OECD Regional Development Papers

Assessing Spatial Disparities in Internet Quality using Speed Tests

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The quality of Internet connections is increasingly important for people's daily lives as work and access to services move to the digital sphere. Likewise, businesses and public agencies need to rely more and more on the digital networks for service delivery. However, the way individuals experience the Internet can vary substantially within countries, notably along the urban-rural continuum. Measuring such variation in a consistent way is important to understand where intervention is most needed to deliver better connections to everyone. This paper assesses within-country spatial disparities in connectivity across OECD and G20 countries, using publicly available data on the speed of connections from an Internet speed test provider, applying consistent spatial definitions – i.e. the OECD classification of regions and the Degree of Urbanisation. Using data from Denmark, it finds that the use of speed tests to assess the quality of internet connection is coherent with national sources. Results show that, in OECD countries, regions far from metropolitan areas can experience up to 24 % slower Internet speeds than the national average. Overall, cities have 75 % higher speed of connection than rural areas, on average.

JEL codes: O18, C80, C55
Keywords: Digital Infrastructure, Open Source Data, Regional Disparities

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Introduction and key messages

Ubiquitous and high-quality connectivity is fundamental for the digital transformation in all regions. Yet, substantial within-country disparities in the speeds of broadband connections exist in OECD countries (OECD, 2018[1]). With the increased uptake of remote work and more daily activities occurring through digital devices, connectivity has taken unprecedented importance (OECD, 2021[2]) and has become a critical part of framework conditions for innovation across all regions (OECD, 2022[3]). Unfortunately, geographically granular, and timely information on the quality of Internet connections from official sources continues to be difficult to find and often lacks international comparability. Unconventional data can help to overcome these limitations.

This paper aims to examine one dimension of the digital divide – i.e., the divide in Internet connection speeds across types of areas – leveraging publicly available data from an Internet speed test provider. It focuses on the spatial dimension of the disparity, highlighting how Internet experiences vary widely across space within OECD and G20 countries. Spatial disparities are assessed at two geographical levels. The first, more granular, geographical approach based on the Degree of Urbanisation (OECD et al., 2021[4]) allows an assessment of the digital connectivity divide along the urban-rural continuum. This, in turn, allows for meaningful comparisons across countries, as the Degree of Urbanisation is the definition of cities, urban and rural areas recommended by the United Nations for international statistical comparisons.[1] The second geographical approach highlights disparities across regions, notably small regions (Territorial Level 3 or TL3), that are classified according to the density and access to metropolitan areas (Fadic et al., 2019[5]).

Focusing on relative differences[2] within countries, the paper finds substantial regional variation in Internet speeds. Regions far from metropolitan areas can experience up to 24 % slower Internet speeds than national averages and 48 % below metropolitan regions. There is a similarly stark rural-urban divide using a more granular approach. Based on grid-level data, on average, individuals in rural areas experience Internet speeds almost a third slower than national averages, while those living in cities and metropolitan areas tend to experience 13 % faster speeds.

The paper first describes the data source used in the analysis, highlighting the characteristics that make it novel and relevant to the policy debate. It then provides a picture of the spatial divides in connectivity within and across OECD and G20 countries. Methodological information for processing and generating indicators are presented in boxes. The paper concludes by discussing possible caveats of the data in terms of comparisons with existing, although scarce, administrative data sources of speed measurements.

Key facts

- In 31 OECD countries, residents in regions far from metropolitan areas (3-tier typology) experience, on average, 24 % slower fixed Internet connections than the national average.
- Looking at these differences from a more geographically granular perspective (i.e., urban-rural divide) reveals that individuals in rural areas experience 47 percentage points slower download speeds than those living in cities, on average in 31 OECD countries.
- Comparing indicators based on data from Ookla, a private provider, with data from public agencies shows similar trends at the regional level (TL3) in terms of regional ranking, although absolute speed levels remain markedly different.

[1] https://unstats.un.org/unsd/statcom/51st-session/documents/BG-Item3j-Recommendation-E.pdf

[2] Using relative rather than absolute speed measurements is done, in part, to remove focus from the absolute speed levels reported by Ookla, whose testing methodology may lead to higher speed estimates than other providers in the market, as elaborated in *"Bridging digital divides in G20 Countries"* (OECD, 2021[14])

Assessing spatial disparities in Internet quality using speed tests

Private sector data on Internet speeds

Broadband quality is determined by a variety of factors that can be measured in different ways. One of these dimensions is broadband speeds. Since 2012, the OECD has worked systematically on broadband performance, establishing speed tiers with the intention of promoting internationally comparable indicators on Internet coverage at different speeds (OECD, 2013[6]; OECD, 2014[7]). Although useful, indicators of coverage based on speed tiers are currently calculated using *advertised* speeds, based on subscriptions data provided by network operators to regulators.

However, advertised broadband speeds reported to regulators may differ from actual speeds experienced by users. Data on *experienced* speeds is hard to find, and even more so from sources providing enough coverage and measurement consistency to allow for international comparisons. Data from private speed test providers can help measure "actual" broadband speeds experienced by users to obtain comparable national average or peak speeds (e.g., Ookla, M-Lab and Steam). These data can be of great value by enabling a more granular analysis of Internet speeds across places. However, they can also be vulnerable to testing and sampling biases, that occur, for example, because of fast connections being tested potentially more frequently, or strategic testing by Internet Service Providers (ISPs).

When available, several sources of speed data should be compared, as different providers measure the speed of connections from their perspective of the Internet, using different methodologies (OECD, 2021[8]). Such an approach is possible for speed levels reported at the national level, for which several data sources are available. However, at the time of writing, no source other than Ookla openly releases data on actual broadband speeds at a sufficiently high level of granularity to allow for spatial comparisons. This paper therefore relies solely on one source of external data and, as noted above, some care is needed in the interpretation of results.

Ookla's data report metrics based on self-administered speed tests. In methodological terms, Ookla speed tests measure the *sustained peak throughput* achieved by users of the network. In other words, when a user asks for a speed test, the device pings nearby dedicated testing servers, saturates the network connection, and measures the sustained peak speed achieved by the device during the test window. Therefore, the Ookla speed measurements do not reflect the day-to-day speeds experienced by users, but rather the actual maximal speeds attainable by the network connection when a users' device sends the maximum amount of data to one of 14 000 testing servers.

The publicly available dataset released by Ookla is valuable as it provides a high degree of spatial granularity and global coverage, while based on a consistent testing methodology across countries. The indicators are aggregated to tiles measuring approximately 610 by 610 metres at the equator. Also noteworthy is the scale of the dataset, which records approximately 74 million tests for OECD countries in the second quarter of 2021 (Table 1).

To be able to provide metrics at a sufficiently granular spatial level, the publicly available data by Ookla are filtered to results containing GPS-quality location accuracy (Ookla, 2021[9]) performed via the

Speedtest by Ookla applications for Android and iOS devices. Although based on readings performed on mobile devices, Ookla differentiates tests performed via cellular connections (e.g. 4G LTE, 5G NR) and non-cellular connections (e.g. WiFi, Ethernet). For simplicity, the coming sections refer to these connection types as *mobile* and *fixed* connections. Ookla's metrics include the average latency, download and upload speeds per tile.

Table 1. Overview of number of tests and tiles in Ookla's data

Description	Period	OECD and G20	OECD
Number of tests	2019Q1	91 535 754	50 045 995
	2019Q2	89 950 371	47 998 186
	2019Q3	120 234 099	61 856 581
	2019Q4	170 778 756	82 109 482
	2020Q1	188 066 362	88 187 338
	2020Q2	232 560 241	107 823 265
	2020Q3	207 966 768	89 926 967
	2020Q4	178 616 149	78 549 913
	2021Q1	194 933 959	88 983 325
	2021Q2	178 646 175	73 968 824
Number of tiles	2019Q1	8 108 281	4 922 792
	2019Q2	8 197 724	4 874 697
	2019Q3	9 557 418	5 566 446
	2019Q4	10 296 722	5 869 433
	2020Q1	10 591 831	5 819 442
	2020Q2	11 014 624	6 004 698
	2020Q3	11 211 179	6 157 652
	2020Q4	10 502 841	5 691 989
	2021Q1	10 813 688	5 775 169
	2021Q2	10 932 729	5 825 299

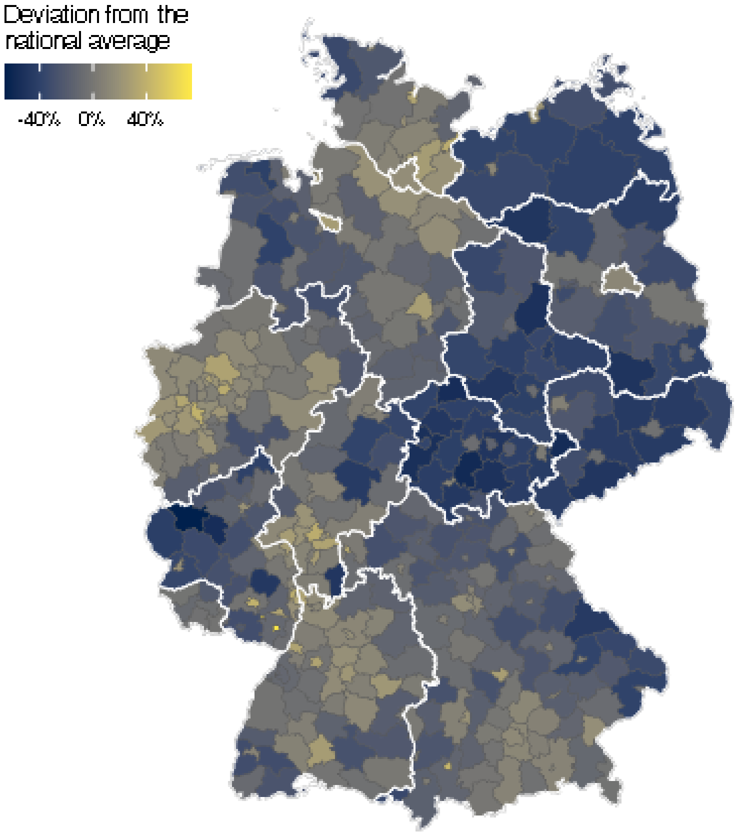
Source: OECD calculations based on Speedtest® by Ookla® Global Fixed and Mobile Network Performance Maps. Based on analysis by Ookla of Speedtest Intelligence® data for 2021Q2. Provided by Ookla and accessed 2021-07-21. Ookla trademarks used under license and reprinted with permission

Using deviations from country averages to highlight spatial disparities

This paper is concerned about the variation in access to quality communications infrastructure and services between different areas or regions in the same country. As such, it privileges the use of indicators expressed as deviations from country means. This approach has the added benefit of correcting for any country-specific and measurement biases (e.g. due to differences in popularity of the speed test provider, or the way in which speed tests are conducted).

An example of this approach is illustrated in Figure 1, showing the fixed average download speed of German small regions (TL3), expressed as the percent deviation from the national average. Similar estimates can be presented for other territorial or spatial definitions, including the Degree of Urbanisation.

Figure 1. Speed deviations from the national average, TL3 regions in Germany, 2020Q4



Note: German TL3 regions, coloured according to the deviation of fixed speeds from the national average.
Source: OECD calculations based on Speedtest® by Ookla® Global Fixed and Mobile Network Performance Maps. Based on analysis by Ookla of Speedtest Intelligence® data for 2020Q4. Provided by Ookla and accessed 2021-07-21. Ookla trademarks used under license and reprinted with permission.

Assessing urban-rural gaps in connectivity through a granular, population-based approach

The analysis relies on the urban-rural categories defined in the Degree of Urbanisation (OECD et al., 2021[4]). The Degree of Urbanisation provides a classification of areas along the rural-urban continuum that can be applied to all countries in the world. Coupling Ookla's Speedtest data with GHS-SMOD layer grids and applying the Degree of Urbanisation make it possible to create indicators showing connectivity divides within countries, including along the urban-rural continuum (see in Box 1).

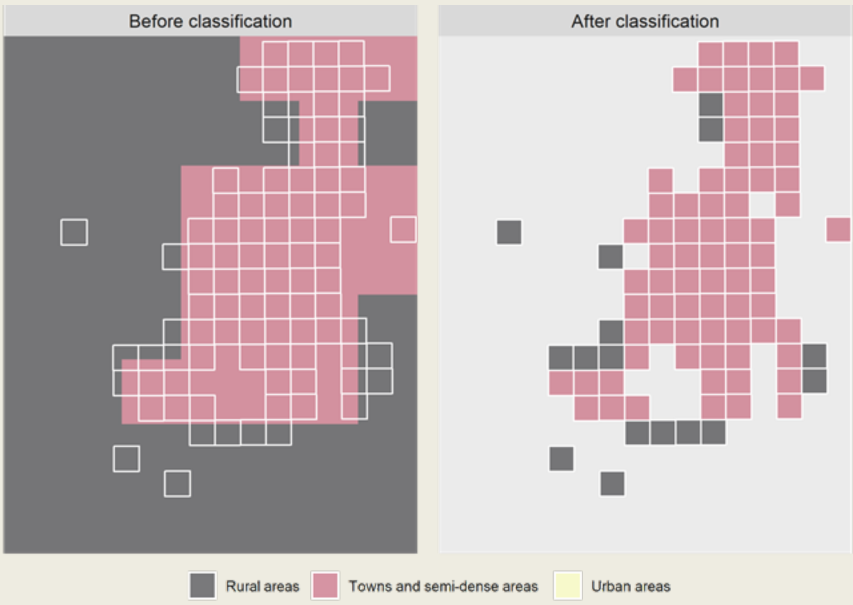
Box 1. Leveraging the Degree of Urbanisation

The Degree of Urbanisation (DEGURBA) is a simple method of classifying areas that can be applied to every country in the world. The classification relies primarily on population size and density thresholds applied to a population grid with cells of 1 by 1 km. The types of areas classified by DEGURBA are:

- **Cities** consist of contiguous grid cells that have a density of at least 1 500 inhabitants per km^2 or are at least 50% built up. They must have a population of at least 50 000.
- **Towns and semi-dense areas** consist of contiguous grid cells with a density of at least 300 inhabitants per km^2 and are at least 3% built up. They must have a total population of at least 5 000.
- **Rural areas** are cells that do not belong to a city or a town and semi-dense area. Most of these have a density below 300 inhabitants per km^2. The population grid used in this study is the Global Human Settlement Layer (GHSL) provided by the Joint Research Centre of the European Commission (Pesaresi et al., 2019[11]).

Ookla tiles can be classified according to the Degree of Urbanisation using the GHS Settlement Model (GHS-SMOD) layer grid[3]. Matching between the two spatial sources relies on the centroids of the Ookla tiles. Each tile centroid is used to extract the DEGURBA classification of the underlying cell in the GHS-SMOD layer grid. The DEGURBA categories are then attributed to the tile. With this information, average speeds are calculated at the national level, per DEGURBA category, using as weight the number of tests performed in the tile.

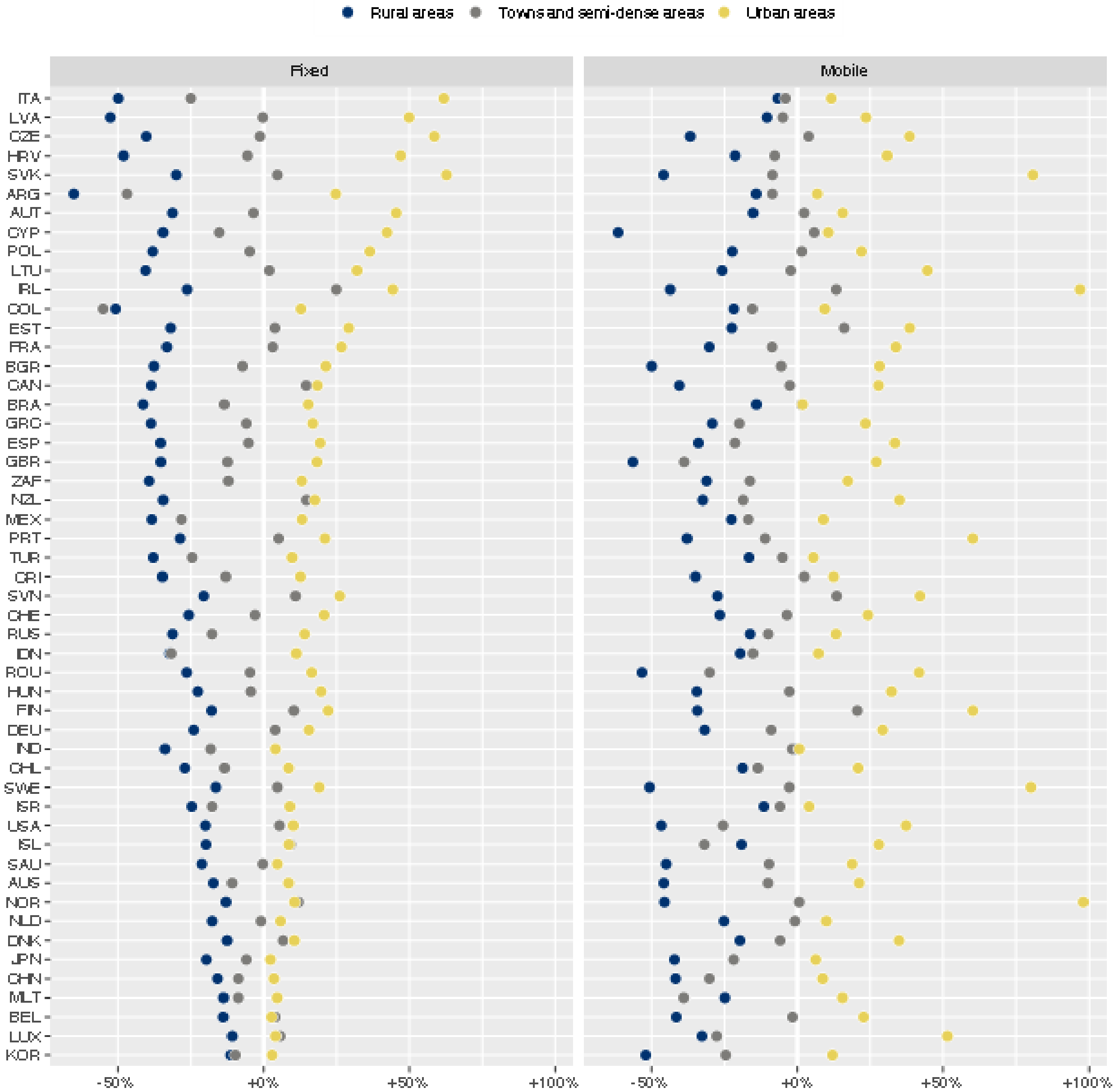
Figure 2. Classifying tiles according to the degree of urbanisation



Note: This is an example using the Kaufbeuren, Kreisfreie Stadt region (Germany). Tiles' centroids are used to extract the DEGURBA classification of the underlying cell in the GHS-SMOD layer grid at 1 by 1 km resolution. The panel on the left depicts the boundaries of the Ookla and the underlying GHS-SMOD layer grid, coloured according to the DEGURBA level 1 classification; the panel on the right depicts shows the final classification of the Ookla tiles, based on the values captured via the tiles' centroids.

In 51 OECD and G20 countries, download speeds over fixed networks in rural areas are on average 31 % slower than the national average (Figure 3). Download speeds in cities, on the other hand, are on average 13 % faster than the national average. These average differences are similar in magnitude for mobile download speeds, with people experiencing 24 % slower and 13 % faster speeds in rural areas and cities relative to the national average, respectively. When restricting to OECD countries, these gaps remain equally stark, with rural areas experiencing 29 % slower fixed speeds than the national average.

Figure 3. Rural-urban disparities in connectivity in OECD and G20 countries according to the degree of urbanisation (2021 Q2)



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3 A similar, albeit less granular, approach was explored by Perpiña Castillo et al. (2021[9]). In their analysis, the authors aggregated Ookla's speed indicators to Local Administrative Units (LAU) that had already been classified according to the degree of urbanisation.

Note: Figure depicts OECD and G20 countries. Speedtest data corresponds to 2021Q2. Aggregation according to the degree of urbanisation is based on GHS Settlement Model (GHS-SMOD) layer grids. The figure presents average download peak speed tests, weighted by the number of tests, as the percentage deviation from the national average.
Source: OECD calculations based on Speedtest® by Ookla® Global Fixed and Mobile Network Performance Maps. Based on analysis by Ookla of Speedtest Intelligence® data for 2021Q2. Provided by Ookla and accessed 2021-07-21. Ookla trademarks used under license and reprinted with permission. Pesaresi et al., (2019[10]) GHS settlement grid, updated and refined REGIO model 2014 in application to GHS-BUILT R2018A and GHS-POP R2019A, multi-temporal (1975-1990-2000-2015), R2019A. European Commission, Joint Research Centre (JRC) [Dataset], doi:10.2905/42E8BE89-54FF-464E-BE7B-BF9E64DA5218 PID: http://data.europa.eu/89h/42e8be89-54ff-464e-be7b-bf9e64da5218

These findings are relatively consistent with those developed by the European Commission's Joint Research Centre using the same data source (Perpiña Castillo et al. (2021[11])). Despite methodological differences[4], the latter study shows that cities have the highest speeds in broadband connections, according to Ookla data from the second quarter of 2020. In addition, they find that Denmark, Sweden and Finland have the highest speeds in remote areas with relatively low disparities with respect to cities. Their findings are consistent with the findings shown in Figure 3 for the second quarter of 2021. Similarly, Greece, the Czech Republic, France and Italy show very low download speeds in rural areas, and, at the same time, relatively high city-rural disparities.

Assessing gaps in connectivity across regions

While the degree of urbanisation can provide valuable and granular insight into the Internet experiences of people living in different areas in the same country, it does not provide regional policy makers with information at their level of action – i.e., regions and places. Using a regional-based classification can therefore be useful to communicate insights to local policymakers, are often tasked with helping identify and provide digital access to under-served areas.

Spatial disparities in download speeds are substantial whether assessed through the granular lens of the Degree of Urbanisation or at the regional scale (TL3). Using the OECD classification of regions based on the degree of access to a metropolitan area (see OECD (2021[4]) and Box 1 for a more detailed description) helps provide an overall picture of the regional differences in the speed of broadband connections. In the second quarter of 2021, metropolitan regions in OECD had, on average, 48 % higher speeds than non-metropolitan regions. While substantial, such differences are lower than those observed at a more granular geographical level, between cities and rural areas (71 %) (Figure 3 and Figure 5). This is because looking at such spatial gaps across regions implies averaging out the starker differences in the speeds of connection between settlements within regions.

[4] The authors use mobile and fixed speed average levels rather than deviations from national averages, generate aggregates according to the degree of urbanisation based on the classification of LAUs rather than using grids, and limit their analysis to EU countries.

Box 2. The OECD regional typology and access to functional urban areas

The aggregation of territories in this analysis is based on the territorial levels defined in the OECD Territorial Grid[5] and which, for European countries, are largely consistent with the Eurostat Nomenclature for Territorial Units for Statistics (NUTS 2016). In each country, Ookla Speedtest tiles are mapped to small regions (Territorial Level 3, TL3) that reflect administrative or statistical-based boundaries[6]. This territorial level is relatively stable over time in all OECD member countries and is used as a framework for disseminating regional statistics (OECD, 2020[12]).[7]

The analysis in this report leverages on the OECD regional typology that classifies TL3 regions based on the degree of access to metropolitan areas (Fadic et al., 2019[5]). Under this classification, regions are classified according to the density and share of the population living in functional urban areas (FUAs), which is the EU-OECD definition of metropolitan areas. The 5-tier typology splits TL3 regions into two large categories of metropolitan or non-metropolitan regions. To ease the interpretation of figures and following the convention used in other OECD reports, this paper aggregates the five types of regions to the three classes presented in the table below.

Table 2. Regional typology by access to metropolitan areas

Acronym	Grouping	Reduced grouping
MR-L	Large metropolitan region	Metropolitan region
MR-M	Metropolitan region	
NM-M	Region near a metropolitan area	Region near a metropolitan area
NM-S	Region with/near a small-medium city	Region far from a metropolitan area
NM-R	Remote region	

Source: OECD (2020[13]), "Regions and Cities at a Glance 2020", https://doi.org/10.1787/959d5ba0-en

On average, residents in regions far from a metropolitan area experience slower fixed Internet connections than the national average. On the other hand, people living in metropolitan regions can count on higher download speeds than their counterparts (Figure 4, using territorial definitions in Box 2). In a sample of 33 OECD countries, metropolitan regions benefit from fixed download speeds 7 % faster than the national average, in contrast with regions far from a metropolitan area, which experience download speeds nearly one fourth slower than the national average. This 31-percentage point gap in fixed download speeds is slightly larger than the one in mobile speeds, of 28 percentage points.

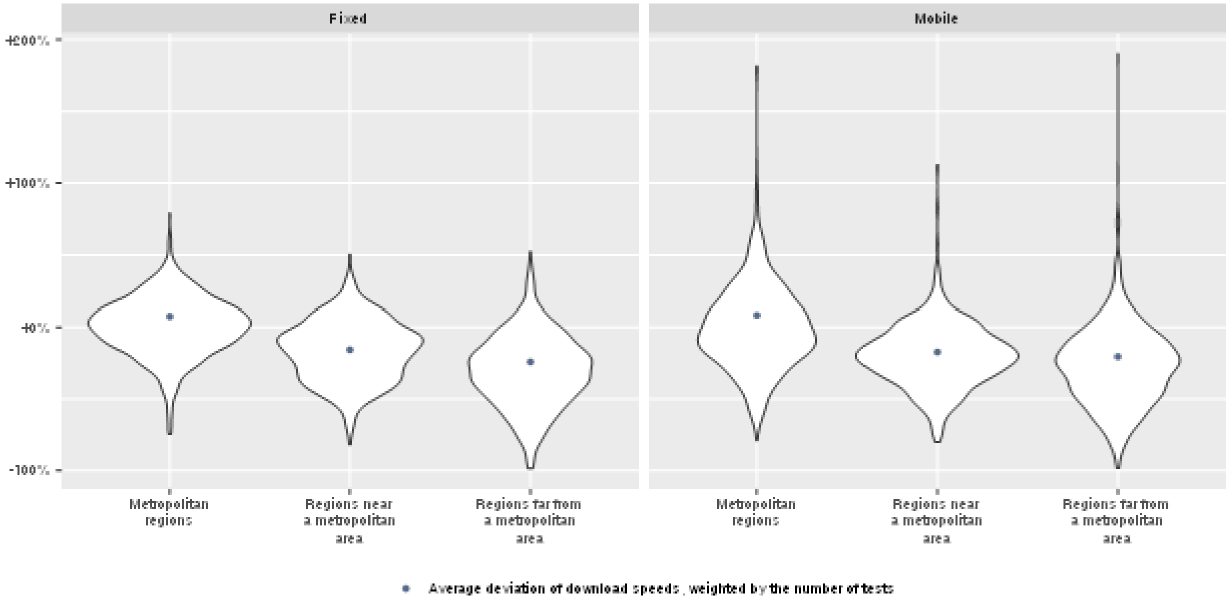
[5] https://www.oecd.org/regional/regional-statistics/territorial-grid.pdf

[6] Small (TL3) regions are administrative areas with the exception of Australia (Statistical Areas Level 4 and Greater Capital City Statistical Area), Canada (Census divisions), Netherlands (COROP regions), Latvia (Statistical regions) and Slovenia (Statistical regions).

[7] The 2 296 OECD small (TL3) regions correspond to administrative regions, with the exception of Australia, Canada and the United States. The 433 OECD large (TL2) regions represent the first administrative tier of subnational government, for example, the Ontario Province in Canada. These TL3 regions are perfectly nested within TL2 regions, with the exception of the United States for which TL3 regions (Economic Areas) cross the States' borders. For Colombia, Costa Rica, Israel and New Zealand, TL2 and TL3 levels are equivalent. All the regions are defined within national borders.

Moreover, the data show that average speeds for mobile connections are more volatile than those for fixed connections.[8] While some places within the most remote areas may seem to have incredibly fast Internet speeds through mobile connections (e.g. up to 190 % faster than the national average), the average user experience is still bundled at the lower end of the distribution, with mobile connection speeds that are on average 20.5 % slower than the national average (Figure 4, right-hand panel).

Figure 4. Distribution of deviations in download speeds, at the regional level (TL3) for 2021Q2



Note: The figures are based on the TL3 regions of 33 OECD countries with available regional typologies (Box 3). Colombia, Costa Rica, Israel, New Zealand and Turkey are presently excluded. Data corresponds to 2021Q2.
Source: OECD calculations based on Speedtest® by Ookla® Global Fixed and Mobile Network Performance Maps. Based on analysis by Ookla of Speedtest Intelligence® data for 2021Q2. Provided by Ookla and accessed 2021-07-21.

However, differences in download speeds by type of region are not universally large within countries (Figure 5). In OECD countries, differences between metropolitan regions and regions far from metropolitan areas range from 6pp (in the Netherlands) to 84pp (in Latvia) in terms of percentage deviation from national averages. In the Netherlands, for example, broadband quality is relatively equal across space, both for fixed and mobile connections. Variation in Internet speed across types of regions are comparatively moderate also in countries such as Finland and Germany, which are relatively large and where rollout of broadband may be more difficult across space.

Although useful to compare Internet experiences across different types of regions, the proposed indicators are not well-suited for studying the complementarity or substitutability of fixed versus mobile connections in the same country. A country may have low spatial disparities in both fixed and mobile download speeds, yet users may experience vastly different average speed levels depending on the type of technology used to connect to the Internet. In this sense, minimising regional disparities is a policy objective that comes second to the main goal of ensuring sufficiently good quality connections regardless of the type of technology used.

[8] This is in part due to the smaller number of mobile speed tests. The effect of large regional outliers on the country average is mitigated when weighed by the number of tests.

Figure 5. Territorial disparities in connectivity in OECD countries, by types of regions (2021 Q2)

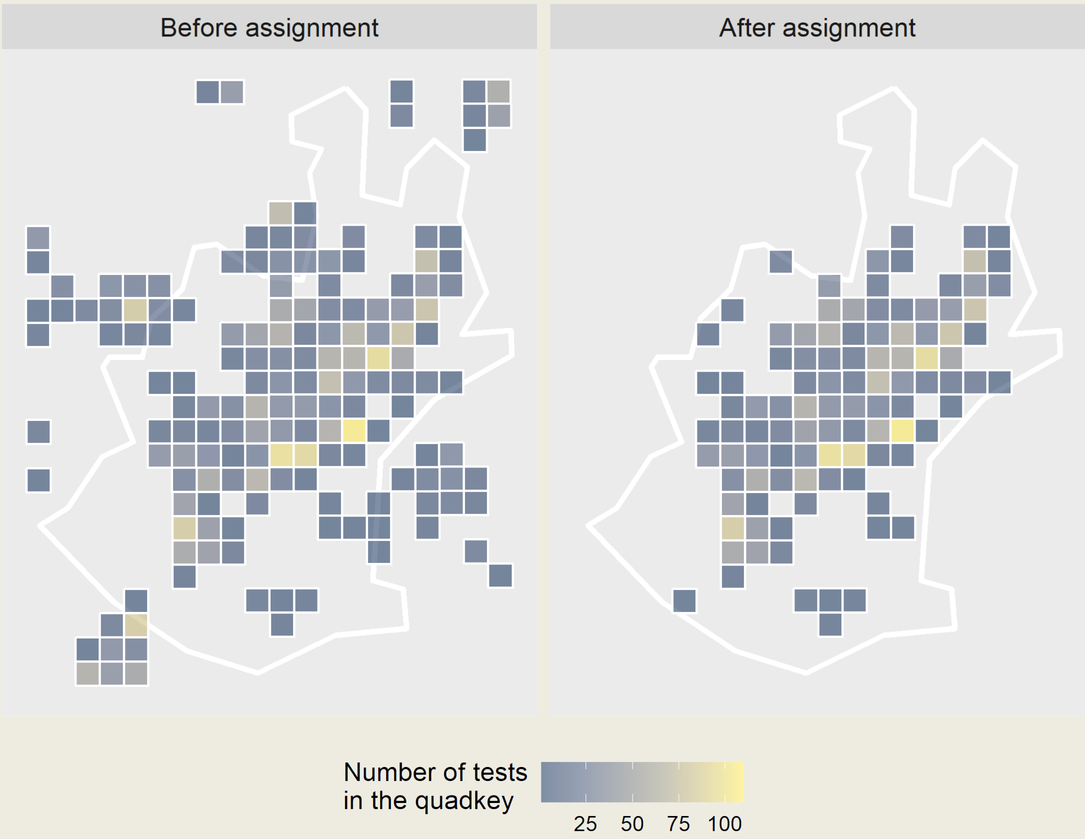
Note: The figure presents 33 OECD countries with available regional typologies. Colombia, Costa Rica, Israel, New Zealand and Turkey are presently excluded. Speedtest data corresponds to 2021Q2. The figure presents average peak download speed tests, weighted by the number of tests, as the percentage deviation from the national average.
Source: OECD calculations based on Speedtest® by Ookla® Global Fixed and Mobile Network Performance Maps. Based on analysis by Ookla of Speedtest Intelligence® data for 2021Q2. Provided by Ookla and accessed 2021-07-21. Ookla trademarks used under license and reprinted with permission.

Box 3. Generating territorial indicators based on Ookla Speedtest data in small administrative regions (TL3)

The first step for processing Ookla Speedtest data into territorial indicators is to map the tiles to the different territorial levels within each country. Concretely, tiles are allocated to a territorial unit if their centroids fall within the borders of a given territory (Figure 6). Later, average speeds at each territorial level are calculated from the average speeds reported by Ookla per tile, weighting by the number of tests performed in each tile[9]. Using the number of tests as weights guarantees that the territorial average computed from the summarised tiled data corresponds to the territorial average that would have been computed from the test-level data had it been available.

Figure 6. Assignment of tiles to territorial units

Example using the Schweinfurt, Kreisfreie Stadt region (Germany)



Note: Tiles are allocated to a territorial unit if their centroids fell within the borders of a given territory. The panel on the left depicts the tiles inside and surrounding the Kreisfreie Stadt Schweinfurt region; the panel on the right, the final allocation of tiles to the region according to their centroids.
Source: OECD calculations based on Speedtest® by Ookla® Global Fixed and Mobile Network Performance Maps. Based on analysis by Ookla of Speedtest Intelligence® data for 2021Q2. Provided by Ookla and accessed 2021-07-21. Ookla trademarks used under license and reprinted with permission.

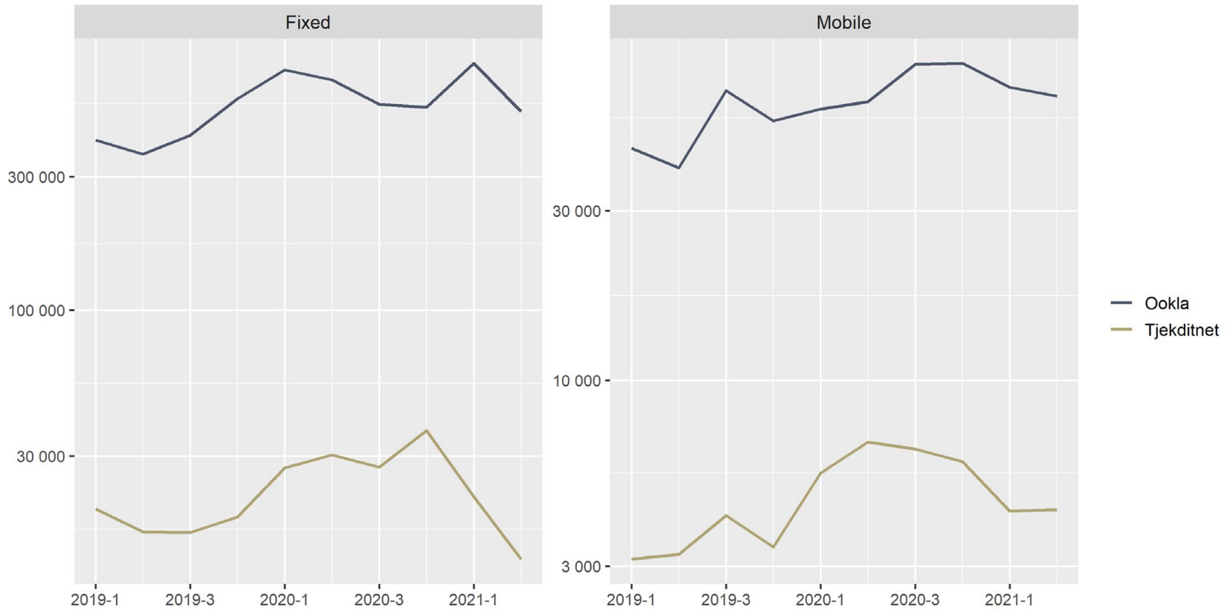
Comparisons with public sector data: The case of Denmark's Tjekditnet.dk speed measurements

At present, few government agencies collect and release indicators on the speed of connections at a level that allows for comparisons across regions. When gridded data is available, it generally presents coverage indicators by speed tiers based on advertised or potential (technically possible) speeds. Only rarely are actual broadband speeds experienced by users, such as those measured by Ookla and other private providers, available. One exception is the Danish Energy Agency, which releases data on the speed measurements performed by Internet users through the Tjekditnet.dk website.

The data from Tjekditnet.dk therefore provides a vehicle for comparisons with Ookla's Speedtest data, despite differences in testing methodology. Notably, the data from Tjekditnet.dk is based on the self-reports by users concerning the address and type of technology used during testing, whereas Ookla Speedtest automatically determines these two features at the time of testing, using information on the GPS location of the device and the technology of the network. Because of the need to rely on GPS locations, the data provided by Ookla is also limited to measurements made via mobile devices, while no such restriction is present for Tjekditnet.dk.

The main drawback of the Tjekditnet.dk data comes from its testing volume, which is markedly lower than Ookla's. During the ten quarters between 2019Q1 and 2021Q2, Tjekditnet.dk registered a total of 273 209 fixed and mobile speed tests, compared to 6 112 226 by Ookla (Figure 7). Despite the differences in scale, similar movements in overall testing activity can be observed in both data sources. For example, both sources show an uptake in speed testing activity between 2019Q4 and 2020Q1 for fixed connections, and between 2019Q2 and 2019Q3 in mobile connections.

Figure 7. Comparison in the number of speed tests reported by Ookla and Tjekditnet.dk



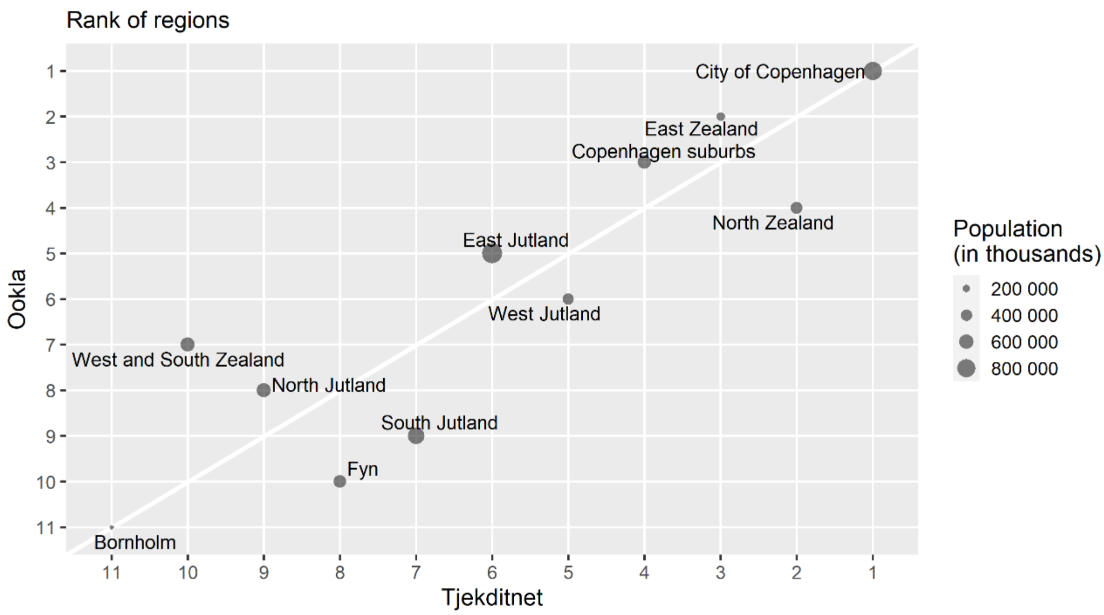
Note: Because of large differences testing scale between Ookla and Tjekditnet.dk, values in the vertical axes are presented in logarithmic scale.

[9] At the TL3 regional level, the aggregated number of tests is highly correlated with population, as evidenced by a Pearson correlation coefficient of 0.82 and 0.80 for fixed and mobile, respectively. For this reason, the reported averages at the regional level are not further weighted by the population.

Source: OECD calculations based on Speedtest® by Ookla® Global Fixed and Mobile Network Performance Maps. Based on analysis by Ookla of Speedtest Intelligence® data for 2021Q2. Provided by Ookla and accessed 2021-07-21. Broadband measurements, Tjek dit net website, https://tjekditnet.dk/dataudtr%C3%A6k, accessed 2021-08-04.

Overall, the comparison of indicators at an aggregated level (TL3) shows similar regional trends for the data source coming from the private provider and the one collected by the Danish Energy Agency, albeit differences in levels exist (Figure 8). Both sources identify Copenhagen and Bornholm as the regions with the highest and lowest average download speed, respectively. In between, there are three clusters of regions with small differences in rankings: East Zealand, Copenhagen suburbs and North Zealand; East and West Jutland; West and South Zealand, North Jutland, South Jutland and Flyn. Given the differences in reporting methods, measurement biases, and scale of testing, it is difficult to envision an exact match between both sources at this time. The exercise serves as an example on how to assess the validity of the data on a case-by-case basis for different countries, where institutional and local factors may affect the quality of the private providers' data. Lastly, in pursuing a methodology using relative measures, biases related to country-specific differences between private sector and official sources are reduced.

Figure 8. Comparisons of fixed download speed measurements from Tjekditnet.dk and Ookla, at the regional level (TL3)



Note: Data for 2021Q2. Pearson's correlation coefficient is 0.72 (p-value 0.01204) and Kendall's rank correlation coefficient is 0.71 (p-value 0.0016).
Source: OECD calculations based on Speedtest® by Ookla® Global Fixed and Mobile Network Performance Maps. Based on analysis by Ookla of Speedtest Intelligence® data for 2021Q2. Provided by Ookla and accessed 2021-07-21. Broadband measurements, Tjek dit net website, https://tjekditnet.dk/dataudtr%C3%A6k, accessed 2021-08-04.

Conclusions

This paper leverages unconventional data from Internet speed test to assess the quality of connections as experienced by users in different places. With an increased consistency of evidence across regions due to the use of harmonised data across countries, the set of indicators developed in this paper aims to support policy makers looking to bridge divides in service provision in communication infrastructure. With increasing demand of communications infrastructure triggered by changes in remote working trends and public service delivery, developing consistent and timely indicators on quality of the Internet connection based on user experiences is key to help reach the goal of ubiquitous provision of critical information and communication services.

Future work could focus on using this type of data to assess access to quality connections, notably by creating indicators on coverage. Similarly, extending the analysis to a longer time horizon could help identify under deserved places. Lastly, complementing this information with indicators on the number of providers and types of Internet technologies would lead to more nuanced discussions on the optimal mix of market policies, subsidies and regulatory options that would ensure quality and reliable Internet across places.

References

Fadic, M. et al. (2019), "Classifying small (TL3) regions based on metropolitan population, low density and remoteness", *OECD Regional Development Working Papers*, No. 2019/06, OECD Publishing, Paris, https://doi.org/10.1787/b902cc00-en. [5]

OECD (2022), *Unlocking Rural Innovation*, OECD Rural Studies, OECD Publishing, Paris, https://doi.org/10.1787/9044a961-en. [3]

OECD (2021), *Bridging digital divides in G20 countries*, OECD Publishing, Paris, https://doi.org/10.1787/35c1d850-en. [14]

OECD (2021), *Implications of remote working adoption on place based policies: A focus on G7 countries.*, OECD Publishing, https://doi.org/10.1787/b12f6b85-en. [2]

OECD (2021), *Promoting high-quality broadband networks in G20 countries*, OECD Publishing, Paris, https://doi.org/10.1787/cf0093dc-en. [8]

OECD (2020), *OECD Regions and Cities at a Glance 2020*, OECD Publishing, Paris, https://doi.org/10.1787/959d5ba0-en. [13]

OECD (2020), *OECD Territorial Grids*, https://www.oecd.org/cfe/regionaldevelopment/territorial-grid.pdf. [12]

OECD (2018), "Bridging the rural digital divide", *OECD Digital Economy Papers*, No. 265, OECD Publishing, Paris, https://doi.org/10.1787/852bd3b9-en. [1]

OECD (2014), "Access Network Speed Tests", *OECD Digital Economy Papers*, No. 237, OECD Publishing, Paris, https://doi.org/10.1787/5jz2m5mr66f5-en. [7]

OECD (2013), *OECD Communications Outlook 2013*, OECD Publishing, Paris, https://doi.org/10.1787/comms_outlook-2013-en. [6]

OECD et al. (2021), *Applying the Degree of Urbanisation: A Methodological Manual to Define Cities, Towns and Rural Areas for International Comparisons*, OECD Regional Development Studies, OECD Publishing, Paris/European Union, Brussels, https://doi.org/10.1787/4bc1c502-en. [4]

Ookla (2021), *https://registry.opendata.aws/speedtest-global-performance/*. [9]

Perpiña Castillo, C. et al. (2021), *Broadband accessibility and quality connection in Europe by urban-rural typology including remoteness*, European Comission, https://publications.jrc.ec.europa.eu/repository/handle/JRC124456. [11]

Pesaresi, M. et al. (2019), *GHS settlement grid, updated and refined REGIO model 2014 in application to GHS-BUILT R2018A and GHS-POP R2019A, multitemporal (1975-1990-2000-2015), R2019A*, European Commission, Joint Research Centre (JRC), https://doi.org/10.2905/42E8BE89-54FF-464E-BE7B-BF9E64DA5218. [10]