandemic on the stock markets.

This paper aims at estimating how the economic support to households differs according to the NPI and structural characteristics at country level. Measuring changes in economic policies is critical for assessing the effectiveness of counterbalancing the economic crisis during the different waves, in particular for more vulnerable countries. Authors such as Cirera et al. (2021) find that policy support has been largely limited with respect to the most vulnerable firms and countries. We have focused here on the economic vulnerability of the countries studied, paying special attention to three dimensions: firstly, taking income per capita into account. Secondly considering service specialization; and thirdly, each country's level of specialization in terms of the tourist industry. Arguments, such as a larger share of informal work (Williams and Kayaoglu, 2020), higher temporary work levels and more prevalent gender differences (ILO, 2020; Kong and Prinz, 2020; Dang and Nguyen, 2021) justify our interest in those economic characteristics that may have resulted in distinct types of governmental reactions with respect to economic policies.

The above has motivated our specific interest into whether the deployment of economic responses devoted to households are different with regard to distinct state-based subsets. Our database contains daily time data on the economic policy responses, and the application of NPIs, for 59 countries. The information is collected and systematized by the Blavatnik School of Government at University of Oxford and its design brings several advantages. First, observations for most indicators are reported on monotonic ordinal scales facilitating the quantitative analysis of the heterogeneous government responses. Second, the indicators are also aggregated into composite indices that provide a snapshot of the number and degree of policies in place in a given area. In this regard, we use the economic support index as focal variable of the analysis. Further, the OxCGRT (Oxford Covid-19 Government Response Tracker) data strives for comparability, legibility and transparency. The rich time-series offered have already fostered considerable research outputs in epidemiology, health economics and data-science, with this article, we offer our own application to economic analysis.

To fully exploit the time dimension, and to reduce as much as possible issues of likely endogeneity and unobserved characteristics, we apply a Poisson counting model with fixed effects and robust errors clustered at country level. The econometric specification used here has been largely developed and recommended by Wooldridge (1999, 2000, 2005), and has proven a solid tool in many different contexts. Furthermore, it allows us to precisely quantify the delicate balance between NPIs and household economic supports such as income support and debt relief.

We have made three relevant contributions in this empirical study. Firstly, at an empirical level, many studies have used daily time economic support. However, this time dimension has been neglected in the analysis of economic responses. The works of Khalid et al. (2021) and Elgin et al. (2020) analysed the influence of different country characteristics on the economic response. However, they measured the time-average level and did not consider the daily reaction. Economic support is crucial in avoiding social breaks and ensuring aggregated demand, so data at a more precise time scale facilitates better analysis of the policies deployed during the current pandemic. Second, we evidence how responses have been country-dependent. The pandemic has dramatically affected whole countries, but their responses are asymmetric depending on their individual characteristics. Dosi et al.'s (2020) hypothesis is confirmed here, as our results show that heterogeneous initial conditions may affect individual governmental responses to the pandemic. At the global level, Covid-19 caused large common shocks to the tourism industry. However, the response in terms of speed and depth differed according to the economic framework. Finally, we contribute to the analysis of the differences in the NPIs applied to reduce social interactions during the outbreak and in public aid to households. NPIs are necessary to control the pandemic, but they constrain the economy by affecting the purchasing power of households. Our results highlight that the imposition of NPIs is quite heterogeneous and its economic response also.

The structure of the article is as follows. Section 2 reviews the literature and our theoretical framework. The third section describes the database and the econometric methodology. Finally, we present the results and concluding remarks.

2. Theoretical framework

The theoretical models analysing the spread of Covid-19 pandemic have mainly focused on the infection spread considering mobility as a proxy (Perra, 2021). However, economists have also raised attention to the economic shocks caused by the pandemic. In this regard, NPIs such as stay-at-home requirements or closure public transport, directly limit mobility, while other measures such as workplace closure and international travel controls constrain economic activity. Hence, NPIs have affected mobility but have also had direct economic consequences by generating a demand and supply shock (see Demertzis et al., 2020 and Demigurc-Kunt et al. (2020)). However, some studies on the effects of NPIs on social mobility highlight the reaction of citizens differs across a country's income groups. In general, low-income groups are more sensitive to the restrictions imposed by the NPIs, while, for higher-income groups, the restriction of mobility is largely voluntary. For example, in the USA and Sweden the decrease in the social mobility occurred before the imposition of any NPIs (Maloney and Taskin, 2020). Adopting a regional level and using the near-real-time data provided by the Facebook platform, Bonaccorsi et al. (2020) analysed the impact of mobility restrictions according to their different socioeconomic consequences. Their results show that Italian municipalities with the lowest per capita income had the highest decrease in mobility.

With the aim of integrating the pandemic and its consequences, economists have started to focus their attention on the economic outcomes (see Padhan and Prabheesh, 2021 for a survey). For instance, Stiglitz (2020) develops a

theoretical framework where precautionary behaviours propagate the economic crisis to sectors not directly affected by the pandemic. Similarly, [Bodenstein et al. \(2020\)](#) take a supply-side perspective that is centred on the effects of the pandemic on the parts of the economy that provide essential inputs. The transmission mechanism between the epidemiological variables and the economic variables is through the change in labour supply. Infected people cannot participate in the workforce, which is a direct cost of the disease. Similarly, [Guerrieri et al.](#) model the lockdown and social distancing effect triggered by a pandemic as a “Keynesian” supply shock, which generates a drop in aggregate demand larger than the supply shock itself.

These theoretical models measuring the incidence of the pandemic and the NPIs may also find some empirical evidence from previous pandemics. [Correia et al. \(2020\)](#) demonstrate that cities and states in US with higher mortality rates during the 1918 pandemic eventually had worse economic impacts (as measured by growth in manufacturing employment) over the following five years. Interestingly, they show that speedier, stricter, and longer NPIs were associated with better economic outcomes in the long run. A somehow contrary view is that held by [Gordon et al. \(2021\)](#), which showed that in Nordic countries at least, poorer public health performance in the containment of Covid-related deaths led to a poorer economic performance. Nonetheless, and as highlighted by [Watkins and Maruthappu \(2021\)](#), the first year of the pandemic was characterized by the continuous attempt of governments to find the tipping point between public health and economic responses.

The economic impacts of the Covid-19 pandemic are diverse and have been triggering a severe short-term economic crisis ([Bordo and Duca, 2020](#); [Wheelock, 2020](#); [Jena et al., 2021](#)). According to [Dosi et al. \(2020\)](#) the impacts include production, global value chains, business failures, job and income losses, debt accumulation, financial instability, and markets volatility. Consequently, the economic policies implemented vary across countries in both breadth and scope, and target households, firms, health systems, and banks ([Weder di Mauro, 2020](#); [Cheng et al., 2020](#); [Makin and Layton, 2021](#)). Among the different initiatives we highlight tax payment deferrals, tax regulation relaxation, new loans and liquidity support, direct cash transfers to short-time work compensation, relaxing eligibility requirements for unemployment insurance, and compensatory sick pay for those affected by Covid-19. All of these aim at mitigating the crisis resulting from the NPI control measures on supply and demand. The deployment of economic initiatives is in line with [Stiglitz \(2020\)](#) who suggests that governmental initiatives may mitigate the precautionary behaviour of individuals, leading to reduced unemployment.

Indeed, current evidence shows clear economic consequences of the pandemic and the importance of the economic response in mitigating the crisis. [Brewer and Gardiner \(2020\)](#) analyse the incidence of Covid-19 pandemic among different types of individuals and show the particular vulnerability of individuals who of working age and in low-income households. [Li et al. \(2020\)](#) employ a large panel data of 5.6 million daily transactions from 2.6 million debit cards of low-income owners in the U.S. Applying difference-in-differences, they find that, inter-temporally, state lockdowns diminished the daily average spending relative to the same period in 2019 by \$3.9 per card, whereas the stimulus payments elevated the daily average spending by \$15.7 per card. Therefore, the effects of NPIs causing economic shocks are counterbalanced by the economic support of governments ([Fig. 1](#)).

Economic countermeasures have been very varied. [Cirera et al. \(2021\)](#) find that policy support was largely limited in terms of the most vulnerable firms and countries. As stated by [Dosi et al. \(2020\)](#) regional determinants may affect the deployment of economic policies. Similarly, [Brodeur et al. \(2020\)](#) suggest that, since government responses differ across countries, the type and level of economic stimulus will also vary significantly across countries. Additionally, [Elgin et al. \(2020\)](#) analyse the influence of different factors related to the demography, economy and health on the economic response for 166 countries. The authors apply Principal Component Analysis to develop their Covid-19 Economic Stimulus Index. Their results show that the economic stimulus is larger for countries with higher Covid-19 infections, median age, and GDP per capita. However, their analysis assumes a homogeneous impact depending on the sectoral composition of each economy.

In particular, the restrictions to control the Covid-19 pandemic have been unparalleled and particularly damaging to some sectors. [Benedetti Fasil et al. \(2021\)](#) show that the Covid-19 crisis has had markedly-different effects across industrial sectors in Europe. The most affected sectors were travel agencies, tourist accommodation, food and beverage service activities, employment activities, advertising and market research, and transportation and storage.

For instance, [Gössling et al. \(2020\)](#), [Hall et al. \(2020\)](#) and [Sigala \(2020\)](#) have remarked the unprecedented effect of the current pandemic in terms of size and impact in the tourism sector. Consequently, countries with a higher dependence on tourism are more affected by the crisis and must deploy a wider range of economic policies. For a pool of 136 countries, [Khalid et al. \(2021\)](#) find a positive relation between the weight of the tourism sector and the extent of the economic policy response to mitigate the effects of the Covid-19 pandemic. In line with this, [Kong and Prinz \(2020\)](#), when studying the relation between containment measures and Google searches, found the marked impact of NPIs on the number of unemployed people in the US, especially in service and tourism-related sectors. Finally, a country’s wealth has inevitably been related to pandemic management in several aspects. Richer countries have mostly been able to impose stronger containment measures, while guaranteeing economic aid to the public. [Verschuur et al. \(2021\)](#) also looked at global trade patterns, and showed how low-income economies have been especially subject to the greatest economic losses particularly after school closures and the halting of public transportation.

Similarly, [Gourinchas et al. \(2020\)](#) point out that without substantial and timely macroeconomic intervention, the output lost from the economic downturn will be greatly amplified, especially as economic agents try to protect themselves

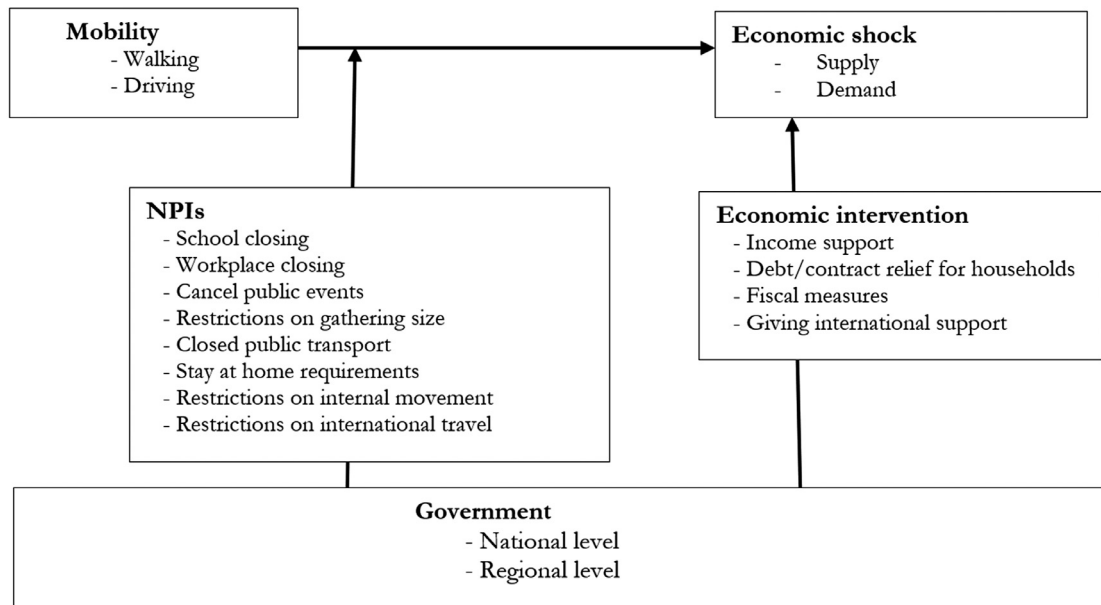


Fig. 1. Governmental responses to the economic shock.
Source: Own elaboration.

from Covid-19 by reducing consumption and investments, and by engaging in lower credit transactions. The author suggests that there should be cross-regional variation in governmental responses based on country characteristic so the type and level of fiscal and monetary stimulus designed to buffer the economic downturn should vary significantly across countries.

Hence, the available empirical and theoretical evidence points out the need for economic responses to the current economic crisis, in particular to mitigate the drop in aggregate demand. The measures employed must be accurate and country-specific, and consequently heterogeneous. A key point is to mitigate the decrease in household purchasing power. In this regard, all the above evidence demonstrates the relevance of specific structural dimensions, among which we have focused on each country's wealth, proxied by GDP, service- and tourism-dependence.

3. Data and econometrics

3.1. Description of the dataset

To obtain the dataset for analysis, we merged mainly two different sources of data. The OxCGRT database is the main source from which we obtain the daily tracking of the individual NPIs applied by governments, as well as the aggregate index of economic policies. This data source also reports the number of deaths due to Covid-19. From the Apple mobility data (aggregated navigation data from Apple Maps), we obtain daily information on the variations in walking and driving mobility during the pandemic. Since we cannot include both measures (walking and driving) simultaneously due to multi-collinearity, we have computed the average of the two measures as an indicator of mobility (Cot et al., 2021). The final dataset covers from 1 January 2020 until 31 December 2020, the first year of the Covid-19 pandemic, and it tracks countries from the first case detected within each national borders.

Finally, in order to consider the economic heterogeneity of the countries investigated, we have used information from two different databases. First, the value of GDP per capita and the ratio of value added in Services with respect to GDP are derived from the World Bank data centre. Second, the ratio of inbound visitors' expenditure with respect to GDP comes from the World Tourism Organization.¹ Table A.4 reports the division of countries according to the median value of these three variables. The median values which facilitate the split of the sample are as follows: GDP per capita obtains a median value of \$ 29,481.2, service-intensity (Services with respect to GDP) in a value equal to 60.91%, and finally Tourism-Intensity (total visitor expenditure with respect to GDP) with a value equal to 2.1×10^{-8} . The structural variables (GDP per capita, Service with respect to GDP and Tourism intensity) are relative to 2019 or, when unavailable, to the last available year.

¹ In the case of missing data, we filled the blanks with the most recent available information.

Table 1
Share of days during which the NPIs were active in year 2020.

	Whole sample	Period of time		GDP per capita		Services/GDP		Tourism/GDP	
		Wave 1	After Wave 1	Rich	Poor	High	Low	High	Low
School closure	36.1	44.3	25.8	25.1	47.0	29.2	42.0	25.6	46.4
Work-place closure	15.0	19.5	9.4	14.3	15.4	16.2	13.5	12.5	17.3
Cancellation of public events	61.8	58.2	64.9	58.9	63.8	61.8	60.8	55.2	67.7
Restrictions on gatherings	39.1	33.1	45.1	42.3	34.8	46.7	30.9	36.2	41.3
Closure of public transport	9.8	13.4	5.5	2.7	17.2	4.8	14.5	4.2	15.6
Stay-at-home requirements	3.0	4.8	1.0	0.9	5.3	1.3	4.6	0.4	5.8
Restrictions on internal movements	35.2	38.7	30.3	28.2	41.9	30.8	38.7	26.5	43.6
International travel controls	21.9	30.4	11.5	14.7	29.0	15.8	27.2	16.2	27.3

Note: The first wave was considered to have ended when the country achieved a minimum number of deaths for one entire week after the declaration of the global pandemic.

Source: Own elaboration from OxCGRT.

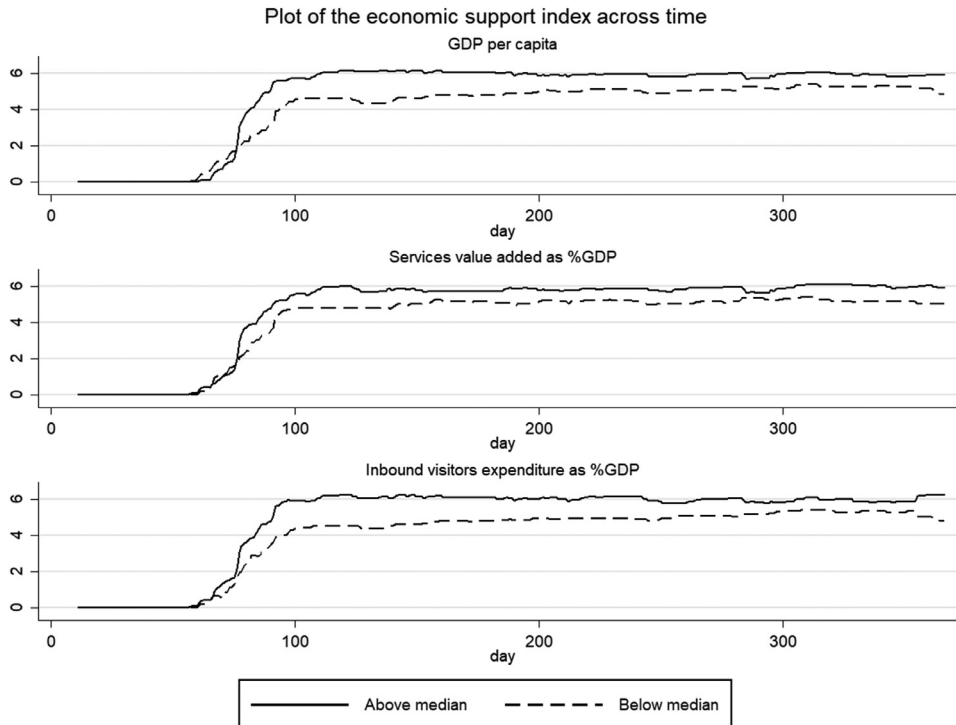
Using the NPIs indicators and the economic support index has many advantages in this context. On the one hand, they track daily the evolution of these measures, thus constituting a rich and almost real-time data source. On the other hand, the codification through which they have been created also implies a high degree of harmonization that allows us to obtain clean estimates from a 59-country sample. The detailed descriptive statistics and the associated correlation matrix can be found in Tables A.1 and A.2 of Appendix.

Table 1 gives an overview of the relevance of the structural variables we selected for the governance of the pandemic (GDP per capita, Services with respect to GDP and Tourism intensity); it shows the number of days (in percentages) during which each containment measure was active. During the whole period of time, the cancellation of public events was the most applied NPI, with a share of 61.8% over the total year. Other measures, such as the closure of public transport and the stay-at-home requirements were less active, with a share equal to 10%. Clearly, those NPIs that directly affected productive activity were applied temporarily to a lesser extent, as were the stay-at-home requirements established for the entire population due to the restrictions on basic human rights. Finally, the differences before and after the first wave are also remarkable. After the first wave, school closure, work-place closure, the closure of public transport and international travel controls diminished significantly in their frequency. However, the cancellation of public events and the restriction on gatherings increased in comparison with the first wave.

When approaching the intensity of the measures applied in accordance with the three economic dimensions considered, we also obtained relevant conclusions. The differences are widespread on both dimensions, but some are especially prominent. For instance, in countries with a lower GDP per capita, a less productive service economy, or a smaller tourism industry, schools and public transport have been closed for at least twice the number of days in the other countries. A similar rationale holds for measures focused on international movements that have been applied for a shorter duration in countries focused on services, tourism, or that are simply richer. On the other hand, measures such as workplace closure and the cancellation of public events were closer for all the groups. Finally, it is worth noticing how the first wave was characterized by a much stricter containment policy.

In line with the trends emerging for the containment policies, Graph 1 shows the change over time of the economic support index, conditioned on the different structural variables, during the year 2020, our period of observation. It emerges that, at the beginning, probably due to imitation in a largely unknown reaction domain, economic support did not differ significantly among countries. Following this first phase, a considerable divergence starts to become evident. This is valid across all three variables used to sub-set the group of countries under analysis. As expected, rich countries have the possibility and ability to support the economy more. Further, looking at the tourism indicator, the last days suggest the beginning of a divergence that hints at the fact that countries relying strongly on tourism income needed to provide more economic help to the sector of the population that, after one year, was still unable to work at previous levels. A similar trend can be noticed when looking at countries classified according to their GDP per capita. Nevertheless, in this context, the more likely economic explanation is even simpler and reflects the fact that richer countries have more resources to provide support, while the others struggle more and cannot support provision at the same levels and for such prolonged periods of time.

Finally, in Graph A.1, we report the time trend and the dispersion of the economic support index for our sample. The figure plots, per day, the share of countries at every level of the economic support index. It is compelling to observe how the daily time scale is key in this exercise of identifying the trade-off between containment measures and economic support. Indeed, during 2020, this support varied considerably and followed very heterogeneous trends. The first phase is characterized by a lack of economic support and then, from day 50 to 100 after the detection of the first case, we see the emergence of different behaviours with countries offering noticeably different levels of economic support to their population.



Graph 1. Economic Support Index over time. Means by classification group.
 Source: Own elaboration from OxCGRT.

3.2. The empirical model

Our econometric model focuses on the relationship between the intensity of economic support to households measures and the containment policies imposed by governments with the aim of containing the contagion. Further, we complement the explanatory variables with the daily count of new deaths due to Covid-19, a variable representing the daily mobility trend (averaged between driving and walking), and a dummy variable differentiating the first wave from the rest. The empirical specification assumes that the intensity of the economic support put in place follows a Poisson process with parameter λ which shapes distribution according to the variance and mean of the dependent variable. This procedure induces assumptions rarely satisfied in cross-sectional applications; however, the use of dynamic data overcomes this issue and other possible problems that arise from over-dispersion or weak exogeneity, thus leading to a consistent and efficient estimator. In this context, the distribution of Y_{it} given x_{it} is unrestricted, and allows for the above violations, as well as for potential temporal dependence (Wooldridge, 2002). Table 2 details our dependent and independent variables. The model has therefore been specified as follows:

$$E[Y_{it}|x_{it}] = \lambda_{it} = \exp(\text{new_deaths}_{it} + \text{containment_measures}_{it} + \dots + \text{average_mobility}_{it} + \text{wave}_{it}) \tag{1}$$

where Y_{it} is the intensity of the economic support index of country i in day t , and all the explanatory variables are measured per country and per day. As dependent variable of interest, we focus on the economic index to households, which is an aggregate of the two NPIs focused on the economic side, as classified by the OxCGRT. For each day and country, it represents the intensity of the economic support offered by the government. The index is a discrete variable, it can take up values from 0 to 100, and by construction, each interval is equally spaced by 12.5 intervals. For the sake of our study, the index is recoded into 9 intensity levels from 0 to 8.

In terms of informative content, the economic support index results from the linear aggregation of measures, which correspond respectively to income support² and debt/contract relief,³ with higher values corresponding to more economic

² It consists of income support offered to either formal or informal sector workers. This difference among the two categories is weighted in the construction of the index by the OxCGRT researchers. Also, if a government instead of putting in place radically new unemployment benefits, expanded the existing ones, also these figures in the data.

³ The indicator considers exclusively debt relief efforts aimed at private households, meaning that the aim is freezing financial obligations on the part of households. Concrete examples of this are the stopping of loan repayments, the prevention of water and electricity from being stopped by suppliers, and the ban of evictions.

Table 2
Description of variables.

Variables	Description	Source
Dependent variable		
Y	Economic index to households, this is an aggregate of the two NPIs that focuses on the economic aspect. It represents the intensity of the economic support offered by an individual government over each day. The index is a discrete variable, it may comprise values from 0 to 100, and by construction, each interval is equally spaced by 12.5 intervals. In the case of our study the index is recoded into 9 intensity levels, from 0 to 8.	OxCGRT
Independent variables		
Log (new deaths)	Number of deaths officially registered (in logs).	OxCGRT
Containment measures	Dummy variables indicating the eight containment policies: school closure, work-place closure, cancellation of public events, restrictions on gatherings, closure of public transport, stay-at-home requirements, restrictions on international movements, and international travel controls. The variable takes a value equal to 1 for the maximum level of containment in each policy and 0 otherwise.	OxCGRT
School closure		
Work-place closure		
Cancel public events		
Restrictions on gatherings		
Close public transport		
Stay-at-home requirements		
Restrictions on international movements		
International travel controls		
Log (average mobility)	Average of the walking and driving mobility indicators (in logs).	Apple Maps
Wave 1	Dummy variable equal to 1 during the first wave. The first wave was considered to have ended when the country achieved a minimum number of deaths for one entire week after the declaration of the global pandemic.	OxCGRT

support.⁴ Although the “economic support index” does not include the support provided to firms or businesses, and it does not take into account the total fiscal value of economic support, these characteristics possess two advantages. On the one hand, the index allows for efficient and simple cross-national comparisons of government interventions. On the other hand, it proxies very representatively the economic aids to workers and households in a highly representative manner, and which have been directly and severely affected by the containment measures on several aspects.

As explanatory variables, we include the logarithmic value of new deaths caused by Covid-19,⁵ eight binary variables reporting containment and closure policies, two variables proxying for the diffusion of economic support measures at global and regional level, the logarithmic average value of the mobility trends in walking and driving,⁶ and a binary variable identifying Wave 1.⁷

The eight containment policies are school closure, work-place closure, cancellation of public events, restrictions on gatherings, closed public transport, stay-at-home requirements, restrictions on international movements, and international travel controls. For ease of interpretation, it should be noted that, for each of the containment policies, the original data has been recoded into binary variables, taking the value of 1 for the maximum level of containment in each policy and 0 otherwise. This recoding operation also allows for a further harmonization of the data and the establishment of a level playing field, as not all shades of containments require economic aid. Finally, we include a binary variable distinguishing, for each country, whether it is experiencing the first wave or not. This is constructed at country and daily level by individuating the global minimum for each curve. Table A.3 in the Appendix reports the variance inflation factor (VIF) test. The results reject the existence of multicollinearity among the explanatory variables.

Although the fixed-effect panel estimator only allows for time-varying variables, the aim of this paper is to also analyse the impact that structural variables may have had on the governmental economic responses. Thus, in order to capture the different sensitiveness of the NPIs to the initial conditions in a country, we repeat the estimations of Eq. (1) dividing the sample of countries according to the characteristics of interest: GDP per capita, service intensity and touristic income. Specifically, for each of these variables, we compute the median value and create two groups based on that. Table A.4 in the Appendix reports the final country classification.

⁴ For the detailed methodology behind the Economic Support Index or the construction of the OxCGRT dataset please refer to Hale et al. (2021).

⁵ N.B. one is added to each day to allow for the log transformation.

⁶ Cot et al. (2021) suggest applying the average between the driving and the walking mobility change. A model including both mobility measures would produce a multicollinearity issue.

⁷ When isolating the first wave from the rest of the 2020 series, the most straightforward approach would be to use a date chosen *a-priori* looking at the data or at the shape of the curve. Nevertheless, given the fact that our sample comprises 59 countries that experienced the pandemic waves with considerably different timings, we preferred not to aggregate, and we made this variable country- and time-dependent, meaning that we use the global minimum of each curve as a reference point for the end of the first wave. This allows a more precise tracking of the pandemic trend at a country-level. In most cases, this corresponds to the 2020 summer period, although not for all countries.

Table 3
Estimates of determinants of the economic response to households during Covid-19 pandemic. Poisson with fixed effects.

	Waves			GDP per capita		Service dependence		Tourism intensity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Base	Wave 1	After Wave 1	Rich	Poor	High	Low	High	Low
Log (new deaths)	0.092*** (0.015)	0.213*** (0.034)	0.001 (0.016)	0.070*** (0.015)	0.114*** (0.028)	0.098*** (0.023)	0.079*** (0.024)	0.031* (0.017)	0.142*** (0.021)
School closure	0.109** (0.052)	−0.018 (0.089)	0.012 (0.037)	0.131** (0.062)	0.082 (0.075)	0.114* (0.059)	0.136 (0.086)	0.071 (0.070)	0.178** (0.074)
Work-place closure	0.054 (0.050)	−0.084 (0.072)	−0.002 (0.036)	0.011 (0.060)	0.118 (0.095)	−0.063 (0.059)	0.153* (0.079)	0.044 (0.061)	0.063 (0.071)
Cancel public events	0.414*** (0.077)	0.965*** (0.211)	0.064* (0.037)	0.415*** (0.093)	0.408*** (0.121)	0.432*** (0.095)	0.400*** (0.117)	0.426*** (0.091)	0.316*** (0.122)
Restrictions on gatherings	0.036 (0.056)	−0.016 (0.089)	0.084 (0.057)	0.078 (0.081)	−0.019 (0.086)	0.072 (0.084)	0.003 (0.082)	0.021 (0.083)	0.104 (0.074)
Close public transport	0.318*** (0.071)	0.315*** (0.122)	0.157*** (0.059)	0.149 (0.119)	0.410*** (0.086)	0.156 (0.148)	0.413*** (0.078)	0.260*** (0.097)	0.298*** (0.093)
Stay-at-home requirements	0.229** (0.097)	0.481*** (0.108)	−0.298* (0.168)	0.232** (0.117)	0.229* (0.130)	−0.024 (0.126)	0.315*** (0.120)	0.169* (0.100)	0.260** (0.109)
Restrictions on international movements	0.116** (0.051)	0.112 (0.0992)	−0.006 (0.038)	0.101 (0.069)	0.179** (0.075)	0.130* (0.069)	0.127* (0.074)	0.082 (0.061)	0.153** (0.064)
International travel controls	0.219*** (0.073)	0.281*** (0.102)	−0.055 (0.089)	0.298*** (0.080)	0.133 (0.113)	0.334*** (0.088)	0.153 (0.105)	0.195 (0.125)	0.253*** (0.081)
Log (average mobility)	0.248*** (0.069)	0.232** (0.108)	0.102* (0.061)	0.195** (0.096)	0.262*** (0.101)	0.180** (0.081)	0.334*** (0.097)	0.108 (0.103)	0.329*** (0.103)
Wave 1	−0.489*** (0.055)			−0.474*** (0.071)	−0.506*** (0.097)	−0.447*** (0.071)	−0.560*** (0.083)	−0.496*** (0.070)	−0.554*** (0.080)
Pseudo-R ²	0.1938	0.3078	0.0923	0.1746	0.2056	0.1850	0.2029	0.1397	0.2500
Observations	20,616	10,811	9,680	10,542	10,074	10,198	10,418	10,467	10,149
Number of countries	59	56	57	30	29	29	30	30	29

Note: Standard errors in parenthesis. Stars correspond to * significant at 10%, ** significant at 5%, while *** significant at 1%.
Source: Own elaboration from OxCGRT, World Bank, World Tourism Organization and Apple mobility data.

With the aim of treating specific issues arising from the discreteness of the economic policy index, particularly in the context of daily panel data, tailored econometric models of the Poisson regression family are essential. The discrete non-negative nature of the dependent variable generates non-linearities that make the usual linear regression models inappropriate and forces to one opt for counting models. Standard treatment of panel data including the treatment of these country-unobserved specific effects falls into two categories: fixed and random effects models.

Although the above choice cannot be considered superficial, when these country-specific effects show correlations with the right-hand-side explanatory variables, the random effects model loses its consistency.⁸ Consequently, we opted for the model proposed by Wooldridge (1999, 2000) that implies the estimation of robust standard errors clustered at the country level. This specification is fully robust to violation of the strict exogeneity assumption (Wooldridge, 2000) as well as unmodelled serial correlation in the dependent variable within a country. Moreover, in panel data, the presence of country-specific “unobserved heterogeneity” (Wooldridge, 2005) such as the internal government dynamics and the extent of regional differences are undeniable, and these unobservable factors influence the way in which countries react to pandemics and make decisions to support the economy. Finally, this modelling choice is also helpful in minimizing potential biases that derive from cultural and social normative differences among those geographical areas under consideration.

4. Results

Table 3 shows the results of our model. The first column contains the baseline estimates, Columns (2) and (3) before and after the end of the first wave, and the remaining ones are sub-sampling according to the structural characteristics of interest. Starting the analysis from the containment measures, it is immediately evident how the cancelation of public events is the measure involving biggest trade-off in terms of economic restoration. Column (1) shows that one of the most evident results is that countries that imposed more control on social contacts deployed a larger number of economic policies.

⁸ In order to obtain further empirical verification of this choice, we also run a Hausman test, whose chi-squared value is negative, thus confirming the better fit for the fixed effect model.

Although in line with [Sebhatu et al. \(2020\)](#) the estimated coefficients are bigger for countries that are deeply involved in the service and the tourism industries, the difference is not statistically significant ([Table A.5](#)). Nonetheless, this evidence points to the diffusion of the measure, which is also the one most applied in the sample, while it also testifies to the economic obstacle that this policy constitutes. Similarly, containment applied to public transport exhibits a strong and positive elasticity with the intensity of economic support.

Finally, the measures imposed on the borders, both in terms of additional controls and restrictions, show a strong positive relation in the baseline model, but then, these follow different trends when dividing the sample according to the countries' structural characteristics. These measures seem particularly relevant for countries intensive in services, but not in tourism.

The estimated coefficient for new deaths corresponds to a positive elasticity between this variable and economic support. It seems clear that this information, reported daily on several media, induces fear and possibly desire for further containment which finally needs more economic support. Mobility is also significantly and positively related to the intensity of economic aid to households. In this case, the main explanation is that after the huge initial drop in mobility due to the pandemic shock, mobility recovered in parallel to the implementation of economic support. Reinforcing this explanation, [Chen et al. \(2020\)](#) report that “people’s mobility is a de-facto measure of mitigation efforts and captures de jure NPIs” and that “the economic impact of Covid-19 is mostly captured by changes in people’s mobility”. Although our findings do not fully support this statement, we agree that people’s mobility is a working proxy for the economic impact of the pandemic. We cannot ignore the pandemic and NPIs applied by governments affect not only economic activity in the short term, but also have structural effects on mobility, population location and working from home. Since the first manifestations of the pandemic, social distancing measures have caused an increase in telework, most especially among the more highly educated and those who receive higher wages ([Bonacini et al., 2021](#)).

Disentangling the estimation for the first wave from the rest of the days, both the estimated coefficients and the R^2 show that some learning dynamics are involved. At first, countries closed down activities and helped households as much as they could, it is they likely that they then put in place more structured programs for economic support that became more independent of the daily decisions regarding the individual containment measures. Similarly, the considerably lower explanatory power of the model when applied to highly tourism-oriented countries suggests that in those countries, the economic support was more independent of our selected determinants and more dependent on unobserved characteristics (i.e., seasonal/sectoral unemployment). Lastly, it is interesting to analyse the differences in the estimated coefficients for the first wave between the sub-samples (rich vs. poor, service-intensive vs. non-intensive, and tourism-intensive vs. non-intensive). Here, the coefficient is always negative and significant, but also robustly inferior for richer (or intensive) countries implying that these countries were more ready to make the intervention and were quicker in implementing at least the basics of economic support.

Finally, we must add that despite the differences in the coefficients, the significant levels between the coefficients must be taken into account. [Table A.5](#) in the appendix shows the significance of the coefficients according to our group classification. In order to test the differences between the estimated coefficients in a non-linear context with fixed effect, we re-estimated the model with the full sample and included the sub-sampling variable as an interaction effect on all explanatory variables. Our results show that among the Wave 1 sample and after it, the intensity of the new deaths, the cancellation of public events and the international travel controls are all significantly different. Among rich and poor countries, we see that the closure of public transport exerts a significantly different effect on economic response. For the service intensity, work-place closure and stay-at-home requirements were significantly different. These results further emphasize the high levels of heterogeneity, among the countries studied and that within the countries belonging to each group.

Robustness checks

To start, [Table A.6](#) shows the interaction between three different dummies: being in a rich country, being in a country intensive in services and being in country with a high intensiveness of tourism. If we compare our baseline (Column (1) from [Table 3](#)) and our new estimates in Column (1–3), we observe slight differences, with the exception of variables *Work-place closure* and *Restrictions on gatherings* present more noticeable changes. The first one is equal to 0.054 on the Base Column (1) from [Table 3](#), while it takes a value equal to 0.110 and 0.145 when we consider that GDP per capita and the service specialization (Column (1) and Column (2) from [Table A.6](#), respectively). The variable *Restrictions on gatherings* shows a higher difference. The base Column (1) shows a result of 0.0363, while GDP per capita, Services and Tourism present results of 0.001, -0.016 and 0.132, respectively. Therefore, once we include our results, the results are quite robust. Finally, our variables of interest, the different NPIs, once they are interacted with the structural characteristics are not significant. The main exception is for Services Column (2) in [Table A.6](#). The cross product between the work-place closure, the stay-at-home requirements and the international travel controls, with coefficients equal to -0.173 , -0.313 and 0.242, respectively. Hence, the economic response to these particular policies is affected by the specialization in services.

Finally, in order to further investigate the effect of the structural characteristics, [Table A.7](#) repeats the analysis with a cross-product between the average mobility as a proxy of the activities and three dummy variables: those belonging to a rich country (Column (1)), those that are intensive in service sectors (Column (2)) and in those in tourism (Column (3)). Our results show that poor countries are slightly more sensitive than rich countries; furthermore, countries with a low intensity in services denote more intensive economic policies to households. The latter result confirms the different

reactions between countries that are less intense in terms of services. A possible explanation is the fact that those governments in countries with less dependence on service activities were in a better position to reactivate their economic activities.

5. Discussion and conclusions

Governments around the world have implemented policies to mitigate the negative effects of public health restrictions on the economy. Countries have, however, deployed a wide variety of economic measures in terms of breadth and scope. Among these measures, those targeted directly at households aim to counterbalance the initial shock among the most vulnerable segment of the population. The following section discusses the previous results and suggests several policy recommendations. To this end we present our main research questions, and we summarize our main statistical and econometric results and provide our interpretations.

This paper explores two research questions. Our main research question is to analyse if the governments analysed deployed different economic responses to households with respect to non-pharmaceutical interventions. The second research question was to assess if this response differs with respect to the economic and sectoral context of the countries. Our hypothesis is based on the fact that the Covid-19 pandemic is characterized by its asymmetric sectoral shock. At a theoretical level, this analysis is supported by [Stiglitz \(2020\)](#) model. At an empirical level, the pertinent literature has already highlighted its profound impact on social contact sectors, such as services (culture, entertainment, etc.) and especially on the tourism sector ([Khalid et al., 2021](#)). While many analyses attempt to disentangle the impact of the governmental economic reactions on the financial markets ([Topcu and Gulal, 2020](#); [Zaremba et al., 2021](#)), a review of the literature shows the scarce attention paid to the sensitive nature of these structural differences, such as the GDP per capita level, in addition to service and tourism specialization. The degree of complexity involved in our analysis is markedly high, due to the large number of interactions between both the health shock and the wide socioeconomic shock (see [Fig. 1](#)). Our work seeks to disentangle these differences using data provided on a daily basis.

Using daily time data from the Oxford Covid-19 Government Response Tracker (OxCGRT), we have estimated this relationship for 59 developed and developing countries. Our main results are the following.

Firstly, a statistical analysis reveals that the frequency of the application of several NPIs differs according their dependence on service or touristic sectors. We have confirmed that school closure, the closure of public transport, restrictions on international movements and international travel controls were higher in poor countries, those with lower service specializations, and those with a lower intensity in terms of tourism. These characteristics have meant that those countries that are highly dependent in some sectors have reacted by deploying restrictive measures during a longer period of time.

Secondly, statistical analysis shows that the containment policies influence the economic support measures to households. This result is mainly due to the negative effects in terms of economic activities, firms and workers. Finally, we have to mention the importance of response persistence. The countries analysed reacted quite persistently over time after a quick response.

Thirdly, the impact is heterogeneous and confirms some already-anticipated results: namely that richer countries are better-equipped to respond economically to the current pandemic. Countries that are highly specialized in services and tourism have also deployed more intense economic policies focused on households. In proximity services such as retail, medical assistance or education, face-to-face interaction emerges as an essential dimension for remaining operational. Weeks after the first infections were detected, most developed countries tried to control the coronavirus outbreak by limiting internal mobility and border closures. Over the course of the pandemic, all countries implemented some travel restrictions, including travel bans from selected countries and arrival quarantines ([Gössling et al., 2020](#)). In order to promote tourism activities in national and supranational areas, health certificates are being implemented throughout territories to guarantee the control of infections in a scenario of international de-escalation.

Fourthly, our econometric results confirm that the severity of the health crisis has driven economic response. Additionally, the deployment of economic responses to households has been more intense with the cancellations of public events, the closure of public transport, restrictions on international movements and international travel controls. These results highlight the greater effects of some measures applied by governments when they have decided to restrict social contact.

Last but not least, at an econometric level we have seen that groups of countries differ in their levels of sensitivity with respect to the non-pharmaceutical interventions that have been applied. Furthermore, few of these differences are significant. Several explanations arise in this context. In line with [Elgin et al. \(2020\)](#), countries have responded

heterogeneously in terms of the intensity and speed. Curiously, the socioeconomic effect of NPIs and in general, the Covid-19 pandemic is heterogeneous across countries. In the absence of any guiding model or prescriptions on how countries should react to an event as unprecedented as Covid-19, some countries were slow in imposing travel bans and lockdowns (Phan and Narayan, 2020). This result also highlights the fact that the long-term expenses that countries will have to pay in terms of their economic debt will certainly differ.

These findings offer important lessons for policymakers. First, our results show that governments responded quickly to the economic shock. Second, their economic stimulus was more intense in richer countries and those which have a sectoral structure more vulnerable to the pandemic, this being particularly among countries highly dependent on international tourism. Furthermore, it will be crucial that countries continue with the coordination of different policies to ensure a balanced recovery. A future line of research will be to analyse whether the economic response was enough to mitigate the economic shock. Third, we observe the strong interlinkages between those interventions to control the pandemic and the economic answer given by governments. These results reveal an initial “do whatever it takes” policy to contain the pandemic and avoid damaging the economy in the short term. However, once the recovery phase arrives, policymakers will adjust policies by trying to compensate for their unequal impact on different social groups and economic activities.

Some limitations regarding this study need to be acknowledged. Especially the reliance on data that may underestimate the death counts for some countries and the time period limited to 2020. Nevertheless, the first year of pandemics is a unique source of data that may be used to understand how governments reacted under the pressure of an almost unpredictable event. Also, the possible bias in terms of death numbers is hardly solvable but this measure is still far more robust than case counts. Finally, the economic support index summarizes the support measures implemented in a harmonized and comparable way, however it obviously covers only one side of the story.

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Appendix

See Tables A.1 and A.7 and Graph A.1.

Table A.1
Descriptive statistics for the sample.

Variable	Mean	Std. Dev.	Min	Max
Economic support index	4.401	2.660	0	8
Log (new deaths)	1.987	2.126	0	8.226
School closure	0.361	0.480	0	1
Work-place closure	0.150	0.357	0	1
Cancel public events	0.618	0.486	0	1
Restrictions on gatherings	0.391	0.488	0	1
Closed public transport	0.098	0.297	0	1
Stay-at-home requirements	0.030	0.172	0	1
Restrictions on international movements	0.352	0.478	0	1
International travel controls	0.219	0.413	0	1
Log (average mobility trend)	4.443	0.510	2.061	6.589
Wave 1	0.530	0.499	0	1
GDP per capita	31,701.65	18,682.71	3645.07	94,277.97
Services value added over GDP	60.556	7.976	38.848	79.158
Visitors’ expenditure over GDP	3.4×10^{-8}	3.1×10^{-8}	2.1×10^{-9}	1.7×10^{-7}

Number of observations: 20,616. Number of countries: 59.

Source: Own elaboration from OxCGRT, World Bank, World Tourism Organization and Apple mobility data.

Table A.2
Correlation matrix.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Economic support index	1										
(2) Log (new deaths)	0.254*	1									
(3) School closure	0.074*	0.353*	1								
(4) Work-place closure	0.145*	0.299*	0.401*	1							
(5) Cancel public events	0.348*	0.441*	0.413*	0.324*	1						
(6) Restrictions on gatherings	0.308*	0.397*	0.230*	0.319*	0.496*	1					
(7) Closed public transport	0.048*	0.174*	0.397*	0.278*	0.195*	0.195*	1				
(8) Stay-at-home requirements	0.051*	0.105*	0.229*	0.284*	0.131*	0.153*	0.276*	1			
(9) Restrictions on international movements	0.209*	0.432*	0.460*	0.418*	0.487*	0.348*	0.359*	0.209*	1		
(10) International travel controls	0.124*	0.135*	0.393*	0.204*	0.268*	0.124*	0.301*	0.212*	0.343*	1	
(11) Log (mobility trend-average)	-0.083*	-0.184*	-0.511*	-0.448*	-0.423*	-0.335*	-0.333*	-0.246*	-0.377*	-0.401*	1
(12) Wave 1	-0.409*	-0.147*	0.201*	0.146*	-0.061*	-0.117*	0.135*	0.114*	0.095*	0.236*	-0.283*

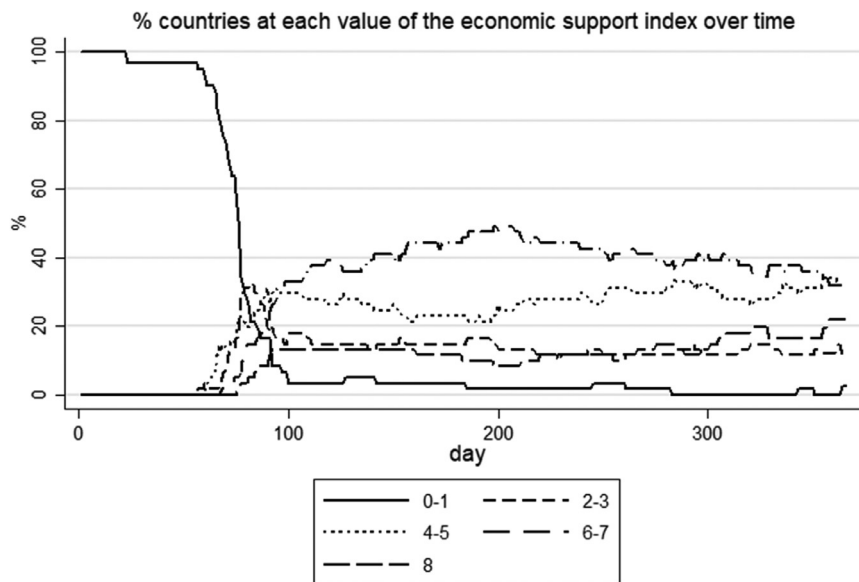
Note: * denotes 5% significant.

Source: Own elaboration from OxCGRT, World Bank, World Tourism Organization and Apple mobility data.

Table A.3
Variance inflation factors test.

Variable	VIF	1/VIF
Log (average mobility)	1.81	0.552765
Cancel public events	1.80	0.554723
School closure	1.79	0.559433
Restrictions on international movements	1.74	0.575975
Log (new deaths)	1.52	0.656907
Restrictions on gatherings	1.52	0.659718
Work-place closure	1.49	0.669024
International travel controls	1.36	0.732910
Closed public transport	1.33	0.7750538
Wave 1	1.23	0.812389
Stay-at-home requirements	1.16	0.858774
Mean VIF	1.52	

Source: Own elaboration from OxCGRT, World Bank, World Tourism Organization and Apple mobility data.



Note: the range of intensity of the economic support index is [0, 8].

Graph A.1. Share of countries according to the economic support index to households. Note: The range of the intensiveness of the economic response is [0, 8].

Source: Own elaboration from OxCGRT, World Bank, World Tourism Organization and Apple mobility data.

Table A.4
Country classification.

	Rich	Service-intensive	Tourism-intensive
Albania	NO	NO	YES
Argentina	NO	NO	NO
Australia	YES	YES	YES
Austria	YES	YES	YES
Belgium	YES	YES	NO
Brazil	NO	YES	NO
Bulgaria	NO	YES	YES
Cambodia	NO	NO	YES
Canada	YES	YES	NO
Chile	NO	NO	NO
Colombia	NO	NO	NO
Croatia	NO	NO	YES
Czech Republic	YES	NO	YES
Denmark	YES	YES	YES
Egypt	NO	NO	NO
Estonia	YES	YES	YES
Finland	YES	NO	YES
France	YES	YES	YES
Germany	YES	YES	NO
Greece	NO	YES	YES
Hungary	NO	NO	YES
Iceland	YES	YES	YES
India	NO	NO	NO
Indonesia	NO	NO	NO
Ireland	YES	NO	YES
Israel	YES	YES	YES
Italy	YES	YES	YES
Japan	YES	YES	NO
Latvia	NO	YES	YES
Lithuania	YES	YES	NO
Luxembourg	YES	YES	YES
Malaysia	NO	NO	YES
Mexico	NO	NO	NO
Morocco	NO	NO	YES
Netherlands	YES	YES	YES
New Zealand	YES	YES	YES
Norway	YES	NO	NO
Philippines	NO	YES	NO
Poland	NO	NO	NO
Portugal	NO	YES	YES
Romania	NO	NO	NO
Russia	NO	NO	NO
Saudi Arabia	YES	NO	NO
Serbia	NO	NO	NO
Singapore	YES	YES	YES
Slovak Republic	YES	NO	NO
Slovenia	YES	NO	YES
South Africa	NO	YES	NO
South Korea	YES	NO	NO
Spain	YES	YES	YES
Sweden	YES	YES	NO
Switzerland	YES	YES	YES
Thailand	NO	NO	YES
Turkey	NO	NO	NO
Ukraine	NO	NO	NO
United Kingdom	YES	YES	NO
United States	YES	YES	NO
Uruguay	NO	NO	YES
Vietnam	NO	NO	NO

Note: X denotes countries with GDP per capita, service intensity and tourism intensity above the median.
Source: Own elaboration from OxCGRT, World Bank, World Tourism Organization and Apple mobility data.

Table A.5
Testing differences among coefficients for the sub-samples.

	Waves	GDP per capita	Service intensity	Tourism intensity
Log (new deaths)	YES	NO	NO	YES
School closure	NO	NO	NO	NO
Work-place closure	NO	NO	YES	NO
Cancel public events	YES	NO	NO	NO
Restrictions on gatherings	NO	NO	NO	NO
Close public transport	NO	YES	NO	NO
Stay-at-home requirements	NO	NO	YES	NO
Restrictions on international movements	NO	NO	NO	NO
International travel controls	YES	NO	NO	NO
Log (average mobility)	NO	NO	NO	NO
Wave 1	–	NO	NO	NO

Note: The estimated test statistic after each coefficient corresponds to the test of the null hypothesis that there is no difference in effect between these groups. The significance threshold applied is <10% (or 0.1 in *p*-value).

Table A.6
Estimates of determinants of the economic response to households during Covid-19 pandemic. Cross-product of the mobility and the structural characteristics. Poisson with fixed effects.

	(1)		(2)		(3)
Log (new deaths)	0.092*** (0.015)		0.094*** (0.016)		0.093*** (0.016)
School closure (NPI1)	0.070 (0.072)		0.100 (0.082)		0.137* (0.077)
Work-place closure (NPI2)	0.110 (0.093)		0.145* (0.076)		0.062 (0.068)
Cancel public events (NPI3)	0.423*** (0.114)		0.386*** (0.113)		0.367*** (0.126)
Restrictions on gatherings (NPI4)	0.001 (0.085)		–0.016 (0.082)		0.132* (0.072)
Close public transport (NPI5)	0.398*** (0.081)		0.373*** (0.072)		0.275*** (0.089)
Stay-at-home requirements (NPI6)	0.214* (0.126)		0.308** (0.120)		0.192* (0.106)
Restrictions int'l movements (NPI7)	0.177** (0.074)		0.108 (0.075)		0.149** (0.067)
International travel controls (NPI8)	0.121 (0.107)		0.124 (0.101)		0.197*** (0.069)
Rich(=1)× NPI1	0.073 (0.094)	Services(=1)× NPI1	0.0425 (0.101)	Tourism(=1)× NPI1	–0.040 (0.108)
Rich(=1)× NPI2	–0.098 (0.109)	Services(=1)× NPI2	–0.173* (0.097)	Tourism(=1)× NPI2	–0.018 (0.094)
Rich(=1)× NPI3	–0.014 (0.145)	Services(=1)× NPI3	0.051 (0.143)	Tourism(=1)× NPI3	0.059 (0.153)
Rich(=1)× NPI4	0.057 (0.112)	Services(=1)× NPI4	0.090 (0.112)	Tourism(=1)× NPI4	–0.170 (0.107)
Rich(=1)× NPI5	–0.218 (0.145)	Services(=1)× NPI5	–0.207 (0.164)	Tourism(=1)× NPI5	0.094 (0.134)
Rich(=1)× NPI6	0.056 (0.170)	Services(=1)× NPI6	–0.313* (0.173)	Tourism(=1)× NPI6	0.042 (0.150)
Rich(=1)× NPI7	–0.077 (0.103)	Services(=1)× NPI7	0.039 (0.101)	Tourism(=1)× NPI7	–0.054 (0.093)
Rich(=1)× NPI8	0.197 (0.129)	Services(=1)× NPI8	0.242* (0.127)	Tourism(=1)× NPI8	0.042 (0.144)
Log(avg. mobility)	0.244*** (0.069)	Log(avg. mobility)	0.249*** (0.067)	Log(avg. mobility)	0.230*** (0.072)
Wave 1	–0.492*** (0.057)	Wave 1	–0.488*** (0.056)	Wave 1	–0.504*** (0.055)
Pseudo-R ²	0.1953	Pseudo-R ²	0.1965	Pseudo-R ²	0.1949
Observations	20,616		20,616		20,616
Number of idcountry	59		59		59

Note: Standard errors in parenthesis. Stars correspond to * significant at 10%, ** significant at 5%, while *** significant at 1%.

Source: Own elaboration from OxCGRT, World Bank, World Tourism Organization and Apple mobility data.

Table A.7

Estimates of determinants of the economic response to households during Covid-19 pandemic. Cross-product of the mobility and the structural characteristics. Poisson with fixed effects.

	(1)	(2)	(3)
Log (new deaths)	0.090*** (0.016)	0.087*** (0.016)	0.091*** (0.015)
School closure	0.108** (0.052)	0.111** (0.052)	0.105* (0.054)
Work-place closure	0.047 (0.051)	0.030 (0.047)	0.052 (0.049)
Cancel public events	0.415*** (0.077)	0.416*** (0.076)	0.414*** (0.076)
Restrictions on gatherings	0.033 (0.057)	0.034 (0.056)	0.035 (0.056)
Close public transport	0.324*** (0.072)	0.361*** (0.074)	0.320*** (0.070)
Stay-at-home requirements	0.235** (0.095)	0.252*** (0.097)	0.252*** (0.094)
Restrictions on int'l movements	0.118** (0.052)	0.124** (0.051)	0.117** (0.050)
International travel controls	0.224*** (0.073)	0.235*** (0.072)	0.227*** (0.0757)
Wave 1	-0.493*** (0.056)	-0.501*** (0.054)	-0.488*** (0.055)
Rich(=0)×log(avg. mobility)	0.273*** (0.079)		
Rich(=1)×log(avg. mobility)	0.215** (0.087)		
Serv (=0)×log(avg. mobility)		0.339*** (0.080)	
Serv (=1)×log(avg. mobility)		0.165** (0.076)	
Tour(=0)×log(avg. mobility)			0.300*** (0.089)
Tour(=1)×log(avg. mobility)			0.221*** (0.081)
Pseudo-R ²	0.1939	0.1940	0.1940
Observations	20,616	20,616	20,616
Number of idcountry	59	59	59

Note: Standard errors in parenthesis. Stars correspond to * significant at 10%, ** significant at 5%, while *** significant at 1%.

Source: Own elaboration from OxCGRT, World Bank, World Tourism Organization and Apple mobility data.

References

- Ashraf, B.N., 2021. Stock markets' reaction to COVID-19: Moderating role of national culture. *Finance Res. Lett.* 41, 101857.
- Benedetti Fasil, C., Del Rio, J.C., Domnick, C., Fako, P., Flachenecker, F., Gavigan, J., Janiri, M., Stamenov, B., Testa, G., 2021. High Growth Enterprises in the COVID-19 Crisis Context. Publications Office of the European Union, ISBN: 978-92-76-37269-1, <http://dx.doi.org/10.2760/63402>, JRC124469.
- Bodenstein, M., Corsetti, G., Guerrieri, L., 2020. Social distancing and supply disruptions in a pandemic. In: Finance and Economics Discussion Series 2020-031. Board of Governors of the Federal Reserve System, Washington, <http://dx.doi.org/10.17016/FEDS.2020.031>.
- Bonaccorsi, G., Pierri, F., Cinelli, M., Flori, A., Galeazzi, A., Porcellini, F., Schmidt, A.L., Valensise, C.M., Scala, A., Quattrociocchi, W., Pammolli, F., 2020. Economic and social consequences of human mobility restrictions under COVID-19. *Proc. Natl. Acad. Sci.* 117 (27), 15530–15535.
- Bonacini, L., Gallo, G., Scicchitano, S., 2021. Working from home and income inequality: Risks of a 'New Normal' with COVID-19. *J. Popul. Econom.* 34 (1), 303–360.
- Bordo, M.D., Duca, J.V., 2020. How New Fed Corporate Bond Programs Dampened the Financial Accelerator in the Covid-19 Recession (No. W28097). National Bureau of Economic Research, <http://dx.doi.org/10.3386/w28097>.
- Brewer, M., Gardiner, L., 2020. The initial impact of COVID-19 and policy responses on household incomes. *Oxford Rev. Econom. Policy* 36 (Supplement_1), S187–S199.
- Brodeur, A., Gray, D.M., Islam, A., Bhuiyan, S., 2020. A literature review of the economics of COVID-19. In: GLO Discussion Paper, vol. 601. GlobalLabor Organization (GLO), Essen, <http://hdl.handle.net/10419/222316>.
- Capano, G., Howlett, M., Jarvis, D.S., Ramesh, M., Goyal, N., 2020. Mobilizing policy (in) capacity to fight COVID-19: Understanding variations in state responses. *Policy Soc.* 39 (3), 285–308.
- Chen, S., Igan, D., Pierri, N., Presbitero, A.F., 2020. Tracking the economic impact of Covid-19 and mitigation policies in Europe and the United States. IMF Working Paper 20/125.
- Cheng, C., Barcelo, J., Hartnett, A., Kubinec, R., Messerschmidt, L., 2020. CoronaNet: A Dyadic Dataset of Government Responses To the COVID-19 Pandemic. Center for Open Science, <https://ideas.repec.org/p/osf/socarx/dkvyx.html>.
- Cirera, X., Cruz, M., Davies, E., Grover, A., Iacovone, L., Cordova, J.E.L., Medvedev, D., Maduko, F.O., Nayyar, G., Ortega, S.Reyes., Torres, J., 2021. Policies to support businesses through the COVID-19 shock: A firm level perspective. *World Bank Res. Observ.* 36 (1), 41–66.
- Correia, S., Luck, S., Verner, E., 2020. Pandemics depress the economy. In: Public Health Interventions Do Not: Evidence from the 1918 Flu. Mimeo available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3561560.
- Cot, C., Cacciapaglia, G., Sannino, F., 2021. Mining google and apple mobility data: temporal anatomy for COVID-19 social distancing. *Sci. Rep.* 11, 4150. <http://dx.doi.org/10.1038/s41598-021-83441-4>.
- Cowling, B.J., Ali, S.T., Ng, T.W., Tsang, T.K., Li, J.C., Fong, M.W., Liao, Q., Kwan, Mike, Y.W., Lee, S.L., Chiu, S.S., Wu, J.T., Wu, P., Leung, G.M., 2020. Impact assessment of non-pharmaceutical interventions against coronavirus disease 2019 and influenza in Hong Kong: an observational study. *Lancet Publ. Health* 5 (5), e279–e288.
- Dang, H.A.H., Nguyen, C.V., 2021. Gender inequality during the COVID-19 pandemic: Income, expenditure, savings, and job loss. *World Dev.* 140, 105296.
- Demertzis, M., Sapir, A., Tagliapietra, S., Wolff, G.B., 2020. An effective economic response to the coronavirus in Europe. *Policy Contribution* 06/2020, Bruegel.
- Dosi, G., Fanti, L., Virgillito, M.E., 2020. Unequal societies in usual times, unjust societies in pandemic ones. *J. Indust. Bus. Econom.* 47 (3), 371–389.
- Eichenbaum, M.S., Rebelo, S., Trabandt, M., 2020. The macroeconomics of epidemics. National Bureau of Economic Research working paper 26882.
- Elgin, C., Basbug, G., Yalaman, A., 2020. Economic policy responses to a pandemic: Developing the COVID-19 economic stimulus index. *Covid Econom.* 1 (3), 40–53.
- Engelhardt, N., Krause, M., Neukirchen, D., Posch, P.N., 2021. Trust and stock market volatility during the COVID-19 crisis. *Finance Res. Lett.* 38, 101873. <http://dx.doi.org/10.1016/j.frl.2020.101873>.
- Erdem, O., 2020. Freedom and stock market performance during Covid-19 outbreak. *Finance Res. Lett.* 36, 101671.
- García, R., Gayer, C., Hölzl, W., Payo, S., Reuter, A., Wohlrabe, K., 2020. The impact of the COVID-19 crisis on European businesses: Evidence from surveys in Austria, Germany and Spain. *EconPol Policy Brief* No. 31. http://www.econpol.eu/publications/policy_brief_31.
- Gentilini, U., Almenfi, M., Orton, I., Dale, P., 2020. Social protection and jobs responses to COVID-19. ©World Bank. <https://openknowledge.worldbank.org/handle/10986/33635> License: CC BY 3.0 IGO.
- Gordon, D.V., Grafton, R.Q., Steinshamn, S.I., 2021. Cross-country effects and policy responses to COVID-19 in 2020: The nordic countries. *Econ. Anal. Policy* 71, 198–210.
- Gössling, S., Scott, D., Hall, C.M., 2020. Pandemics, tourism and global change: a rapid assessment of COVID-19. *J. Sustain. Tour.* 29 (1), 1–20.
- Gourinchas, P.O., Ş, Kalemli-Özcan, Penciakova, V., Sander, N., 2020. Covid-19 and SME failures. National Bureau of Economic Research working paper 7877.
- Guerrieri, V., Lorenzoni, G., Straub, L., Werning, I., 2020. Macroeconomic Implications of COVID-19: Can Negative Supply Shocks Cause Demand Shortages? National Bureau of Economic Research working paper 26918.
- Hale, T., Angrist, N., Goldszmidt, R., Kira, B., Petherick, A., Phillips, T., Webster, S., Cameron-Blake, E., Hallas, L., Majumdar, S., Tatlow, S., 2021. A global panel database of pandemic policies (Oxford COVID-19 government response tracker). *Nat. Hum. Behav.* <http://dx.doi.org/10.1038/s41562-021-01079-8>.
- Hall, C.M., Scott, D., Gössling, S., 2020. Pandemics, transformations and tourism: Be careful what you wish for. *Tour. Geograph.* 22 (3), 577–598. <http://dx.doi.org/10.1080/14616688.2020.1759131>.
- ILO, 2020. International Labour Organization Monitor: COVID-19 and the world of work. Second edition updated estimates and analysis. www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/documents/briefingnote/wcms_740877.pdf.
- Jena, P.R., Majhi, R., Kalli, R., Managi, S., Majhi, B., 2021. Impact of COVID-19 on GDP of major economies: Application of the artificial neural network forecaster. *Econ. Anal. Policy* 69, 324–339.
- Khalid, U., Okafor, L.E., Burzynska, K., 2021. Does the size of the tourism sector influence the economic policy response to the COVID-19 pandemic? *Curr. Issues Tour.* 1–20.
- Kong, E., Prinz, D., 2020. Disentangling policy effects using proxy data: Which shutdown policies affected unemployment during the COVID-19 pandemic? *J. Publ. Econom.* 189, 104257.
- Li, K., Foutz, N.Z., Cai, Y., Liang, Y., Gao, S., 2020. Impacts of COVID-19 Lockdowns and Stimulus Payments on Low-income Population's Spending in the United States.
- Makin, A.J., Layton, A., 2021. The global fiscal response to COVID-19: Risks and repercussions. *Econ. Anal. Policy* 69, 340–349.
- Maloney, W., Taskin, T., 2020. Determinants of Social Distancing and Economic Activity During COVID-19: A Global View. The World Bank.
- Weder di Mauro, B., 2020. Macroeconomics of the flu. Center for Economic Policy Research. <http://repository.graduateinstitute.ch/record/298218>.

- Padhan, R., Prabheesh, K.P., 2021. The economics of COVID-19 pandemic: A survey. *Econ. Anal. Policy* 70, 220–237.
- Perra, N., 2021. Non-pharmaceutical interventions during the COVID-19 pandemic: A review. *Phys. Rep.* <http://dx.doi.org/10.1016/j.physrep.2021.02.001>, (in press).
- Phan, D.H.B., Narayan, P.K., 2020. Country responses and the reaction of the stock market to COVID-19—A preliminary exposition. *Emerg. Mark. Finance Trade* 56 (10), 2138–2150.
- Sebhatu, A., Wennberg, K., Arora-Jonsson, S., Lindberg, S.I., 2020. Explaining the homogeneous diffusion of COVID-19 nonpharmaceutical interventions across heterogeneous countries. *Proc. Natl. Acad. Sci.* 117 (35), 21201–21208.
- Sigala, M., 2020. Tourism and COVID-19: Impacts and implications for advancing and resetting industry and research. *J. Bus. Res.* 117, 312–321. <http://dx.doi.org/10.1016/j.jbusres.2020.06.015>.
- Stiglitz, J.E., 2020. The pandemic economic crisis, precautionary behavior, and mobility constraints: an application of the dynamic disequilibrium model with randomness. National Bureau of Economic Research. Working paper 27992.
- Størdal, S., Lien, G., Mydland, Ø., Haugom, E., 2021. Effects of strong and weak non-pharmaceutical interventions on stock market returns: A comparative analysis of Norway and Sweden during the initial phase of the COVID-19 pandemic. *Econ. Anal. Policy* 70, 341–350. <http://dx.doi.org/10.1016/j.eap.2021.03.009>.
- Topcu, M., Gulal, O.S., 2020. The impact of COVID-19 on emerging stock markets. *Finance Res. Lett.* 36, 101691.
- Verschuur, J., Koks, E.E., Hall, J.W., 2021. Observed impacts of the COVID-19 pandemic on global trade. *Nat. Hum. Behav.* 5 (3), 305–307.
- Škare, M., Soriano, D.R., Porada-Rochoń, M., 2021. Impact of COVID-19 on the travel and tourism industry. *Technol. Forecast. Soc. Change* 163, 120469.
- Watkins, J., Maruthappu, M., 2021. Public health and economic responses to COVID-19: finding the tipping point. *Publ. Health* 191, 21.
- Wheelock, D.C., 2020. Comparing the COVID-19 Recession with the Great Depression, vol. 39. Federal Reserve Bank of St. Louis, Economic synopses, <http://dx.doi.org/10.20955/es.2020.39AvailableatSSRN3745250>.
- Williams, C.C., Kayaoglu, A., 2020. Covid-19 and undeclared work: Impacts and policy responses in Europe. *Serv. Indust. J.* 40 (13–14), 914–931.
- Wooldridge, J.M., 1999. Distribution-free estimation of some nonlinear panel data models. *J. Econometrics* 90 (1), 77–97.
- Wooldridge, J.M., 2000. A framework for estimating dynamic, unobserved effects panel data models with possible feedback to future explanatory variables. *Econom. Lett.* 68 (3), 245–250.
- Wooldridge, J.M., 2002. *Econometric Analysis of Cross-Section and Panel Data*. MIT Press, 978-0-262-23258-6.
- Wooldridge, J.M., 2005. Simple solutions to the initial conditions problem in dynamic, nonlinear panel data models with unobserved heterogeneity. *J. Appl. Econometrics* 20 (1), 39–54.
- Zaremba, A., Aharon, D.Y., Demir, E., Kizys, R., Zawadka, D., 2021. COVID-19, government policy responses, and stock market liquidity around the world: A note. *Res. Int. Bus. Finance* 56, 101359.