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Abstract: 2020 was a very exceptional year from many points of view. It will be remembered as COVID-19 year. The pandemic started in China at the end of 2019 and gradually reached all countries worldwide, producing an unprecedented global health, social and economic crisis. In this paper, first of all, we analyse the economic consequences of this pandemic, considering the European framework. A secondary aim of this paper is to identify (a) the actual impact of the containment measures adopted by each state, (b) the connection between the extent to which the pandemic has hit each country and the income supports provided. The analysis involves 31 European countries (the 27 European Union countries more Iceland, Norway, Switzerland, and the United Kingdom). Results highlight great differences across countries in terms of economic response to the pandemic and job losses. Indeed, from the second quarter of 2020, all the countries registered a contraction in GDP. However, some of them resumed their positive trend in GDP very fast, with a positive balance at the end of 2020. This is the case in some Eastern countries and Ireland. Conversely, we can say that Continental and Mediterranean countries registered a decline and, finally, Nordic countries showed almost stationarity.

Keywords: COVID-19; economic crisis; containment measures; panel-data tobit models

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La pandemia da COVID-19 e le principali determinanti della crisi economica

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Sommario: Il 2020 è stato un anno eccezionale da molti punti di vista. Esso sarà ricordato per sempre come l'anno della pandemia mondiale da COVID-19 che, diffusasi dapprima in Cina alla fine del 2019, gradualmente ha raggiunto tutti i paesi del mondo, provocando una crisi economica, sociale e sanitaria senza precedenti.
Focalizzando l'attenzione sul contesto europeo, in questo articolo, verranno analizzate le conseguenze economiche della pandemia. Un secondo obiettivo consiste nell'identificazione degli effetti che le misure di contenimento del virus adottate nei vari paesi hanno avuto sulla reale diffusione del virus e sull'economia in generale. Infine, un altro interrogativo sul quale si vuole investigare riguarda la possibilità di identificare un legame di tipo diretto tra il grado con cui ciascun paese è stato colpito dalla pandemia e le misure di supporto al reddito elargite. L'analisi ha coinvolto 31 paesi europei (i 27 paesi dell'Unione Europea, più l'Islanda, la Norvegia, la Svizzera ed il Regno Unito).
I risultati evidenziano forti differenze tra i paesi in termini di risposta economica alla pandemia. Tutti i paesi hanno registrato una contrazione del PIL a partire dal secondo trimestre del 2020, ma mentre per alcuni di essi, per esempio l'Irlanda ed alcuni paesi dell'Est, il recupero è stato molto rapido, consentendo di terminare l'anno con un bilancio positivo, per i paesi mediterranei e per alcuni paesi dell'Europa continentale la situazione è risultata più problematica.

Parole chiave: COVID-19; crisi economica; misure di contenimento; modelli tobit per dati panel

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Indice

1. Introduction

The COVID-19 pandemic produced a devasting recession due to a global macroeconomic shock affecting both the demand and supply side (Bodnàr et al., 2020). Within the European framework, not all

European countries were hit by the pandemic in the same way, and the economic consequences of the pandemic were very different (Bouckaert et al., 2020). According to the first point, it is not easy to identify countries more severely hit by the pandemic. Indeed, countries greatly differed in the levels of contagions, their distribution over time and the consequences in terms of deaths. In 2020, we had two main waves of the pandemic. The first one, in the Spring, invested more severely few countries – mainly Italy, the Czech Republic, Luxembourg, and Spain - while the second wave arose in Autumn and hit more evenly all the European countries (Meoni, 2021). Looking at the diffusion of the pandemic in terms of the share of the population which contracted the disease, considering the whole of the year 2020, countries more severely hit were the Czech Republic, where 12.4% of the population contracted the COVID-19, followed by Slovenia and Luxembourg, with a share of 9%. On the opposite, Greece, Norway, and Finland registered a share of just over 1%[1]. The Nordic countries resulted overall less hit. However, the countries whose population paid the highest price in terms of deaths were Belgium, Slovenia, and the UK. Conversely, Iceland, Denmark, Greece, and Malta registered the minimum death rates in the population.

The second point of interest consists in the identification of the countries that suffered the stronger economic repercussions. Comparing the values of the GDP observed in January 2020 with that observed at the end of 2020, in December, countries more economically hit by the pandemic were, in the order: the UK (-5.93 points), the Iberian countries of Portugal (-1.91) and Spain (-1.68), other Mediterranean countries and Germany. Conversely, the Eastern countries of Romania, Bulgaria and Poland registered an increase of, respectively, 10.81, 6.03 and 3.78 points. It does not seem to be a strong correlation between the economic crisis measured by GDP contractions and the severity with which countries have been hit by the pandemic (Pitterle and Niermann, 2021). Some first pioneering studies have highlighted that the global nature of the crisis extended the strong economic consequences of the pandemic to all countries, even if some of them were less affected by the pandemic (Bell at al., 2020). In this work, we want: (a) to verify if this connection exists and (b) eventually to measure this relationship. A secondary aim of this paper is to identify the actual effect that the containment measures adopted by each state to encompass the pandemic had on the contagion levels and on their economies. On the one hand, we expect that higher containment measures should have reduced contagions. However, these measures should have a depressing effect on the countries' economies (Auriemma and Iannaccone, 2020). Finally, it is interesting to understand if the income support was proportional to the restriction measures adopted.

Unfortunately, the pandemic has still not been completely overcome; therefore, it is still not possible to verify the real damages in terms of job losses and deaths that it has produced. In any case, it is important to start studying how the pandemic has hit the different economies, to identify the most relevant policy actions able to favour a fast recovery and support the weakest segments of the population, resuming the path toward sustainable development and greater well-being.

[1] The data provided in this article are from ad hoc elaborations on the Blavatnik School of Government and University of Oxford website, that for each country constantly informed about daily data on the pandemic in terms of contagions, deaths, containment measures and income support measures (https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker).

To reach these scopes, we analyse the main measures taken by each State Government to front the pandemic, including both the containment restriction measures and the income supports provided to the most hit categories.

Countries analysed are all 27 EU member States, more Iceland, Norway, Switzerland and the United Kingdom. The analysis concerns 2020 and is based on monthly indicators. Data come from different sources. Data from the Blavatnik School of Government and University of Oxford's website was used to construct monthly indicators; absolute values were transformed in percentages of the relative population in order to get cross-countries comparable indicators. Different indicators come from the Eurostat on-line database.

This research paper could give a valid help to the definition of future policies to drive the recovery; in more detail, it could set up a resilient approach aimed at boosting investments to contrast the structural part of unemployment, and to addressing the development versus more sustainable paths, especially for countries with high levels of unemployment.

The rest of the paper is as follows. Section 2 shows the framework of analysis describing the economic condition of the European countries before the pandemic and how the contagions spread across them in 2020. Section 3 presents the data used for the analysis and the methodology. Section 4 shows the results and Section 5 concludes.

2. The economic scenario

Before the pandemic, European countries showed very different economic conditions. When the pandemic spread across Europe, some of these countries had still not completely recovered from the 2007 financial and economic crisis. Indeed, comparing the pre-crisis levels of unemployment (registered in January 2006) with those registered in January 2020, many countries were still not returned to the pre-crisis levels. This is the case, for example, of the Mediterranean countries of Italy, Spain, and Greece. For Italy, the adult unemployment rate in January 2020 was 8% and the youth unemployment rate was 28.8%. The corresponding values in 2006 were 5.8% and 23%, respectively. The highest increases concerned men for all ages. In 2020, the first data show that the countries more economically hit by the pandemic corresponded to the weakest European countries' economies, regardless of the effective degree of severity with which each country was hit by the pandemic. Therefore, the pandemic produced a consistent increase of the social and economic inequalities across European countries. To describe the condition of the European countries before the pandemic, we can identify three main groups. The first one is composed of the Mediterranean countries, which showed the highest levels of unemployment and the slowest economic growth rates. The second group, formed by the Continental and Nordic countries, highlighted opposite characteristics. Finally, the third group is composed of the Eastern European countries' economies. These latter countries, after a common past of planned economies, showed a GDP growth higher than the EU average, and therefore a fast recovery in comparison to the richest economies of North and Central Europe.

The covid-19 pandemic reached Europe in February but rapidly expanded to many European countries, even if with different degrees of severity. The measures activated to front the pandemic and contain contagions were different, as well, among European countries and differed in comparison to those applied in many Asian countries which, being more inspired by the principle of coercion, resulted in a long period of more efficacious than in Europe (Carraro et al., 2020). Despite this, in many European countries, negationist movements and actions of protest against the imposed restrictions diffused rapidly, creating in many cases some obstacles to the efficacious prevention measures adopted almost everywhere (Hazelton, 2021).

The coronavirus pandemic has totally changed the labour market worldwide, as well (ILO, 2020).

The economic effects of the pandemic relate to many factors. Besides the extent to which the pandemic has widespread within each country, a great role is also played by the solidity of the economy, by the capacity of the Institutions to manage the pandemic and mechanisms regulating the labour market (Anderton et al., 2020). In this latter case, the reference is to its degree of flexibility and the diffusion of informal and temporary contracts. The capacity of the pandemic containment is strictly linked also to extra-political factors, such as the demographic composition of the population, the population density, the air pollution, the efficiency of public services such as health or transport services and the cultural predisposition of the population to accept the limitations to freedom (Sharifi and Khavarian-Garmsir, 2020). Indeed, where the mean age of the population is higher, it is reasonable to expect a higher number of deaths, as the coronavirus was a disease that hit more older and fragile people. In addition, where the density of the population is higher, the opportunities of contagions are higher, as the distancing measures are more difficult to apply. The first studies on the virus propagation also demonstrated a strict link between the areas more hit by the pandemic and their level of air pollution (see, for example, Veronesi et al., 2022). Finally, inefficiencies in public transport make the application of the distance measures difficult to apply even if the population density is not high while an efficient health service is the most efficacious instrument to prevent severe forms of disease up to death.

On the other side, the sectoral composition of each country's economy has certainly played a fundamental role. Not all the economic sectors were hit to the same extent by the pandemic (European Parliament, 2021). In 2020, some of them had even had some margins of economic gains. The economic sectors which the pandemic has more hit were, first, the non-essential economic activities which could not have been performed remotely, such as those related to the tourism sector, restaurants, the cultural sector, involving music and entertainment, the transport sector and the sport industry. Other sectors which were also severely hit, even if to a less extent, were the manufacturing sector, other services, such as those linked to the personal care and in general all the not essential activities.

Economic sectors that instead have benefited from the pandemic are, without any doubt, the digital sector, the pharmaceutical sector, freelancing-gig economy and electronic transfers.

3. Data and methodology

3.1 Data

Data for this study come from different sources. Table 1 contains the variables used, their description, and the data sources for a more concise and clear understanding.

Table 1 – Variables, their description and the correspondent data source

Variable name	Description	Source
GDP	Monthly GDP obtained through the Denton-Cholette method, imposing the constraint that the sum of monthly data in each quarter is equal to the quarter value	Eurostat on-line database for quarterly data
YUR	Youth Unemployment Rate, monthly	Eurostat on-line database, monthly data
AUR	Adult Unemployment Rate, monthly	Eurostat on-line database, monthly data
Contagions/Pop	N. of new contagions /county population, monthly	https://ourworldindata.org/coronavirus

Death/Pop	N. of deaths /county population, monthly	https://ourworldindata.org/coronavirus
Stay at home	Synthetic index. The original variable was coded as: 0 - no measures 1 - recommend not leaving house 2 - require not leaving house with exceptions for daily exercise, grocery shopping, and 'essential' trips 3 - require not leaving house with minimal exceptions (eg allowed to leave once a week, or only one person can leave at a time, etc)	https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker (Blavatnik School of Government and University of Oxford)
School closures	Closings of schools and universities (all levels) Synthetic index. The original variable was coded as: 0 - no measures 1 - recommend closing or all schools open with alterations resulting in significant differences compared to non-Covid-19 operations 2 - require closing (only some levels or categories, eg just high school, or just public schools) 3 - require closing all levels	https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker (Blavatnik School of Government and University of Oxford)
Income support	if the government is providing direct cash payments to people who lose their jobs or cannot work. Synthetic index. The original variable was coded as: Level 1: Government is replacing less than 50% of lost salary (or if a flat sum, it is less than 50% median salary) Level 2: Government is replacing 50% or more of lost salary (or if a flat sum, it is greater than 50% median salary)	https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker (Blavatnik School of Government and University of Oxford)
Workplace closing	Closings of workplaces. Synthetic index. The original variable was coded as: 0 - no measures 1 - recommend closing (or recommend work from home) 2 - require closing (or work from home) for some sectors or categories of workers 3 - require closing (or work from home) for all-but-essential workplaces (eg grocery stores, doctors)	https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker (Blavatnik School of Government and University of Oxford)
Contact tracing	Government policy on contact tracing after a positive diagnosis. Synthetic index. The original variable was coded as: 0 - no contact tracing 1 - limited contact tracing; not done for all cases 2 - comprehensive contact tracing; done for all identified cases	https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker (Blavatnik School of Government and University of Oxford)

Indicators from "Our world in data portal" and from "Blavatnik School of Government-University of Oxford" correspond to daily measures and have been aggregated in monthly observations. Some qualitative indicators concerning the containment measures adopted during the pandemic were collected with a daily frequency using an ordinal scale as explained in table 1. For the analysis, they have been transformed into the number of days each of this level of restriction has been pursued.

For each month, the corresponding new variable is calculated as a weighted mean, summing the number of days in the month each particular degree of restriction was in force. We assigned a higher weight to the number of days related to the most severe degree of restriction and a lower weight to the number of days in which the degree of restrictions was lower. For example, for the school-closure the monthly value was calculated as follows:

School_closure= (n. days low restrictions) x 1 + (n. days medium restrictions) x 2+ (n. day high restrictions) x 3

The indicator was then divided by the number of days in the month, in order to have a sound and comparable measure over time of the degree of severity of the restrictions in force, corrected for the different number of the days in a month.

In the following section European countries are compared according to the degree of severity with which the population was hit by the pandemic, measured in terms of the share of population who contracted the disease and the death rate. For the measures of the pandemic containment, we consider, on the one side, those imposed on the population, that is the severity of the stay-at-home imposition and the duration of the school closures. On the other side, as measures to prevent further contagions, we considered the actions taken for the contact tracing. Finally, for a major comprehension of how the Governments tried to help their citizens from an economic perspective, we considered the level of income support adopted.

3.2. Methodology of analysis

The econometric analysis is based on tobit panel models with GLS estimates. In order to respond to the research questions discussed in the introduction, we will analyze the following models:

$$Contagions_{it} = f(stay\text{-}at\text{-}home_{it-1}, school\text{-}closures_{it-1}, contact\text{-}tracing_{it-1}, d_i) \quad (1)$$

$$Income\_support_{it} = f(stay\text{-}at\text{-}home_{it-1}, school\text{-}closures_{it-1}, contact\text{-}tracing_{it-1}, d_i) \quad (2)$$

$$GDP_{it} = f(stay\text{-}at\text{-}home_{it-1}, workplace\text{-}restrictions_{it-1}, contact\text{-}tracing_{it-1}, d_i) \quad (3)$$

where d_i are the specific countries' effects, introduced as dummy variables.

Covariates are considered delayed of one period because it is reasonable to expect that the social distancing restrictions and the contact tracing measures may produce an effect with some delay. The delay on the covariates is also useful to avoid the problem of reverse causality, which is the risk of inverse relationship between each covariate and the dependent variable. This could occur, for example, in the case that one of the containment measures, for example the school closures, is established in response to an increase in the contagions.

For each of the relationships above, we considered two alternative specification models. The first model excludes the dummy variables while the second model includes them. In this latter case, the reference category will be identified in the country that the descriptive statistics indicated as the best or worst performer, to make easier the interpretation of the results. The temporal dimension consists in the 12 months of 2020 and the units are the 31 European countries, for a total of 372 observations. We used random effects, but the results with fixed effect are almost identical. The estimates for equations 1-3 are based on a linear function.

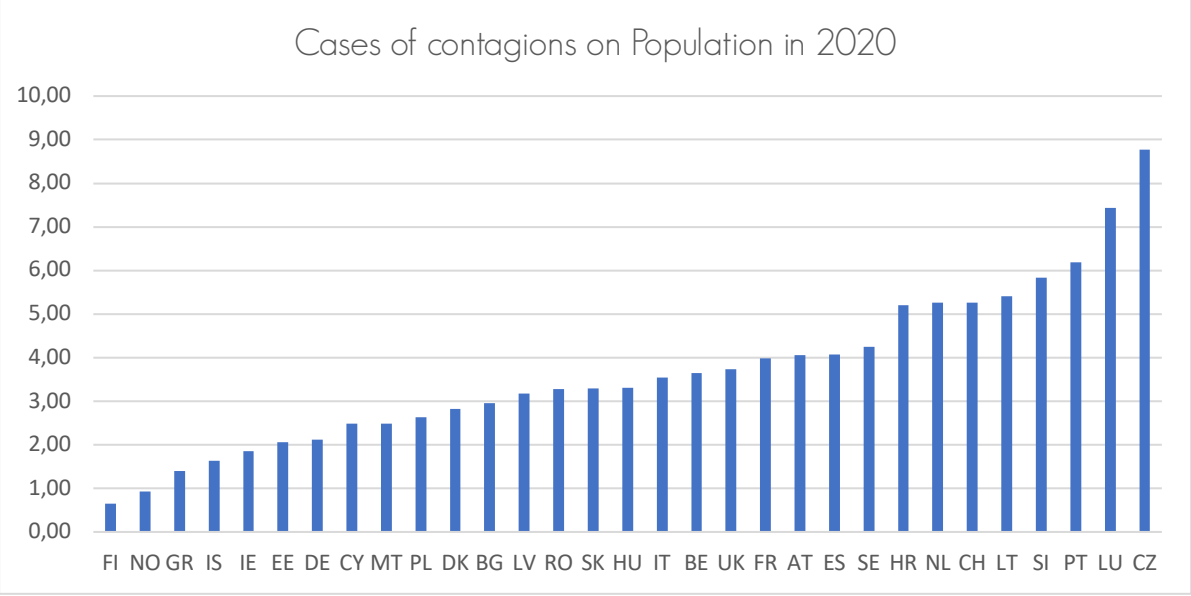
4. Results

4.1. The impact of Covid-19 pandemic on the population: some first descriptive statistics

Considering the EU-27 countries more Norway, Iceland, Switzerland, and the UK, they globally accounted for a population of 453,090,377 individuals. During 2020, about 18 millions of them contracted the COVID-19 with a general rate of the contagions of 4% and a mortality of 0.10% on the total population, which reaches 2.36% if at the denominator we consider the number of contagions.

Considering the population dimension, countries with the highest shares of the population who contracted the COVID-19 were the Czech Republic, 8.77%, Luxembourg, 7.43%, and Portugal, with 6.18%. Conversely, countries which have been less hit are, in the order, Finland, Norway, Greece and Iceland, with percentages lower than 1.7% (Figure 1).

Figure 1 – Share of contagions by Covid-19 pandemic on total population



Source: Authors' own elaborations on Eurostat and Ourworldindata data.

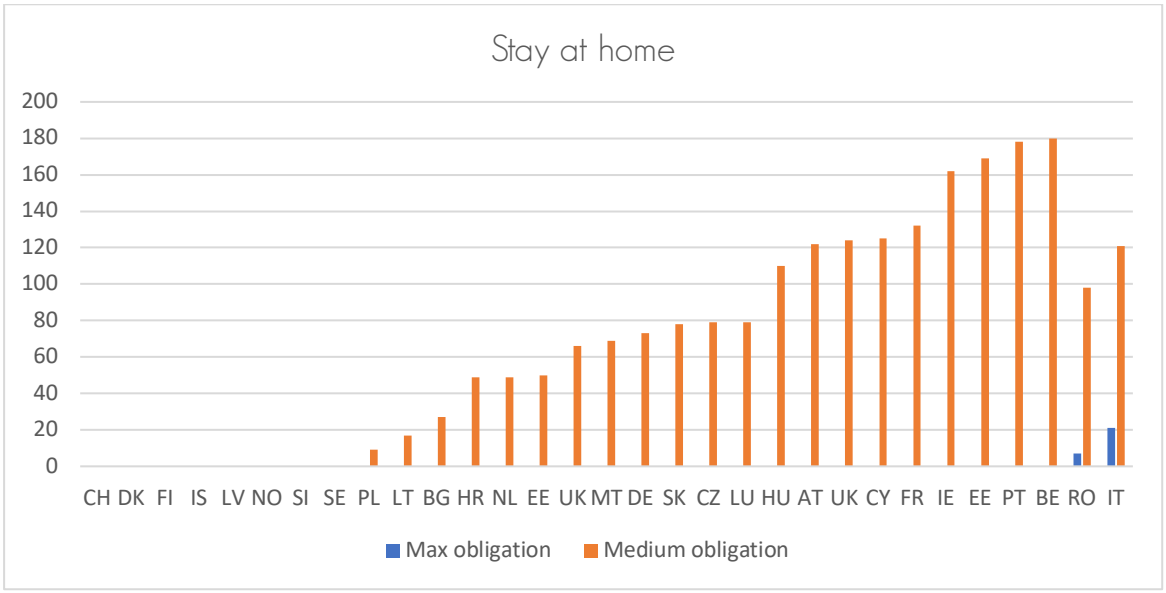
However, when we look at the share of deaths on the number of the individuals who contracted the virus, the highest rates concern Bulgaria, with 3.85%, Greece, 3.70%, and Italy, 3.53%. Conversely, Iceland, Cyprus, Denmark, Estonia, and Norway highlight a morality rate for the Covid pandemic lower than 1%.

At country level, the response to the pandemic has not been the same in the various European countries. Analysing the data from the Oxford Covid-19 Government response tracker, we can observe the restriction measures adopted in each country. Looking at the "*stay-at-home*" obligation,

the higher restrictions were imposed in Italy and Romania, where for a longer period (about 2 months for Italy and almost a month in Romania) populations were obliged to not leave their home with minimal exceptions. Other countries, mainly Belgium, Portugal, Estonia, Ireland, and Portugal imposed for a longer period not leaving home with exceptions for daily exercise, grocery shopping, and 'essential' trips. Conversely, Switzerland and the Nordic countries imposed less restrictions for almost the whole period.

Figure 2 shows the number of days in 2020 that each country spent with a moderate and a severe degree of restrictions as described above.

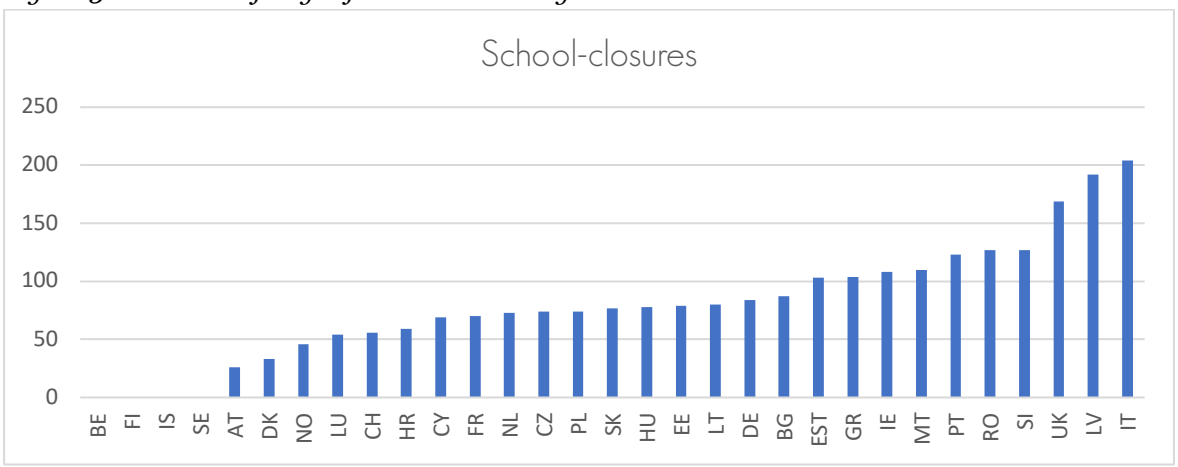
Figure 2 – Stay at home restrictions by degree of severity



Source: Authors' own elaborations on Blavatnik School of Government and University of Oxford data.

Italy shows a primate even for the stronger adoption of the *school closures* measure, with a distance learning activity which involved all levels of schools for a longer period, followed by Latvia, Romania, Bulgaria, Cyprus, Spain, and the UK. Conversely, school restrictions were never imposed in Belgium, Finland, Sweden, and Iceland and were minimal (less than 50 days) in Austria, Denmark, and Norway (Figure 3). Very similar the country distribution according to the restrictions concerning the workplace closures.

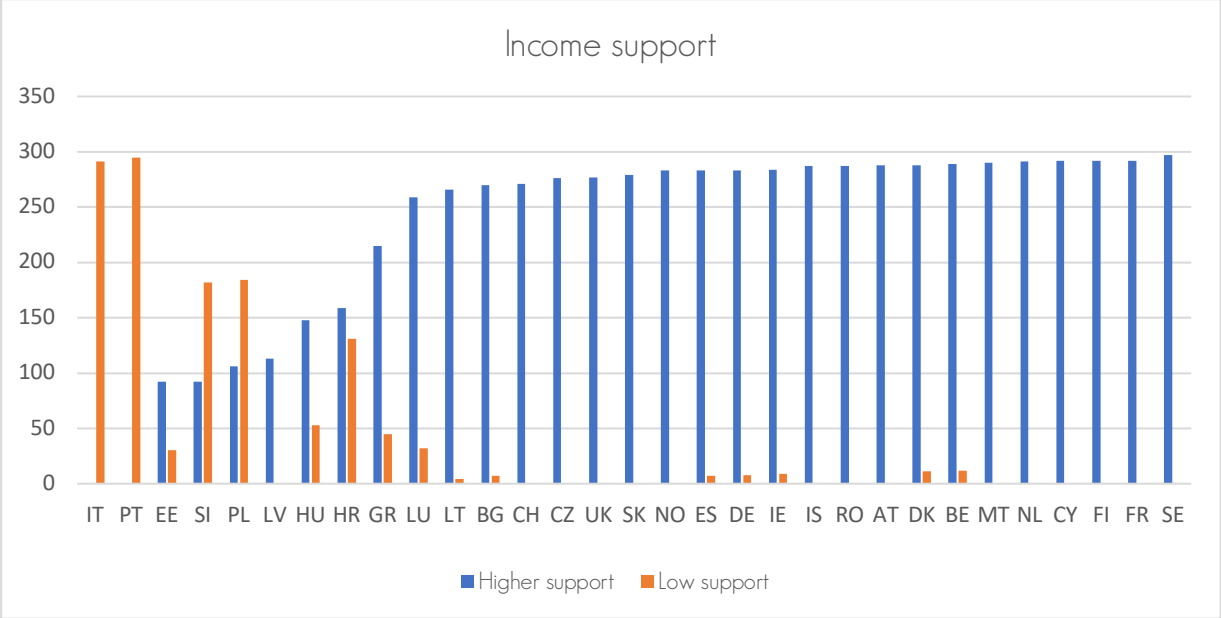
Figure 3 – Number of days of distance learning



Source: Authors' own elaborations on Blavatnik School of Government and University of Oxford data.

However, the differences in the restrictions imposed do not seem directly connected, as one may expect, with those on the *income supports* provided to the segments of the population more economically hit by the pandemic. Indeed, if we look at the countries that gave an income support less than 50% of the salary that was lost, they are even those who imposed the highest restrictions, namely Estonia, Italy, Latvia, Poland, Portugal, and Slovenia (Figure 4).

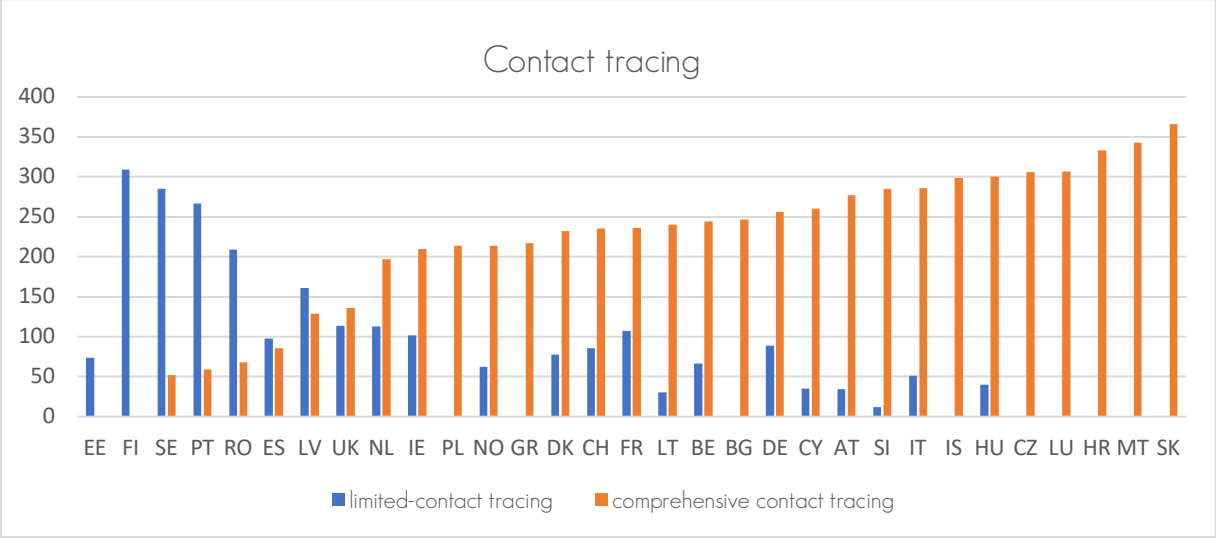
Figure 4 – Income support measures provided by level of support



Source: Authors' own elaborations on Blavatnik School of Government and University of Oxford data.

With reference to the *contact tracing* activity (Figure 5), it was very developed in Slovakia, Malta, Croatia, and Luxembourg, while it was minimum in Estonia and Finland, where for a limited number of days only a limited system of contact tracing has been in force. Luxembourg and Malta, with Denmark and Cyprus result even the countries that implemented the highest number of tests on the population.

Figure 5 – Contact tracing activities developed by level of coverage



Source: Authors' own elaborations on Blavatnik School of Government and University of Oxford data.

For a major comprehension of the connections among these different indicators related to the pandemic, it is useful to analyze the bivariate correlations among these indicators. Table 2 shows these correlations and highlights a positive relationship, even if low, between the "stay at home" and "school closures" restriction measures (0.2). Conversely, the income support measures indicator shows an inverse correlation with the school closure restriction (-0.5363) and an almost inexistent relationship with the stay-at-home imposition (-0.0609). In other words, looking at the bivariate correlation analysis, it seems that countries that imposed a higher level of restriction measures, rather than enlarging higher amounts of benefits, were even countries that gave lower income supports to the population. Before moving to the econometric analysis, to verify if this outcome persists even when we control for other relevant and connected factors, we report the results of a cluster analysis grouping countries on the basis of these variables.

Table 2 – Correlation matrix

	School closures	**Stay at home**	**Contact tracing**	**Income support**	**Contagions**	
School closures	1					
Stay at home	0.200	1				
Contact tracing	-0.0441	0.0278	1			
Income support	-0.5363***	-0.0609	0.1173	1		
n. of contagions	0.0929	0.1020	0.2177	-0.1391	1	

*Note: *** significant at 0.01; ** significant at 0.05; * significant at 0.01*

Through a k-means cluster analysis, we identify four homogeneous groups of countries according to the virus containment measures, the income supports and the levels of contagions analysed (Table 3). Estonia, Italy, Latvia, Poland, and Portugal show all high levels of restriction measures and low levels of income supports while the majority of the Nordic countries, more Bulgaria, and Switzerland show very low restrictions, low contagions and high levels of income support.

Table 3 – Homogeneous groups of countries as resulting from a k-mean clustering based on the variables indicated

	Countries	**School restrictions**	**Stay at home**	**Income support**	**Contagions**	**Contact tracing**
Group 1	*BG,CH,DK,FI,IS,LT,NL,NO,SE*	Low	No	high	Low	On av.
Group 2	*EE,IT,LV,PL,PT*	High	High	low	On av.	On av.
Group 3	*CZ,HR,HU,LU,MT,SI,SK*	on average	On av.	high	High	High
Group 4	*AT,BE,CY,DE,ES,FR,GR,IE,RO,UK*	on average	On av.	high	Low	Low

4.2. The econometric models

Through the econometric models, we want to verify the effects of the containment measures on: 1) the contagions and the deaths (table 4); 2) the income supports given (table 5); 3) the GDP (table 6). At this aim, it is important to move to multivariate analysis. The main difference in comparison to the previous descriptive and simpler analysis consists in the fact that, in this case, we analyse the effect of each measure controlling for all the other aspects that could affect the final results.

Table 4 reports in the first two columns the regression models where the dependent variable is the ratio between the new cases of contagions and the population while in the last two columns the dependent variable is the ratio between the number of the new deaths due to the COVID-19 and the total population.

Considering two different dependent variables is important to have a wider view on this complex phenomenon. Indeed, the first one could be affected by the capacity of each state to detect the cases of pandemic. The second one should be a more precise measure, as it is based on the effective deaths, but even in this case it may be affected by the different ways each state identify with the COVID-19 the mean cause of the deaths (we refer to the known debate about who died *with* or *for* COVID-19). For each of these dependent variables, we estimated two different models' specifications. Model 1 limits to include the covariates referred to the containment measures while in model 2 we control even for the different countries' effects introducing a dummy variable for each country and considering as reference country the Czech Republic because the previous descriptive analysis identified it as the most hit country by the pandemic. The containment measures are introduced in the model with a delay of one period (one month), to account for the fact that their effect on the contagions or even on the deaths is necessarily delayed (table 4). The models estimated are tobit specifications for time series data, to account for the limited range of the dependent variable, that, being a percentage, ranges from 0 to 100. The first specification contains the variables: school closure, stay at home and contact tracing measures. We did not introduce the workplace closures because it showed a correlation of 0.7 with school closures. We preferred to include school closure rather than workplace closing because schools represent in our opinion a vehicle of contagion greater than offices.

With reference to the model where the dependent variable is the new cases on the population, it shows that school-closure is the only measure with an effective significant capacity to reduce the contagions. The corresponding coefficient is indeed negative and significant at the 1%. It is evident that in the majority of the countries the system of contact tracing failed, probably because with the increases of the contagions it was very difficult to manage and because of the high number of individuals who were asymptomatic and, therefore, very difficult to detect. The coefficients for the dummies measuring the country effects are all negative and significant, with the exception of dummies for Bulgaria, Estonia, UK, Luxembourg, Lithuania, Latvia, Poland, Portugal, Romania, Slovenia, and Sweden. All these countries are indeed the most hit by the pandemic in terms of the rate of the population who contracted the disease.

When we consider as dependent variable the new deaths on the population, school-closure loses its statistical significance while the other two measures, that is the stay-at-home imposition and contact tracing, are significant and positive, indicating a direct relationship, that should indicate a higher rate of deaths in countries with more attention to prevent and monitor the pandemic. Effectively, further information not available at the moment could help to understand the causes of this apparent paradox; for example, the average age of the population and the rules adopted to identify the deaths due to the COVID-19.

Table 4 – Effects of the measures for the contagion containment on the share of infections and of deaths in the population. Reference category: the Czech Republic

Covariates	New cases on the population		(New deaths on the population)*100	
	Model 1	Model 2	Model 3	Model 4
School closure $_{t-1}$	-0.005***	-0.006***	-0.002	-0.003
Stay at home $_{t-1}$	0.007	0.007	0.007**	0.008*
Contact tracing $_{t-1}$	0.007	0.008	0.007***	0.009***
AT		-0.470**		-0.697
BE		-0.546***		-0.932**
BG		-0.343		-0.077
CH		-0.382*		-0.493
CY		-0.601***		-1.230***
CZ		-		-
DE		-0.565***		-0.899**
DK		-0.565***		-1.110***
ES		-0.374*		-0.301
EE		-0.281		-0.748
FI		-0.555***		-0.961**
FR		-0.432*		-0.411
GB		-0.316		-0.183
GR		-0.644***		-0.806*
HR		-0.372*		-0.465
HU		-0.573***		-0.516
IE		-0.597***		-0.882**
IS		-0.609***		-1.140***
IT		-0.448**		-0.195
LT		-0.245		-0.599
LU		-0.252		-0.683
LV		-0.285		-0.591
MT		-0.599***		-0.938**
NL		-0.387*		-0.670
NO		-0.577***		-1.055**
PL		-0.330		-0.646
PT		-0.178		-0.332
RO		-0.281		-0.368
SK		-0.532**		-1.015**
SI		-0.172		-0.020
SE		-0.349		-0.429
Constant	0.130**	0.531***	0.214	0.870**
R^2within	0.109	0.110	0.039	0.041
Sigma_u	2.13e-17	3.44e-19	0.076	0
Sigma_e	0.535***	0.512***	1.075	1.075
N	341	341	341	341

*Note: *** significant at 0.01; ** significant at 0.05; * significant at 0.1*

The second relationship analyses the dependence of the levels of income support from the stay-at-home imposition, the workplace closing and the system of contact tracing (table 5). All these factors are significantly and positively related to the levels of income supports provided. Therefore, while the bivariate analysis of the correlation suggested an inverse relationship between the levels of income support on the one side and the school closure and the stay-at-home imposition on the other side, the multivariate analysis suggests the presence of a positive relationship. In other words, when we control simultaneously for the workplace closure and the stay-at-home imposition and consider even the contact tracing system, we can say that the amounts of income support provided were proportional to the containment measures adopted.

In model 2, the reference category is Estonia, because it provided the minimum level, on average, of income supports to the population. Results for model 2 show that, in comparison to Estonia, the weakest economies of Italy, Latvia, Hungary, and Portugal provided a significant lower level of income support, even controlling for the containment measures adopted.

Table 5 – Income supports provided in relation to the measures for the contagion containment. Reference category: Estonia because it is the country who gave the lowest income supports

Income support	**Model 1**	**Model 2**
Workplace closure $_{t-1}$	0.245***	0.259***
Stay at home $_{t-1}$	0.110*	0.107*
Contact tracing $_{t-1}$	0.408***	0.410***
AT		11.060*
BE		8.977
BG		16.837***
CH		8.454
CY		13.540*
CZ		9.325
DE		9.824
DK		12.774**
ES		12.540**
EE		-
FI		25.519***
FR		9.744
GB		13.015**
GR		14.037**
HR		-1.611
HU		-11.585**
IE		8.853
IS		16.239***
IT		-21.716***
LT		10.737*
LU		9.643
LV		-16.218***
MT		14.012**
NL		9.150
NO		19.195***
PL		1.885
PT		-12.500**
RO		20.155***
SK		8.205
SI		-5.384
SE		23.340***
Constant	16.970***	8.752**
R^2within	0.495	0.495
R^2 between	0.027	1.000
R^2 overall	0.366	0.604
N	341	341

*Note: *** significant at 0.01; ** significant at 0.05; * significant at 0.1*

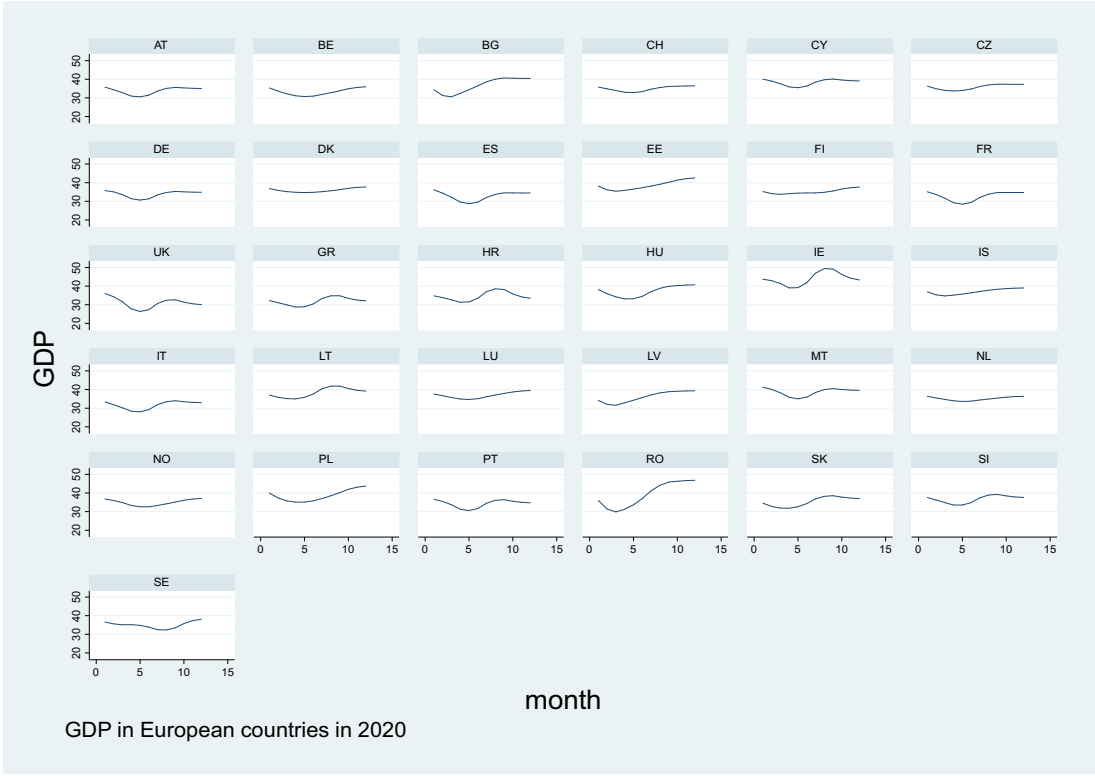
4.3 The impact of the Covid-19 pandemic on GDP

When the Covid-19 pandemic widespread, the majority of the Governments promptly reacted, interrupting the majority of productive activities. This break favoured a rapid contraction of GDP almost everywhere. Even if not all European countries were hit by the pandemic at the same extent,

the economic repercussions in terms of GDP contraction first and job losses second, interested all countries, even if with a different degree of severity (Figure 6). In many countries, GDP registered a sharp contraction during the Spring of 2020 and a rapid recovery during the Summer. The positive trend in the second part of the Summer is certainly linked to the reduction of contagions and to the recovery boosted by the touristic sector that, especially for Mediterranean countries, gave a breath of oxygen to the respective economies. Indeed, it was the case especially of Cyprus, Spain, France, Greece, Croatia, Italy, Malta, and Portugal.

However, in the Autumn, the second wave of the pandemic provoked a new decrease in the GDP almost everywhere. The only countries where GDP did not suffer a further decrease in the Autumn were: Luxembourg, Belgium, Switzerland, Denmark, Sweden, Finland, Norway, Iceland, Estonia, the Netherlands, Romania, Poland, Latvia, and Hungary.

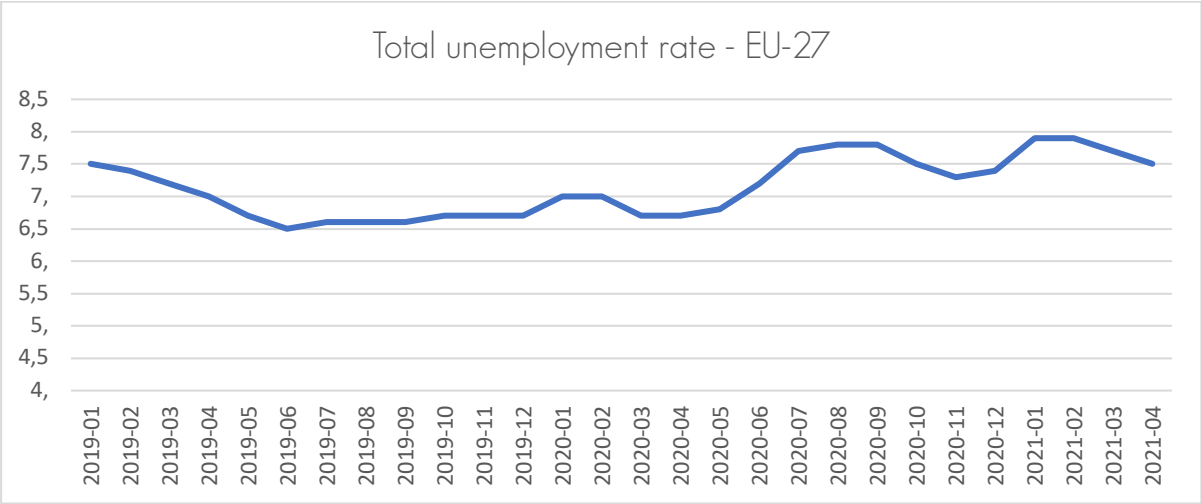
Figure 6 – Monthly GDP during the year 2020 in the European countries analysed



The rapid downturn in the GDP caused an increase in the unemployment rates. Figure 7 shows the variations in the unemployment rates at EU-27 level from the beginning of 2019 until the first months of 2021. The unemployment rate suffered a consistent increase in the Spring of 2020 and after a slightly decreasing trend in the Autumn, restarted to increase at the beginning of 2021.

The delay with which it reacted to the GDP variations is also due to the fact that in many countries Governments, besides providing supports to enterprises, blocked any dismissals. However, it was only a temporaneous measure and many enterprises, at the end of the period, started to dismiss employees or definitively interrupted their activities.

Figure 7 – Total unemployment rate for the EU-27 countries over time



Comparing the variations in the unemployment rates by country from the end of 2019 to the end of 2020, the majority of the countries registered an increase, which reached the 2.5% in Iceland, Lithuania, and Estonia. Conversely, in the Mediterranean countries of Greece, France, Italy, and Portugal, even registering in the same period higher contractions in the GDP, the unemployment rates did not increase (Figure 8).

Figure 8 – Variations in the unemployment rates calculated as the difference between the value in December 2020 and the value in December 2019

Table 6 shows the results of the regression of the GDP on the workplace closure, the stay at home imposition and the contact tracing system. As expected, the containment measures in terms of workplace closures and stay at home imposition had a significant effect in reducing the GDP growth. Conversely, the contact tracing, being connected to the reduction of contagions, significantly increased GDP.

When the country-fixed effects are introduced in the model (Model 2), the cross-country differences already highlighted in the descriptive section emerge more clearly. In comparison to the UK, that is the country registering the higher loss in GDP, only the dummy for Italy presents a not

significant coefficient, denoting that it does not significantly differ from the UK. The other countries show all better performances in GDP. Looking at the other countries, the Eastern countries, especially Romania and Bulgaria appear as the best performers.

Table 6 – Effects on the GDP of the measures for the contagion containment. Reference category: UK

GDP	**Model 1**	**Model 2**
Workplace restrictions t-1	-0.0120***	-0.020*
Stay at home t-1	-0.0245***	-0.025**
Contact tracing t-1	0.063***	0.064***
AT		1.937***
BE		1.939***
BG		5.359***
CH		3.265***
CY		6.970***
CZ		3.874***
DE		1.847***
DK		4.489***
ES		2.228***
EE		8.920***
FI		4.539***
FR		1.032***
UK		-
GR		1.128***
HR		2.319***
HU		5.025***
IE		13.114***
IS		4.629***
IT		-0.017
LT		6.953***
LU		5.108***
LV		5.332***
MT		5.832***
NL		3.986***
NO		3.056***
PL		7.500***
PT		3.899***
RO		9.329***
SK		2.599***
SI		4.475***
SE		4.065***
Constant	33.992***	29.595***
R^2within	0.2727	0.4947
R^2 between	0.0010	1.000
R^2 overall	0.0988	0.6041
N	341	341

*Note: *** significant at 0.01; ** significant at 0.05; * significant at 0.1*

5. Conclusions

The COVID-19 pandemic caused an unprecedented health, economic, and social crisis, acting both on the supply and on the demand side. Across EU countries, the impact of the disease on the population was not the same and a significant different impact can be observed even on each country's economy.

The sudden break of all the activities that occurred in the Spring of 2020 provoked a stop in economic growth almost everywhere. However, in the Summer 2020, due to the contagions reduction, many economies resumed their economic growth, but in the Autumn of the same year, a new wave of the pandemic hit almost all the EU countries, determining a new stop in many productive activities.

In this paper, through the analysis of the data on the contagions, the adopted containment measures and income supports, we tried to ask to the following questions: 1) Had the containment measures effectively reduced the contagions? 2) Was the adoption of income support measures proportional to the degree of the containment measures adopted? 3) Was the level of the income supports related to the GDP recovery?

It is not easy to give an answer to these questions. Our analysis, based on a panel model with delayed covariates to account for and correct for the possible reverse causality, may be considered as an empirical investigation to describe the main differences across countries.

Results highlight the school-closure imposition as the most efficacious measure of contagions reduction. Conversely, the closure of the offices and the contact tracing did not showed the same effectiveness.

As for the income support measures, despite the bivariate analysis in par. 4.1 showed an inverse correlation with the containment measures, when we move to the multivariate analysis, that is controlling for other covariates, the relationship with the containment measures demonstrates to be inverse, as expected. In other words, the income support measures were higher where more containment measures were adopted.

Finally, the third model shows that GDP growth was significantly and positively related to the contact tracing measures and inversely related to the stay-at-home imposition and the workplace closures. In other words, where the contact tracing was activated, this prevented high GDP losses while the closures of the offices and the imposition to remain at home had as an effect a significant reduction in economic growth, as all the activities were suspended.

Synthesizing, we can conclude that the containment measures adopted, even if had a negative impact on GDP, demonstrated the capacity to reduce the contagions. The economic losses, in general, were even compensated by income supports which appear to be directly proportional to the closure impositions.

In conclusion, we can say that the COVID-19 pandemic was an event for which we were totally unprepared. The recovery by this crisis seems to be almost complete and the world is learning to live with the various cyclical pandemics. However, it is essential, after this experience, that some prevention measures be considered, to avoid that in the future other pandemics could produce similar fatal consequences in terms of deaths, infections and economic losses.

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