

# Unpacking the cost of mobile broadband across countries



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NOVEMBER 2022



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## NOVEMBER 2022

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# EXECUTIVE SUMMARY

## BACKGROUND CONTEXT AND RESEARCH OBJECTIVES

### **The COVID-19 pandemic has accelerated digital transformation around the globe.**

Six years ago, around a third of the global population was using mobile broadband. By the end of 2020, it was over half. Over the past decades, mobile technology has emerged as a crucial engine of economic development worldwide, stimulating huge private-sector expenditure in both research & development (R&D) and infrastructure, and deeply transforming people's lives everywhere.

With every step forward in core technologies, new digital services come online, with the potential to positively affect fields that have substantial social and economic impact, such as health care, finance, and education. Against this backdrop, **interest in the affordability of mobile broadband has risen**, as demonstrated by the number of studies that attempt to rank countries based on broadband prices.

Many of these international price comparisons to date, however, **lack a holistic lens and mostly focus on average price levels across the mobile offerings in a country's wireless marketplace**. Relying on studies with such an approach risks generating misleading conclusions, particularly for policymakers.

Failure to account for differences in the types of plans offered and households' needs across countries is problematic for two main reasons. First, broadband operators offer a wide range of packages. The offering of low-end, mid-range, and high-end plans reflects operators seeking to satisfy an array of customers with varying needs met by different cost categories. Not everyone will have the desire or budget for the most high-end offering, so this diversification allows customers who are looking for a less expensive solution to still find a plan that works for them. For this reason, **it is important to evaluate broadband prices across multiple broadband baskets rather than just looking at the average cost**.

Secondly, international pricing comparison studies that do not account for variation in household spending capacity are inherently flawed. Affordability is the term to refer to a family's or an individual's ability to purchase a service (in this study's case, mobile broadband), but what constitutes affordability varies by income level—and income levels vary considerably by country. This is why **this report uses broadband prices as a share of disposable income as the key metric of interest**.

Against this backdrop, Oxford Economics has been commissioned to assess:

- How developed countries compare in terms of the entry-level, mid-tier, and flagship price plans for mobile broadband. Prices are contextualized to the local macroeconomy, with reference to the average level of household disposable income.

## UNPACKING THE COST OF MOBILE BROADBAND ACROSS COUNTRIES

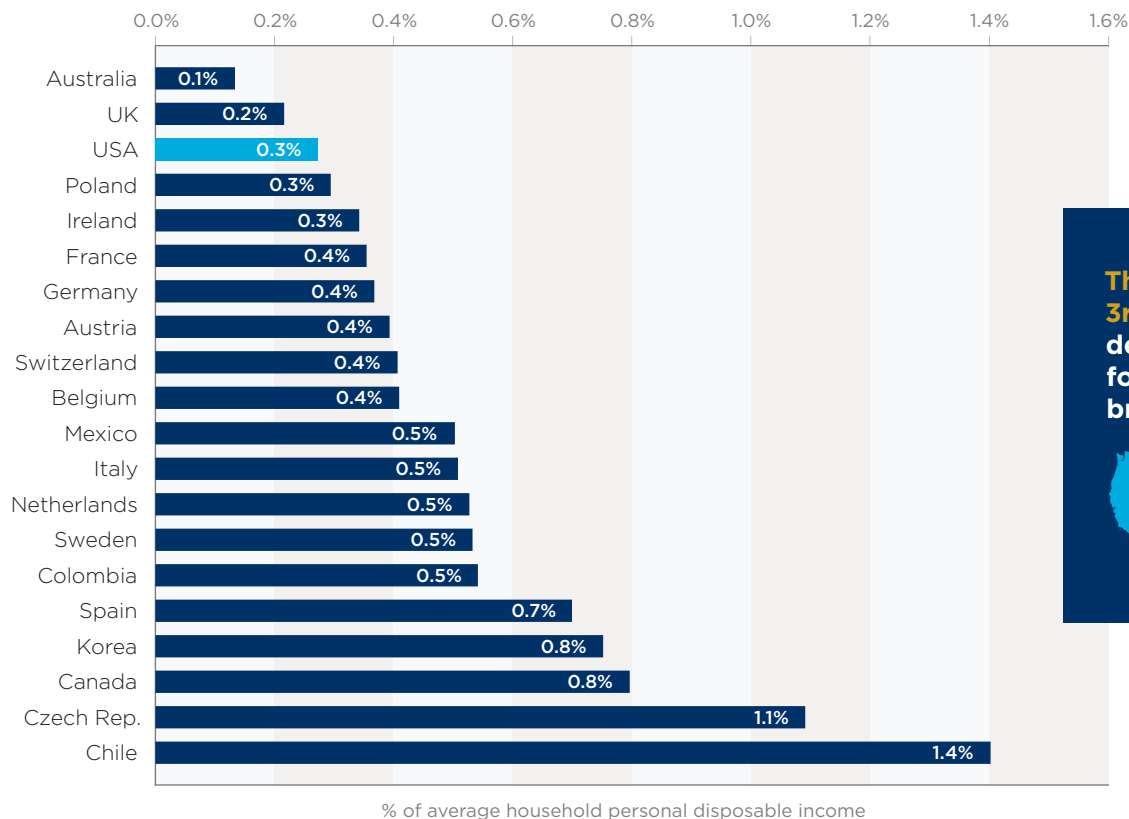
We used the ratio between annual mobile broadband costs and average household personal disposable income as our main metric of affordability. We find that, across all plans, the United States consistently ranks in the most affordable half of the distribution when accounting for the incomes earned by the average household. **This is especially true for entry-level plans, with the US ranking as the 3rd most affordable for this mobile service category among the 20 benchmark countries**, with an annual cost equivalent to 0.3% of the average household personal disposable income (Fig. 1).

**Furthermore, our analysis shows US affordability has improved substantially between 2018 and 2021, with entry-level plans falling by 44% as a proportion of household disposable income.**

While this study builds on previous work, it also expands beyond price differences to include perspectives on affordability, and controls for a host of competitive distinguishers such as plan attributes and service quality. This modeling framework better explains affordability differences across countries in a consistent way.

**Prices of US entry-level plans fell by 44% as a proportion of household disposable income between 2018 and 2021.**

**Fig. 1. Affordability of entry-level wireless plans, by country**



**The United States is the 3rd most affordable developed country for entry-level mobile broadband packages**

Source: Strategy Analytics, Oxford Economics

# 1. INTRODUCTION

The COVID-19 pandemic has accelerated digital transformation around the globe. The swift spread of remote teaching and health services, e-commerce, and online working has emphasized the significance of the internet. Six years ago, around a third of the global population was using mobile broadband. By the end of 2020, it was over half.

**Mobile technology has emerged as a crucial engine of economic development worldwide**, stimulating huge private-sector expenditure in both R&D and infrastructure, and deeply transforming people's lives everywhere. With every step forward in core technologies, new digital services become available online, with the potential to transform fields that have substantial social and economic impact, such as health care, finance, and education. And as a consequence, consumers expect that mobile will keep improving and transforming their lives, supplying an even wider variety of services that will connect them with everything, everywhere.

Against this backdrop, a focus on **the affordability of mobile broadband has increased**, as demonstrated by the number of studies that attempt to compare broadband prices across countries. CTIA commissioned Oxford Economics to build upon these international wireless broadband price comparison studies. Specifically, the focus of this study is to provide:

A comparison of the entry-level, mid-tier, and flagship price plans for mobile broadband in a range of developed economies. Plan prices are then contextualized to the local macroeconomy, as a percentage of the average household disposable income.<sup>1</sup>

**We demonstrate that, when accounting for international differences in purchasing power, the United States outperforms most of its peers for mobile broadband affordability.**

<sup>1</sup> This contextualization aims to reflect the affordability of plans across countries. This kind of affordability measure is widely used in a host of applications, including the [OECD Affordable Housing Database](#) and [USDA's](#) estimate for the percentage of consumers' disposable personal income that is spent on food (as discussed further in Section 2.2). This shows how important it is to understand the prices of services in the wider context of household spending capacity, as opposed to standalone values.

## 2. ANALYSIS OF MOBILE BROADBAND PRICES AND AFFORDABILITY

Academic and professional studies have been published around the topic of mobile broadband availability, prices, and the socio-economic importance of digital inclusion. These studies attempt to rank countries by the performance of their telecommunications markets. However, **most of the existing studies lack a holistic lens and mostly focus on average price levels** across the mobile offerings in a country's wireless marketplace and ignore all other price-influencing factors, including plan attributes and service quality. Relying on studies with such an approach risks generating misleading conclusions, particularly for policymakers. Simple price comparisons also fail to account for the fact that the cost of building and maintaining a mobile wireless network can vary significantly across countries.<sup>2</sup> These omissions are problematic for two main reasons.

First, broadband operators compete in a dynamic market, and thus seek to offer a wide range of packages. The existence of low-end, mid-range, and high-end plan pricing means operators are able to satisfy an array of customers with varying needs, who will be better served by different cost categories. Not everyone will have the need or the budget for the most high-end offering, so this diversification allows those customers who are looking for a less expensive solution to still find a plan that works for them. For this reason, **we evaluate mobile broadband at different price points, differentiating by plan characteristics.**

Secondly, international pricing comparison studies that do little to nothing to account for variation in household spending capacity are inherently flawed. Affordability is a term that refers to a family's or an individual's ability to purchase a service (in this study's case, mobile broadband) at a reasonable cost, but what constitutes affordability varies by income level—and income levels vary considerably by country. This is why it is important to consider broadband price as a share of average disposable income. We find that, across all plans, **the United States consistently ranks as one of the more affordable markets when accounting for average household income.**

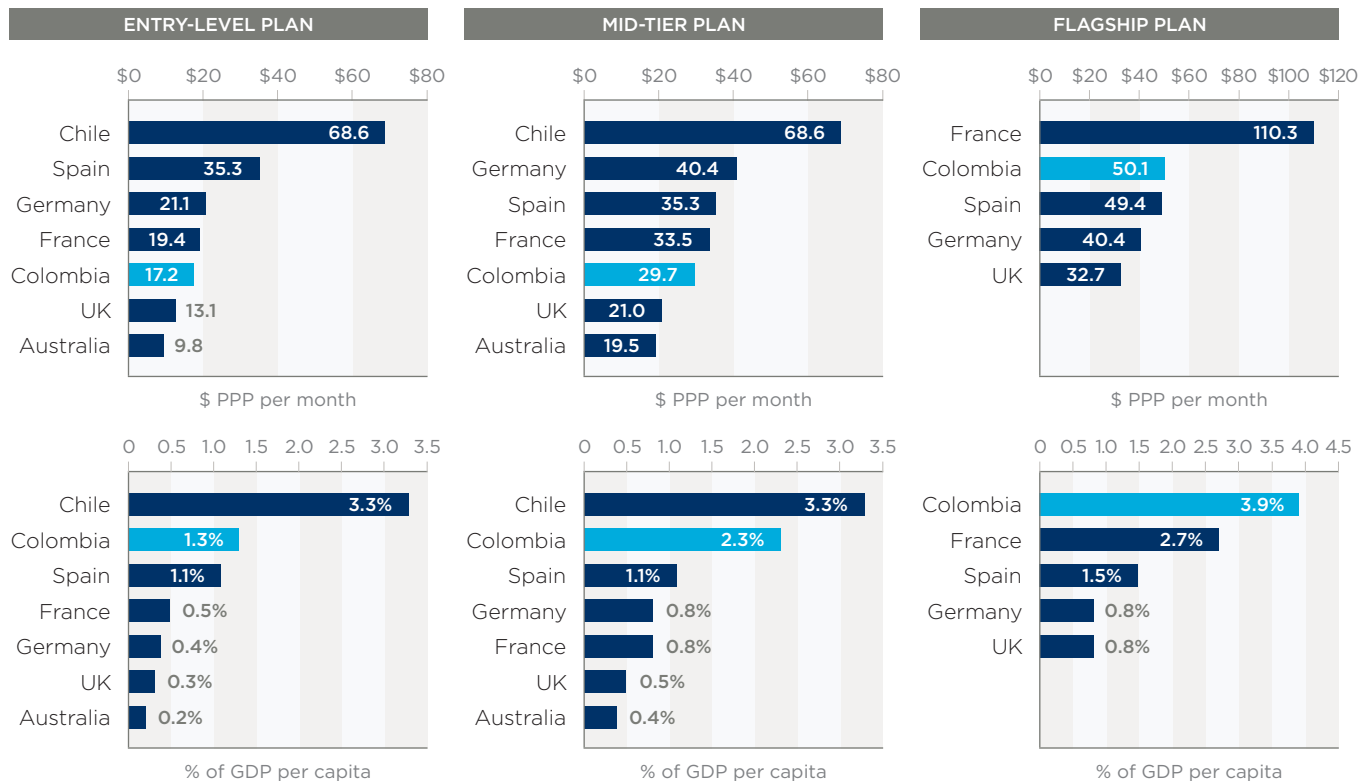
<sup>2</sup> Some studies, including recent work by [Rewheel](#) and [Cable.co.uk](#), showcase the average cost of one gigabyte (GB) of mobile data in a host of countries and jurisdictions. However, many mobile plans include calling and text packages as well as the data, which could be seen as a confounding variable and may yield counterintuitive results. In addition, these studies implicitly assume that consumers care only about how much data they can get for a certain budget, while all other competitive differentiators (i.e., plan and quality differences) and cost differences (e.g., size of network built) are irrelevant.

## 2.1 COMPARING PRICE LEVELS AND AFFORDABILITY ACROSS COUNTRIES

To demonstrate the importance of evaluating mobile broadband at different price points and of using household income to generate a more accurate affordability comparison lens, we start by analyzing price levels across countries, differentiating by basket characteristics. The baskets analyzed include an ‘entry-level basket,’ a ‘mid-tier basket,’ and a ‘flagship basket’ (see Appendix 1 for further details on the basket selection).

Relying solely on a narrow price-centric view, however, is misleading because it tells an incomplete story. For example, entry-level plans may seem quite cheap in Colombia compared to France, Germany, and Spain, costing only \$17.20 PPP, but when contextualized to the average household personal disposable income in that country, the same entry-level plan in Colombia is less affordable than its counterparts in France, Germany, and Spain.

**Fig. 2. Comparison of price level and affordability across countries**



Source: Strategy Analytics, Oxford Economics

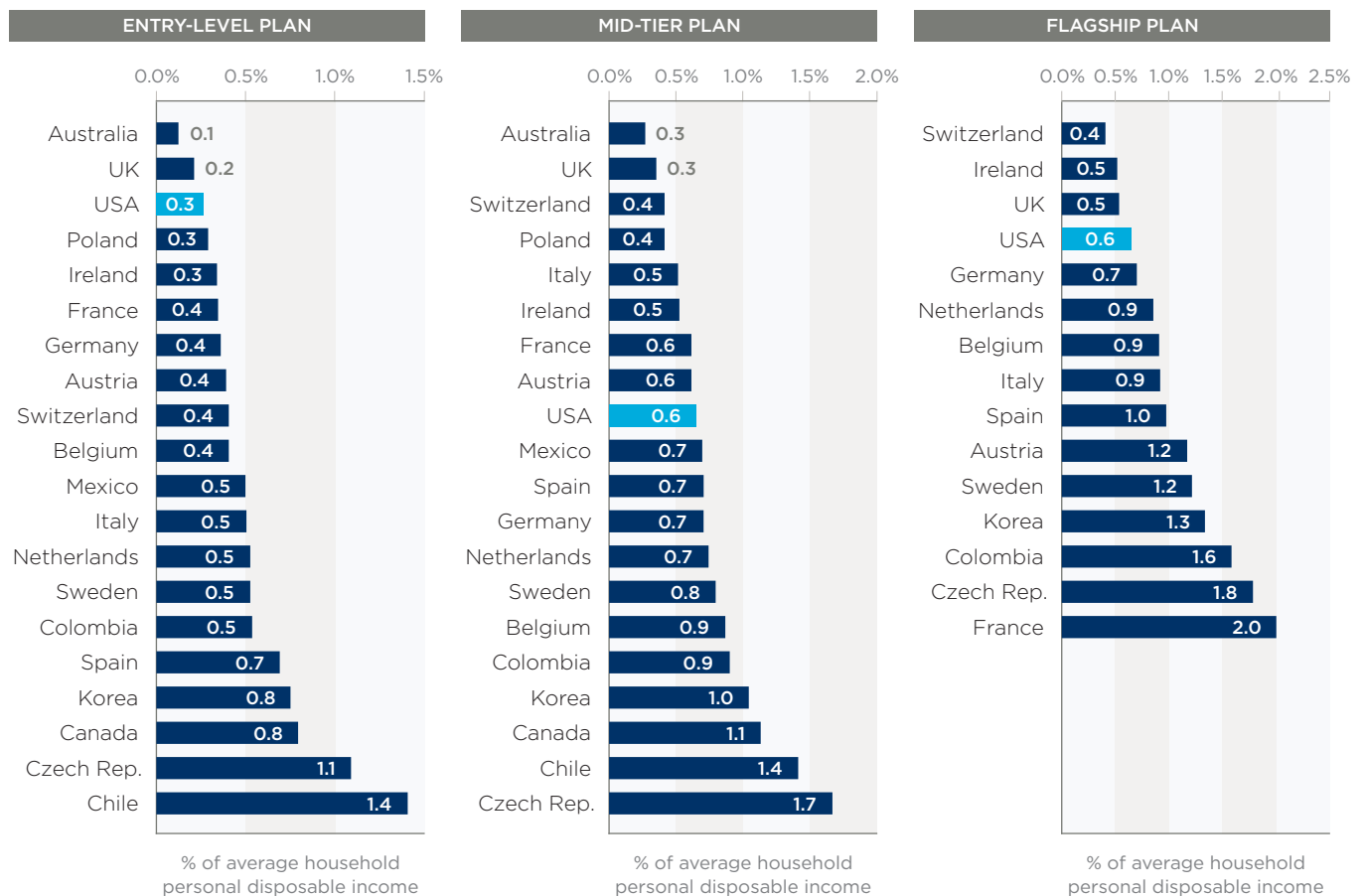
In other words, findings generated by such a price-centric approach tells us little about the relative *affordability* of mobile broadband. Contextualizing these results to account for differences in households’ purchasing power across countries allows us to reach a better understanding of the relative affordability of mobile broadband plans.



## 2.2 AFFORDABILITY OF US PLANS

Whenever consumers face a higher price for a good or service, its purchase forces them to forgo or buy less or another item. When evaluating the extent to which differences in price create trade-offs for consumers across countries, a complete analysis must also consider differences in consumers' purchasing power. A product price that is higher in absolute but lower in proportionate (as a share of disposable income<sup>3</sup>) terms should be regarded as more affordable because its purchase requires fewer trade-offs for a typical consumer—in economics jargon, the 'opportunity cost' is lower.

**Fig. 3. Annual cost of a plan as a % of average household personal disposable income, by country and by basket of plans<sup>4</sup>**



Source: Strategy Analytics, Oxford Economics

<sup>3</sup> This kind of affordability measure is widely used in a host of applications. For example, the [OECD Affordable Housing Database](#) publishes the proportion of households that spend more than various percentages of their disposable income on housing costs. Similarly, the [US Department of Agriculture \(USDA\)](#) regularly reports the percentage of consumers' disposable personal income that is spent on food, in order to track the affordability of food at home and away from home.

<sup>4</sup> Results are presented in USD per month, adjusted for Purchasing Power Parity (PPP), in order to equalize the purchasing power of different currencies and thereby eliminating the differences in price levels between countries. All monthly costs include VAT and refer to May 2021. Tariffs describe a new connection of a single cell phone service, for a new customer.

Our analysis shows that when accounting for average household purchasing power, mobile broadband offerings in the US rank as some of the most affordable across the benchmark countries, particularly for entry-level plan offerings.<sup>5</sup> In terms of the entry-level plans, the US ranks as the 3rd most affordable, while it ranks 9th in the mid-tier plan rankings and 4th in the flagship plan rankings.

In other words, across all plans, the United States consistently appears as one of the more affordable markets when accounting for average household income. This is especially true for entry-level plans, whose annual cost is equivalent to 0.3% of the average household personal disposable income in the United States, making it the 3rd most affordable developed country for these types of packages.

This compares favorably, for instance, to entry-level plans offered by major operators in Germany (0.4%), Sweden (0.5%), South Korea (0.8%), and Canada (0.8%). In Italy, where some have pointed to some plan offerings as evidence of the relative cost of US wireless plans, our study finds that entry-level plans offered by the largest providers are 87% more expensive than the US, relative to household personal disposable income.<sup>6</sup>

**The United States is the 3rd most affordable developed country for entry-level mobile broadband packages**



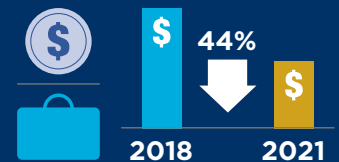
## 2.3 TRENDS IN ENTRY-LEVEL PLANS' AFFORDABILITY

The dataset assembled for this study further enables us to track affordability across countries over time. We find that US entry-level plans have become more affordable relative to other countries over the past four years.<sup>7</sup>

These plans have become more affordable between 2018 and 2021 in most of the countries we analyzed (13 out of 19), including in the US, which experienced the 4th highest increase in entry-level affordability (Fig. 4). In addition to the entry-level price decline in the US, consumers in the country also saw mid-tier and flagship prices decline.

Here, we choose to focus on entry-level plans, which tend to be the “go to” choice of low-income consumers. In 2018, the US was the 8th most affordable country in the list and by 2021 it had become the 3rd most affordable. For context, the most affordable entry-level plan went from costing 0.5% of a household disposable income in 2018 to 0.3% in 2021—in other words, entry-level plans in the US became 44% more affordable.<sup>8</sup>

**Prices of US entry-level plans fell by 44% as a proportion of household disposable income between 2018 and 2021.**



<sup>5</sup> As a proxy, we use average household personal disposable income, which is the amount of money that a household has to spend or save after income taxes have been deducted.

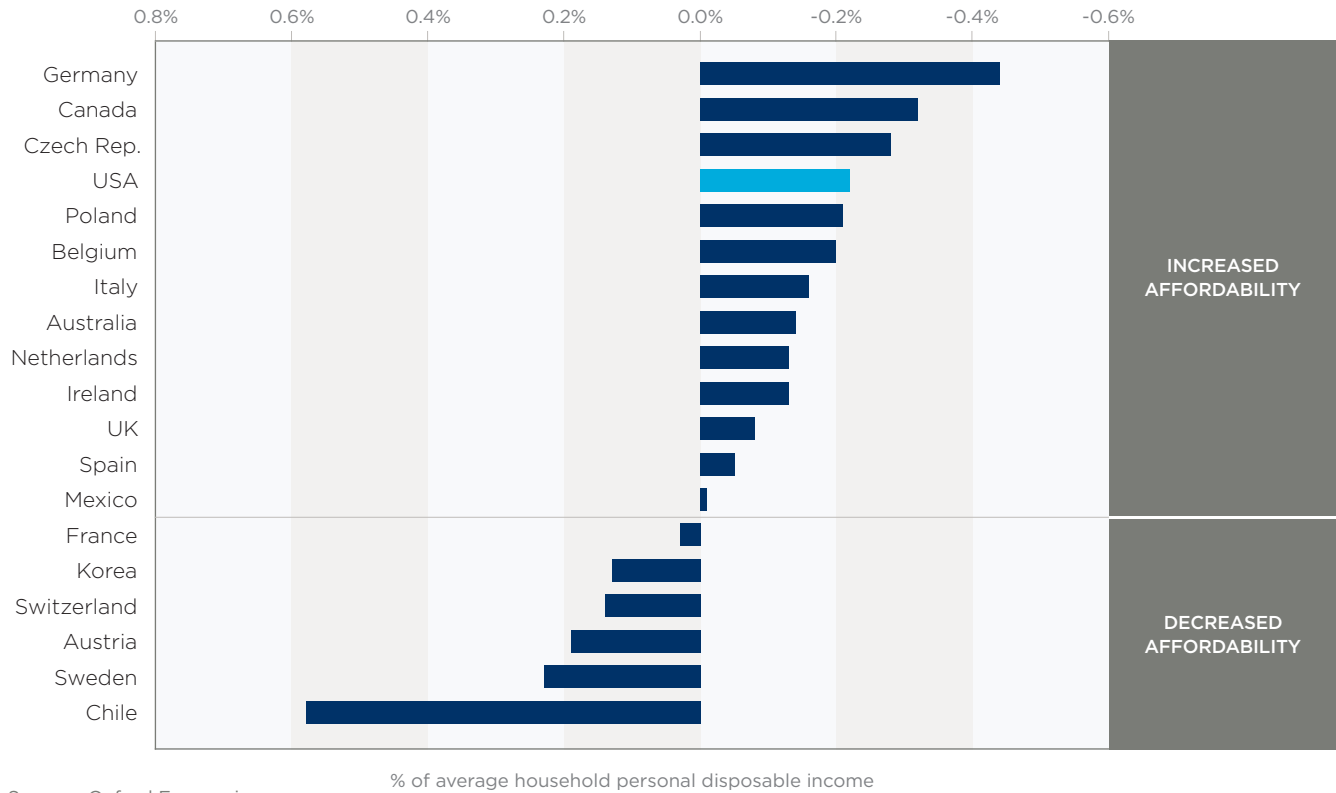
<sup>6</sup> See, e.g., <https://twitter.com/stopthecap/status/1389638785512747018?s=11>

<sup>7</sup> This report uses the OECD basket definitions agreed in 2017, for which the first available data are for 2018. This is the reason for selecting 2018 as the comparison year in this section.

<sup>8</sup> The main driver for this improvement involved the 2021 introduction of a \$25/month pre-paid 12-month contract by one of the main providers, halving the cost for the lowest-cost plan from \$50/month.

In six countries, entry-level plans have become less affordable over the same period. Chile, Sweden, Austria, and Switzerland were the countries experiencing the greatest decline in entry-level plan affordability between 2018 and 2021.

**Fig. 4. Annual cost of entry-level plan as a % of average household personal disposable income, by country, 2018-2021 differential in percentage points**



Germany, Canada, Czech Republic, and the US were the countries experiencing the **greatest affordability gains** between 2018 and 2021.



# 3. CONCLUSION

The COVID-19 pandemic has brought about a swift spread of remote teaching and health services, e-commerce, and online working, all of which have emphasized the significance of the internet. Even before the pandemic, mobile technology had emerged as a crucial engine of economic development worldwide, stimulating huge private-sector expenditure in both R&D and infrastructure, and deeply transforming everyday lives everywhere.

Against this backdrop, ensuring the affordability of mobile broadband has gained traction, as demonstrated by the number of studies that attempt to rank countries based on broadband prices. This report demonstrates that plan pricing alone is a poor metric to understand mobile broadband.

When household purchasing power is accounted for, the United States ranks favorably against its peers for mobile broadband affordability. The country consistently positions in the most affordable half of its peer group when accounting for the incomes earned by the average household. This is especially true for entry-level plans, whose annual cost is equivalent to 0.3% of the average household personal disposable income in the United States, making it the 3rd most affordable developed country for these types of packages.

# APPENDIX 1: DATA AND ASSUMPTIONS

In this study, we present data on the prices of mobile packages across 20 major advanced economies. The price plans analyzed in this study include an ‘entry plan’ (defined as one offering at least 5 GB per month and unlimited calls), a ‘mid-tier plan’ (defined as one offering at least 20 GB per month and unlimited calls), and a ‘flagship plan’ (defined as one offering unlimited voice, SMS, and data).<sup>9</sup> To give a sense for how widespread each type of plan is, we calculate that in the US some 96% of the plans offer at least 5 GB, 77% offer at least 20 GB, and 31% include unlimited data.

These plans correspond with standardized baskets defined by the OECD, which has been collecting telecommunications prices across countries for over 20 years. This report adopts the basket methodology agreed in 2017. The organization uses a basket approach consisting of 12 baskets each including different levels of voice calls, messages (SMS), and data use (GB). Drawing from these data, Strategy Analytics produces commercially available ranking reports and data that it updates regularly. This dataset is called OECD Mobile Voice and Data Price Benchmarking tool and it is the main data source for our analysis. The dataset is a comprehensive Excel-based system which is updated quarterly and tracks mobile voice and handset data pricing for the two main providers in most OECD countries (plus Brazil)<sup>10</sup> and it allows us to:

- Track the best prices in and between national markets across all included providers at different usage levels.
- View results in a number of different ways, e.g., with/without VAT, in national or common currency.
- View the detailed price information on each plan, including data allowances, SMS pricing, promotional offers, usage restrictions, and contract terms.<sup>11</sup>

<sup>9</sup> In the US, mobile broadband minimum service standards are set by the US Federal Communications Commission. As of today, this is set at 3 GB/month with a view to bring the mobile broadband usage available to the US’ most vulnerable consumers more in line with what other Americans expect and receive from their mobile broadband service, while maintaining a service that is affordable for low-income consumers. With this in mind, this study uses 5 GB/month as the entry-level basket.

<sup>10</sup> In countries where the two largest providers make up less than 50% of the market, additional providers are also included to cover at least this portion of the market.

<sup>11</sup> Discounts are incorporated in the calculations of prices for each basket. Typical discounts include promotional discounts on monthly rental and/or connection charges. Promotional offers must be available for at least one month, and valid at the time of data collection.

# APPENDIX 2: MOBILE BROADBAND MARKET PRICING

Several factors influence the price of broadband within countries. Scholars have suggested that price differences are broadly driven by six factors: supply, demand, governmental policy and regulation, average price level throughout the economy as a whole, physical/infrastructural factors, and the characteristics of the plans offered (Fig. 5).<sup>12</sup> However, a critical evaluation of the roles these drivers play in determining broadband price is under-examined.<sup>13</sup>

**Fig. 5. Factors that influence broadband price differences across countries**

Factor	Examples of variables
Supply	Country-level broadband operators' market concentration (calculated using the "Hirschman Herfindahl Index" or HHI), average mobile speed levels, bandwidth capacity, and network coverage.
Demand	Country-level numbers of internet users/ mobile subscribers, literacy levels, population levels, income levels, mobile broadband traffic, and ICT skills level.
Government	Country-level government initiatives along a range of dimensions (e.g., public Wi-Fi initiatives, availability of e-Government services, open data policies, support for digital literacy, privacy regulations, broadband strategies).
Price levels	Partly accounted for through PPP adjustments, but other variables may also be important to consider (such as the average/minimum cost of a smartphone). <sup>14</sup>
Physical factors	Country-level urban population rate, population density, and surface area, but also telecoms investment.
Plan characteristics	SIM-only, contract length in months, minutes of voice allowance, SMS allowance, data allowance, speed advertised (Mb/s), and technology (3G, 4G or 5G).

Demand and supply factors determine the equilibrium price for most goods and services in an economy. However, in the case of broadband services, there are certain peculiarities; low broadband demand is not associated with low price (as generally happens for other products and services), but rather with an inflated fee. This is because providing broadband across larger geographies, including sparsely populated areas, requires substantial infrastructure expenses. These higher expenses are spread among few users in a low demand situation.

<sup>12</sup> Grechyn, V and McShane, I. What Influences International Differences in Broadband Prices?, *The Australian Journal of Telecommunications and the Digital Economy (AJTDE)*. Vol 4. No 4. (2016).

<sup>13</sup> Flamm, K & Chaudhuri, A. An analysis of the determinants of broadband access. *Telecommunications*. Vol. 31. Issue 6-7. (2007).

<sup>14</sup> All our results are presented in USD, adjusted for Purchasing Power Parity (PPP), with a view to equalize the purchasing power of different currencies thereby eliminating the differences in price levels between countries.

# APPENDIX 3: EXPLAINING CROSS- COUNTRY DIFFERENCES IN AFFORDABILITY

Our study includes the exploration of factors that influence not just prices but also affordability across markets. We developed a model to analyze how changes in these factors are associated with changes in affordability. The results of our modeling can inform discussions of mobile broadband pricing, competition, and overall mobile broadband value proposition across countries.

Our main data source is the May 2021 database referenced in Appendix 1. This database uses information from over 2,600 retail plans offered by 47 mobile wireless providers in 37 countries. The data were fit to a cross-sectional regression model. As our main dependent variable, we used annual broadband cost as a percentage of average household personal disposable income. As detailed in Chapter 2, this is interpreted as the inverse of affordability, because it measures the proportion of household income that is spent on mobile broadband over a year, on average, in each country. The larger the broadband price-to-income ratio, the higher the share of income households need to devote to broadband charges, and the lower the affordability. For this part of the analysis, we used price data from all the plans included in our database as the source for our statistical model.

We adopted a ‘general to specific’ approach, which involved testing the broadest list of potential explanatory variables available in the database and then gradually narrowing these down to the most statistically significant sample. **We find that the share of the population with internet access, and capital investment to be among the key factors that can explain variation in broadband affordability.**

Fig. 6 reports the estimates of the model specification that best describes the factors affecting broadband affordability. The coefficient for each explanatory factor provides specific insights on the influence each factor has on affordability. Most of the coefficients in the regression are significant (as visually indicated by the number of asterisks [\*] associated with each coefficient).

The signs of each coefficient (i.e., the positive or negative influence on affordability) are in line with our predictions and existing literature. For example, the unlimited data/voice flags are associated with a positive coefficient, implying that the cost of broadband as a share of disposable income is higher when unlimited data/minutes are included.

**Fig. 6. Main econometric results: explanatory factors of broadband affordability across countries**

Explanatory factor	Coefficient	Statistical significance
Unlimited data	0.006	***
Unlimited voice	0.005	***
Speed advertised in Mbs (log)	0.000	
Broadband operators market share (log)	0.004	***
Network coverage min 4G (log)	-1.299	***
Individuals using the Internet (log)	-0.055	***
Support for digital literacy	0.024	***
SIM only plan	-0.001	
Provider CAPEX 5yr average	0.006	***

Below we outline potential interpretations for some of the above explanatory factors showing a statistically significant coefficient.

A higher percentage of population with **access to the internet** allows carriers to achieve economies of scale, as they can connect more subscribers to the deployed infrastructure. The rollout is therefore less costly per mobile broadband subscriber and network providers can spread the cost of the network over more users, with each one paying a lower price. Referred to as a network effect, this is a peculiarity of the broadband market, whereby higher broadband demand is not associated with inflated price (as generally happens for other products and services), but rather with a lower fee.<sup>15</sup> Holding all other factors constant, an increase in people using the internet is associated with more affordable broadband plans.

Geographic size of network coverage also matters. The cost of deploying mobile broadband across diverse terrain and often large swaths of rural areas is more expensive than concentrated urban-heavy economies. Our model attempts to control for this, by using the provider-specific **capital investment** undertaken over the past five years as a proxy for the fixed costs incurred to construct and maintain domestic broadband networks. Model findings show that when other factors are constant, markets where providers invest more in capital (e.g., property and equipment) tend to offer less affordable plans.

Intuitively, this makes sense. Mobile broadband carriers' capital expenditure to improve reliability and increase speeds (often to existing consumers and not new consumers) requires some level of return on their investment. Improving speeds and reliability, as well as sustaining a growing network infrastructure, generally coincide with higher costs.

<sup>15</sup> To that end, we note that broadband affordability programs, like the Emergency Broadband Benefit and the Affordability Connectivity Program in the US, may be proven to have longer-term positive affordability impacts beyond helping make broadband services more affordable to consumers in a given month.



# APPENDIX 4: MODEL IMPLICATIONS FOR THE US

The econometric results developed through a multi-country model lend themselves to US-specific insights. The US ranks above the average for the share of individuals using the internet, at 89.4%. While showing room for improvement (in Iceland, this proportion is higher than that of the US and is 99%), recent policies acknowledge the vital role played by digital inclusion, as exemplified by the Affordable Connectivity Program.<sup>16</sup> The program is a long-term, \$14 billion investment in broadband affordability to help families and households struggling to afford an internet service. The findings from our analysis suggest that such a program has the potential to not only make broadband more affordable for eligible households, but also to increase affordability more broadly for the average US consumer, assuming the program successfully expands the proportion of individuals using the internet in the US.

Additionally, we have shown how prices are affected by the vastly different geographic environments in which networks are built and services provided. For instance, the investment requirements in a country with a low population density (e.g., the United States with 36 people per square kilometer) may be significantly higher than in a country with high population density (e.g., South Korea with 527 people per square kilometer). These enhanced capital investment needs can explain the need for charging relatively higher prices—unadjusted for average household income—in the US. It is nevertheless crucial to be reminded that the US ranks highly in both affordability and capital expenditure among its peers, which suggests that the positive effects of capital investments are more important in the overall analysis.

<sup>16</sup> This program replaced the Emergency Broadband Benefit on December 31, 2021.



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