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Economic Effects of the COVID-19 Pandemic – Evidence from Panel Data in the EU

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Evidence from Panel Data in the EU

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Abstract

The study evaluates the effects that the COVID-19 pandemic and the restrictions imposed to prevent its spread have on the economy. The study estimates a fixed effects model with different specifications for a total of 17 EU countries for which comparable data is available. The impact of the pandemic on the economy has been measured with both a general economic confidence indicator and a separate service sector confidence indicator. The severity of the epidemic has been measured by the demand for hospital care. In addition, the models include key variables that have been used to measure people's mobility, the number and type of restrictions imposed, and economic support measures. The main result of the study is that the increase in the need for hospital care by an average of 10 persons per month (per 1 million inhabitants) will reduce the general economic confidence indicator by about 0.21 points. In addition, the restrictions and mobility are found to have a significant effect on economic activity in some model specifications. The estimated model parameters may, subject to certain reservations, be used to assess cyclical trends in the economy when an evaluation of the macroeconomic impact of epidemic-related scenarios is required for decision-making.

Keywords COVID-19, discussions paper, business cycle fluctuations, economic crises, economic impacts, economic models

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COVID-19-pandemian taloudelliset vaikutukset

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Kieli	Englanti	**Sivumäärä**	29

Tiivistelmä

Tutkimuksessa arvioidaan COVID-19-pandemian ja sen leviämisen estämiseksi asetettujen rajoitustoimien vaikutuksia talouteen. Tutkimuksessa on estimoitu kiinteiden vaikutusten (fixed effects) malli eri spesifikaatioilla yhteensä 17 EU-maalle, joille on ollut saatavilla vertailukelpoista aineistoa. Pandemian vaikutuksia talouteen on mitattu sekä talouden yleisellä että palvelusektorin erillisellä luottamusmittarilla. Epidemiatilanteen vakavuutta on arvioitu sairaalahoidon tarpeen avulla. Näiden lisäksi mallit sisältävät sellaisia keskeisiä muuttujia, joiden avulla on mitattu ihmisten liikkuvuutta, toimenpantujen rajoitustoimien määrää ja laatua sekä talouden tukitoimia. Tutkimuksen päätulos on, että sairaalahoidon tarpeen lisääntyminen keskimäärin kymmenellä hengellä kuukaudessa (miljoonaa asukasta kohden) heikentää talouden yleistä luottamusindeksiä noin 0,21 pistettä. Lisäksi rajoitustoimilla ja liikkuvuudella havaitaan eräissä mallispesifikaatioissa olevan merkitsevä vaikutus taloudelliseen aktiviteettiin. Tutkimuksessa estimoituja joustoja voidaan tietyin varauksin käyttää talouden suhdannekehityksen arvioimisessa silloin, kun päätöksentekoa varten tarvitaan arviota epidemiaan liittyvien skenaarioiden makrotaloudellisesta vaikutuksista.

Asiasanat COVID-19 , keskustelualoitteet, suhdannevaihtelut, taloudelliset kriisit, taloudelliset vaikutukset, taloudelliset mallit

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COVID-19-pandemins ekonomiska konsekvenser

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Referat

I undersökningen bedöms vilka konsekvenser COVID-19-epidemin och de restriktioner som införts för att förhindra spridning av viruset har för ekonomin. I undersökningen har man estimerat en modell med fasta effekter (fixed effects) med olika specifikationer för sammanlagt 17 olika EU-länder för vilka det finns jämförbar information tillgänglig. Pandemins konsekvenser har undersökts med hjälp av en allmän ekonomisk förtroendemätare och en separat förtroendemätare för servicesektorn. Bedömningen av hur allvarligt epidemiläget är har gjorts utifrån behovet av sjukhusvård. Dessutom innehåller modellerna viktiga variabler med vars hjälp man har undersökt människors rörlighet, antalet införda restriktioner och deras art samt ekonomiska stödåtgärder. Undersökningens viktigaste resultat är att ett ökat behov av sjukhusvård på i genomsnitt tio personer i månaden (per en miljon invånare) försvagar ekonomins allmänna förtroendeindex med cirka 0,21 poäng. Vissa modellspecifikationer visar dessutom att restriktioner och rörlighet har en signifikant inverkan på den ekonomiska aktiviteten. Den parametrar som estimerats i undersökningen kan med vissa reservationer användas till att bedöma konjunkturutvecklingen när det behövs en bedömning av vilka makroekonomiska konsekvenser olika scenarion knutna till epidemin har för att beslutsfattarna ska kunna fatta beslut.

Nyckelord COVID-19, debattinitiativ, konjunkturväxlingar, ekonomiska kriser, ekonomiska konsekvenser, ekonomiska modeller

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TO THE READER

The original manuscript has been previously published in Finnish in December 2020 under the title "COVID-19-pandemian taloudelliset vaikutukset".

Olli Palmén

February 2021

1 Introduction[1]

The COVID-19 pandemic has been a simultaneous economic and health crisis of unprecedented magnitude. Even though containing the disease has been the top priority, the restrictions imposed by governments to prevent its spread have led to a sharp economic downturn. So far, the restrictions and the fact that people have voluntarily reduced mobility have had an impact on the demand for services and tourism. However, as the pandemic continues, the economic effects may also spread to other sectors, as growing unemployment and uncertain outlook weaken aggregate demand or growing financial risks lead to a reduction in credit supply (Gourinchas, 2020).

Because of the unprecedented nature of the crisis, it is extremely difficult to predict the effects of the spread of the disease and the measures introduced to contain it. The purpose of this study is to examine the economic effects of the COVID-19 pandemic and the restrictions imposed by governments. A further aim of the study is that the results of empirical models can be used together with epidemiological forecasts in the drafting of the scenarios describing the economic impact of the epidemic.

Economic effects of the COVID-19 pandemic have received considerable attention recently. The economic effects have been studied empirically by using country-specific data on the level of economic activity and mobility (Chen, Igan, Pierri, & Presbitero, 2020) and individual-level data (Chetty, Friedman, Hendren, & Stepner, 2020). The economic effects of the pandemic have also been studied using time series methods (Primiceri & Tambalotti, 2020; Ludvigson, Ma, & Ng, 2020).

This study presents the results of the estimations on the economic effects of the COVID-19 pandemic. The economic impacts of the pandemic have been measured using two different variables. The level of economic activity is measured separately by a general economic confidence indicator and a service sector confidence indicator. The intensity of the epidemic has been estimated by the need for hospital care. The model also contains several key variables, which measure citizens' mobility, the extent and type of the restrictions and economic support measures.

1 I would like to thank my colleagues in the Ministry of Finance for useful comments in preparation of the manuscript. I would also like to thank Ari Hyytinen, Jaakko Nelimarkka, Juho Nyholm and Harri Pönkä for useful comments on the first draft.

The indicators describing the level of economic activity are included because monthly data on them is available for many EU countries and because previous studies have shown that these indicators closely follow the GDP, figures for which are published on a quarterly basis. Variables describing the epidemic that can reliably and in a uniform manner measure changes in the epidemiological situation over time are used as independent variables in the empirical models. A number of other indicators that take into account the effects of the restrictions and support measures and changes in citizens' behaviour are also used as independent variables.

In the empirical part of the study, one-way and two-way fixed effects models have been estimated for both response variables using a range of different model specifications. The model has been estimated for the period 2020:M3-2020:M10 using monthly data for 17 EU countries for which comparable data is available.

The main conclusion of the study is that an increase in the number of patients receiving hospital care by an average of ten persons/month (per million inhabitants) weakens the general economic confidence indicator by about 0.21 points. In Finland, this would mean that an average of about 55 additional persons would require hospital care during a period of one month and that this increase would cause the confidence indicator to fall by about 0.21 points. When compared with the normal monthly variation of the confidence indicator in Finland (about 1.6 points in the period 2017-2019), the figure appears quite small.[2] However, the figure only describes the impact of hospital care, whereas economic confidence is also affected by voluntary and government-imposed mobility restrictions and support measures, which depend on the epidemic situation.[3]

The second major finding is that the increase in the need for hospital care by an average of ten persons each month (per million inhabitants) would weaken service sector confidence by between 0.15 and 0.27 points, depending on the model specification. The impact of the epidemic on service sector confidence is slightly higher that its impact on overall confidence. This is in line with the general view that the service sector has been hardest hit by the epidemic and the measures taken to contain it. However, the average monthly

2 If the epidemic situation worsens and an average of about 550 additional persons (100 persons per million inhabitants) would require hospital care during any given month, the confidence indicator would fall by as much as 2.1 points, or significantly more than expected. In spring, the COVID-19 situation was worse than this in such countries as Belgium, France and Italy and thus, the epidemic in Finland could, at least theoretically, reach the level described above.

3 To be precise, the data and the selected method do not allow causal inference. However, the link can be interpreted as causal impact if a) the selected response variable (confidence indicator) cannot cause any need for hospital treatment of COVID-19 patients and that b) there is no third variable missing from the model that would lead to changes in both variables and thus result in an erroneous conclusion that there is link between the confidence indicator and the need for hospital care. The prerequisites described above are likely to be met.

variation of the service sector confidence indicator is about 2.9 points and thus, in relation to the ordinary variation of the indicator, effects of the epidemic have been moderate.

The parameter estimates of the model specifications may, in certain situations, be used in the estimates of GDP growth when decision-makers need estimates of the macroeconomic impacts of the epidemic-related scenarios.

2 Description of data

This study uses comparable data on EU countries to measure the impacts of citizens' behaviour, the development of the COVID-19 pandemic and restrictions and economic support measures on the level of economic activity.

The Economic Sentiment Indicator (ESI) and the Services Confidence Indicator (SCI) of the European Commission have been used as indicators of the level of economic activity. ESI is a weighted average of business and consumer confidence indicators and it is aimed to follow the GDP. SCI provides a more detailed description of cyclical development in the service sector. Modelling the SCI is useful because the COVID-19 pandemic has significantly affected the demand for services, compared with other sectors. This study uses confidence indicators because they measure cyclical trends at more frequent intervals than measures of the GDP. The main reason for using the ESI is that it describes the level of economic activity at more frequent intervals than quarterly national accounts and it includes all economic activities. Moreover, confidence indicators are available for all EU countries and the country-specific figures are comparable with each other.

The monthly average of daily patients receiving hospital care reported by individual countries has been used as the indicator describing the spread and intensity of the epidemic (Roser, Ritchie, Ortiz-Ospina, & Hasell, 2020). The reported number of patients receiving hospital care (hereafter 'need for hospital care') has been used instead of other indicators describing the spread of the epidemic, such as identified cases of infections because the need for hospital care does not depend on the level of testing.[4] The reported number of deaths has also been used as the optional measure for the spread of the disease.[5]

The impact of the pandemic on citizens' behaviour is described using the Google Community Mobility Index. (Google LLC, 2020) The index is based on data on daily

4 The indicator of identified infections contains a substantial measurement error because there have been differences in access to tests between countries and over time. However, the assumption is that the measurement error concerning the need for hospital care has been lower even though during the worst phases of the epidemic, hospital capacity has been insufficient, especially for the treatment of the most serious cases. The need for hospital care is also connected with morbidity in different age groups and advances in treatment, which have not been considered in this study.

5 These results are available on request.

movements near grocery stores and leisure-time locations collected using geographic information. The percentage change in the number of visitors or the amount of time spent in a specific location in relation to the baseline value is used as the daily index value. The median value calculated in the period between 3 January and 6 February 2020 is used as the baseline value for each day of the week. The study uses an index that describes changes in the number of visits to grocery stores and leisure-time locations because the assumption is that self-imposed isolation substantially affects the consumption of services. As the index is based on mobility relative to the baseline value, no consideration is given to the seasonal variation in mobility and no comparisons can be made with previous years. The monthly average of the mobility index is used.

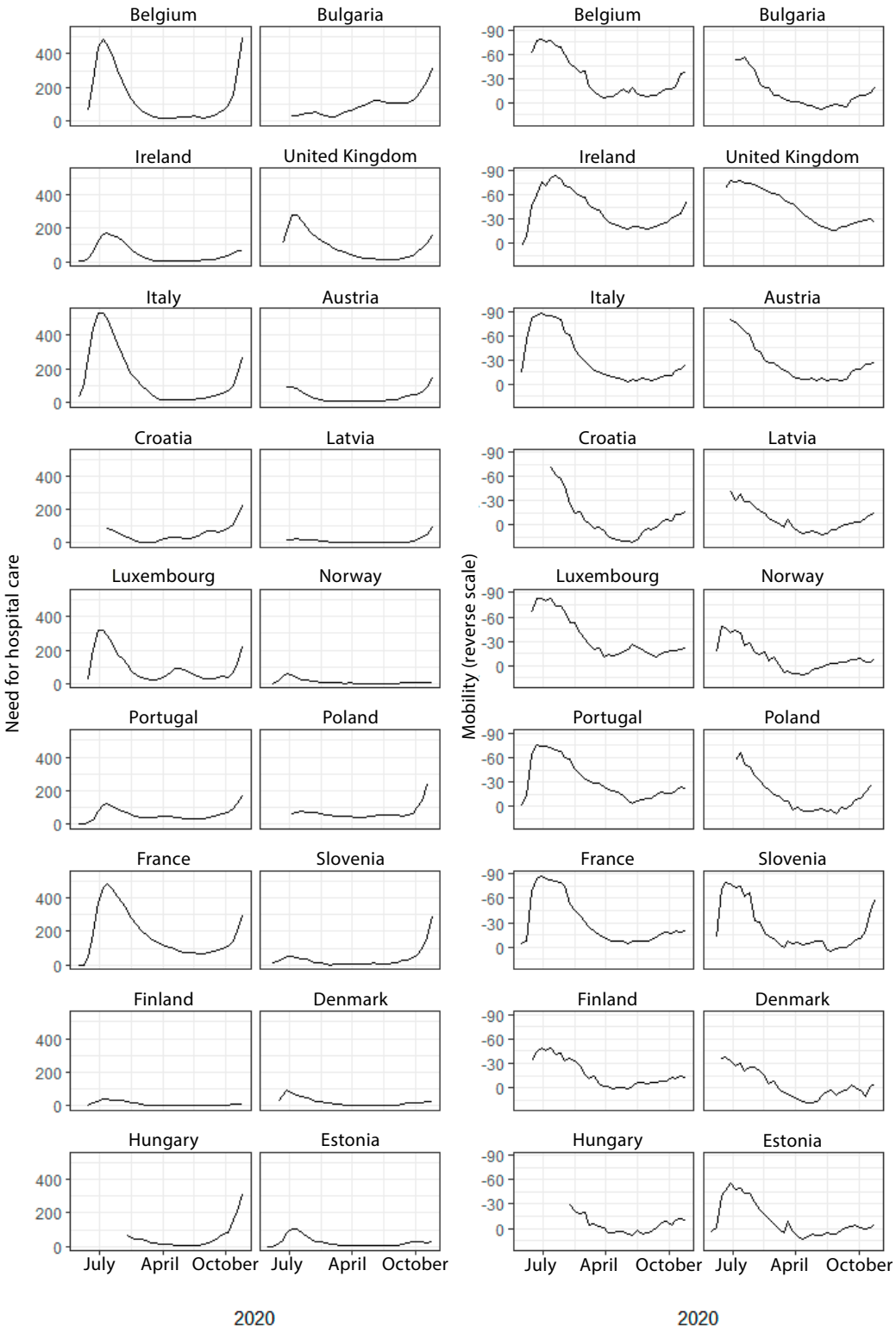
The indicators developed by the University of Oxford are used to describe the country-specific restrictions and support measures introduced to contain the pandemic (Hale, Webster, Petherick, Phillips, & Kira, 2020). The monthly averages of the indicators are used. The extent of the restrictions has been described using the Containment and Health Index (CHI), which is based on the average of 12 variables describing restrictions and public health measures. The variables describing the restrictions include the closure of schools and workplaces or mobility-related restrictions, whereas the public health measures include public announcements, face mask recommendations and testing criteria. The Economic Support Index (SI) describes economic support measures, such as improvements in income security or debt relief, introduced in different countries. However, differences in social or income security between countries (automatic stabilisers) are not considered in the indicator and thus, it may underestimate the extent of the support measures in Finland, where the social security system is broader than most EU countries.

3 COVID-19 pandemic in European countries

The COVID-19 disease started to spread in Europe in early 2020 and, in many European countries, the first wave peaked in April. After spring, the epidemic abated in many countries, but the number of cases again started to increase after the summer. The spread and abatement of the disease have occurred more or less simultaneously in all European countries but there are significant cross-country differences in the incidence of COVID-19.

Figure 1 (a) shows the number of patients receiving hospital care relative to population (in millions) in different European countries. In many European countries, COVID-19 incidence reached in its peak in March and April and since then the number of hospitalised patients has gradually declined as restrictions have been introduced. In spring 2020, Belgium, France, Ireland, Italy, Luxembourg and Portugal had the largest number of hospitalised COVID-19 patients relative to population. COVID-19 incidence has been on the increase again after summer. In Belgium, France, Italy and Luxembourg, the number of hospitalised patients relative to population is close to the peak experienced during the first wave, while in Portugal, there is now more need for hospital care than in spring.

Figure 1. Mobility and hospital care in European countries (weekly average), March-October 2020.

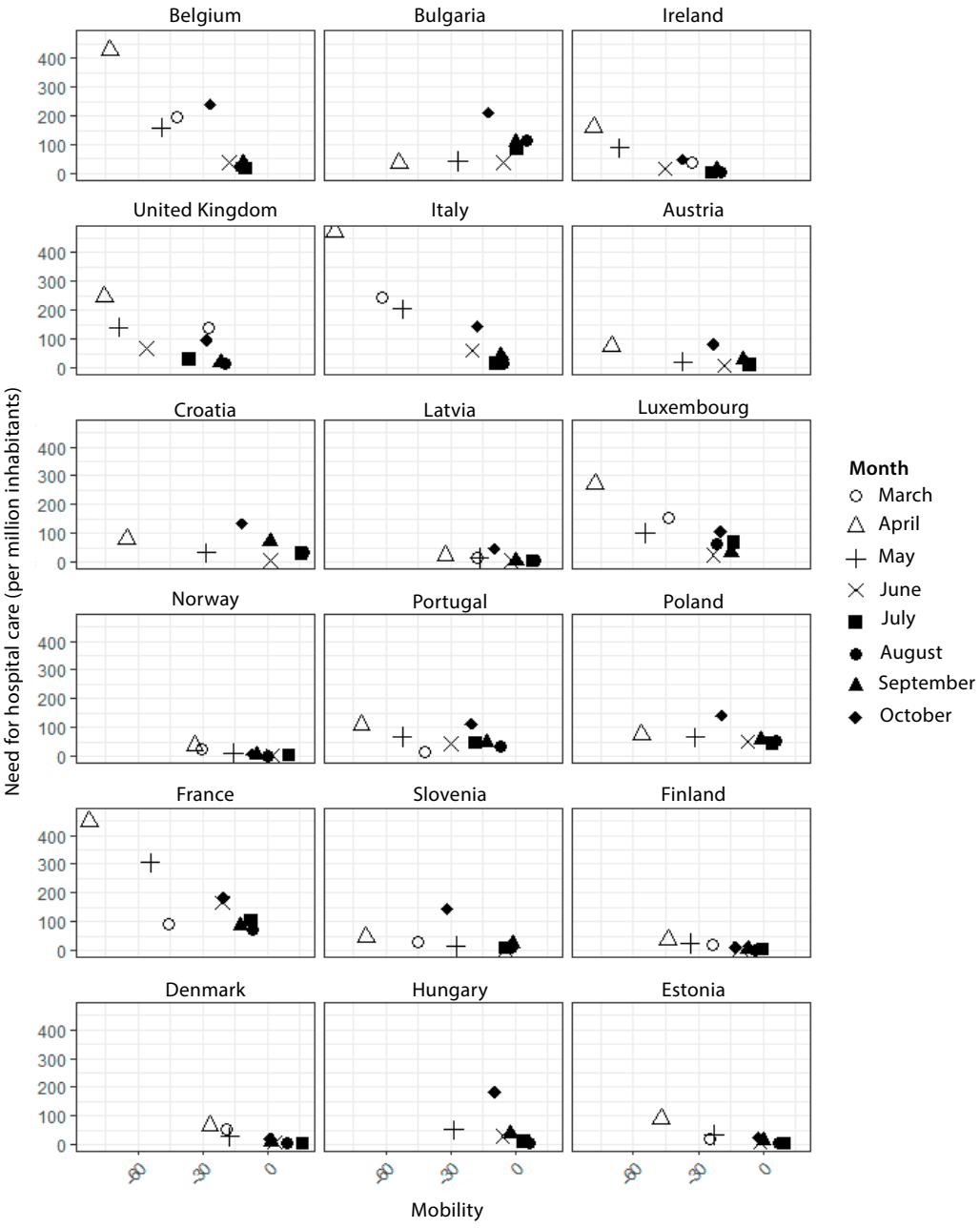


In most European countries (such as Estonia, Finland and Norway) COVID-19 incidence remained low during the spring months, a result of restrictions introduced early on. In these countries, the number of patients receiving hospital care has remained low after spring and there has been no substantial increase in the need for hospital care during the autumn. At the same time, in such countries as Croatia, Poland, Slovenia and Hungary, where only a small number of infections were reported in spring, there was a sharp increase in incidence in the autumn.

Restrictions introduced in many countries, such as curfews, and closure of schools and workplaces have affected citizens' mobility, as intended. Figure 1 (b) shows mobility of citizens near grocery stores and leisure-time locations compared with a similar five-week period at the start of 2020. Mobility is illustrated on a reverse scale in which the lowest values indicate reduction in mobility relative to the reference period. The figure shows that there were significant reductions in mobility in all European countries during the spring months. The reduction was at its sharpest in April 2020, after which mobility recovered, such that in the summer it was close to the levels in the reference period. In autumn, mobility decreased in many of the countries in which COVID-19 incidence has increased. At the same time, people have reduced their mobility less than in spring even though COVID-19 incidence is close to the spring peak in many countries.

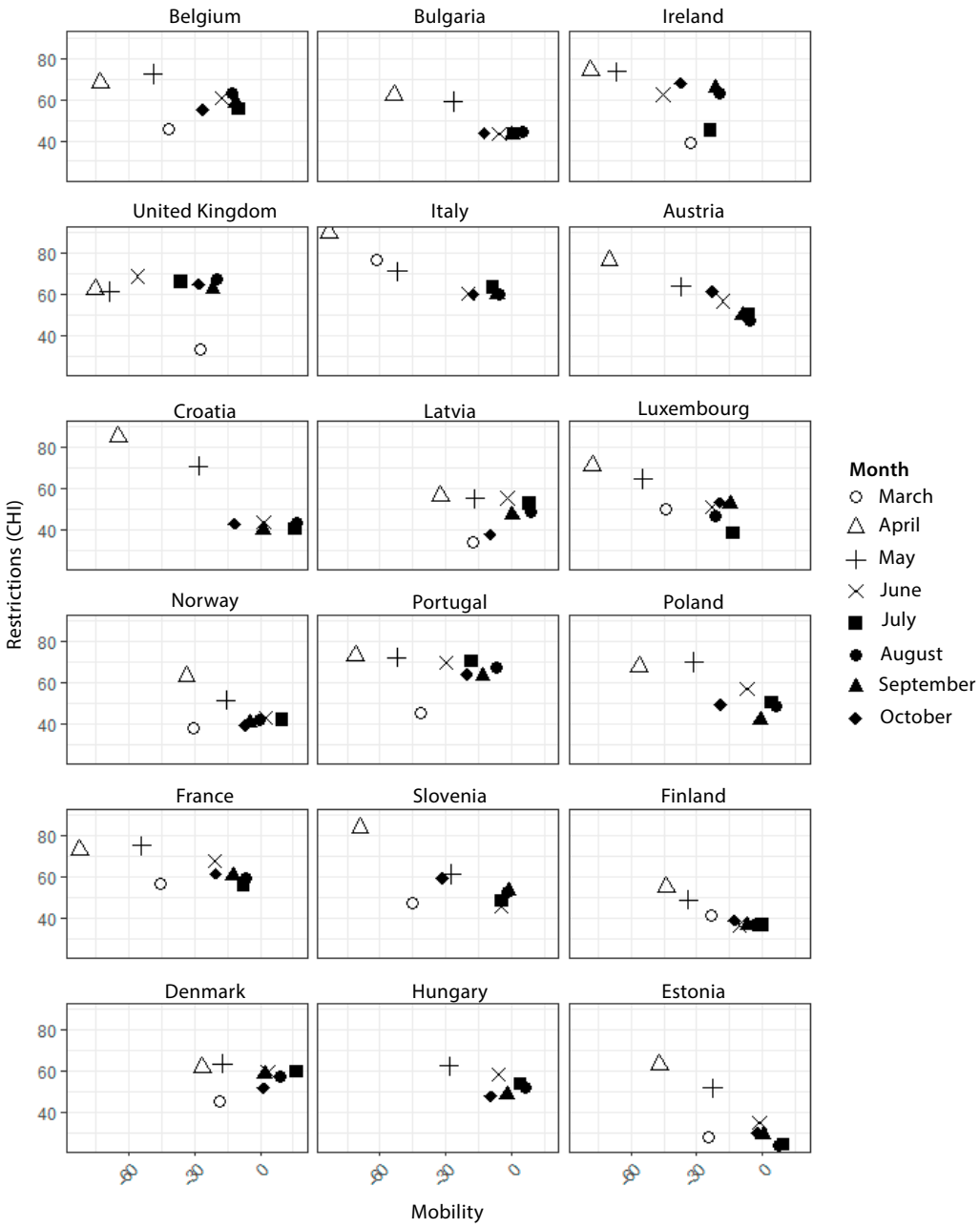
In addition to the restrictions, the epidemic situation has also affected mobility among citizens. Figure 2 describes COVID-19 incidence and mobility in several European countries in different months. The figure shows that in spring, there were also significant reductions in mobility in countries with low COVID-19 incidence. This may partially be connected with the restrictions introduced in many countries in spring to contain the disease. In countries such as Italy, France and the United Kingdom, where COVID-19 incidence was high in spring 2020, there is a more significant positive correlation between mobility and spread of the disease. At the same time, however, the figure shows that there were also changes in mobility between spring and autumn. In autumn, mobility in many countries was significantly higher than in the similar epidemic situation in spring.

Figure 2. Mobility and need for hospital care in European countries, March-October 2020



Mobility is also affected by public attitudes towards restrictions during different periods. Figure 3 illustrates restrictions and mobility in different European countries. The figure shows that there is a strong negative correlation between restrictions and mobility in many countries. However, it also shows that despite the restrictions, mobility largely recovered during the summer months.

Figure 3. Mobility and restrictions in European countries, March-October 2020



4 Description of the model

In this article, economic impacts of the COVID-19 pandemic are studied by estimating a two-way fixed effects model for 17 EU countries.[6] The model is well-suited for assessing the impacts of the spread of the disease and the effects of the restrictions because it takes into account any country-specific and time-specific unobserved effects that are not captured by the dependent variables.[7] Results of the one-way fixed effects model are shown in Appendix (Table 3 and Table 4).

The model equation for a country and i=1,2,…,N the moment t=1,2,…,T can be formulated as

$$Y_{it} = \alpha_i + \gamma_t + \beta X_{it} + \varepsilon_{it},$$

in which Y_{it} is the dependent variable, α_i is the fixed effect, γ_t is the time effect, β is the parameter vector, X_{it} is the vector of independent variables and ε_{it} is the random error term.

Economic Sentiment Indicator (ESI) and Services Confidence Indicator (SCI) are used as dependent variables. Reported patients receiving hospital care, the Community Mobility Index, the Economic Support Index (SI) and the indicator describing restrictive measures (CHI) are used as independent variables. The monthly observations of the dependent variables are averages of the daily observations of the variables in question. The model is estimated for the period 2020:M3-2020:M10 using monthly data.[8] The statistical indicators of the variables used are described in the Appendix (Table 7).

6 Belgium, Bulgaria, Ireland, United Kingdom, Italy, Austria, Croatia, Latvia, Luxembourg, Poland, Portugal, France, Slovenia, Finland, Denmark, Hungary, Estonia. Because of missing data, Luxembourg is not included in the models in which the Services Confidence Indicator is used as the dependent variable.

7 According to the Lagrange test, time is relevant to explaining the level of economic activity, and this can be used as a justification for using the two-way fixed effects model.

8 In a number of countries (Austria, Bulgaria, Croatia, Hungary and Poland) the missing observations for March 2020 (for Hungary also the missing observations for April 2020) on the need for hospital care are assumed to grow linearly from February 2020 for which month the assumed need for hospital care is zero. Replacing the missing observations with zero or the next observed value does not have any significant impact on the results.

5 Results

This section discusses the results of the selected model specifications.[9] Table 1 presents four different model specifications and their results. In model (1) the economic confidence indicator (ESI) is the dependent variable and the independent variables include the need for hospital care, a measure of government restrictions and the economic support index. Model (2) is identical with (1) except that mobility is also included as an independent variable. Model (3) is identical with (2) except that the variable describing the need for hospital care is not included in the set of independent variables. Model (4) is identical with model (2) except that the interaction between mobility and CHI is also included as an independent variable, which means that the model takes into account changes in mobility concerning the restrictions.

Table 1. Estimation results for four different model specifications. Economic Sentiment Indicator (ESI) used as the dependent variable.

	Dependent variable ESI			
	(1)	(2)	(3)	(4)
Patients in hospital care	-0.0201***	-0.0192**		-0.0159*
	(0.005)	(0.006)		(0.007)
Mobility		0.01751	0.07589	
		(0.062)	(0.057)	
CHI	-0.1275¨	-0.1189	-0.0760	-0.0786
	(0.076)	(0.091)	(0.094)	(0.098)
SI	0.03915	0.03947	0.043425	0.0397
	(0.038)	(0.038)	(0.041)	(0.038)
Mobility x CHI				0.00090
				(0.000)
Fixed effects	Yes	Yes	Yes	Yes
Time effect	Yes	Yes	Yes	Yes
Observations	135	135	135	135
Countries	17	17	17	17
Time periods	7-8	7-8	7-8	7-8
R^2	0.90	0.90	0.89	0.90
Adjusted R^2	0.87	0.87	0.86	0.87

¨ $p<0.1$,* $p<0.05$, ** $p<0.01$, *** $p<0.001$
Standard errors are in parentheses

9 Standard errors reported in the model specifications are heteroscedasticity-consistent and clustered by country.

Increase in the need for hospital care has an independent and statistically significant impact in model specifications (1), (2) and (4). In model (1) the variable describing the restrictions (CHI) is also at least statistically insignificant (<0.1 = ¨) but the economic support measures do not have a statistically significant impact in any of the models. Mobility does not have a statistically significant impact on economic confidence.

Table 2. Estimation results for four different model specifications. Services Confidence Indicator (SCI) used as the dependent variable.

	Dependent variable SCI			
	(5)	(6)	(7)	(8)
Patients in hospital care	-0.0263¨ (0.013)	-0.0219 (0.015)		-0.0154 (0.015)
Mobility		0.09221 (0.072)	0.15956* (0.063)	
CHI	-0.1468 (0.108)	-0.0985 (0.095)	-0.0446 (0.106)	-0.0159 (0.110)
SI	0.04505 (0.061)	0.04685 (0.062)	0.05024 (0.063)	0.04647 (0.061)
Mobility x CHI				0.00233* (0.000)
Fixed effects	Yes	Yes	Yes	Yes
Time effect	Yes	Yes	Yes	Yes
Observations	127	127	127	127
Countries	16	16	16	16
Time periods	7-8	7-8	7-8	7-8
R^2	0.90	0.90	0.90	0.90
Adjusted R^2	0.87	0.87	0.87	0.87

¨ $p<0.1$, $*p<0.05$, $**$ $p<0.01$, $***$ $p<0.001$
Standard errors are in parentheses

In Table 2 Services Confidence Indicator (SCI) is used as dependent variable. Otherwise, the model specifications are identical with those in Table 1. Increase in the need for hospital care has a statistically insignificant impact in model specification (5). The parameter value is nearly identical with model specifications (1) and (2), in which the general economic confidence indicator is used as the dependent variable. The main difference between model specifications using dependent variables is the mobility parameter. It increases significantly when the service sector confidence indicator is used as dependent variable instead of the general economic confidence index. A possible explanation is that the restrictive measures and voluntary restrictions on mobility have had a particularly strong impact on service demand. Another plausible explanation is that

mobility has been described using changes in mobility near grocery stores and leisure-time locations, in which case the correlation between these two variables is stronger.

For using the results in producing scenarios for the level of economic activity, the models most suited for this exercise are those that include explanatory variables for which scenarios can possibly be produced. Thus, models (1) and (5) are potentially best-suited for assessing the economic impacts under certain epidemiological scenarios. Even though mobility has a significant impact on service sector confidence, it is difficult to present reliable estimates of mobility trends in different epidemic situations or during different restrictions. Furthermore, the ability to interpret the results in a meaningful manner is to the advantage of the model in producing scenarios.

According to model (1), an increase in the need for hospital care by an average of ten persons/month (per million inhabitants) reduces the general economic confidence indicator by about 0.2 points. In Finland this would mean that if, on average, 55 additional persons would require hospital care during a period of one month, the confidence indicator would fall by about 0.2 points. When compared with the monthly variation in the confidence indicator in Finland (about 1.6 points in the period 2017-2019), this would seem a small figure.[10] At the same time, a fall of about 1.6 points in the confidence indicator would mean that the need for hospital care would increase by about 400 persons, or about 74 persons per million inhabitants. Experiences in other countries indicates that this is also possible in Finland, if the disease is allowed to spread freely. For example, in those European countries in which the epidemic situation significantly weakened during the autumn months, the number of patients receiving hospital care per million inhabitants exceeded 100. Thus, the magnitude of the estimated parameter would seem credible.

In the model, a one-point increase in the index describing the restrictions (CHI) would decrease economic confidence by 0.13 points. The economic impacts of the restrictions included in the CHI index may significantly differ from each other depending on the activities targeted by the restrictions. Thus, even though the index is well-suited for describing differences in restrictive measures between countries, assessing the economic impacts of the measures included in the index involves a significant degree of uncertainty. That being said, to illustrate the size of the index values it can be said that for example, the Finnish government's decision to restrict mobility between the Uusimaa (capital) region

10 In this context, monthly variation means the average of the intrinsic values of the change in index value, or $|x_t - x_{t-1}|$

and the rest of Finland would cause the CHI index to rise by two points. This would mean a fall of about 0.26 points in the economic confidence index.[11]

In model (5), increase in the need for hospital care by an average of ten persons each month (per million inhabitants) would lower service sector confidence by about 0.26 points, which means that the impact of the need for hospital care on service sector confidence is substantially higher than its impact on general economic confidence. This is consistent with the view that the service sector has been hardest hit by the epidemic.[12]

The results for the optional two-way fixed effects model are shown in Appendices (Table 5 and Table 6). The model specifications are identical with those given in Tables 1 and 2 except that the group of dependent variables contains a one-period lagged value of the dependent variable. The parameter value of the variable describing the need for hospital care is substantially lower in the models in which the general economic confidence index is used as dependent variable (cf. models (1) and (B.1)). However, in models that explain service sector confidence, adding the lagged observation does not significantly change the parameter value (cf. models (5) and (B.5)).

11 The variables and weightings used in the indicator are detailed in the description prepared by the University of Oxford (https://github.com/OxCGRT/covid-policy-tracker/blob/master/documentation/codebook.md).

12 Monthly variation in the indicator is slightly higher than in the general index (on average 2.9 points).

6 Using the results in economic impact assessments of the epidemiological scenarios

The results presented in this study indicate that the spread of the disease and the restrictions introduced to contain it have negative impacts on the level of economic activity. The conclusion is that the service sector has been hardest hit by the COVID-19 pandemic but economic activity in general has also been affected. Under certain conditions, the results can be used in assessing the economic impacts of different disease scenarios, assuming that the economic impact channels of the pandemic do not change significantly as the pandemic progresses. The impact channels are significantly affected by such factors as economic and sectoral structures as well as citizens' behaviour.

As the pandemic continues, the economic effects may spread to other sectors through growing unemployment, uncertain prospects or financing-related risks (Gourinchas 2020). Thus, the immediate impacts experienced during the first months of the pandemic may be multiplied as the impacts spread to other areas of the economy. For example, high unemployment and a wave of bankruptcies may weaken the financial position of banks and, thus reduce their lending capacity, which would negatively affect the operations of a large number of business sectors.

The relationship between the variables used in the models also depends on how citizens' behaviour changes over time. As Figures 2 and 3 show, citizens in many EU countries did not reduce their mobility during autumn 2020 as substantially as in spring even though the number of hospital patients is again on the increase. Furthermore, the ratio between restrictions and mobility has been time-specific in many countries.

The economic impacts of the restrictions also depend on how citizens behave. For example, Chetty et al. (2020) have noted that removing restrictions in certain US states has not significantly boost demand or employment. It is thus possible that, contrary to what is assumed in the models estimated in this study, the economic impacts of the restrictions are not symmetrical.

7 Conclusions

The purpose of this study has been to examine the economic impacts of the COVID-19 pandemic and the restrictions prompted by it. It was noted in the study that the spread of the COVID-19 disease and the restrictions introduced to contain it have negatively affected the service sector and the level of economic activity in general in EU countries. Under certain conditions, these results can be used as a basis for assessing the spread of the epidemic and the impacts of the restriction scenarios on the national economy.

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Appendix

Table 3. Estimation results for four different model specifications. One-way fixed effects model. Economic Sentiment Indicator (ESI) used as the dependent variable.

	Dependent variable: ESI			
	(A.1)	(A.2)	(A.3)	(A.4)
Patients in hospital care	-0.0248*	-0.0100		-0.0031
	(0.010)	(0.010)		(0.011)
Mobility		0.11332¨	0.13529*	
		(0.067)	(0.060)	
CHI	-0.6086***	-0.4639*	-0.4499*	-0.3667**
	(0.129)	(0.183)	(0.187)	(0.198)
SI	-0.1506***	-0.1907***	-0.195024	-0.1921***
	(0.042)	(0.054)	(0.055)	(0.051)
Mobility x CHI				0.00237
				(0.000)
Fixed effects	Yes	Yes	Yes	Yes
Time effect	No	No	No	No
Observations	135	135	135	135
Countries	17	17	17	17
Time periods	7-8	7-8	7-8	7-8
R^2	0.60	0.62	0.61	0.63
Adjusted R^2	0.53	0.55	0.55	0.56

¨ $p<0.1$, $*p<0.05$, $**$ $p<0.01$, $***$ $p<0.001$
Standard errors are in parentheses

Table 4. Estimation results for four different model specifications. One-way fixed effects model. Services Confidence Indicator (SCI) used as the dependent variable.

	Dependent variable SCI			
	(A.5)	(A.6)	(A.7)	(A.8)
Patients in hospital care	-0.0199 (0.013)	-0.0161 (0.013)		-0.0069 (0.014)
Mobility		0.02933 (0.102)	0.06330 (0.093)	
CHI	-0.7370*** (0.136)	-0.6996*** (0.181)	-0.6755*** (0.186)	-0.5920** (0.224)
SI	-0.3030*** (0.067)	-0.3136*** (0.075)	-0.321557 (0.076)	-0.3289*** (0.076)
Mobility x CHI				0.00142 (0.001)
Fixed effects	Yes	Yes	Yes	Yes
Time effect	No	No	No	No
Observations	127	127	127	127
Countries	16	16	16	16
Time periods	7-8	7-8	7-8	7-8
R^2	0.55	0.55	0.54	0.55
Adjusted R^2	0.47	0.47	0.47	0.47

$^{\cdot}p<0.1$, $*p<0.05$, $**p<0.01$, $***p<0.001$
Standard errors are in parentheses

Table 5. Estimation results for four optional model specifications. Economic Sentiment Indicator (ESI) used as the dependent variable.

	Dependent variable ESI			
	(B.1)	(B.2)	(B.3)	(B.4)
ESI (t-1)	0.23844*	0.25998**	0.27111**	0.24248**
	(0.097)	(0.092)	(0.091)	(0.091)
Patients in hospital care	-0.0115*	-0.0050		-0.0038
	(0.004)	(0.005)		(0.005)
Mobility		0.11688*	0.13606**	
		(0.051)	(0.047)	
CHI	-0.0316	0.01686	0.03355	0.04248
	(0.062)	(0.066)	(0.071)	(0.071)
SI	0.05013	0.04789	0.04611	0.04935
	(0.046)	(0.048)	(0.048)	(0.046)
Mobility x CHI				0.00164*
				(0.000)
Fixed effects	Yes	Yes	Yes	Yes
Time effect	Yes	Yes	Yes	Yes
Observations	117	117	117	117
Countries	17	17	17	17
Time periods	5-7	5-7	5-7	5-7
R^2	0.90	0.90	0.90	0.90
Adjusted R^2	0.87	0.87	0.87	0.87

¨ $p<0.1$, $*p<0.05$, $**$ $p<0.01$, $***$ $p<0.001$
Standard errors are in parentheses

Table 6. Estimation results for four optional model specifications. Services Confidence Indicator (SCI) used as the dependent variable.

	Dependent variable SCI			
	(B.5)	(B.6)	(B.7)	(B.8)
SCI (t-1)	0.29092**	0.29062**	0.29750**	0.28536**
	(0.100)	(0.098)	(0.098)	(0.094)
Patients in hospital care	-0.0219*	-0.0178¨		-0.0139
	(0.009)	(0.010)		(0.011)
Mobility		0.07782	0.14292¨	
		(0.072)	(0.072)	
CHI	-0.1384*	-0.1063	-0.0499	-0.0567
	(0.055)	(0.068)	(0.068)	(0.086)
SI	0.06783	0.06767	0.06232	0.06870
	(0.053)	(0.052)	(0.052)	(0.053)
Mobility x CHI				0.00178
				(0.001)
Fixed effects	Yes	Yes	Yes	Yes
Time effect	Yes	Yes	Yes	Yes
Observations	110	110	110	110
Countries	16	16	16	16
Time periods	5-7	5-7	5-7	5-7
R^2	0.87	0.87	0.87	0.88
Adjusted R^2	0.83	0.83	0.83	0.84

¨ $p<0.1$, $*p<0.05$, $**$ $p<0.01$, $***$ $p<0.001$
Standard errors are in parentheses

Table 7. Descriptive statistics the variables used in the estimation.

	Variable					
	ESI	SCI	Hospital care	Mobility	CHI	SI
Observations	135	127	130	136	136	136
Missing observations	1	9	6	0	0	0
Minimum	46.9	-67.3	1.3	-83.4	23.8	2.4
Maximum	105.3	10.0	472.1	16.6	89.9	100.0
Average	80.9	-26.8	69.7	-22.8	54.9	69.5
Median	83.0	-26.5	37.4	-18.7	55.5	75.0
Standard deviation	11.9	16.7	86.6	23.6	13.0	23.1

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