1 Effects of COVID-19 on geographic mobility and working habits

This chapter analyses the impact COVID-19 in daily mobility of people across different types of regions. To this end, the chapter uses two new sources of real-time data at the subnational level: Google-maps lifestyle data for TL2 regions in G7 countries data broken down by different types of mobility (e.g. consumer vs workplace), and Mapbox movement data for United States counties and German TL3 regions. The analysis also matches TL2 information with regional data to assess the relationship between mobility trends during February 2020 and February 2021 and regional characteristics.

How much has COVID-19 affected the daily mobility of people, especially in relation to their home-work movements? Has the impact of COVID-19 on mobility been larger in cities than in other areas? Answering these questions requires real-time data that are usually not available from official sources. Recently, non-standard sources of data have been used to analyse the impact of COVID-19 on socio-economic indicators, including mobile-phone, credit card transaction and private business data (Chetty et al., 2020[1]), and mobility reports from Google at the country level (Pareliussen and Glocker, 2021[2]).

This chapter tries to answer these questions by using two new sources of real-time data at the subnational level: Google-maps lifestyle data for TL2 regions in G7 countries data broken down by different types of mobility (e.g. consumer vs workplace) (Google LLC, 2021[3]), and Mapbox movement data for United States counties and German TL3 regions (Mapbox, 2021[4]). The analysis also matches TL2 information with regional data including GDP per capita, the share of urban population and the degree of teleworkability to assess the relationship between mobility trends during February 2020 and February 2021 and regional characteristics.

After this introduction, the next section presents the methodology and results using Google's mobility report data for G7 countries and its relation to regional characteristics. The third section presents the method and results for mobility trends using Mapbox data for Germany and the US. The last section concludes.

Mobility trends and patterns using Google mobility data

This section analyses developments in people's mobility in TL2 regions of Canada, England (UK), France Japan and the US during the period between the 15 February 2020 and the 11 February 2021 using daily data from the Global Mobility Report of Google[1] (Google LLC, 2021[3]). The section starts by describing briefly the processing of Google's data, it then discusses national-level patterns and then proceeds with the analysis of mobility trends for TL2 regions of G7 countries.

Data sources and processing

People's mobility is measured by Google using number of visitors to a set of categorised places, namely:

- "Retail and Recreation" refers to mobility for places like restaurants, cafes, shopping centres, theme parks, museums, libraries, and movie theatres;
- "Grocery and Pharmacy" refers to places like grocery markets, food warehouses, farmers markets, specialty food shops, drug stores, and pharmacies,
- "Transit Stations" refers to places like public transport hubs such as subway, bus, and train stations; and,
- "Workplaces" refers to places of work.[2]

These data are used to compute the percentage change in people's mobility within the geographic area of the considered TL2 region with respect to the median value for the corresponding day of the week of 3 January 2020 to 3 February 2020 period (baseline period).[3] Two time-plots constructed on the basis of this data inform on new trends and/or changes in existing trends in mobility over the period February – February 2021. The next section analyses changes in mobility in each country and fortnight and the following section shows the daily changes in mobility in each TL2 region, both with respect to the areas of:

- "Retail and Recreation" and "Grocery and Pharmacy", indicative of the mobility of consumers, and
- "Transit Stations" and "Workplaces", indicative of the mobility of workers.

For illustrative purposes, the daily time-plots include the name of the leading, median and lower region of each country in each considered place in the last day reported (15 February 2021).

Leaving aside seasonality effects and sample selection biases, reported values around zero would indicate "return to normality" (e.g., within the ±10% interval), whereas large negative and positive values (e.g., above the ±10% interval) would indicate "below normality" and "above normality" situations, respectively.

The mobility time-plots are complemented with the daily change in the "Stringency Index" constructed by (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]) to proxy for the strictness of the "lockdown style" policies that (primarily) restrict people's behaviour for the countries of interest.[4] The reported "Stringency Index" of the Oxford Covid-19 Government Response Tracker is the average of indicators on containment and closure policies, such as school closures and restrictions in movement.

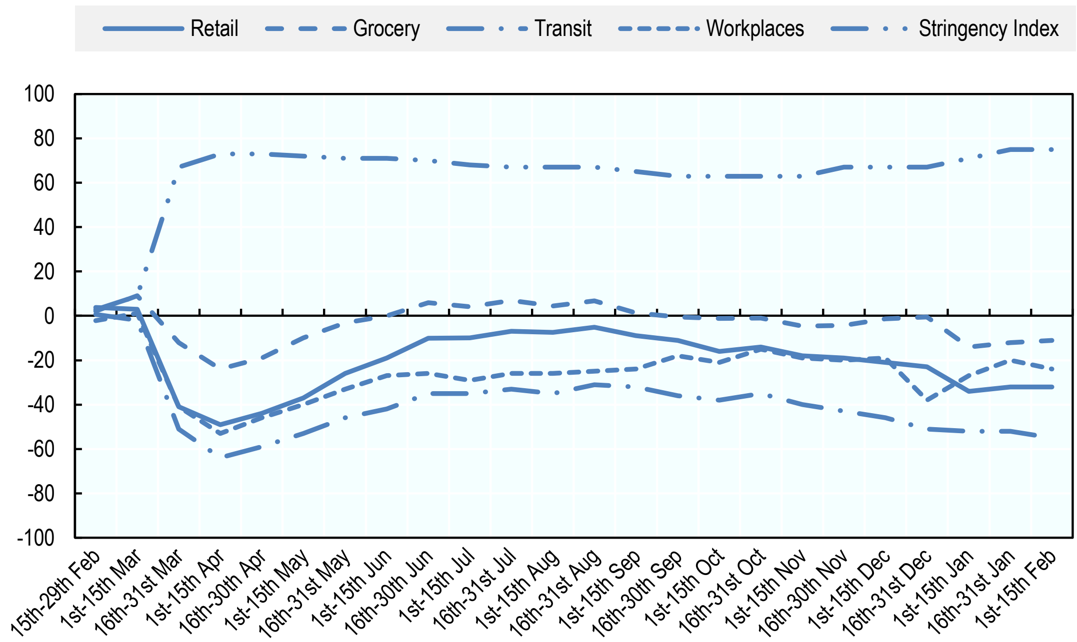
Overall mobility trends in G7 countries

Figures Figure 1.1. to Figure 1.7 illustrate how mobility in the G7 countries (by fortnight) changed during the considered period. Three large sub-periods can be distinguished:

- Across countries, there is an initial drop in mobility up until the month of April 2020 (May 2020 in Japan). The magnitude of this initial drop, however, varies between the lowest 40%-50% in Japan (Figure 1.6) and the US (Figure 1.7), up to the 80% in France (Figure 1.3), Italy (Figure 1.5) and England (UK) (Figure 1.2). The impact was particularly severe in retail and recreation places and transit stations.
- There is a subsequent and progressive recovery in the following five months. The "return to normal" (i.e., values within the ±10% interval) happened during summer, although mostly in consumers' mobility, since all countries still showed values below -20% in mobility around public transport hubs and/or workplaces. Only Japan reached "normal values" in all the considered places at the end of September (Figure 1.6).
- The final period shows another soft and continuous decline in mobility, with minimum values around the Christmas period (Germany at the end of December (Figure 1.4); Canada (Figure 1.1) and England (UK) (Figure 1.2) at the beginning of January), with the exception of France (Figure 1.3) and Italy to a lesser extent (early November) (Figure 1.5) and the US (early February) (Figure 1.7). In terms of magnitude and with the exception of Germany, the impact was not as severe as the initial one in April, but it was still substantial (around 20%-30% in Japan (Figure 1.6) and the US (Figure 1.7), but 40%-50% in the rest of the G7 countries). This, however, does not apply to the mobility around grocery stores and pharmacies ("Grocery and Pharmacy" category), which reached "normal values" in all countries.

The most recent data for 2021 indicates a certain stability and slight upturn in mobility that, nevertheless, still remains on average below "normality levels" in an order of magnitude of between 20% (e.g., Japan) and 40% (e.g., Germany and England (UK)). Again, this does not apply to the mobility around grocery stores and pharmacies places which, with the exception of England (UK), remains in "normal values".

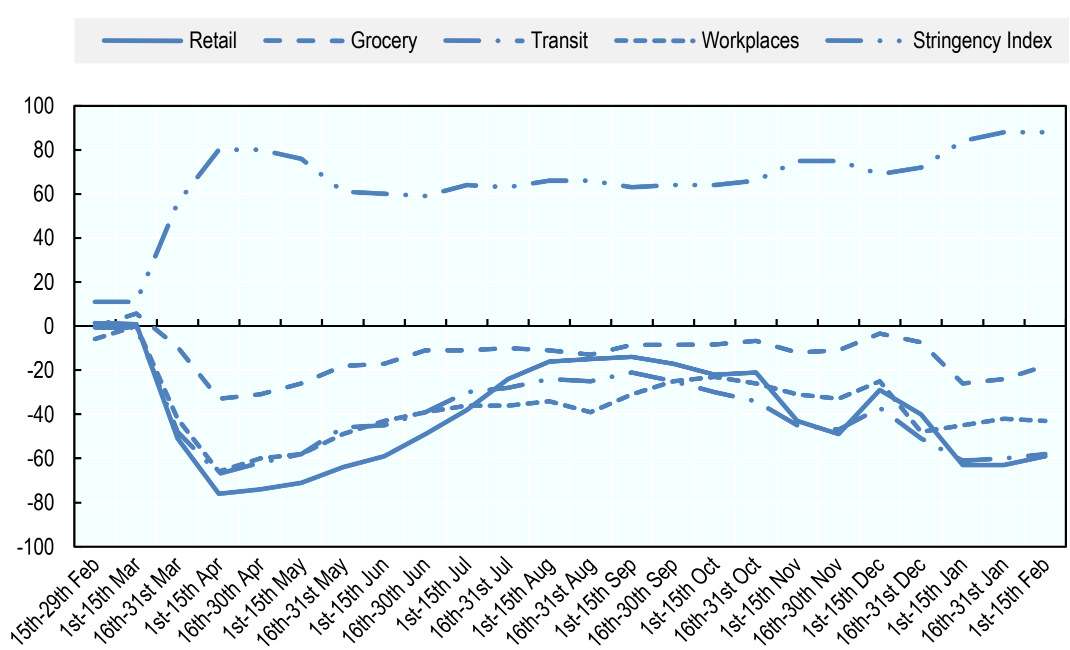
Figure 1.1. Mobility in G7 countries and strictness of lockdown policies, Canada



Note: See Figure 1.7 notes.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

StatLink https://doi.org/10.1787/888934248141

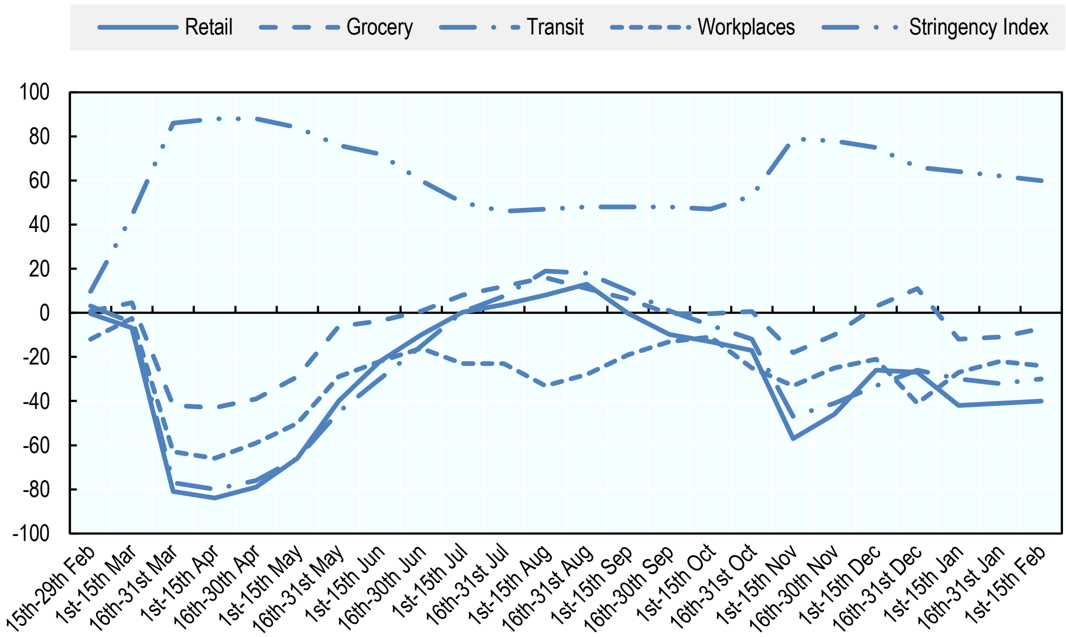
Figure 1.2. Mobility in G7 countries and strictness of lockdown policies, England (UK)



Note: See Figure 1.7 notes.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

StatLink https://doi.org/10.1787/888934248160

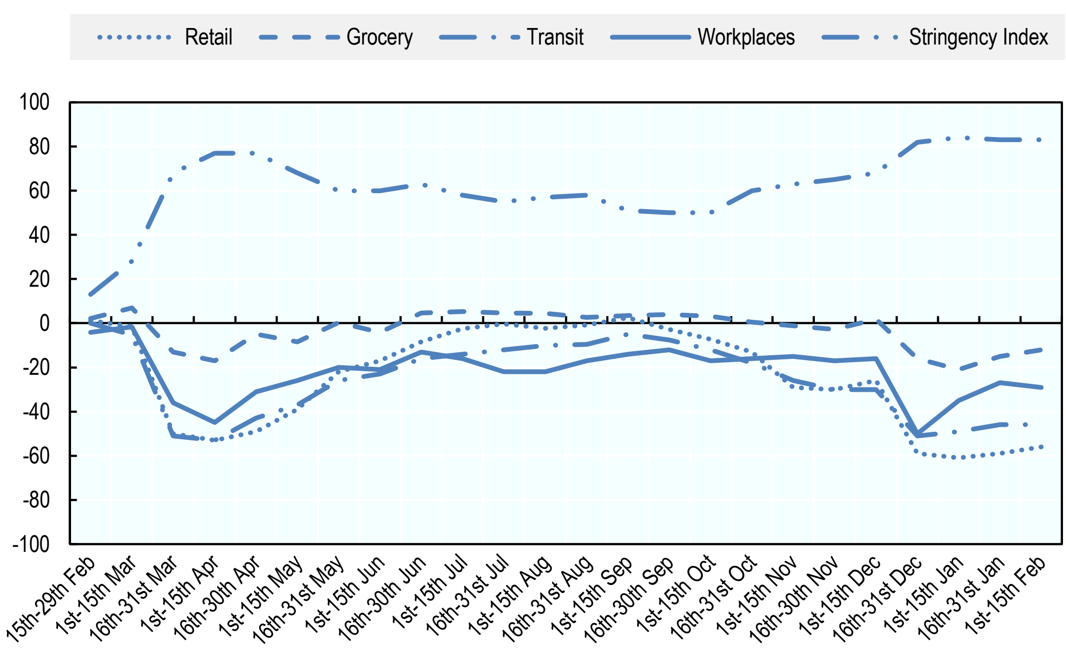
Figure 1.3. Mobility in G7 countries and strictness of lockdown policies, France



Note: See Figure 1.7 notes.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

StatLink https://doi.org/10.1787/888934248179

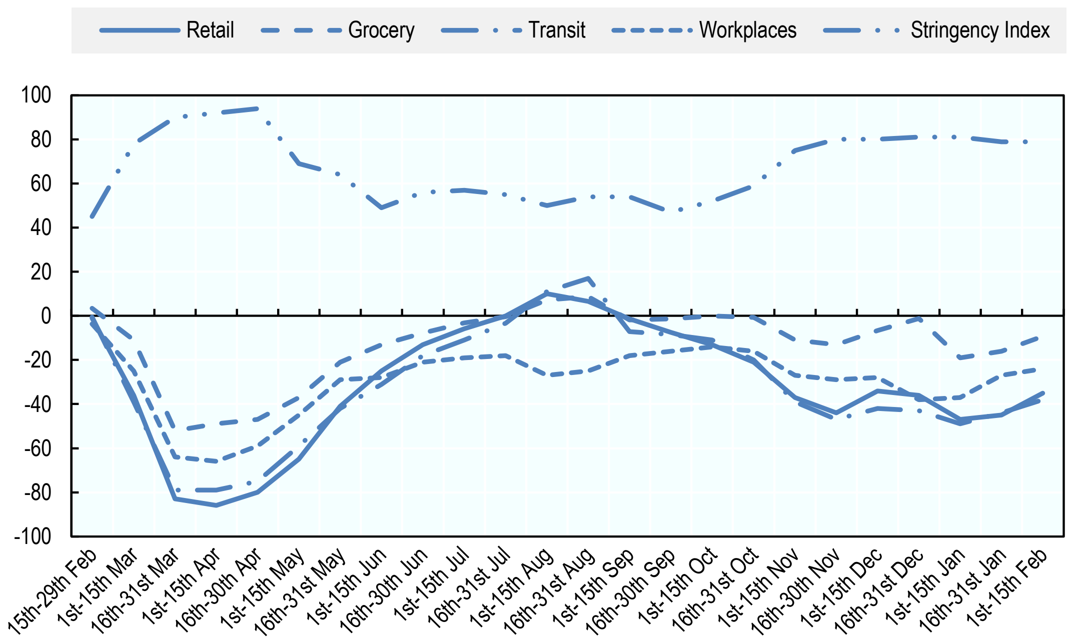
Figure 1.4. Mobility in G7 countries and strictness of lockdown policies, Germany



Note: See Figure 1.7 notes.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

StatLink https://doi.org/10.1787/888934248198

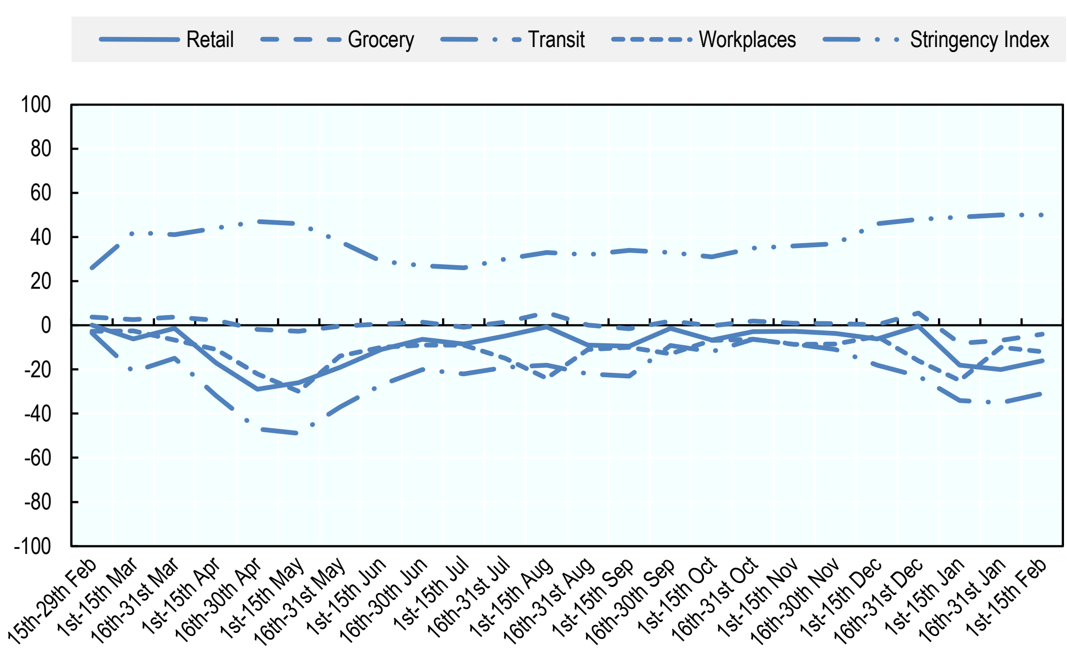
Figure 1.5. Mobility in G7 countries and strictness of lockdown policies, Italy



Note: See Figure 1.7 notes.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

StatLink https://doi.org/10.1787/888934248217

Figure 1.6. Mobility in G7 countries and strictness of lockdown policies, Japan



Note: See Figure 1.7 notes.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

StatLink https://doi.org/10.1787/888934248236

Figure 1.7. Mobility in G7 countries and strictness of lockdown policies, United States

Note: Mobility values correspond to the average of the fortnight's means in the percentage change in mobility (from the median value for the corresponding day of the week from 3 January 2020 to 3 February period) to different places (Retail & Recreation, Grocery & Pharmacy, Transit Stations and Workplaces). The stringency index (dosh line) approximates the strictness of the "lockdown style" policies that (primarily) restrict people's behaviour.
Source: Authors' elaboration based on (Google LLC, 2021[3]) (regional mobility) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

StatLink https://doi.org/10.1787/888934248255

The evidence displays the expected negative association between mobility and lockdown policies, as the evolution of the "Stringency Index" largely mirrors that of mobility. After a clear jump around the month of March, the index started to decline in May, particularly in France, Italy and Japan, while it did so more softly in the remaining countries. It then rose again around November-December to reach March levels, or even higher, like in Japan and England (UK).

Workers' mobility seems to have been affected to a much greater extent than consumers' mobility throughout the period. When comparing different types of mobility, the only area that appeared to have "returned to normal" is the mobility around grocery stores and pharmacies. Across countries, Japan and the US appeared to be less affected than the other, and show more stability throughout the period. The European countries, on the other hand, appeared to have been more affected and showed deeper peaks in mobility (notably in the two drops observed in the period). Lastly, Canada lies somewhere in the middle in terms of both impact and peaks.

While the evidence suggests that lockdown policies were effective in restricting mobility, lockdown policies alone do not seem to explain mobility trends across countries. The correlation between increases in the stringency index and mobility drops is particularly high in the early period and/or when containment and closure policies were more severe. Nevertheless, the levels of the "Stringency Index" in Japan were substantially lower than in other countries: they were at nearly half of the levels reported for the European countries and substantially below those of the US and Canada. In fact, Japan declared a state of emergency, which implies softer lockdown policies than the ones generally imposed in Europe and the US.

This suggests that possibly other economic, technological and/or psychological factors contribute significantly to the observed differences in the impact of COVID-19 on people's mobility.

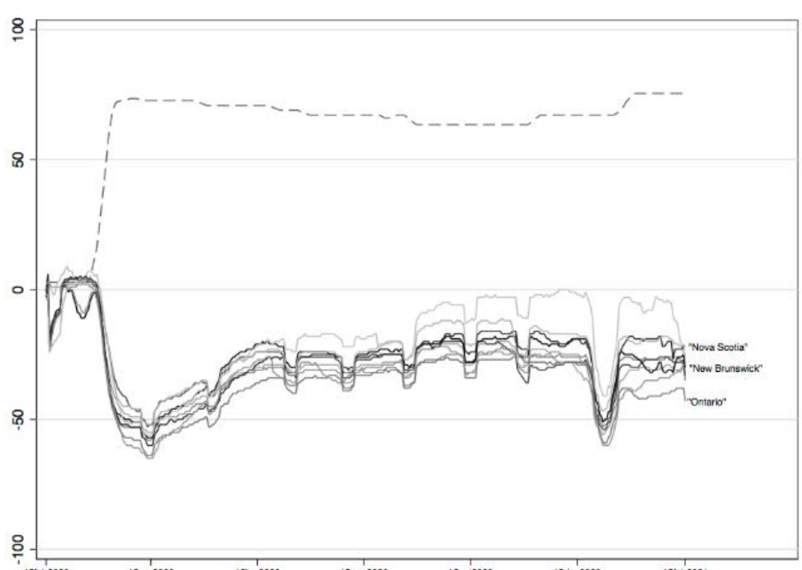
Mobility trends in large regions in G7 countries

Figures Figure 1.8 to Figure 1.14 illustrate the evolution of workplace mobility in TL2 regions of the G7 countries for the considered period. Annex 1.A includes the same figures for the four types of mobility.

While mobility patterns showed substantial variation across regions within each country, it is unclear what part of this variation can be attributed to COVID-19 related policies. The trends by regions show that, while the initial drop affected the regions of the same country in roughly the same way (i.e., in a magnitude similar to that observed for the whole country in the previous section), both the recovery and subsequent fall in mobility show substantial variation across regions of the same country. This is evident from the increasing dispersion in the regional trends after the initial shock. By mid-August 2020 many regions in different countries showed values around zero in consumers' mobility (see Annex 1.A), which means that they were (almost) back to normal levels of mobility. Some examples may help illustrate this point:

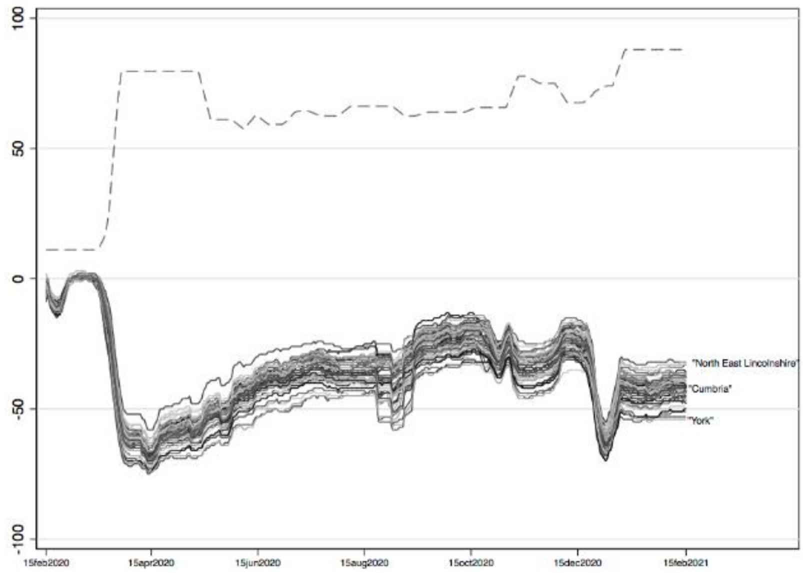
- In the US, both Rhode Island and Oklahoma were just below 5% in the percentage change of consumers' mobility with respect to the baseline period. In contrast, the District of Columbia showed mobility figures of around 50% below the values of the baseline period (in both consumers' and workers' mobility) (Figure 1.14).
- In Japan, values in "Grocery and Pharmacy" remained close to zero practically across the entire period, with average values in January 2020 at around 7% below the values of the baseline period. However, while regions like Tottori and Wakayama showed no difference in mobility levels with respect to the baseline period, the region of Okinawa was 13% below the values of the baseline period (Figure 1.20).

Figure 1.8. Commuting to workplaces in TL2 regions and Strictness of lockdown policies, Canada



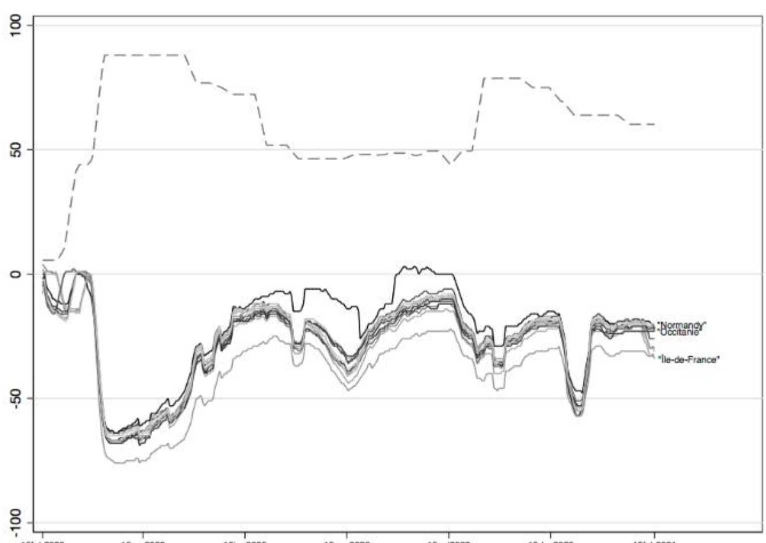
Note: See Figure 1.14 notes.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

Figure 1.9. Commuting to workplaces in TL2 regions and Strictness of lockdown policies, England (UK)



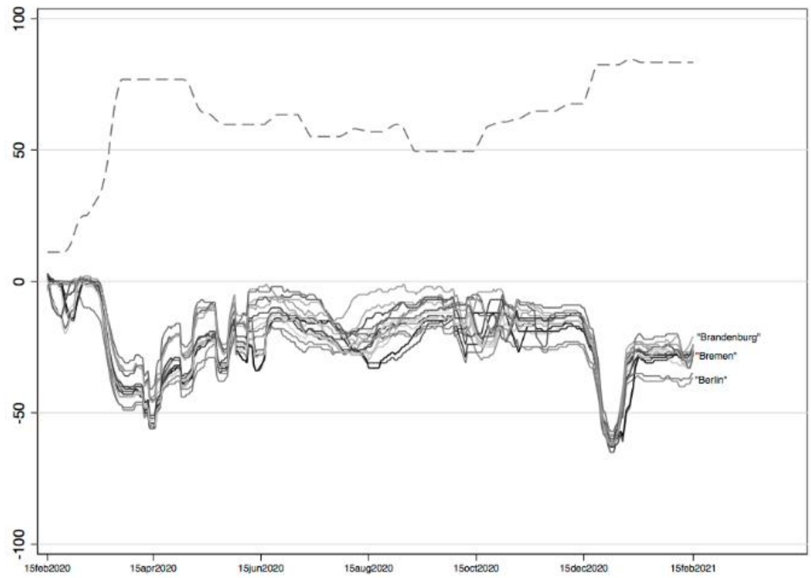
Note: See Figure 1.14 notes.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

Figure 1.10. Commuting to workplaces in TL2 regions and Strictness of lockdown policies, France



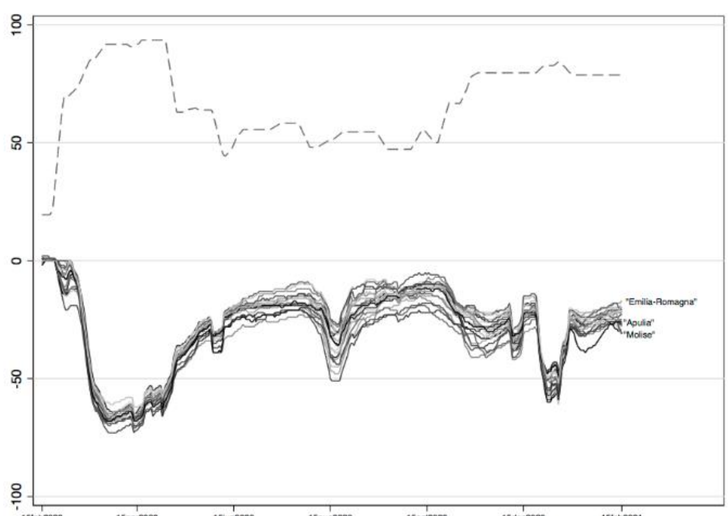
Note: See Figure 1.14 notes.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

Figure 1.11. Commuting to workplaces in TL2 regions and Strictness of lockdown policies, Germany



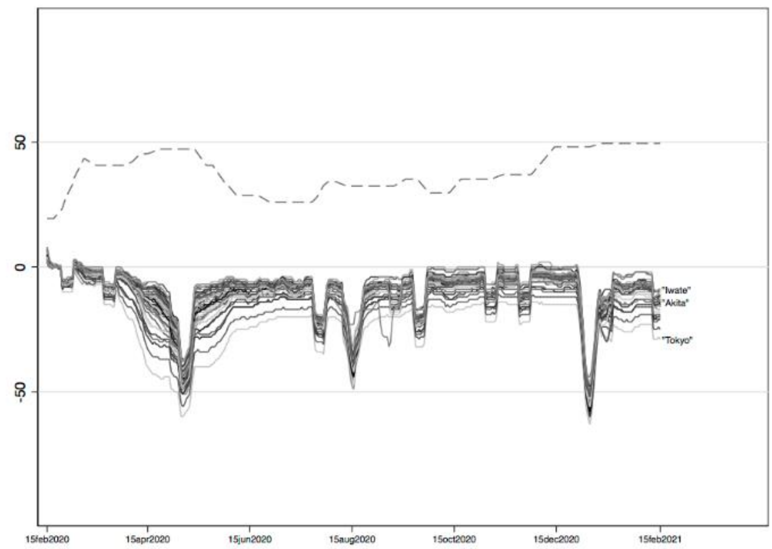
Note: See Figure 1.14 notes.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

Figure 1.12. Commuting to workplaces in TL2 regions and Strictness of lockdown policies, Italy



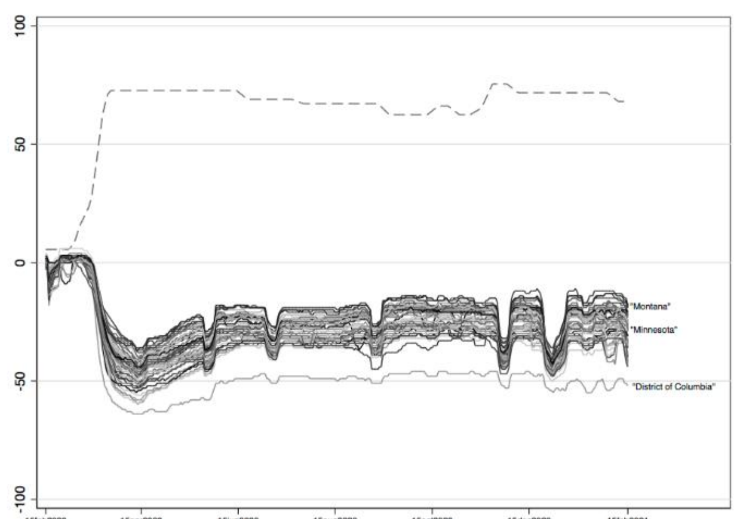
Note: See Figure 1.14 notes.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

Figure 1.13. Commuting to workplaces in TL2 regions and Strictness of lockdown policies, Japan



Note: See Figure 1.14 notes.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

Figure 1.14. Commuting to workplaces in TL2 regions and Strictness of lockdown policies, United States



Note: Mobility values correspond to the percentage change mobility (from the median value for the corresponding day of the week from 3 January 2020 to 3 February) in mobility to Workplaces within the corresponding TL2 geographic area. The stringency index (dosh line) approximates the strictness of the "lockdown style" policies that (primarily) restrict people's behaviour.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

To focus on the relationship between mobility and regional characteristics, Table 1.1 summarises the three least and most affected regions in terms of average mobility[5], as well as in terms of GDP per capita, "teleworkability", and share of urban population. Teleworkability is measured as the estimated share of jobs that can potentially be performed at home[6] (Dingel, J. and Neiman, B., 2020[6]) (OECD, 2020[7]) and the share of urban population is measured as the percentage of people living in Functional Urban Areas (FUAs) in each TL2 region. For each country, three different moments are identified based on average mobility by fortnight:

- the minimum value between 15 February to 30 April 2020 (initial fall in mobility levels),
- the maximum value between in 1 May and 15 September 2020 (gradual recovery period) and,
- the minimum value between 16 September and 15 February 2021 (second drop in mobility levels).

The evidence suggests that factors related to the initial fall in relative mobility during the first wave (including not only containment policies but also possibly regional characteristics) continued to determine, to a large extent, mobility patterns in the rest of the period. Table 1.1 shows that, in many cases, the three most affected regions (i.e., the regions with the lowest relative mobility in the first shock compared to pre-COVID levels in January 2020, see first column), were on average more affected in the second wave (third column) and further away from "normal levels" during the recovery period (second column of the table). Similarly, the three least affected regions in terms of mobility in the initial shock were the least affected in the second wave (third column) and were the closest to "normal levels" during the recovery period. In other words, the ranking of mobility across regions within countries in the initial shock remained relatively stable throughout the year, including the second wave.

The composition of least and most affected regions in Table 1.1 suggests that the evolution of mobility and the return to normal may be related to certain characteristics of the regions. A comparison of the first three and last three columns of Table 1.1 for countries with available data[7] shows that the most affected regions in terms of mobility in the initial and second wave had, in many cases, the highest shares of tele-workability, urban share and, to a lesser extent, higher levels of GDP per capita. This association is observed for Quebec and Ontario in Canada (urban share); Hamburg, Bremen, Bavaria and Berlin in Germany (GDP per capita, remote working and urban share); Lombardy (GDP per capita and urban share) and Trentino-South Tyrol (GDP per capita) in Italy; Tokyo and Kanagawa in Japan (remote working); and District of Columbia (GDP per capita, remote working and urban share), New York (GDP per capita) and Massachusetts (GDP per capita, remote working) for the United States.

Table 1.1. Most and least affected three regions in average mobility during key dates and top and bottom regions in GDP per capita, remote working and rurality indices, G7 countries

Country	Initial wave	Progressive recovery	Second wave	GDP PC	Remote working	Urban share
Canada	**Least affected regions (lowest drop in mobility)**			**Top regions (highest rank)**		
	Nunavut	Prince Edward Island	Nunavut	Alberta	*Ontario*	*Ontario*
	Saskatchewan	Newfoundland and Labrador	Newfoundland and Labrador	Saskatchewan	British Columbia	*Quebec*
	Yukon	New Brunswick	Prince Edward Island	Newfoundland and Labrador	Quebec	Alberta
	Most affected regions (highest drop in mobility)			**Bottom regions (lowest rank)**		
	Quebec	Northwest Territories	Quebec	Prince Edward Island New	Prince Edward Island	Newfoundland and Labrador
	Ontario	Ontario	Ontario	Nova Scotia	Newfoundland and Labrador	Saskatchewan
	Nova Scotia	Yukon	Manitoba	New Brunswick	New Brunswick	Nova Scotia
France	**Least affected regions (lowest drop in mobility)**			**Top regions (highest rank)**		
	Corsica	Corsica	Corsica			
	Bourgogne-Franche-Comté	Nouvelle-Aquitaine	Nouvelle-Aquitaine			

	Provence-Alpes-Côte d'Azur	Brittany	Brittany			
	Most affected regions (highest drop in mobility)			**Bottom regions (lowest rank)**		
	Île-de-France	Île-de-France	Île-de-France			
	Grand Est	Hauts-de-France	Auvergne-Rhône-Alpes			
	Pays de la Loire	Grand Est	Hauts-de-France			
Germany	**Least affected regions (lowest drop in mobility)**			**Top regions (highest rank)**		
	Brandenburg	Mecklenburg-Vorpommern	Brandenburg	*Hamburg*	*Hamburg*	*Berlin*
	Thuringia	Schleswig-Holstein	Saxony-Anhalt	*Bremen*	*Berlin*	*Hamburg*
	Saxony-Anhalt	Brandenburg	Mecklenburg-Vorpommern	*Bavaria*	*Hesse*	*Bremen*
	Most affected regions (highest drop in mobility)			**Bottom regions (lowest rank)**		
	Saarland	Berlin	Berlin	Mecklenburg-Vorpomme	Mecklenburg-Vorpomme	Saxony-Anhalt
	Bavaria	Hamburg	Bavaria	Saxony-Anhalt	Saxony-Anhalt	Rhineland-Palatinate
	Hamburg	Bremen	Hesse	Brandenburg	Thuringia	Thuringia
Italy	**Least affected regions (lowest drop in mobility)**			**Top regions (highest rank)**		
	Sardinia	**Calabria**	Umbria	*Lombardy*	Lazio	Lazio
	Umbria	Aosta	Abruzzo	*Trentino-South Tyrol*	*Lombardy*	Campania
	Molise	Molise	Calabria	Aosta Valley	Liguria	*Lombardy*
	Most affected regions (highest drop in mobility)			**Bottom regions (lowest rank)**		
	Lombardy	Lombardy	Aosta	**Calabria**	Basilicata	Marche
	Trentino-South Tyrol	Calabria	Veneto	Sicily	Calabria	Abruzzo
	Calabria	Piedmont	Lombardy	Campania	Abruzzo	Calabria
Japan	**Least affected regions (lowest drop in mobility)**			**Top regions (highest rank)**		
	Akita	Fukui	Tokushima		*Tokyo*	
	Aomori	Yamagata	Iwate		*Kanagawa*	
	Iwate	Akita	Kagawa		Shimane	
	Most affected regions (highest drop in mobility)			**Bottom regions (lowest rank)**		
	Tokyo	Tokyo	Tokyo		Kagawa	
	Okinawa	Okinawa	Osaka		Kagoshima	
	Kanagawa	Osaka	Ishikawa		Kochi	
United Kingdom (UK)	**Least affected regions (lowest drop in mobility)**			**Top regions (highest rank)**		
	North Lincolnshire	Cornwall	North Lincolnshire			
	East Riding of Yorkshire	Isle of Wight	North East Lincolnshire			
	Redcar and Cleveland	Blackpool	Torbay			
	Most affected regions (highest drop in mobility)			**Bottom regions (lowest rank)**		
	Bath and North East Somerset	Reading	Bath and North East Somerset			
	Reading	Bristol City	Brighton and Hove			
	York	Nottingham	Reading			
United States (US)	**Least affected regions (lowest drop in mobility)**			**Top regions (highest rank)**		
	Arkansas	South Dakota	South Dakota	*District of*	*District of*	*District of*

				Columbia	*Columbia*	Columbia
	Wyoming	Wyoming	Idaho	*New York*	*Massachusetts*	New Jersey
	Oklahoma	Montana	Montana	*Massachusetts*	New Jersey	California
	Most affected regions (highest drop in mobility)			**Bottom regions (lowest rank)**		
	District of Columbia	District of Columbia	District of Columbia	Mississippi	Mississippi	New Hampshire
	New York	Hawaii	Massachusetts	West Virginia	West Virginia	West Virginia
	Hawaii	Florida	New York	Arkansas	Wyoming	Mississippi

Note: Most/least regions in mean mobility changes calculated as the average of the fortnight's means in "Retail and Recreation", "Grocery and Pharmacy", "Transit Stations" and "Workplaces". Selected fortnights correspond to those with the lower mean-country value in the period 15 February to 30 April, the higher mean-country value in the period from 1 May to 15 September and the lower mean-country value from 16 September to 15 February. For Canada: 1-15 April 2020, 16-30 June 2020 and 1-15 January 2021; for France: 1-15- April 2020, 1-15 August 2020 and 1-15 November 2020; for Germany: 1-15- April 2020, 1-15 September 2020 and 16-31 December 2020; for Italy: 1-15- April 2020, 1-15 August and 1-15 January 2020; for Japan 1-15 May 2020, 16-30 September 2020 and 1-15 January 2020; for England (UK): 1-15- April 2020, 16-30 September 2020 and 1-15 January 2020; for US: 1-15- April 2020, 1-15 August 2020 and 1-15 February 2020.
Source: Authors' elaboration based on (Google LLC, 2021[3]) (regional mobility). Own computations using data from (OECD, 2021[8]) (GDP per capita and degree of rurality), (Dingel, J. and Neiman, B., 2020[6]), (OECD, 2020[7]) and Ministry of Land, Infrastructure, Transport and Tourism (share of jobs that can potentially be performed at home).

Rural-urban differences using Mapbox activity data

This section uses Mapbox mobility data to analyse trends below the TL2-level for two countries with available data: US and Germany. The first part briefly discusses data processing. The next part shows national trends compared to the trend in cases in both countries, and the last part discusses the rural-urban comparison for both countries.

Data sources and processing

The analysis in this section is based on the Activity Index derived from Mapbox Movement data for the period 1 January 2020 to 31 December 2020 for two countries with available data: the US and Germany. Mapbox movement data is built from mobile device users and captures significant driving and non-driving mobile device activity. Unlike the Google data, the Mapbox movement data does not distinguish between types of mobility (e.g. consumer vs workplaces). On the other hand, it allows for finer geographical detail suitable for territorial comparisons.

The analysis obtains an indicator of overall activity in a country by summing activity index values observed at the local level (county for US and *Landkreis* (TL3) for Germany). To compare trends across regions with different degrees of rurality, the analysis aggregates the movement data for Germany into region types according to the OECD regional typology based on access to cities (Fadic et al., 2019[9]) (see Box 1.1). For the US, as data are available at the county level, the rural-urban analysis uses the 2013 Rural-Urban Continuum Codes from the Economic Research Service of the United States Department of Agriculture.[8] For the analysis, the eight original codes have been collapsed into four categories: metro; non-metro adjacent to metro with urban population; non-metro non-adjacent to metro with urban population; and non-metro completely rural.

Box 1.1. Classifying TL3 regions by their level of access to cities

The EU-OECD regional classification based on access takes into consideration the presence of and access to a Functional Urban Area (FUA). Access is defined in terms of the time needed to reach the closest urban area, which takes into account not only geographical features but also the status of physical road infrastructure.

The typology classifies TL3 regions into metropolitan and non-metropolitan according to the following criteria:

Metropolitan TL3 region (MR), if more than 50% of its population live in a FUA of at least 250 000 inhabitants.

Non-metropolitan TL3 region (NMR), if less than 50% of its population live in a FUA. NMRs are further classified according to their level of access to FUAs of different sizes into:

- ***Near a city > 250 000***, if more than 50% of its population lives within a 45-minute drive from a metropolitan area (a FUA with more than 250 000 people); or if the TL3 region contains more than 80% of the area of a FUA of at least 250 000 inhabitants.
- ***With/near a city <250 000***, if the TL3 region does not have access to a metro and 50% of its population has access to a small or medium city (a FUA of more than 50 000 and less than 250 000 inhabitants) within a 60-minute drive; or if the TL3 region contains more than 80% of the area of a small or medium city.
- ***Remote region***, if the TL3 region is not classified as NMR-M or NMR-S, i.e. if 50% of its population does not have access to any FUA within a 60-minute drive.

Source: (Fadic et al., 2019[9]). Classifying small (TL3) regions based on metropolitan population, low density and remoteness. OECD Regional Development Working Papers, 2019/06, OECD, Paris.

Importantly, the activity index is not scaled to population, so the size of the country or local unit (e.g. as measured by its population) affects the index. In other words, an increase in activity represents more of a change in a high-density place than in a low-density place. For this reason, the analysis focuses on trends over time and does not compare change rates across places or countries.

Box 1.2. Constructing the Mapbox activity index

The Movement Activity Index is constructed from anonymous location events transmitted from mobile devices with at least one mobile app installed that uses the Mapbox Mobile SDK. These location traces are aggregated into spatial grids of approximately $100m^2$ in size.

A normalisation period is set to January 2020 to calculate an average daily activity level over that period for each app. The activity index varies between 0 and 1. Activity = 1 represents the maximum activity observed in a country during the baseline period January 2020. This maximum activity is likely to occur in a densely populated area (for instance the busiest district of New York City). The majority of Activity Index values will fall into the ranges 0-0.3 because most places show activity levels that are well below those of the main activity centre – even during pre-COVID levels.

Source: (Mapbox, 2021[4]).

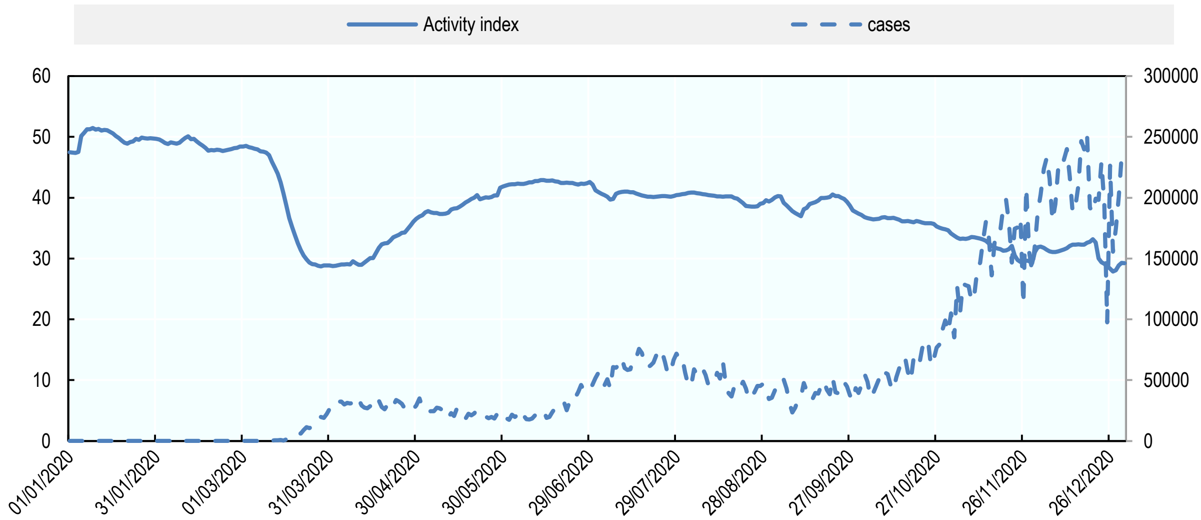
National trends in activity

While the scale of activity differs across countries (highest for US, lowest for Germany), focusing on trends over 2020 shows that, compared to Germany, the US experienced a deeper, more sudden drop in activity at the start of the pandemic crisis in March (Figure 1.15). The largest fall in the activity index in the US occurred in the last week of March, coinciding with the first peak in the number of cases and stay-at-home orders issued on 20 March in New York City. At the same time, the activity index started steadily declining in Germany in early March, reflecting start of the first wave and restrictions affecting mobility that were put in place in mid-March.

While the recovery after the first wave was much slower in Germany than in the US, both countries had regained some of their activity levels by early July – although levels remained markedly below those observed before the pandemic (Figure 1.15 and Figure 1.16). Both countries experienced reductions in activity levels again in late October that lasted through the end of the year, as the second wave emerged in both countries. The relative drop in activity compared to the increase in cases was evidently stronger in Germany than in the US.

These results are in line with those shown by the Google trends data; however the Mapbox data shows a steeper decline in activity in the US in the closing months of 2020.

Figure 1.15. Country-level trends in activity, United States



Note: 7-day moving average.
Source: Author's elaboration using (Mapbox, 2021[4]).

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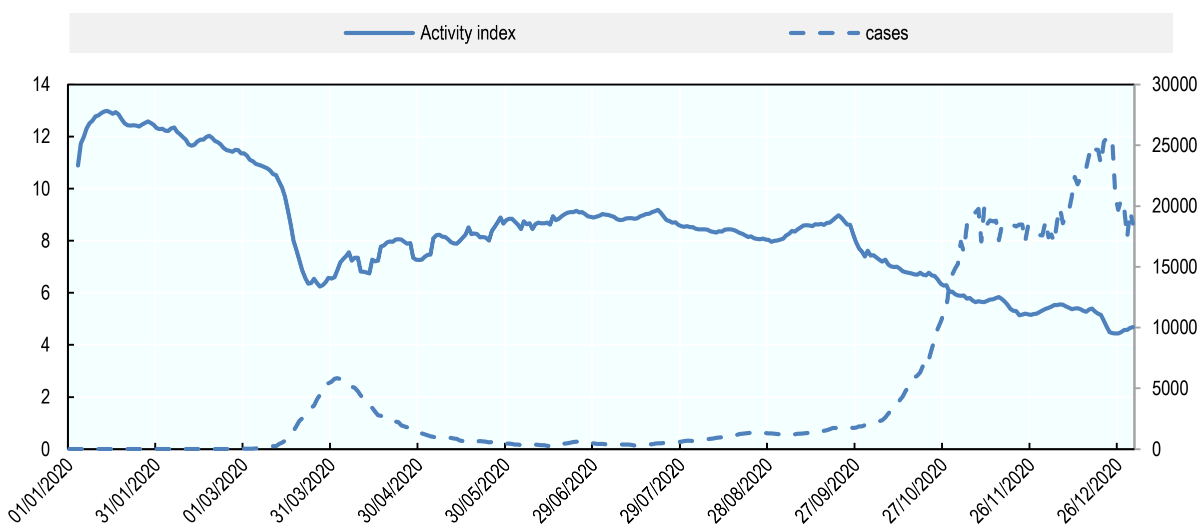
Figure 1.16. Country-level trends in activity, Germany



Note: 7-day moving average.
Source: Author's elaboration using (Mapbox, 2021[4]).

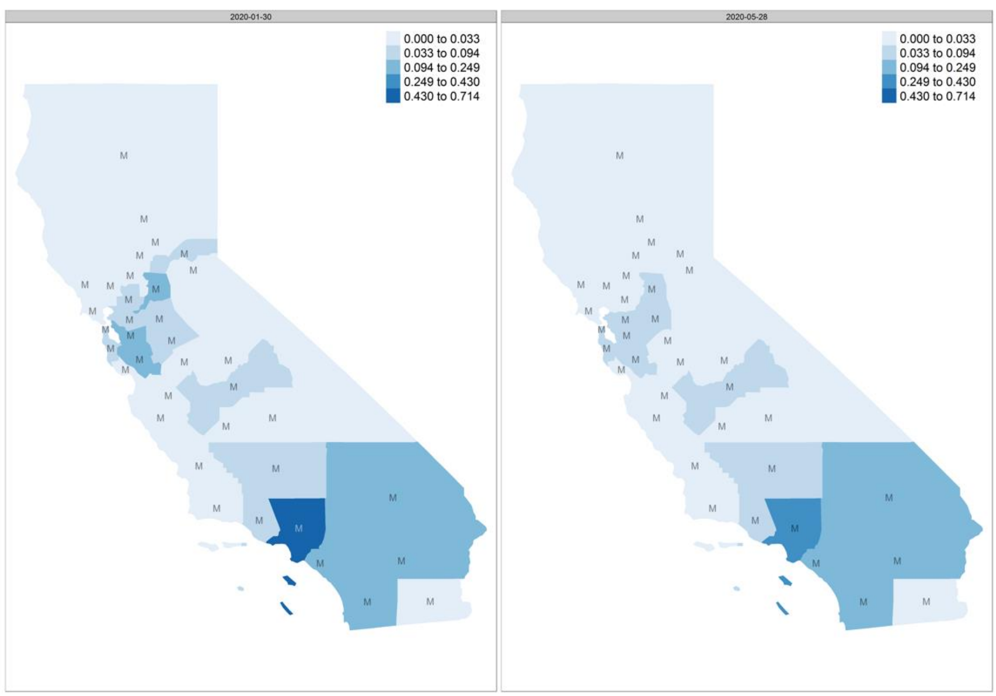
StatLink https://doi.org/10.1787/888934248293

Metropolitan/non-metropolitan differences in Germany and the US

Were falls in activity disproportionally higher in metropolitan regions (especially those with a very large city)? And did non-metropolitan regions around metropolitan regions show more resilience or even increases in activity that could be potentially linked to people inflows? To get a sense of the impact in the months following the shock of the first wave in metropolitan versus non-metropolitan regions, Figure 1.17 and Figure 1.20 compare the activity index across California, Texas and Vermont in the US, and Bavaria, North Rhine-Westphalia and Hesse in Germany between a day before the first wave shock (Thursday 30 January 2020) and a day after the impact of the first wave had subsided (Thursday 28 May 2020).

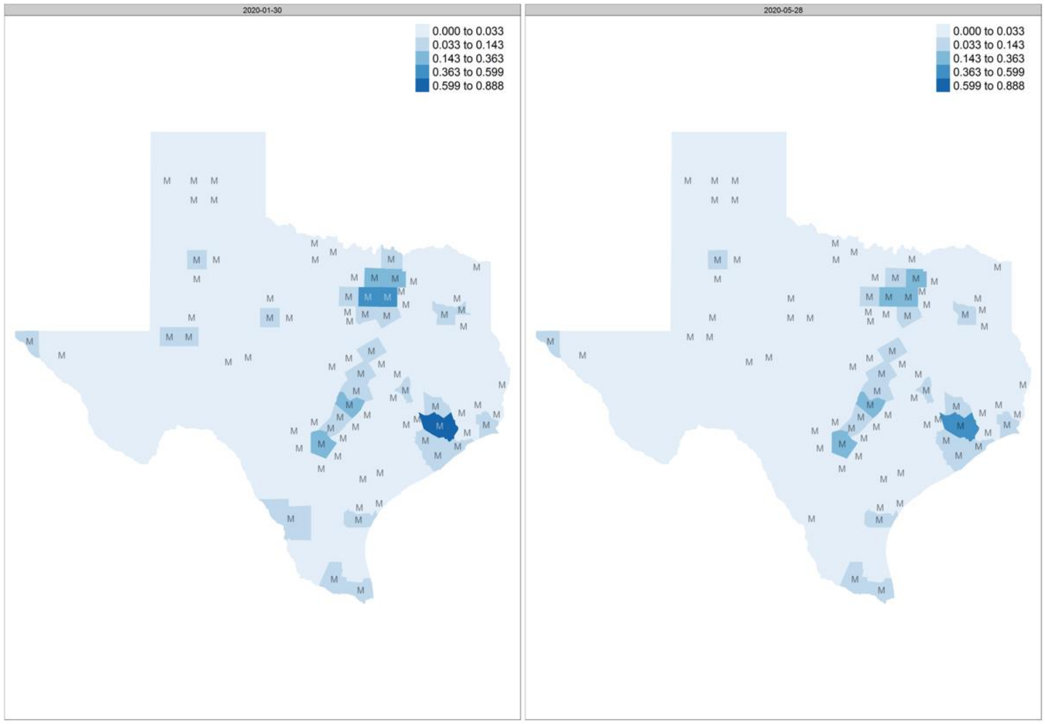
In the US, the comparison suggests that the regions with the largest drops in mobility were large metropolitan regions, while many smaller metropolitan regions maintained their activity levels at similar levels in May 2020 compared to January 2020. Changes in activity levels in non-metropolitan regions are not evident in these maps as they have much lower levels compared to metropolitan regions. The most visible activity drops in May compared to pre-COVID-19 concentrated in Los Angeles and the Silicon Valley area including San Francisco and Sacramento, while smaller metropolitan regions including San Diego do not show changes that are as large (Figure 1.17). In Texas, while a drop in activity is only visible in Houston and Dallas, the strip of metropolitan areas between Dallas and San Antonio, including Austin, showed similar levels of mobility in May 2020 compared to January 2020 (Figure 1.18). Finally, Vermont shows little variation in activity levels between the two periods, although it is worth noting that initial activity index levels were much smaller in this smaller, less urban state (Figure 1.19).

Figure 1.17. Comparison of activity index between January and May 2020, California (US)



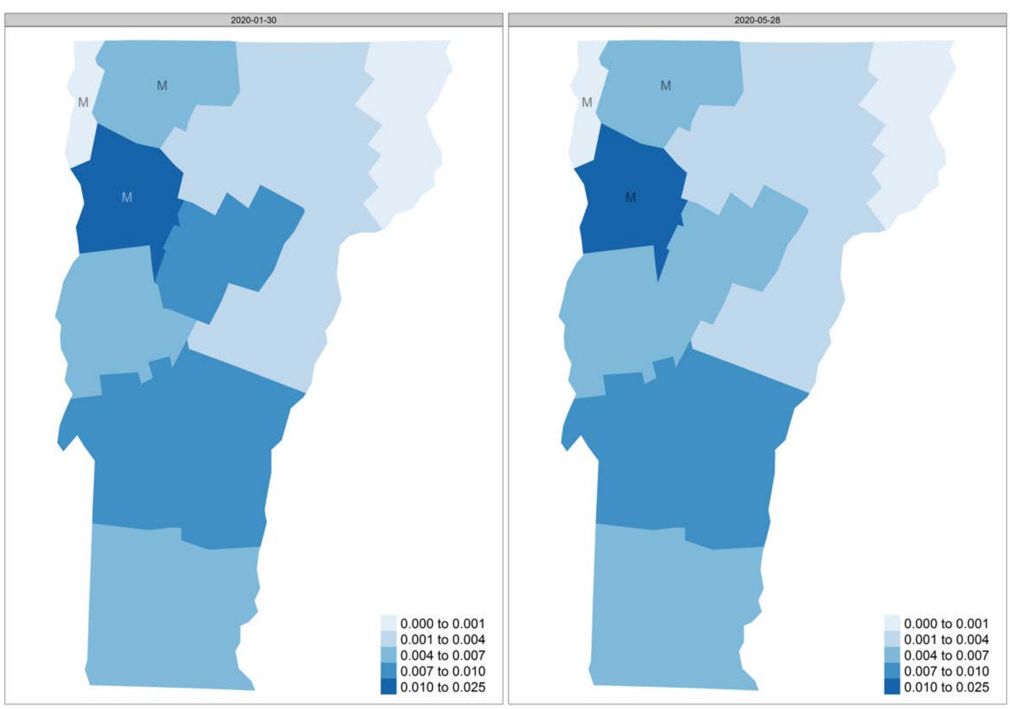
Note: M indicates Metropolitan Region. Regions with no label are non-metropolitan regions.
Source: Author's elaboration using (Mapbox, 2021[4]).

Figure 1.18. Comparison of activity index between January and May 2020, Texas (US)



Note: M indicates Metropolitan Region. Regions with no label are non-metropolitan regions.
Source: Author's elaboration using (Mapbox, 2021[4]).

Figure 1.19. Comparison of activity index between January and May 2020, Vermont (US)

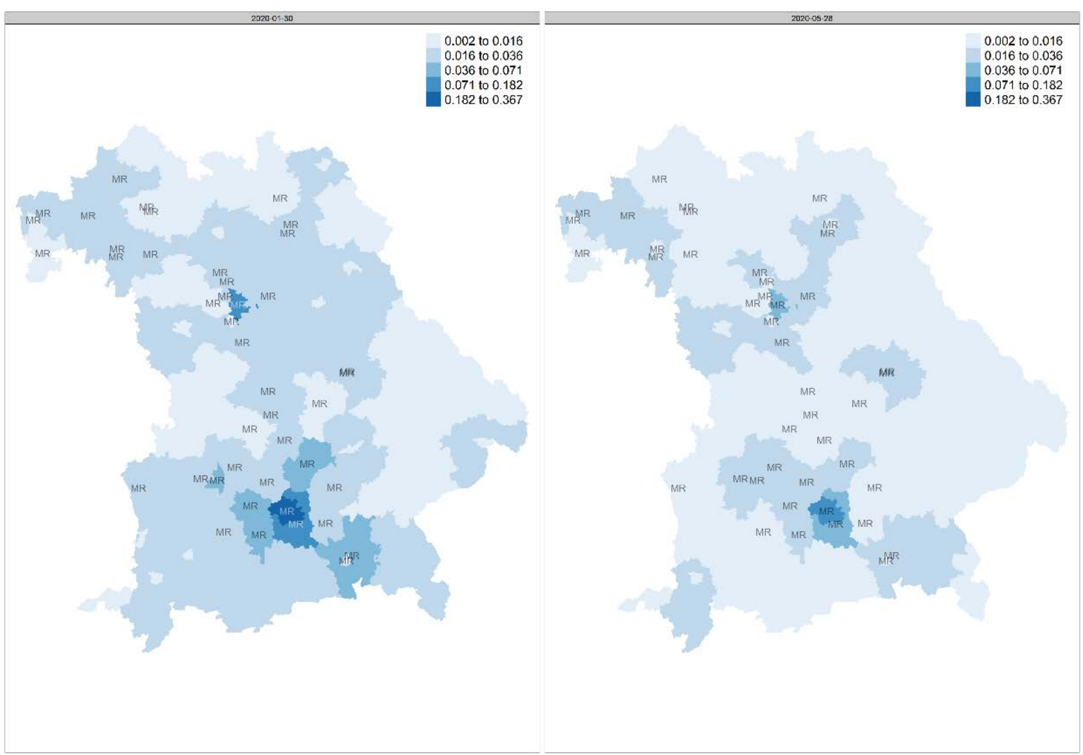


Note: M indicates Metropolitan Region. Regions with no label are non-metropolitan regions.
Source: Author's elaboration using (Mapbox, 2021[4]).

In the selected regions of Germany, activity levels in non-metropolitan regions were not always below those of metropolitan regions to start with, so the changes between January 2020 and May 2020 concern both types of regions. In Bavaria, the fall of activity in the large metropolitan region of Munich coincided with falls in activity in most of the larger economic cluster of manufacturing and ICT industries surrounding the region that covers Nuremberg in the North, Augsburg in the West and the South border, much like the larger economic area around Nuremberg (Figure 1.20). A similar trend is observed in the Ruhr valley in North Rhine-Westphalia centred on Düsseldorf, the most important industrial cluster of Germany that also includes non-metropolitan regions. In this area, the drop in activity in the large metropolitan area of Düsseldorf coincided with similar drops in activity in surrounded areas, compatible with the high level of inter-connection in these areas (Figure 1.21). Finally, in Hesse—besides the drop in activity in Frankfurt and the regions surrounding it—the data does not show higher activity levels in non-metropolitan regions but rather a drop in activity in those areas that had relatively high levels to start with (Figure 1.22).

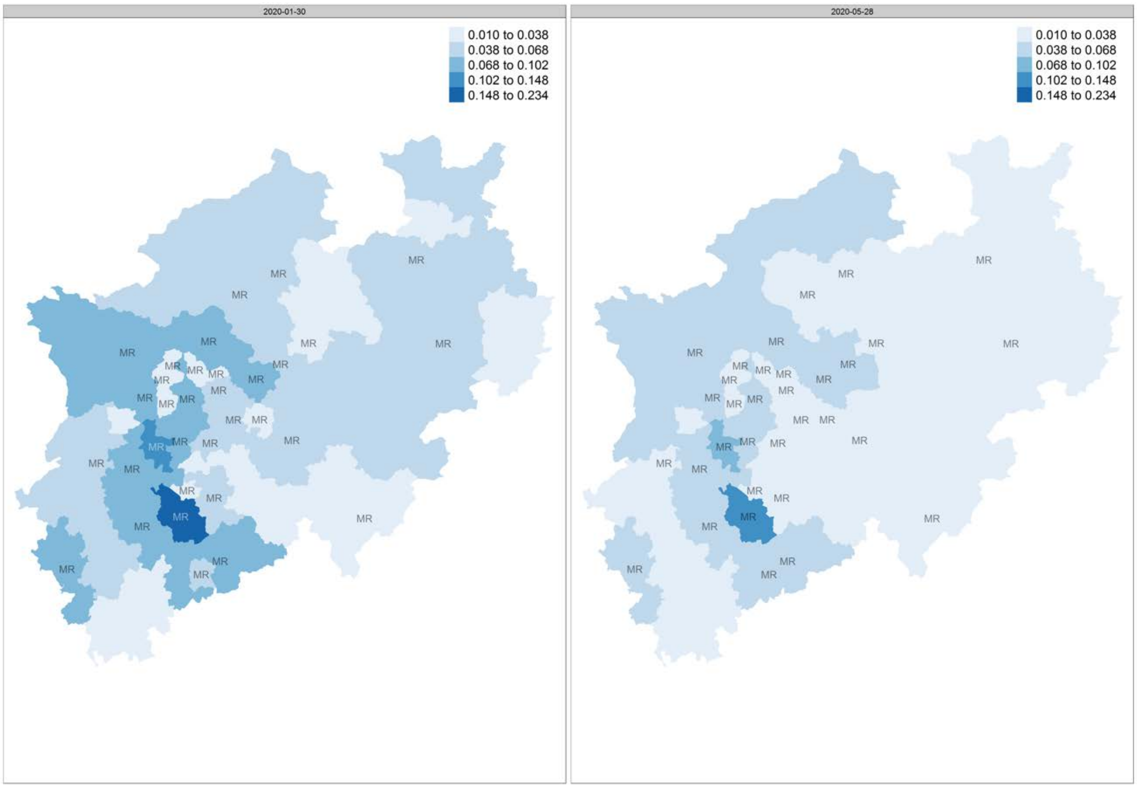
The trends for Germany are consistent with a drop in general activity in these regions that was largest in large metropolitan regions. Unlike the US, in Germany the drop may have affected both metropolitan and non-metropolitan regions. The data however does not lend support to increases in activity outside metropolitan regions that could potentially compensate for the decrease in activity in cities, at least in the months following the first wave shock.

Figure 1.20. Comparison of activity index between January and May 2020, Bavaria (Germany)



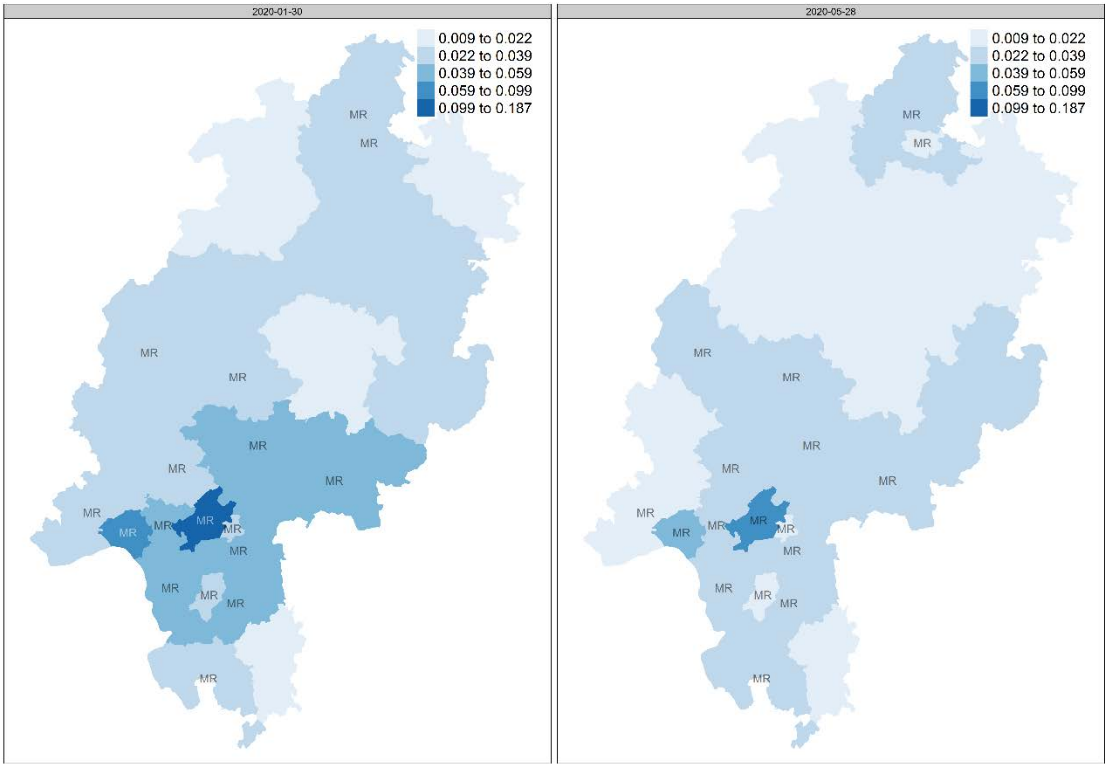
Note: M indicates Metropolitan Region. Regions with no label are non-metropolitan regions.
Source: Author's elaboration using (Mapbox, 2021[4]).

Figure 1.21. Comparison of activity index between January and May 2020, North Rhine-Westphalia (Germany)



Note: M indicates Metropolitan Region. Regions with no label are non-metropolitan regions.
Source: Author's elaboration using (Mapbox, 2021[4]).

Figure 1.22. Comparison of activity index between January and May 2020, Hesse (Germany)



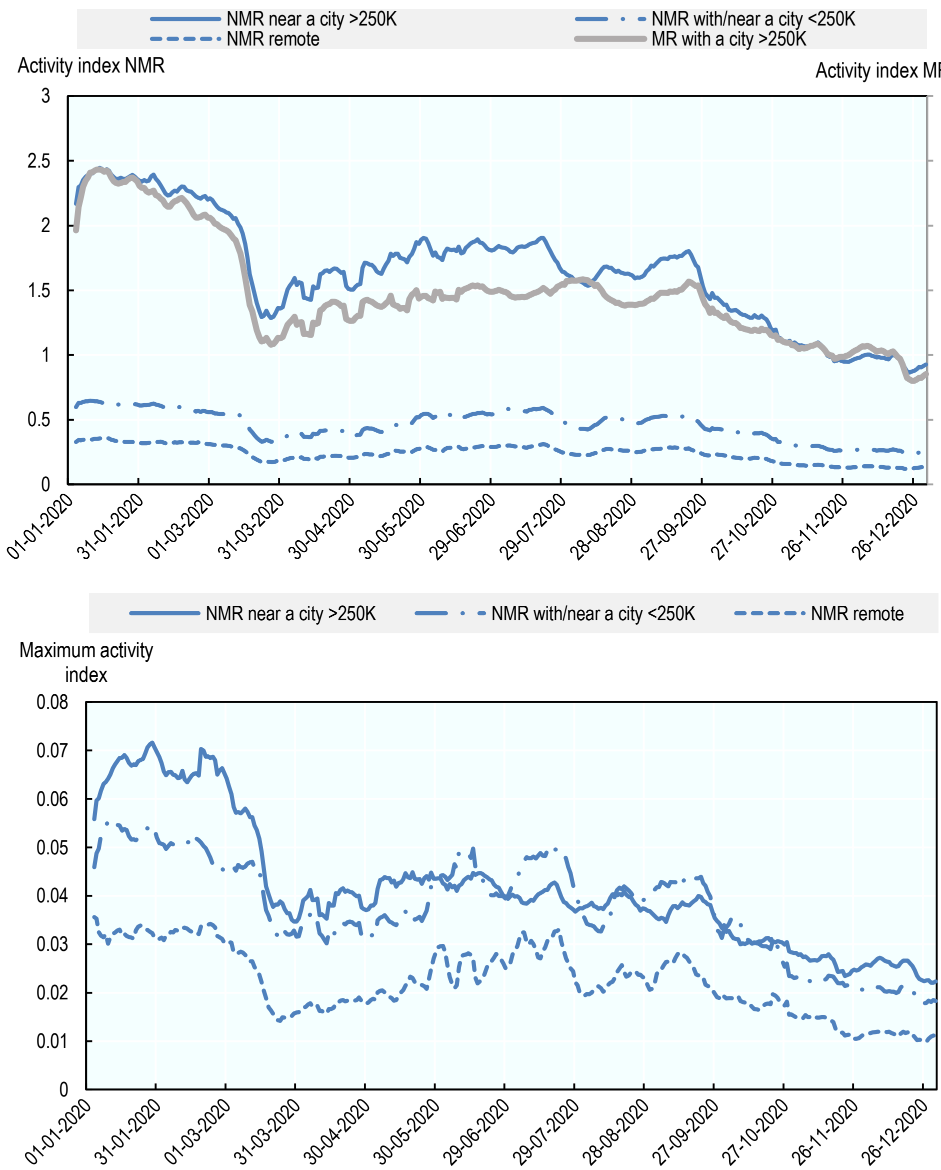
Note: M indicates Metropolitan Region. Regions with no label are non-metropolitan regions.
Source: Author's elaboration using (Mapbox, 2021[4]).

Rural-urban differences in activity in Germany and the US

To identify possible outliers to national trends and their location Figure 1.23 compares the total and maximum activity by type of region in Germany. The analysis of maximum activity focuses only on non-metropolitan regions because metropolitan regions have much higher levels of activity throughout the year.

In Germany, activity levels of regions near or with small/medium cities are closer to levels in remote regions than to levels of regions near a large city (Figure 1.23). Even so, the maximum activity levels are recorded in remote regions in certain weeks during the summer and early fall, and in regions near a large city in January-June and November-December. Then, activity starts decelerating in October, although the fall in Germany is stronger and more even across the different types of regions. This trend coincides with nationally enforced strict regulations regarding mobility as well as school and business closures.

Figure 1.23. Total activity index by type of TL3 region and maximum activity in non-metropolitan regions, Germany



Note: 7-day moving average

Source: Author's elaboration using (Mapbox, 2021[4]).

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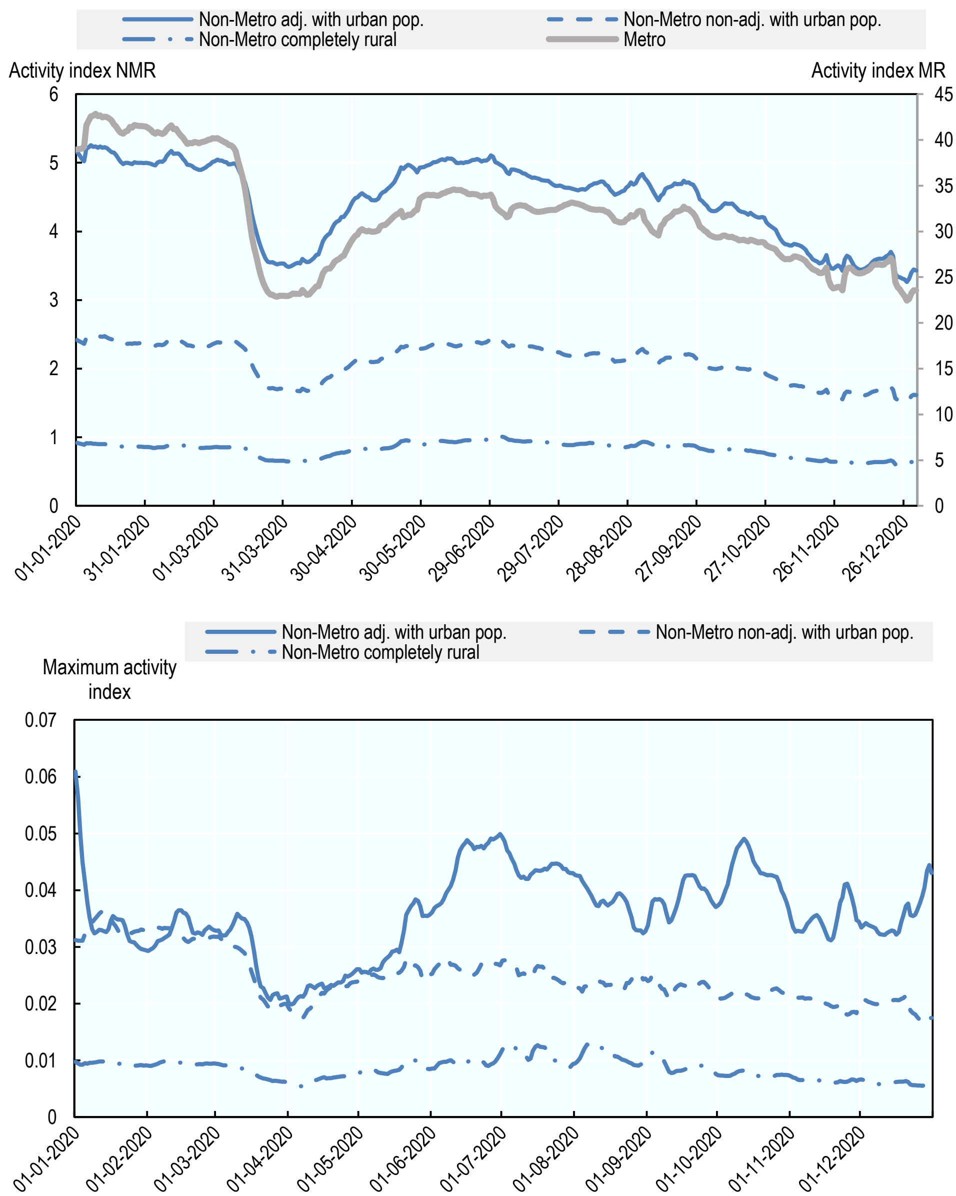
The evidence for the US, based on country-level data, indicates that the hierarchy in mobility (from highest mobility levels in more urban places and lowest in more rural places) is maintained throughout 2020. While the data offers little support to the idea of permanent changes in activity in counties in those states during 2020, it shows that non-metro counties with an urban population adjacent to metro areas experienced a smaller fall in mobility levels and a better recovery after the first wave than metro counties **(**Figure 1.24). The resilience of non-metro counties adjacent to cities is evident in the trends for counties with the highest mobility levels, as both adjacent and non-adjacent metro counties with an urban population had similar maximum mobility levels until May; however, after May, adjacent counties stayed above the rest of non-metro counties throughout 2020.

Figure 1.24. Total activity index by type of county and maximum activity in non-metropolitan counties, US



Note: 7-day moving average

Source: Author's elaboration using (Mapbox, 2021[4]).

StatLink https://doi.org/10.1787/888934248331

Conclusions

Returning to the initial questions (i.e., How much has COVID-19 affected the daily mobility of people, especially in relation to their home-work movements? Has this impact been different for urban or rural areas?) the evidence in this chapter suggests that throughout 2020 and early 2021 the COVID-19 pandemic has had a sustained impact on mobility, with some relief during the summer months. The impact has been stronger on regions with large cities that had the highest levels of mobility to start with, both during the first and second waves. As the Google data suggests, this could be mostly linked to reduced work-related mobility.

The evidence in this chapter does not support a clear increase in activity in rural areas following the decrease in activity in cities, but instead suggests that mobility levels are still far from normal everywhere. At the same time, both mobility trends and regional variation within countries do not seem to be explained by containment policies alone. The evidence in this chapter showed that the ranking of mobility across regions within countries in the initial shock stayed relatively stable throughout the year, including the second shock. This implies that the weight of initial characteristics may be difficult to overcome through differentiated policies at least while the pandemic continues to unfold.

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Notes

[1] These data are available at: https://www.gstatic.com/covid19/mobility/Global_Mobility_Report.csv?cachebust=7d0cb7d254d29111 and are calculated using data from Google users that have opted-in to Location History for their Google Account. This means that while they may reflect major trends in people's mobility they may not be representative of the behaviour of the whole population in the geographical area considered.

[2] "Parks" and "Residential" are other places considered in the Global Mobility Report of Google but not analysed here.

[3] The analysis is limited to TL2 regions because, at the time of access, information on TL3 regions was only available for Canada, France, Italy and Japan. In fact, data for Japan was only available for TL3 units ("prefectures") and data for England was available for "local authorities" and "districts". In any case, using lower levels of aggregation may obscure the graphical representation (in England, for example, using district data would mean plotting around 1 700 lines) while it is unlikely to result in informative differences in trends.

[4] These data are available at the national level (and the US states) and consist of a set of indicators of government policies on containment and closure (C1 to C8 indicators), economy (E1 to E4 indicators) and health (H1 to H5 indicators). The reported index is the average of C1 to C8 indicators. All data is available at: https://raw.githubusercontent.com/OxCGRT/covid-policy-tracker/master/data/OxCGRT_latest.csv

[5] Average mobility is the mean of the four mobility types for each country and fortnight. Using each area of mobility instead of the mean of the four dimension leads to essentially the same conclusions.

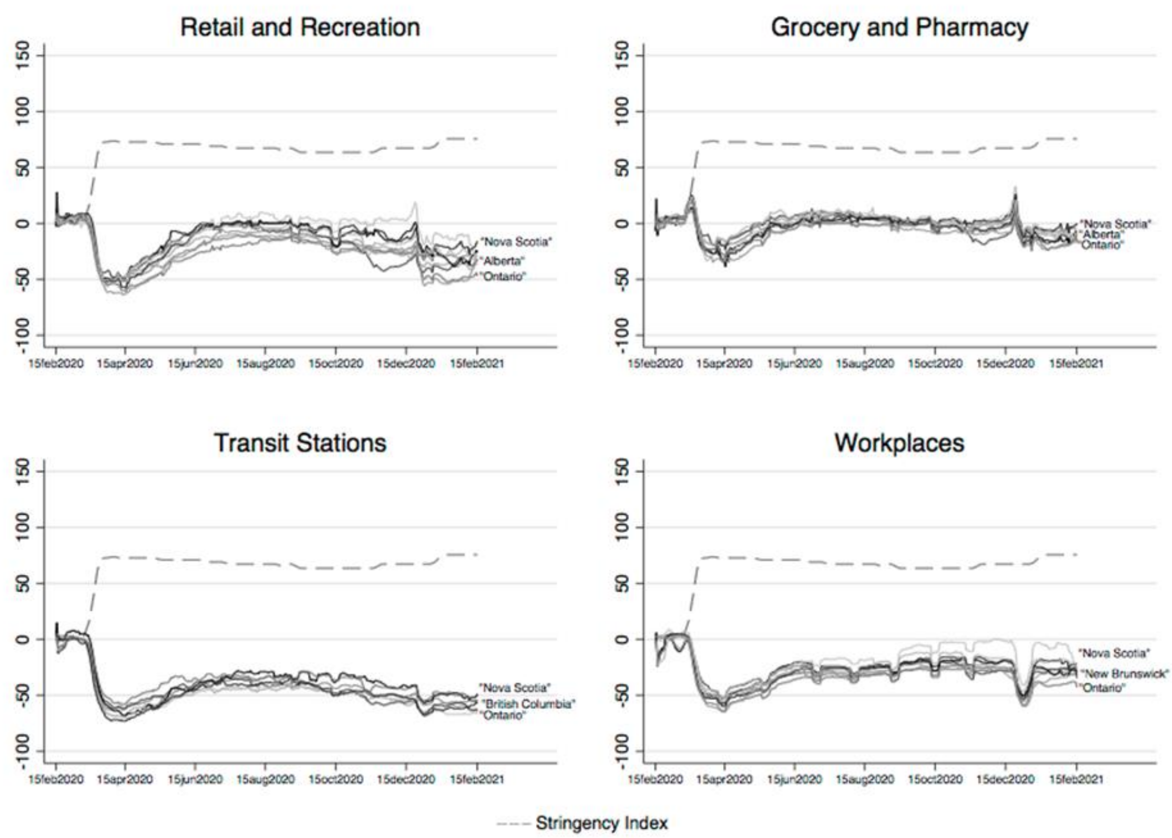
[6] Data for Japan provided by the Ministry of Land, Infrastructure, Transport and Tourism.

[7] For France, Japan and England it was not possible to match the territorial units in the Google data with those in (OECD, 2021[8]).

[8] https://www.ers.usda.gov/data-products/rural-urban-continuum-codes/

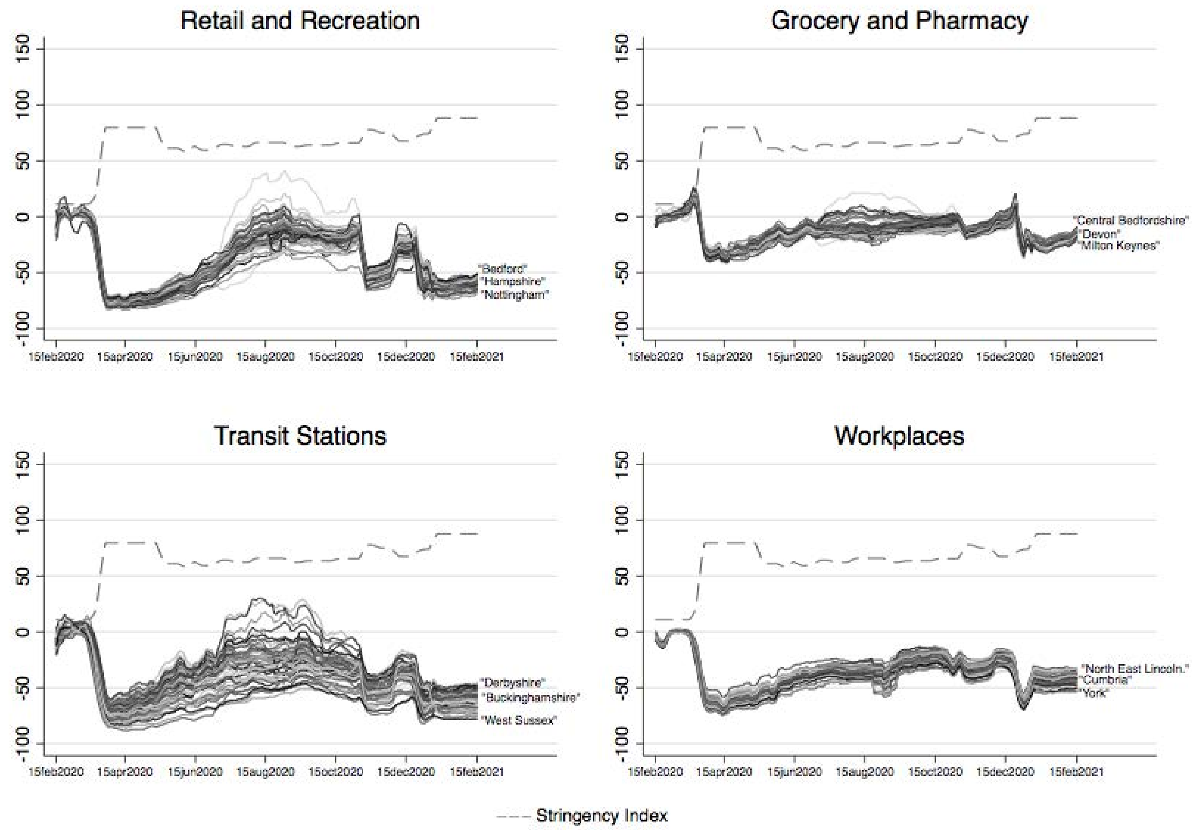
Annex 1.A. Mobility in TL2 regions and Strictness of lockdown policies

Annex Figure 1.A.1. Mobility in TL2 regions and Strictness of lockdown policies, Canada



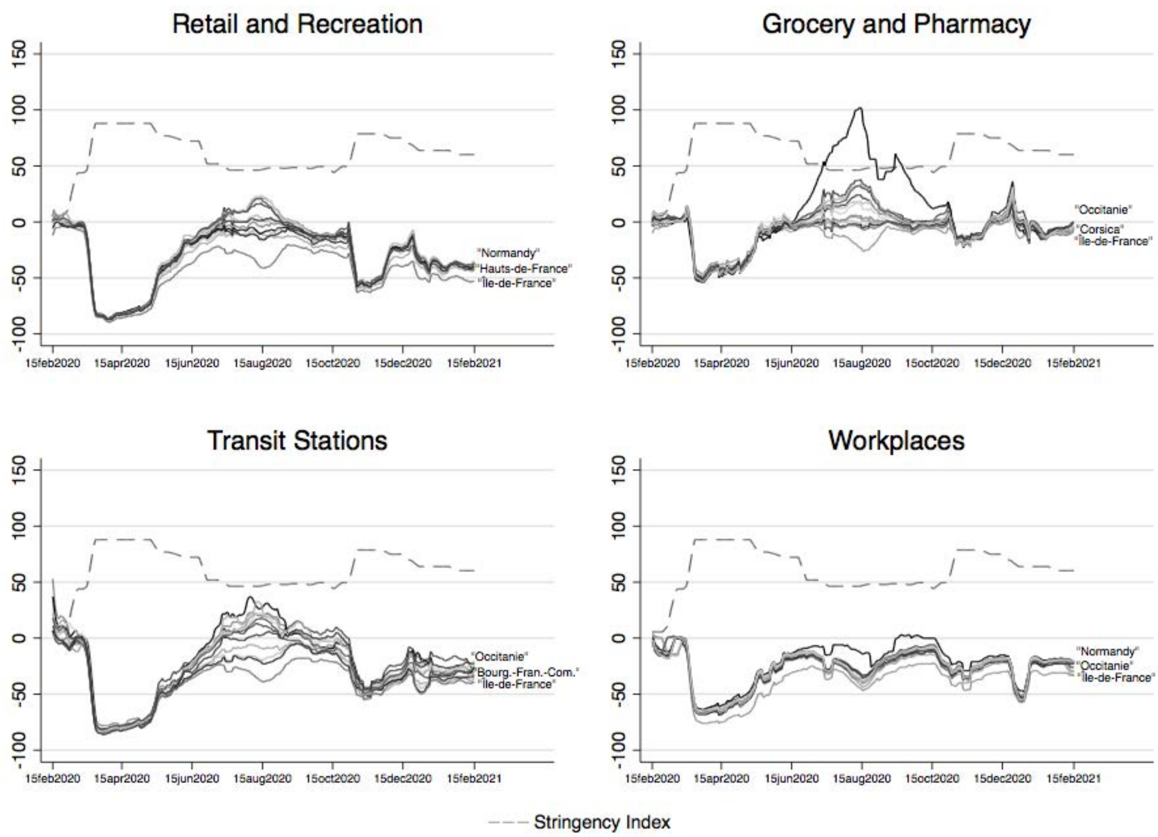
Note: See notes Annex Figure 1.A.7.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

Annex Figure 1.A.2. Mobility in TL2 regions and Strictness of lockdown policies, England (UK)



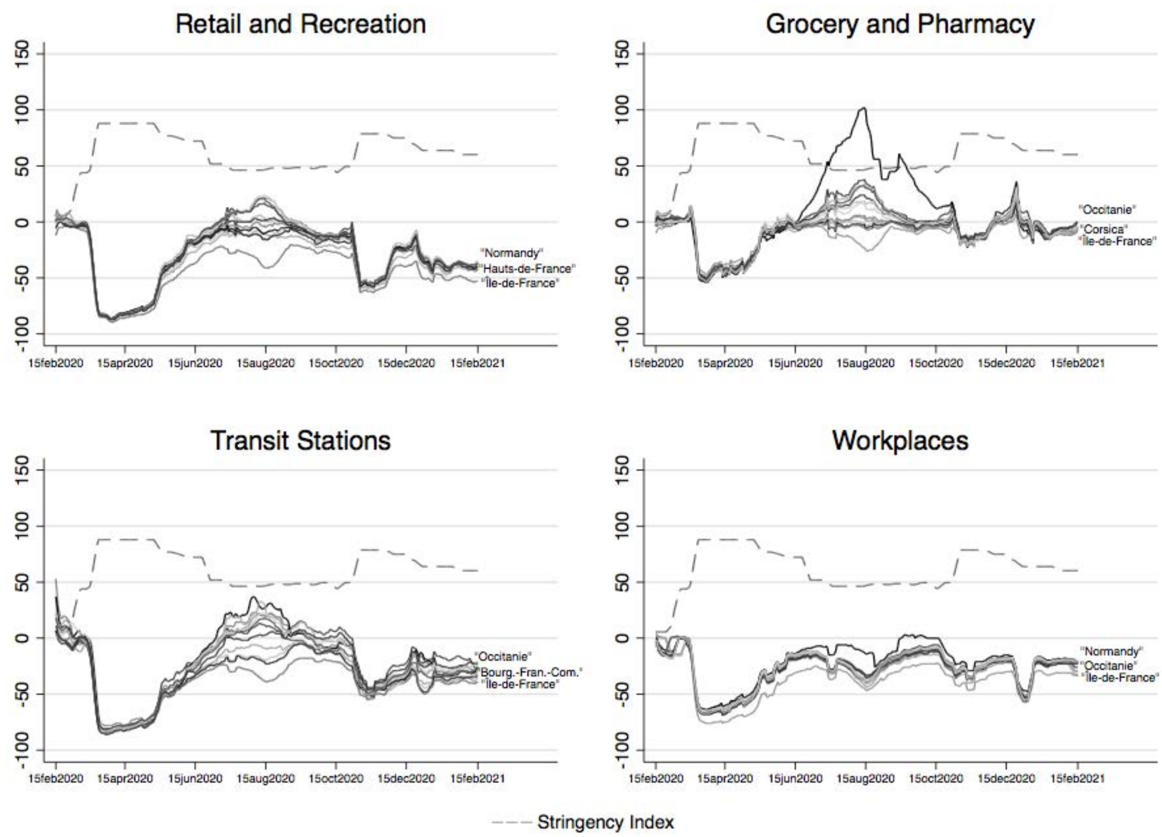
Note: See notes Annex Figure 1.A.7.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

Annex Figure 1.A.3. Mobility in TL2 regions and Strictness of lockdown policies, France



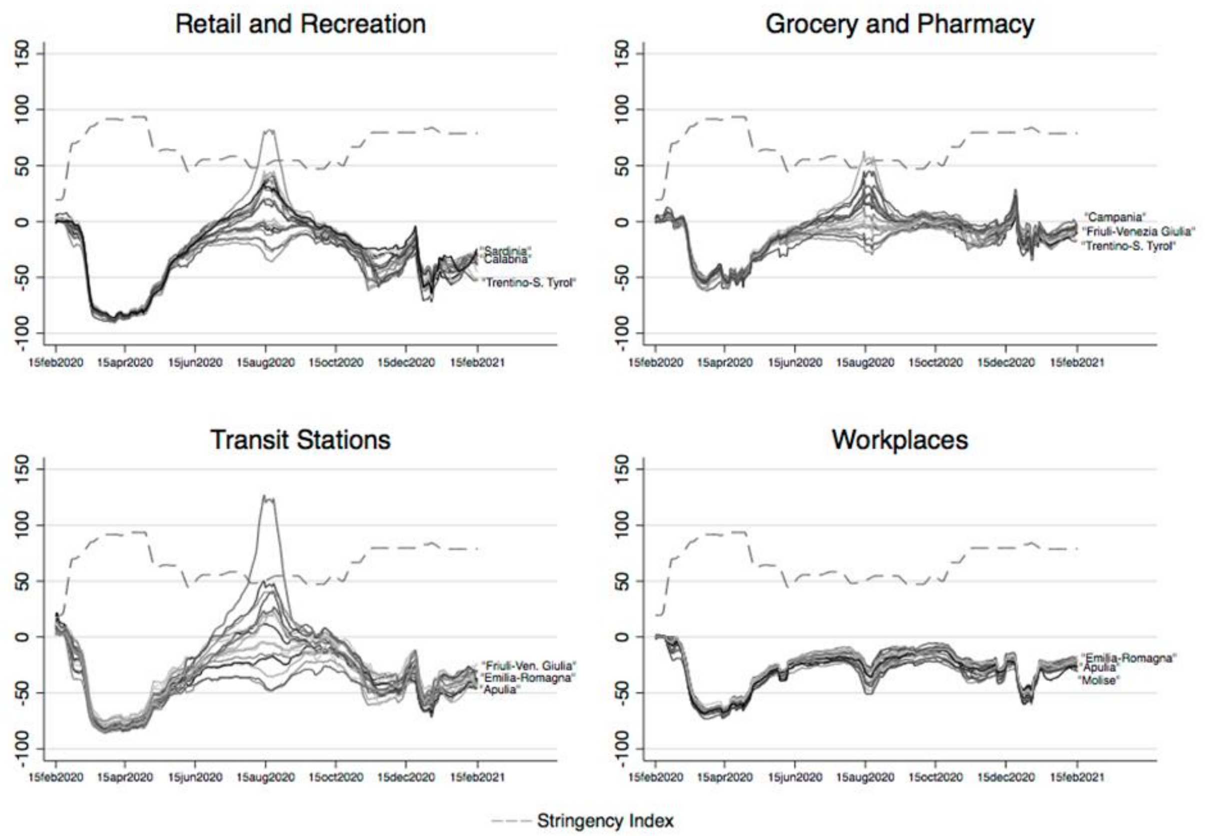
Note: See notes Annex Figure 1.A.7.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

Annex Figure 1.A.4. Mobility in TL2 regions and Strictness of lockdown policies, Germany



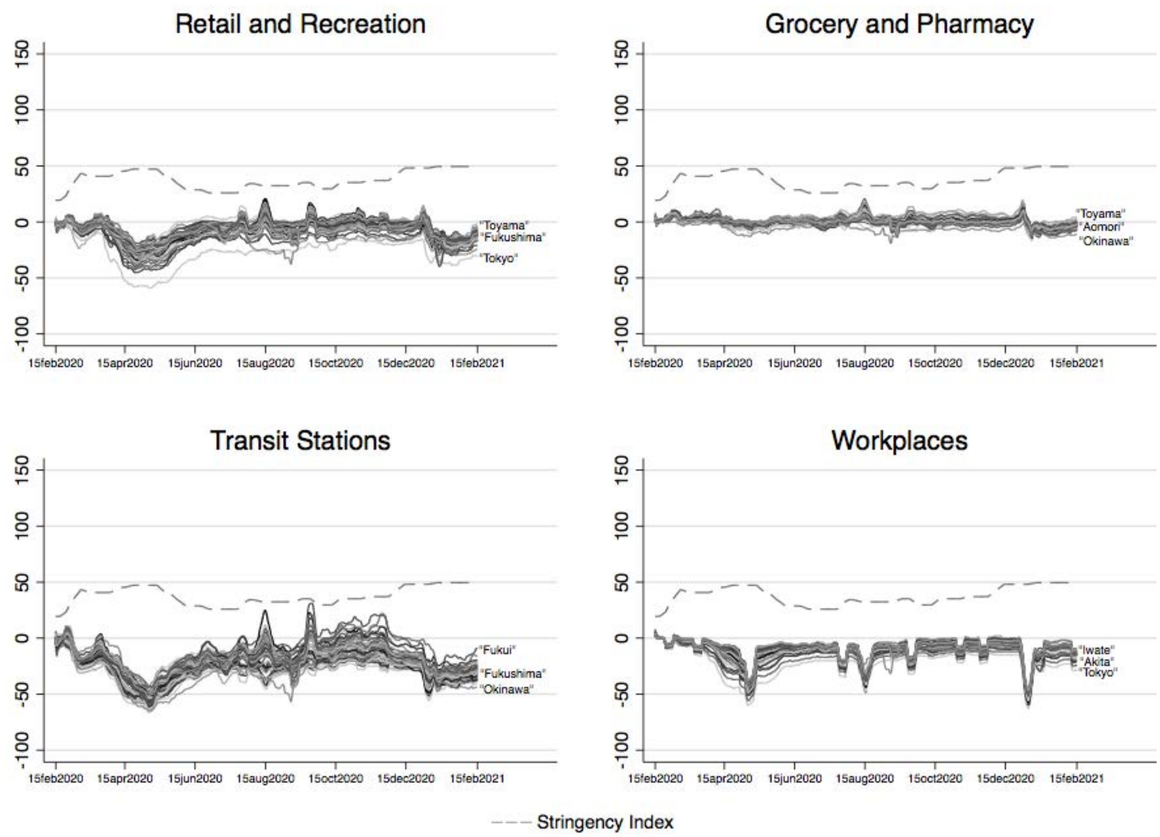
Note: See notes Annex Figure 1.A.7.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

Annex Figure 1.A.5. Mobility in TL2 regions and Strictness of lockdown policies, Italy



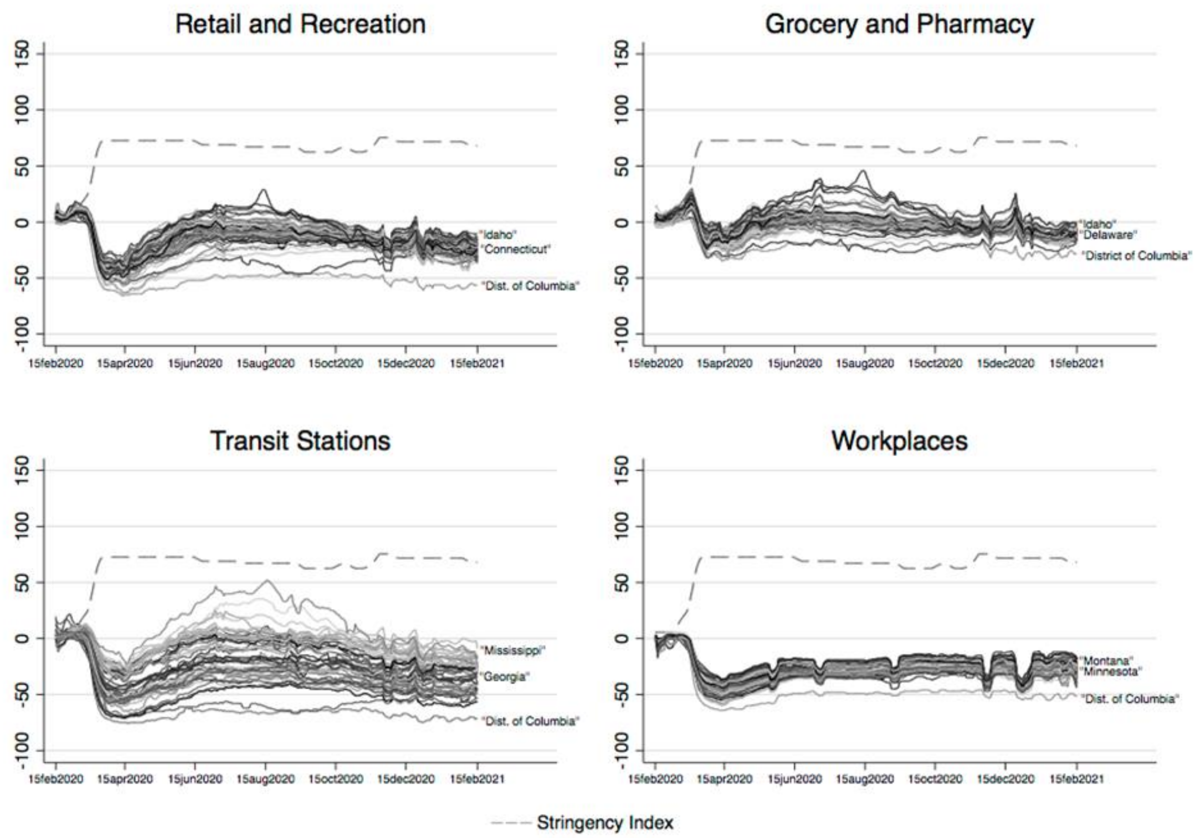
Note: See notes Annex Figure 1.A.7.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

Annex Figure 1.A.6. Mobility in TL2 regions and Strictness of lockdown policies, Japan

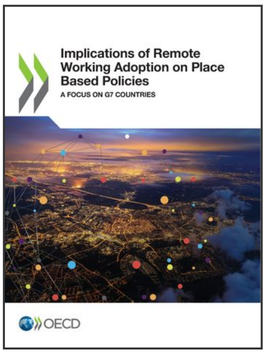


Note: See notes Annex Figure 1.A.7.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).

Annex Figure 1.A.7. Mobility in TL2 regions and Strictness of lockdown policies, United States



Note: Mobility values correspond to the average of the fortnight's means in the percentage change in mobility (from the median value for the corresponding day of the week from 3 January 2020 to 3 February) to different places (Retail & Recreation, Grocery & Pharmacy, Transit Stations and Workplaces). The stringency index (dosh line) approximates the strictness of the "lockdown style" policies that (primarily) restrict people's behaviour.
Source: Authors' elaboration based on (Google LLC, 2021[3]) and (Hale, T., S. Webster, A. Petherick, T. Phillips, and B. Kira, 2020a[5]).



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