THE RELATIONSHIP BETWEEN PANDEMIC CONTAINMENT MEASURES, MOBILITY AND ECONOMIC ACTIVITY

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Abstract

This paper first constructs a regional-scale indicator that seeks to gauge the volume of measures implemented at each point in time to contain the pandemic. Using textual analysis techniques, we analyse the information in press news. At the start of the pandemic, measures were taken in a centralised fashion; but from June, regional differences began to be seen and increased in the final stretch of the year.

Second, using linear estimates, with monthly data and a level of regional disaggregation, the paper documents how most of the reduction in mobility observed in Spain has been due to the restrictions imposed. However, there has been a perceptible change in this relationship over recent months. In the early stages of the pandemic, the reduction in mobility was found to be greater than would be inferred by the restrictions approved. That is to say, at the outset there was apparently some voluntary reduction in mobility. Yet following lockdown-easing, the behaviour of mobility has fitted more closely with what might be attributed to the containment measures in force.

Finally, the findings in the paper suggest that most of the decline in economic activity since the start of the crisis can be explained by the reductions observed in mobility. The analysis considers only the short-term effects on activity, which is very useful for preparing the projections on GDP behaviour in the current quarter. Conversely, the methodological approach pursued does not allow for evaluation of the effect of the pandemic containment measures on activity over longer time horizons. In particular, the adverse impact on the economy's output that occurs concurrently as a result of the restrictions may be countered in the medium term by an effect of the opposite sign, to the extent that the restrictions imposed today may serve to prevent other more forceful ones in the future.

Keywords: nowcasting, GDP, economic activity, textual analysis, sentiment indicators, soft indicators, pandemic, COVID-19, coronavirus, mobility, restrictions, panel data.

JEL classification: I18, I12, E32, E37, C53, C23.

Resumen

En este trabajo se construye, en primer lugar, un indicador a escala autonómica que trata de medir el volumen de medidas desplegadas en cada momento del tiempo para contener la pandemia. Para ello se analiza, mediante técnicas de análisis textual, la información contenida en las noticias de prensa. Al inicio de la pandemia, las medidas se tomaron de forma centralizada, pero a partir de junio comienzan a observarse diferencias entre regiones, que se intensificaron en la parte final del año.

En segundo lugar, utilizando estimaciones lineales, con datos mensuales y con un nivel de desagregación autonómico, se documenta que la mayor parte de la reducción de la movilidad observada en España viene explicada por las restricciones desplegadas. No obstante, se aprecia un cambio en esta relación a lo largo de los últimos meses. Así, en las fases iniciales de la pandemia, se encuentra que la reducción de la movilidad fue superior a la que se desprendería de las restricciones aprobadas. Esto es, al principio se produjo, aparentemente, una cierta reducción de la movilidad de carácter voluntario. Sin embargo, tras la desescalada, el comportamiento de la movilidad se ha ajustado más al explicado por las medidas de contención en vigor.

Por último, los resultados del trabajo apuntan a que la mayor parte de la caída en la actividad económica desde el comienzo de la crisis sanitaria puede explicarse por las reducciones observadas en la movilidad. El análisis considera solamente los efectos de corto plazo sobre la actividad, lo que es de gran utilidad para la elaboración de las proyecciones acerca del comportamiento del PIB en el trimestre corriente. La aproximación metodológica que se ha seguido no permite, por el contrario, evaluar el efecto de las medidas de contención de la pandemia sobre la actividad en horizontes temporales mayores. En particular, el impacto adverso sobre el producto de la economía que tiene lugar de forma contemporánea como consecuencia de las restricciones puede verse contrarrestado en el medio plazo por un efecto de signo opuesto, en la medida en que las restricciones impuestas hoy sirvan para evitar otras más contundentes en el futuro.

Palabras clave: previsión a corto plazo, PIB, actividad económica, análisis textual, indicadores de sentimiento, indicadores cualitativos, pandemia, COVID-19, coronavirus, movilidad, restricciones, datos de panel.

Códigos JEL: I18, I12, E32, E37, C53, C23.

Contents

1 Introduction

This paper presents a methodology to quantify the effect that the measures taken to control the spread of the COVID-19 pandemic in Spain may have had on economic activity through their impact on mobility.

Initially, we attempt to identify what proportion of the observed reductions in personal mobility is attributable to the restrictions in force at each point in time. For this purpose, an indicator is constructed of the severity of these restrictions at regional level by applying textual analysis techniques to press news. We then use a first linear estimation to assess the ability of this indicator to explain the regional behaviour of the average of the Google mobility indicators for retail and recreation outlets, transit stations and workplaces. Subsequently, we use a second linear estimation to analyse the correlation at regional level between observed mobility levels and economic activity,[1] proxied by a composite index that combines information from a broad set of regional activity indicators.

Both linear regressions produce significant coefficients with the expected sign, while the R^2 is in both cases around 0.60, indicating that most of the regional variability in the decline in activity since the start of the pandemic can be explained by mobility reductions, which have in turn been caused mainly by the containment measures in force at each point in time.

1 Doing this in two stages has the advantage of allowing us to separate the voluntary mobility part from that explained by the containment measures. In addition, as a robustness check, the relationship between activity and containment measures was estimated in a single stage, with similar results, but a lower R2, which would support the strategy followed in this article.

2 Regional indicators that proxy the severity of the measures deployed to fight the pandemic

The first step of this study is to create monthly indicators that reflect the regional variability in the containment measures deployed in Spain since March 2020 to contain the pandemic. For this purpose, we apply the textual analysis methodology proposed by Baker et al. (2016) to a press news database. In particular, we analyse, using the Factiva database, articles published in recent months in seven Spanish newspapers *(ABC, El País, El Mundo, La Vanguardia, Expansión, Cinco Días* and *El Economista).*

First, an initial regional indicator is constructed to measure the number of news items that refer to mobility restrictions in each region as a percentage of all news items referring to the region. The numerator of this indicator contains the total number of news items that satisfy three requirements: they refer to the pandemic, they mention a mobility or activity restriction, and they do this within 10 words of a reference to the region in question.

That is to say, the numerator is constructed by counting the number of news items (in Spanish) that simultaneously contain at least one word from each of three blocks. For example, for the Andalusia indicator, the three blocks would be:

— **COVID block:** *(coronavirus* or *covid* or *pandemia* or *Sanidad).*

— **MEASURES block:** *((medida** and *movilidad)* or *aislamiento perimetral* or *((restri** or *limita** or *prohib** or *suspen** or *cierre* or *cerr*)* proximity10 *(aforo** or *horario** or *reunion** or *movilidad* or *ocio nocturno* or *desplazamiento** or *paseo** or *parque** or *evento** or *terraza** or *residencia** or *bar* or *bares* or *restaurante** or *hosteleria* or *hotel** or *colegio** or *guarderia** or *escuela** or *universidad** or *lugar* public*))* or *((fase 1* or *fase uno* or *fase 2* or *fase dos)* and *(movilidad* or *desescalada)))* proximity10.[2]

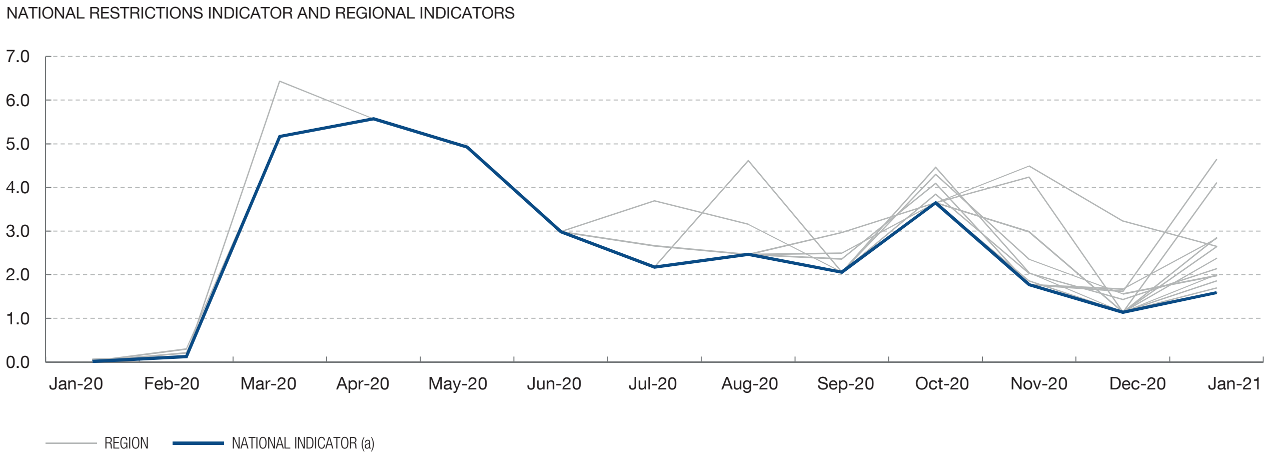
— **REGIONAL block:** *(Andalucia* or *Almeria* or *Cadiz* or *Cordoba* or *Granada* or *Huelva* or *Jaen* or *Malaga* or *Sevilla* or *Gobierno de Andalucia* or *Gobierno andaluz* or *Junta de Andalucia* or *junta andaluza).*

Second, a similar indicator is calculated at national level, which tries to capture nationwide measures: it reflects the number of news items that mention the pandemic and mobility restrictions or lockdown in Spain, as a percentage of the total number of news items relating to Spain in the newspapers considered.

The final indicator used for each region is the higher, for each month, of the national indicator and the corresponding initial regional indicator. Bearing in mind that in the initial

2 This is how the proximity criterion described above is imposed.

Chart 1
RESTRICTIONS INDICATOR



SOURCE: Banco de España.

a The national indicator reflects the number of news items that mention the pandemic and mobility restrictions or confinement in Spain, as a percentage of the total number of news items referring to Spain. The regional indicators reflect the greater of the national indicator and the one calculated for each region.

phases of the pandemic the measures deployed were basically nationwide in scope, it makes sense that in March and April 2020 almost all these adjusted regional indicators are equal to the national indicator.[3]

One advantage of these indicators is that they are compiled at regional level, unlike other measures which are only available at national level. As will be seen in the following sections, exploiting the regional heterogeneity in the severity of the containment measures deployed will allow the effect of these restrictions on mobility and economic activity to be estimated. Chart 1 shows the range of regional indicators constructed using the proposed methodology. Following the spring uniformity, the regions began to take measures of differing severity from the summer. This has continued to be the case since, with the differences widening in the final part of 2020 and at the beginning of 2021.

When assessing how accurately these types of textual indicators reflect the reality they seek to quantify, the lack of a reference variable to check them against is often a problem. In the literature, a narrative approach is normally adopted and an analysis is carried out to see if the behaviour of the indicator in question is consistent with the occurrence of various specific events whose qualitative impact on the variable subject to analysis is uncontroversial. In this specific case, for example, the restrictions indicator might be expected to be at its peak in March and April (when the most stringent

3 The only exception is La Rioja in March; the indicator correctly reflects the fact that certain containment measures were deployed in this region before decisions were taken at national level.

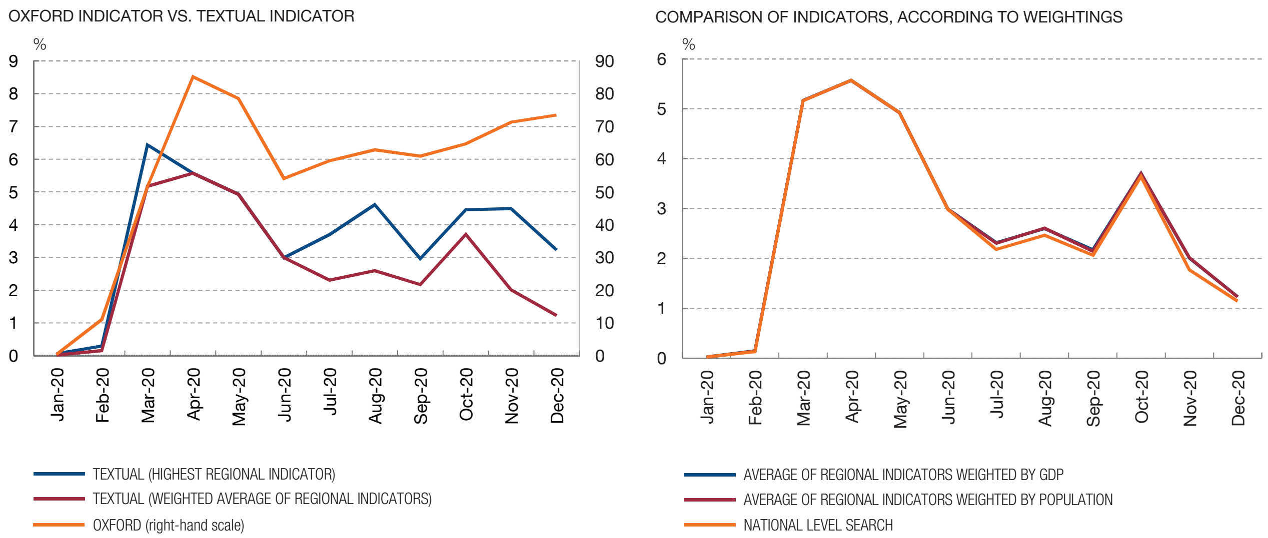
measures were adopted), to fall gradually until June (in line with lockdown-easing) and to increase again in the final stretch of the year, with clear regional heterogeneity, as a consequence of the measures deployed to contain the second and third waves of the pandemic. As seen in Chart 1, the textual indicator constructed in this study is consistent with this narrative.

Also, in this specific case, it is possible to compare – even if only at national level – the indicator compiled in this study with another similar indicator widely used in the literature, the University of Oxford Stringency Index (see Petherick et al. (2020)). This is an indicator of the stringency of the mobility restrictions based on a systematic analysis of the measures implemented in response to the pandemic by different governments (including the Spanish one).

One characteristic of the Oxford Stringency Index is that it reflects the most stringent regional restriction, which may make sense in terms of fighting the spread of the virus, if the most relevant restrictions are considered to be those applied where the incidence is greatest, which will normally be the most stringent ones. However, to analyse the effect of these restrictions on GDP, a measure that takes into account all the regional indicators (appropriately weighted) is more relevant.

Chart 2 presents a comparison between our indicator, constructed on the basis of press news, and the Oxford Stringency Index. If we consider the highest regional indicator at any given moment, the trend is relatively similar, except that the Oxford indicator increases more rapidly at the start of the pandemic. The indicator reflecting

Chart 2
COMPARISON OF RESTRICTIONS INDICATORS



SOURCES: University of Oxford, INE and Banco de España.

the strictest region is only used for the comparison with the Oxford indicator. In the rest of this paper we use the aggregation which weights each region's indicators by its GDP, since this better reflects the time profile of the restrictions applied (the Oxford indicator, for example, does not show additional easing of restrictions from June). The results are very similar if the regional indicators are weighted by population instead of GDP. Given that the ultimate aim of this article is to study the effect of containment measures on activity, the aggregate indicator used hereafter weights the various regions by their GDP.

3 Severity indicators as determinants of mobility

The ultimate aim of this paper is to obtain a measure of the sensitivity of economic activity to containment measures, based on the effect of such measures on mobility. The starting hypothesis is that pandemic containment measures have a direct negative effect on mobility which, in turn, has an adverse impact on activity levels through lower consumption and/or lower production. The analysis also contemplates the possibility that mobility may be reduced not only as a result of the restrictions imposed, but also as a consequence of other factors. In particular, part of the observed reduction in mobility may be purely voluntary due, for example, to fear of infection. In any event, this voluntary mobility reduction will also have a negative impact on activity.

Normally these regressions would be based on rates of change, but the characteristics of the crisis mean that in many cases comparisons with the preceding quarter or year are difficult to interpret. As a result, it was decided to specify the equations in terms of cumulative rates with respect to pre-pandemic levels. This also allows a direct comparison with the mobility indicators, which are published having made this transformation.

To quantify these relationships empirically, first, a linear equation is estimated in which the path of the monthly regional mobility indicators is explained by the greater or lesser severity of the restrictions imposed in each region, proxied by the regional indicators based on press news items as described in the previous section:

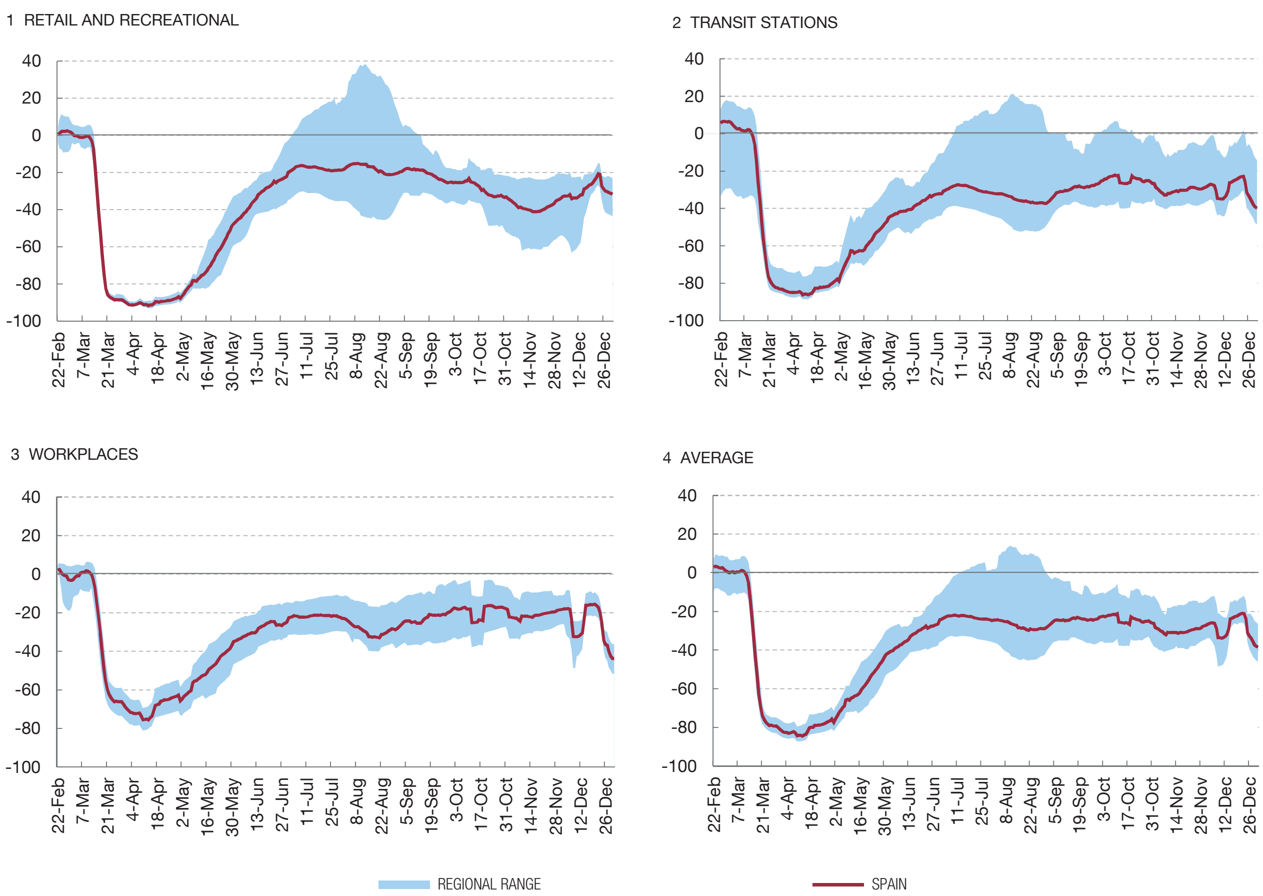
$$\text{Mobility}_{m,region} = a_1 + b_1 * \text{Restrictions}_{m,region} + e_{m,region} \quad (1)$$

This equation is estimated using the data of 17 Spanish regions (Ceuta and Melilla are excluded) with monthly data from February to December 2020. The regional breakdown possible with press-based restrictions indicators enables more robust results to be obtained than using national data: the number of observations is 187, instead of the 11 available at national level.

The level of mobility is measured using the indicators published by Google, which are constructed using the information supplied by mobiles using this company's applications (especially Google Maps). These data are anonymized and aggregated to avoid user privacy problems. Google compiles and publishes these indicators to provide information on the changes in personal mobility as a result of the pandemic and the restrictions implemented to curb it. The indicators show the trends in movements over time, by geographical area and for various place categories. In this latter dimension, for the purposes of this paper, the average of the mobility indicators for retail and recreational outlets, transit stations and workplaces is used.[4] The indicators reflect the changes in the number of visits to each of these place

4 The analysis has also been carried out using each of the three mobility indicators separately, instead of their average, with no change in the results. Google also provides mobility information on supermarkets and pharmacies, parks and residential areas; these categories are not used in the analysis because, a priori, they are less clearly related to economic activity.

Chart 3
GOOGLE MOBILITY INDICATORS FOR SPAIN, BY REGION
(7-DAY MOVING AVERAGE)



SOURCES: Google and Banco de España.

Table 1
EFECTS OF MOBILITY RESTRICTIONS

Mobility = $a_1 + b_1$* Restrictions + e	
	Mobility
Restrictions indicator	-10.115***
	(0.611)
Constant	0.148
	(2.111)
Observations	187
R^2	0.597

SOURCES: Google and Banco de España.
NOTE: Standard error in brackets. *** p < 0.01, ** p < 0.05, * p < 0.1

categories and in their duration in comparison with a five-week pre-pandemic reference period (from 3 January to 6 February 2020). The geographical breakdown used is regional. Chart 3 shows how at the start of the pandemic mobility fell drastically and its cross-region dispersion was low. Subsequently, following what came to be known as the “new normality”, the indicator points to a substantial increase in mobility and in its cross-region dispersion. In the final part of the year no significant fall in mobility is observed, despite the increase in cases linked to the new wave of the pandemic.

In equation (1), the coefficient b_1 represents the sensitivity of mobility to the restrictions for an average region. The changes in mobility not explained by the restrictions, in particular those that may have occurred voluntarily since the start of the pandemic, would be captured by the equation’s residual. The results (see Table 1) are as expected in terms of sign and significance of the coefficients, and the equation fit (measured by R^2) is satisfactory.

4 Indicators of activity

In the second phase of this regional analysis, we estimate a linear equation in which the level of economic activity is explained on the basis of mobility.

$$\text{Activity}_{m,region} = a_2 + b_2 * \text{Mobility}_{m,region} + e_{m,region} \quad (2)$$

In this equation, the coefficient b_2 represents the sensitivity of activity to changes in the degree of mobility for a representative average region.[5]

The dependent variable in equation (2) measures the level of economic activity in each region with a monthly frequency using a regional composite index of activity constructed by combining the information from a broad set of indicators.[6] In particular, among the set of regional indicators available, those that have historically shown a greater correlation with annual GDP[7] are optimally selected[8] and weighted for each region. Table 2 summarises the indicators making up the composite index of activity for each region.

Table 2
INDICATORS USED IN REGIONAL COMPOSITE INDICES OF ACTIVITY

	Social security registrations	Retail Trade Index	Industrial Production Index	Overnight stays by residents	Overnight stays by non-residents	New car registrations	Imports	Exports	Services Sector Activity Index	New commercial vehicle registrations
Andalusia	x	—	—	x	x	—	x	—	—	—
Aragon	x	x	—	x	—	—	x	—	x	—
Asturias	x	x	x	x	x	—	x	—	x	—
Balearic Islands	x	—	x	—	—	—	x	x	—	—
Canary Islands	x	x	x	x	—	—	x	—	—	—
Cantabria	x	—	—	—	x	x	x	—	x	—
Castile-Leon	x	x	x	—	x	—	x	x	x	—
Castile-La Mancha	x	x	—	—	—	x	—	—	—	—
Catalonia	x	x	x	x	—	—	x	—	—	—
Valencia region	x	x	—	—	—	—	x	—	—	—
Extremadura	x	x	x	—	—	x	x	x	x	—
Galicia	x	x	x	—	—	—	x	x	—	—
Madrid region	x	x	—	x	x	—	x	x	—	—
Murcia region	x	—	x	—	x	—	x	—	x	—
Navarre	x	x	x	x	x	x	x	x	x	—
Basque Country	x	—	x	x	x	x	x	x	—	x
La Rioja	x	—	x	x	x	—	—	—	—	—

SOURCE: Banco de España.

5 This same equation has been estimated including a trend and the result shows that the estimation of b_2 is robust to this change.
6 See Artola et al. (2018) for a description of the information available for each region.
7 An alternative possibility for attempting to obtain a regional indicator of activity that summarises the information from the set of indicators available would be to use the principal components technique. However, in this specific case, given the exceptionally atypical behaviour of some of the key indicators available as a result of the pandemic-control measures adopted, this procedure does not yield good results.
8 We select those indicators that are significant in a regression and are of the appropriate sign.

Table 3
EFFECTS OF MOBILITY ON ACTIVITY

Regression 2: Activity = $a_2 + b_2$* Mobility + e

	Actividad
Mobility	0.234***
	-0.015
Constant	-1.756***
	-0.546
Observations	187
R^2	0.582

SOURCES: Google and Banco de España.
NOTE: Standard error in brackets. *** p < 0.01, ** p < 0.05, * p < 0.1.

For the purposes of constructing these composite indices, all the individual indicators are expressed in year-on-year growth rates. In a second stage, the resulting composite indices, also expressed in terms of year-on-year rates of change, are re-defined to reflect deviations from the level of activity in 2019 Q4. As a result, the timeframe for evaluating the change in regional levels of activity approximates more accurately to that envisaged in the mobility indicators described in the previous section.

The results of the regression show a relationship between mobility and activity that is positive, as was to be expected, and moreover significant. The fit of the equation is good: as the R^2 of the estimate shows, most of the regional variability in activity can be explained by differences in mobility.

5 Implications for national GDP

The equations estimated in the previous sections capture the relationship between the restrictions implemented to curb the expansion of the pandemic and its short-term effect on economic activity, as a consequence of the changes in mobility. The use of regional-level monthly data increases the number of observations, which helps improve the accuracy with which the coefficients are estimated. However, as regards practical application, it is worth aggregating the results to calculate effects in terms of national aggregate variables with a quarterly frequency.

We should stress that the estimated effect solely measures the immediate cost, in the short term, on the basis of economic activity. Conversely, the restrictions not only entail benefits in terms of public health, but also reduce the economic costs of the pandemic in the medium term, if they manage to prevent the prolongation of an exponential spread of the virus from forcing even greater restrictions to be adopted later. The analysis in this paper obviates these intertemporal relationships and does not therefore include these positive medium-term effects. Nor can the analysis be used for a cost-benefit analysis of the restrictive measures in economic terms. But the results are useful for preparing macroeconomic forecasts, and for evaluating the short-term impact of the measures implemented at each point in time.

As an initial step we must aggregate the different regional indicators to obtain national aggregates. The national indicators of restrictions, mobility and activity are calculated by always using the weight of each region's GDP in the national total in 2019 as a weighting.

Once we have constructed these variables, we use the estimated coefficient $\hat{b}_1$ in regional regression (1) to calculate the adjusted value of aggregate mobility, which represents the changes in mobility attributable to average restrictions at the national level; the residual of the first regression, for its part, reflects the change in mobility attributable to the other factors (i.e. voluntary mobility).

$$\text{Mobility}.\widetilde{\text{Restrictions}}_{m,nat} = \hat{b}_1 * \text{Restrictions}_{m,nat}$$

$$\text{Mobility}.\widetilde{\text{Voluntary}}_{m,nat} = \text{Mobility}_{m,nat} - \text{Mobility}.\widetilde{\text{Restrictions}}_{m,nat}$$

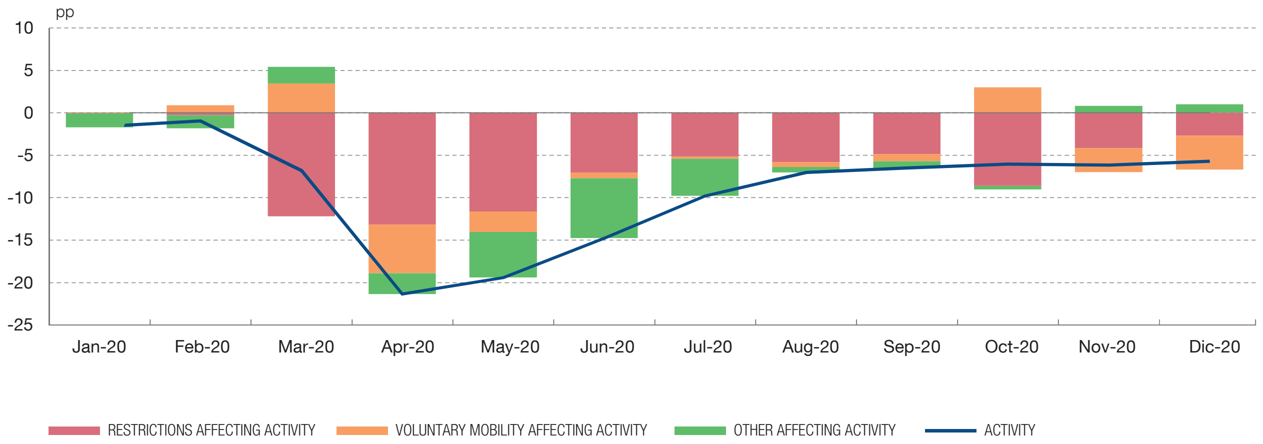
We combine these results (the changes in mobility related to the restrictions and those made voluntarily) with the estimated coefficient $\hat{b}_2$ in regional regression (2) to decompose the indicator of national activity into three parts: (i) the change in activity that can be explained by the changes in mobility in response to the restrictions; (ii) the change in activity that can be explained by the changes in voluntary mobility; and (iii) other, i.e. the portion of the aggregate change in activity that is not explained by changes in mobility:

$$\text{Activity}.\widetilde{\text{Restrictions}}_{m,nat} = \hat{b}_2 * \text{Mobility}.\widetilde{\text{Restrictions}}_{m,nat}$$

$$\text{Activity}.\widetilde{\text{Voluntary}}_{m,nat} = \hat{b}_2 * \text{Mobility}.\widetilde{\text{Voluntary}}_{m,nat}$$

$$\text{Activity}.\widetilde{\text{Other}}_{m,nat} = \text{Activity}_{m,nat} - \text{Act}.\widetilde{\text{Restrictions}}_{m,nat} - \text{Act}.\widetilde{\text{Voluntary}}_{m,nat}$$

Chart 4
MONTHLY INDICATOR OF ACTIVITY (PERCENTAGE DEVIATIONS FROM LEVEL)



SOURCE: Banco de España.

Chart 4 depicts the result of this decomposition, with national-level monthly data.

The chart reveals that the restrictions on mobility account for a significant portion of the decline in activity in recent months (on average between April and December they would explain approximately 70% of the decline).[9] It is worth highlighting an additional result. Specifically, the chart shows that, in the early months of the pandemic, activity contracted more sharply than the observed reduction in mobility would suggest (i.e. the green bars reflecting the residual change in activity are negative). However, this phenomenon ceased to be observable practically from August and even changed sign at the end of the year. That might suggest something of a learning process on the part of economic agents on living alongside the pandemic and its associated distortions. This learning might be related, among other aspects, to increasingly effective new forms of work being set in place (working from home, in particular)[10] and new patterns of consumption (e.g. more skewed towards online consumption).[11]

Translating this indicator into quarterly GDP terms (see Chart 5) requires, first, the aggregation to that frequency of the data in the monthly composite indicator calculated at the national level; and, second, the extraction of a scale factor that links the cumulative rates of the indicator of activity to the rates of GDP itself.

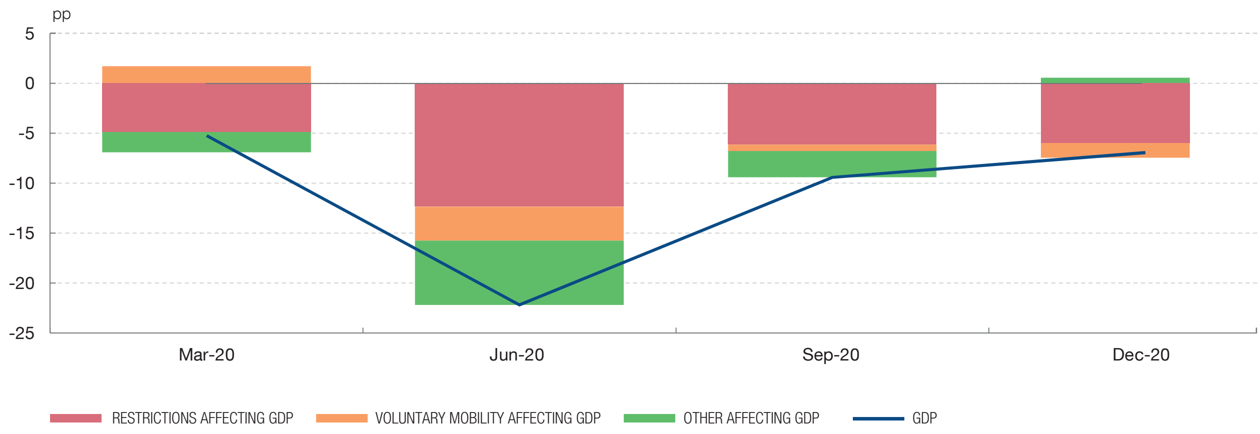
Following the strong decline in activity prompted by the pandemic in spring 2020, a path of recovery began as from Q3, in parallel with ongoing lockdown-easing (see Chart 5).

9 March is excluded as the measures were only in force for a fortnight that month.

10 See Brindusa, Cozzolino and Lacuesta (2020)

11 See González Mínguez, Urtasun and Pérez García de Mirasierra (2020)

Chart 5
GDP (PERCENTAGE DEVIATIONS FROM LEVEL)



SOURCE: Banco de España.

However, the intensity of the recovery was adversely and progressively affected from July by fresh outbreaks of the virus, which led to the re-introduction of some containment measures, this time at regional level.

6 Conclusions

The outbreak of the COVID-19 pandemic has entailed unprecedented disruption to Spanish and global economic activity. Owing to the scale of the crisis and the differences with previous recessionary episodes, the models habitually used to forecast economic activity have shown severe shortcomings.

This paper sets out a new methodological approach that attempts to mitigate these limitations by explicitly incorporating two of the most singular aspects of this crisis: the roll-out of practically unprecedented lockdown measures in an attempt to control the spread of the pandemic and the sharp reduction in people's mobility. In particular, the paper pays particular attention to quantifying, at the regional level, the intensity of the various restrictions imposed in recent months. In this connection, textual analysis techniques are used on a most extensive volume of press news.

Drawing on the regional dimension of this new indicator, the authors estimate the relationship between the intensity of the restrictive measures imposed and people's mobility, proxied by the indices constructed by Google to gauge this latter variable. It is thus possible to obtain an initial assessment of which part of the observed reduction in mobility is forced (i.e. determined by the restrictions imposed) and which part is voluntary (e.g. as a result of self-imposed measures to protect oneself from contagion). Lastly, the paper estimates the possible sensitivity of economic activity to the degree of mobility in the short term, i.e. without including the intertemporal effects related to the fact that short-term costs may give rise to medium-term benefits if they manage to lessen the need to apply greater restrictions in the future or to avoid more persistent damage to the productive system.

The results firstly suggest that the legal restrictions have strongly impacted people's mobility and economic activity. Moreover, individuals voluntarily reduced their mobility in Q2 more than may be explained by the restrictions in place. However, this effect lost momentum with the lockdown-easing measures. Lastly, the paper's findings suggest that, in the early months of the pandemic, activity contracted more sharply than the observed reduction in mobility would suggest. Nonetheless, this phenomenon practically ceased to be observable from August, which would be consistent with economic agents having been on something of a learning curve as regards living with the pandemic and its associated distortions.

References

Artola, C., A. Fiorito, M. Gil, J.J. Pérez, A. Urtasun and D. Vila (2018): "Monitoring the Spanish economy from a regional perspective: main elements of analysis". *Occasional Paper* 1809, Banco de España. https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/PublicacionesSeriadas/DocumentosOcasionales/18/Files/do1809e.pdf.

Baker, S. R., N. Bloom, and S. J. Davis (2016). "Measuring Economic Policy Uncertainty". *The Quarterly Journal of Economics* 131 (4), 1593–1636.

Banco de España (2020): "Quarterly Report on the Spanish Economy". *Economic Bulletin,* 4/2020, December, Banco de España. https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/InformesBoletinesRevistas/BoletinEconomico/20/T4/descargar/Files/be2004-ite.pdf.

Brindusa, A., M. Cozzolino and A. Lacuesta (2020): "Teleworking in Spain". Analytical Article, *Economic Bulletin* 2/2020, Banco de España. https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/InformesBoletinesRevistas/ArticulosAnaliticos/20/T2/descargar/Files/be2002-art13e.pdf.

González Mínguez, J., A. Urtasun and M. Pérez García de Mirasierra (2020): "Consumption in Spain during the state of alert: an analysis based on payment card spending". Analytical Article, *Economic Bulletin* 3/2020, Banco de España. https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/InformesBoletinesRevistas/ArticulosAnaliticos/20/T3/descargar/Files/be2003-art22e.pdf.

Google LLC, *Google COVID-19 Community Mobility Reports.*

https://www.google.com/covid19/mobility/ Accessed: 9 October 2020.

Hale, T., N. Angrist, E. Cameron-Blake, L. Hallas, B. Kira, S. Majumdar, A. Petherick, T. Phillips, H. Tatlow and S. Webster (2020), *Oxford COVID-19 Government Response Tracker,* Blavatnik School of Government.

Petherick, A. et al. (2020), "Variation in government responses to COVID-19", *Blavatnik School Working Paper* 32, Blavatnik School of Government, Oxford University, https://www.bsg.ox.ac.uk/research/publications/variation-government-responses-covid-19.

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