GSMA

Efficient operator scale in European mobile markets

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Contents

Executive summary

European mobile markets are undergoing a structural shift that goes beyond cyclical pressures. The mobile sector has moved from the voice and SMS era (defined by higher average revenue per user (ARPU), lower data usage and a relatively static competitive environment) to a data-intensive era in which revenues per user are declining even with incremental network costs and demand for capacity. With mobile broadband adoption already at saturation point in most European markets, the addressable market offers limited room for growth. Additional traffic generates diminishing incremental revenue, compressing margins even as usage expands. At the same time, Europe needs to close a significant gap with global leaders to meet its connectivity goals and regain its leadership in mobile, a challenge that will require higher levels of investment – with scale being a determining factor in operators' financing capacity. The central question this study addresses is which market structure best positions European markets to maximise investment and consumer welfare.

European markets exhibit the lowest concentration levels in the world

Measured by the Herfindahl-Hirschman Index (HHI) or by C2 (the combined share of the two largest operators), European markets are on average the least concentrated globally, which means individual operators tend to have smaller scale than their global counterparts. This is not the natural outcome of competitive dynamics: it often reflects regulatory decisions that blocked consolidation, imposed structural remedies and created advantageous conditions for new entrants.

As a result, European operators are structurally sub-scale compared with leading mobile connectivity markets. Consistent with this, Europe is also the only major region where in-market concentration has not increased accordingly during the mobile data era, which is the period when scale matters most. This has contributed to a widening gap with 5G leaders in North America, the Middle East and North Africa, China and leading Asia Pacific markets, which generally have fewer players and greater scale per market.

Markets with more scale invest more, build better networks and do not charge higher prices

Since 2016, European operators in three-player markets have invested approximately 48% more per connection than in four-player markets. These investments translate directly into faster networks (download and upload speeds are 15% higher on average), earlier and more extensive 5G coverage and higher 5G adoption.

Importantly, none of this comes at a price cost to consumers. Trend and econometric analyses show no significant price differences between market structures in the mobile data era, with prices in more concentrated markets remaining broadly in line with those in less concentrated ones.

An inverted-U relationship: investment and network quality are maximised at moderate concentration levels that are above average European levels today

Empirical estimations confirm that the relationship between concentration and investment follows an inverted-U shape: investment rises with scale up to an optimal range of approximately HHI 3,100–4,000 and only declines at levels of concentration that most European markets are far from approaching.
The average European four-player market has an HHI of 2,500.

A transition to a three-player structure would typically move HHI to approximately 3,000–3,500, which is precisely the range where investment incentives are strongest, according to our analysis. Network speeds follow the same inverted-U pattern: moderate levels of concentration maximise investment, and that investment translates directly into better network performance.

An evaluation of consolidation and entry events across Europe since 2010 confirms the asymmetry: consolidation improved consumer outcomes, while entries did not

Event study evidence consistently finds that consolidation events are associated with increases in operator capex per connection of approximately 33–45%, reductions in real ARPU and, once networks have been integrated and investment deployed, improvements in network speeds of approximately 9–11 Mbps, equivalent to a 25% average increase in weighted download speeds over the full period (2010–2025).

Consolidation allows fixed network costs to be spread over more subscribers, generating scale efficiencies that are reinvested in the network and passed on to consumers. Entry events tell the opposite story: null or negative effects on investment; negative effects on speeds and 5G adoption; and smaller and less consistent price reductions than those observed after consolidation.

Policy implications

Competition policy should assess mergers across the full range of consumer welfare dimensions, including investment, quality, coverage and consumer prices. Short-term price effects are a relevant consideration but must be assessed alongside dynamic effects. The evidence consistently shows that consolidation in Europe since 2010 has not raised prices and has delivered material improvements in investment and network quality.

Policy should therefore focus less on operator count and more on whether operators can achieve efficient scale. Markets with fewer, well-capitalised operators consistently deliver higher investment per connection and better network outcomes than markets with a larger number of sub-scale operators. Maximising the number of competitors as an objective without considering dynamic factors that drive longer term consumer welfare risks undermining long-term quality, coverage and affordability targets.

01
Rethinking competition in Europe's mobile data and 5G era

1.1
In-market fragmentation as a constraint on investment in Europe

The mobile sector is undergoing significant transformation. Despite a substantial increase in mobile data consumption, the revenue per user for most European operators has been largely stagnant or decreasing in recent years, even as the capital requirements for network deployment have increased. This new paradigm requires an updated assessment of the link between mobile operator scale, competitive intensity, investment and financial sustainability. Supply-side considerations – such as the marginal costs of incremental customers/capacity or the number of subscribers over which large, fixed network costs can be efficiently amortised – have become the key determinant of whether European mobile networks can deliver the investment required.

The link between scale, investment and consumer welfare is particularly important in mobile telecommunications. Network upgrades have historically been the main driver of cost and price reductions, quality improvements and innovation: each successive generation of technology (2G, 3G, 4G and now 5G) has delivered faster speeds, lower unit costs and new services. But the latest mobile technologies have coincided with significant investment requirements and average revenue per user (ARPU) plateauing or declining. This is a challenge that has intensified with the transition to 5G, which has been accompanied by elevated spectrum costs as revenue growth remains uncertain.[1]

Looking ahead, recent GSMA Intelligence projections suggest that maintaining and upgrading mobile networks in Europe will require around €270 billion over the next decade (2026–2036), but that an additional €200 billion would be required in order to catch up with global digital leaders.[2]

Operators that can leverage the multiplicative effects of cell sites and spectrum and spread these investments across a larger subscriber base are better placed to invest, to upgrade faster and to deliver better consumer outcomes. Those that cannot face an increasingly difficult trade-off between financial sustainability and network-quality expansion.

It is clear that the optimal market structure in mobile is not a one-firm monopoly: without competitive pressure, incentives to invest and innovate weaken. Equally, no market can sustainably support a very large number of mobile networks, given the fixed costs involved, the risk of inefficient infrastructure duplication and inherent limitations of critical inputs such as spectrum and operational real estate. Achieving sufficient localised operator scale is therefore essential, as it allows cost efficiencies to strengthen both the ability and the incentive to invest.[3]

An important channel through which scale drives efficiency is spectrum use. A single operator with a larger spectrum portfolio can deploy frequencies across different bands more efficiently than two smaller operators with fragmented holdings. A larger operator benefits from carrier aggregation across a wider set of bands, uses its spectrum more intensively in high-demand areas and faces fewer interference issues (as having fewer operators reduces the likelihood of interference), which, results in greater network capacity per unit of infrastructure cost.

In this context, Europe stands apart from every other major region in a critical aspect of market structure, as it is the most fragmented. Figure 1 illustrates this using two standard concentration metrics.[4] Europe is consistently the least concentrated region globally and it is the only region where concentration did not increase significantly during the mobile data era. In most other regions, the economics of the data consumption era pushed markets towards greater scale.

1 Spectrum costs in Europe have increased significantly, rising from approximately 3% to 8% of operator revenues over the past decade, while revenue per MHz has declined by 54% since 2014, reflecting a disconnect between spectrum pricing and underlying market value. This is partly driven by auction design and non-market factors such as high reserve prices, annual fees and artificial scarcity. For more details, see Spectrum Pricing and Renewals in Europe, GSMA Intelligence, 2025.

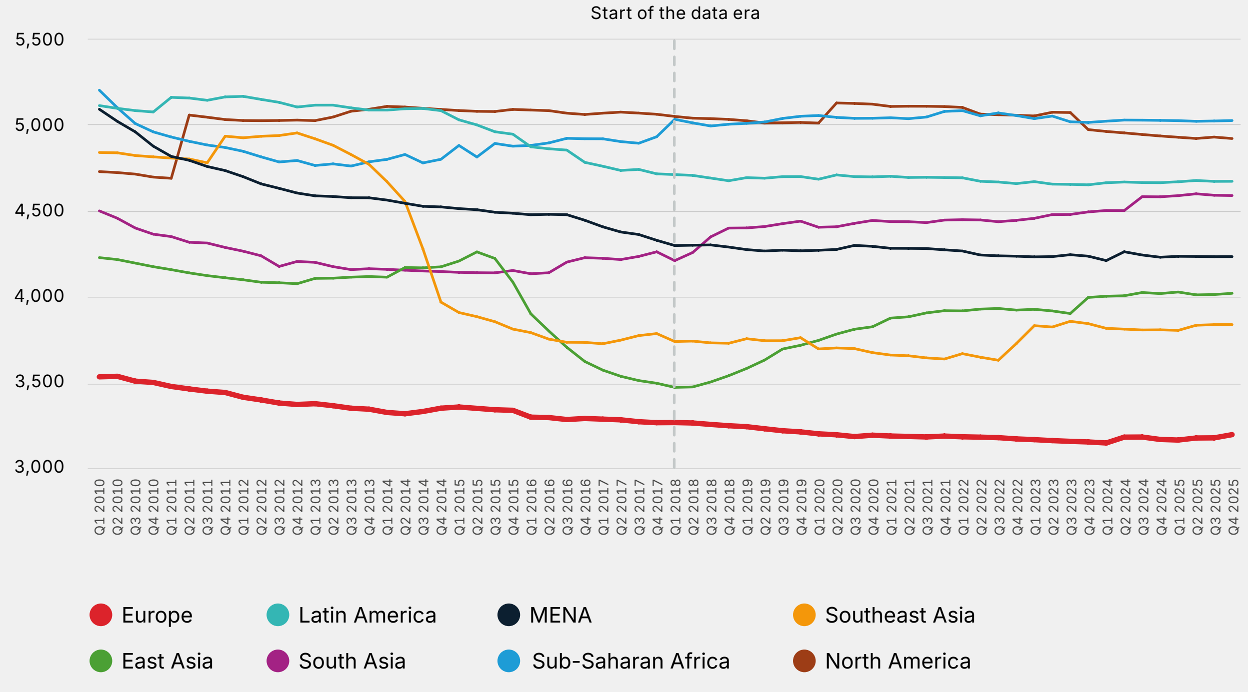
2 Mobile investment needs in Europe, GSMA Intelligence, 2026

3 The trade-off between competitive intensity and scale efficiency has been extensively studied. See for example: Competition and Innovation: An Inverted-U Relationship, Aghion, P., Bloom, N., Blundell, R., Griffith, R. and Howitt, P, 2005; Is there a level of competition intensity that maximises investment in the mobile telecommunications industry?, Jeanjean, F. and Houngbonon, G. V, 2014; Market structure and investment in the mobile industry, Jeanjean, F. and Houngbonon, G. V, 2017; The dynamic effects of competition on investment: the case of the European mobile communications industry, Bahia, K. and Castells, P, 2022; Evaluating market consolidation in mobile communications, Genakos, C., Valletti, T. and Verboven, F, 2018; Market Structure and Investments: A Progress Report, Lefouili, Y. and Madio, L, 2023; Is Draghi report really wrong about telecoms? (An overview of academic papers on telecom market structure and mergers), Jeanjean, F. and Ciriani, S, 2025; Competition dynamics in mobile markets in Europe: effects on investment and quality, GSMA, 2022; Impact of mobile operator consolidation on unit prices, Aimene, L., Jeanjean, F. and Liang, J, 2021; Competition, Technological Change and Productivity Gains: A Sectoral Analysis, Ciriani, S. and Jeanjean, F, 2020; and Competition, Technological Change and Productivity Gains: A European Sectoral Analysis, Ciriani, S. and Jeanjean, F., 2022.

4 The Herfindahl-Hirschman Index (HHI) is the primary measure of market concentration, with values ranging from 0 to 10,000. Higher values indicate a greater level of concentration. The index is calculated by summing the squares of individual operator market shares within each market. Similarly, C2 measures the combined market share of the two largest firms in the market.

Figure 1a

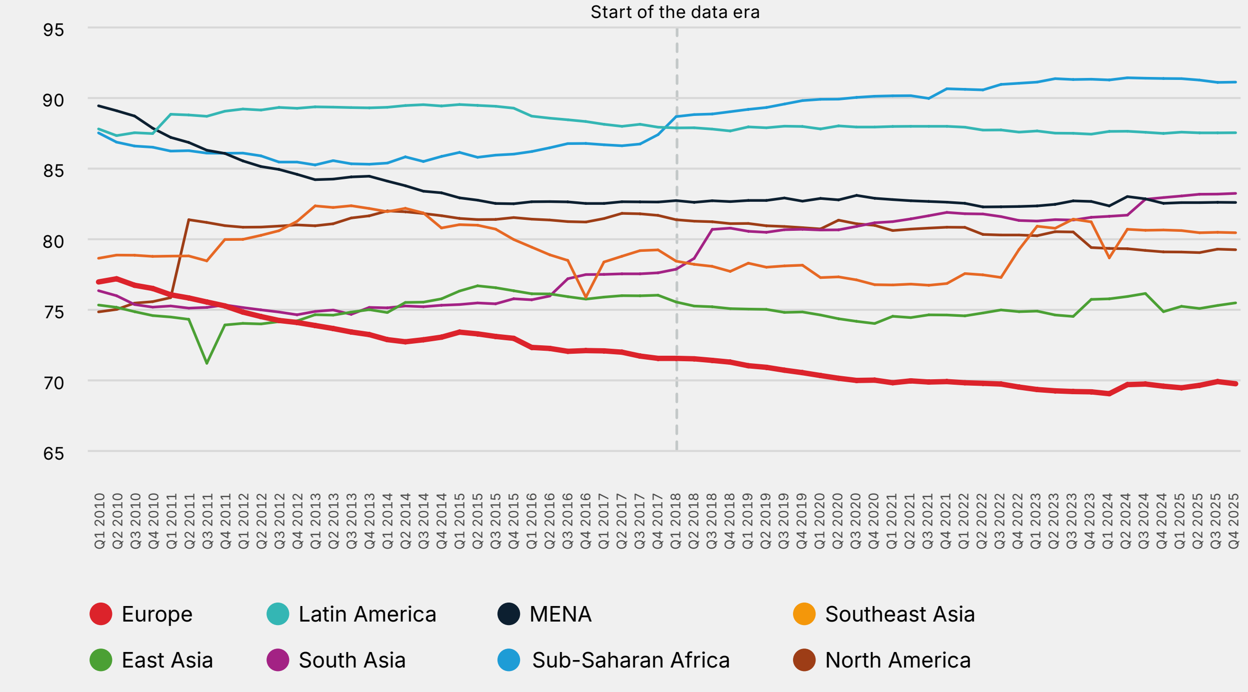
Average Herfindahl-Hirschman Index (HHI) by region[5]



Source: GSMA Intelligence

Figure 1b

Average C2 by region



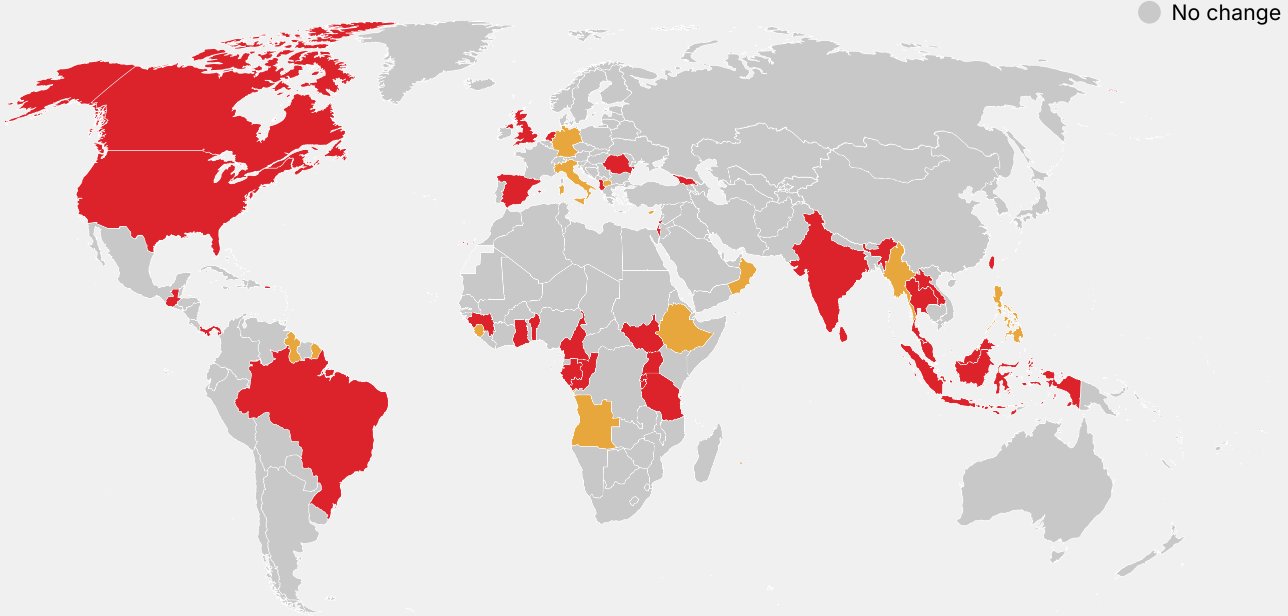
Source: GSMA Intelligence

5 For a limited set of 11 countries globally, the HHI incorporates a consolidated category capturing MVNOs and smaller operators reported only in aggregate, ensuring consistency between operator-level data and total market figures.

This is further illustrated by examining which markets globally have experienced a reduction in the number of mobile operators since the end of 2017. In terms of market count, 35 countries recorded a net decrease in the number of players, compared with 23 countries that recorded a net increase. However, the imbalance is even more pronounced when taking into account the number of connections in each market. Around 2.9 billion connections saw a decrease in the number of players by 2025, versus just 0.55 billion connections in markets where the number of operators increased (see Figure 2). Europe has generally not undergone this structural adjustment, in some cases due to consolidation being restricted.[6]

Figure 2

Changes in number of players in mobile markets between 2017 and 2025[7]



Source: GSMA Intelligence

Some European mergers were blocked or conditioned during this period. Where mergers were approved, structural remedies (e.g. spectrum divestitures, MVNO access obligations or network-sharing conditions) in some cases diluted the potential scale-driven efficiency benefits that initially motivated the transaction.[8] The cumulative effect and general practice have been to maintain a market structure that is not fully aligned with the economics of 5G deployment: a region characterised by a relatively large number of duplicative networks, each serving smaller subscriber bases and therefore facing greater challenges in generating the returns needed to fund the next upgrade cycle.

6 Examples of mobile mergers blocked in Europe since 2010 include Hutchison 3G UK and Telefónica UK (Three–O2), prohibited by the European Commission in 2016, and Telenor and TeliaSonera (Denmark), which was abandoned in 2015 following Commission objections during a Phase II investigation.

7 Players defined as operators holding at least 5% market share at any point.

8 As referenced by A dynamic framework for the assessment of horizontal mergers, BRG and GSMA, 2026. Examples include Hutchison 3G/Orange Austria (2012), Hutchison 3G/ Telefónica Ireland (2014), Telefónica Deutschland/E-Plus (Germany, 2014) and Wind/Tre (Italy, 2016), all approved subject to structural remedies such as spectrum divestments, MVNO access or network-sharing obligations. By contrast, Hutchison 3G/Telefónica UK (Three-O2) was prohibited in 2016, while the TeliaSonera/Telenor Denmark merger (2015) was withdrawn following the Commission's opposition. More recent cases include T-Mobile NL/Tele2 NL (2018), approved without remedies and Orange/MásMóvil (Spain, 2024), approved with remedies.

1.2
Why scale matters more in the mobile data and 5G era

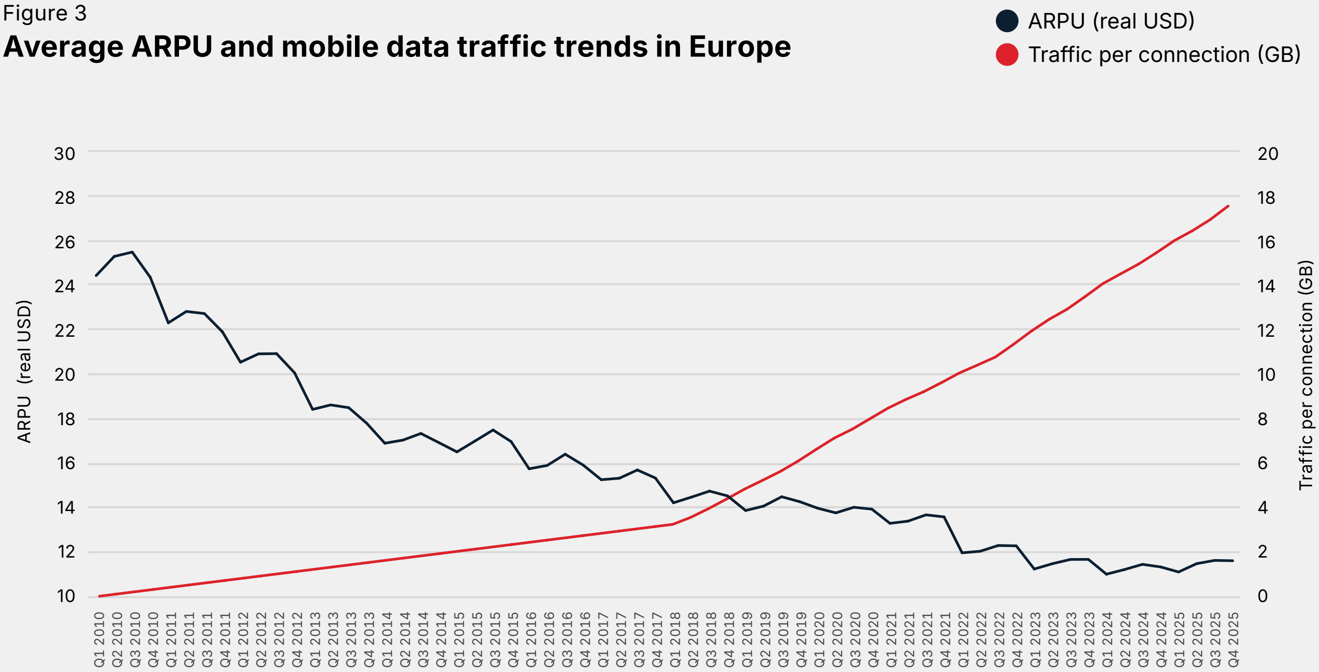
Understanding why scale produces these outcomes requires some economic context. The mobile sector has undergone three structural shifts in rapid evolution, each of which has made scale more relevant.

The first shift was the move from voice and SMS to data. In the voice era, operators generated substantial revenues from a set of services that changed slowly. The capital required for 2G and 3G upgrades was substantial but manageable and the underlying revenue base was sufficient to support multiple operators in most markets. The data era fundamentally changed this dynamic, not by making multiple operators unviable, but by raising the threshold for efficient network investments to upgrade capacity and capability.

The second shift is the saturation of user penetration. With unique mobile internet subscriber penetration exceeding 80% in Europe at the end of 2025, revenue growth can no longer be driven by adding users alone. Instead, operators must extract greater value from an essentially fixed subscriber base. This fundamentally alters investment dynamics: higher traffic no longer translates into proportional revenue gains, constraining operators' ability to scale up revenues in line with network demand.

The third shift reflects the combined effects of these trends. As 4G became the dominant network technology from the end of 2017, data consumption per user surged and ARPU settled at levels consistently lower than in the preceding voice era. Figure 3 illustrates this combination: operators now have exponentially more traffic per connection while earning less per user than they did in 2010.

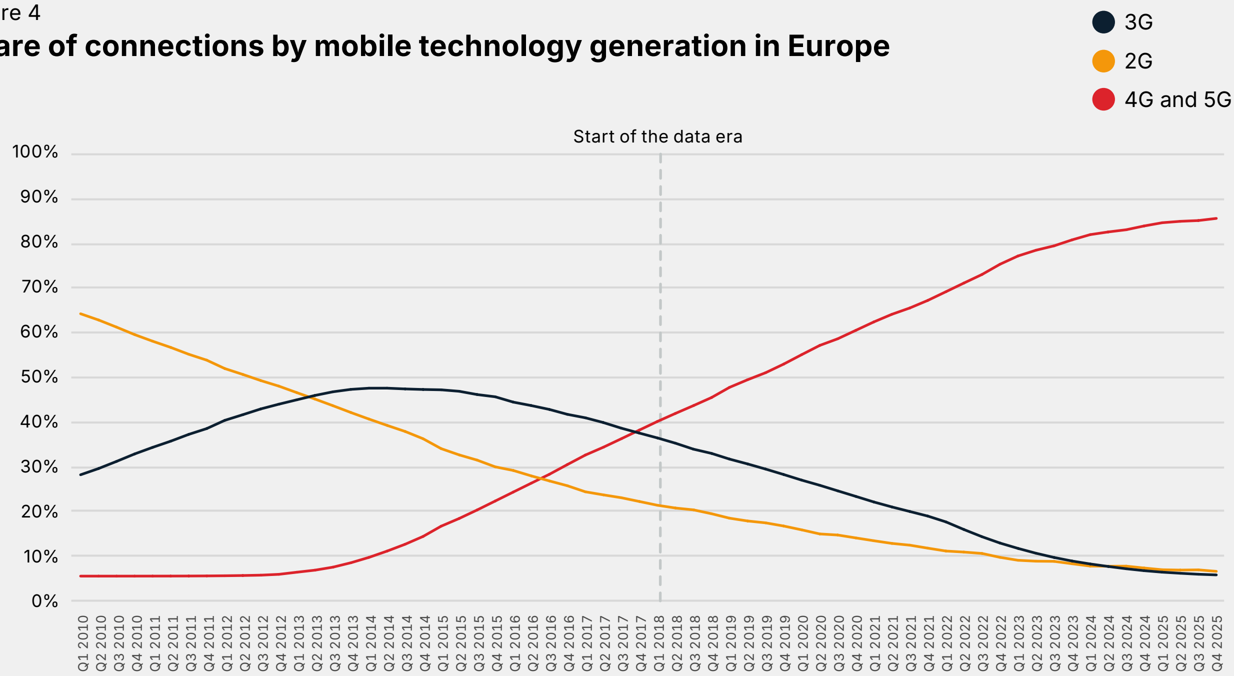
Figure 3
Average ARPU and mobile data traffic trends in Europe



Source: GSMA Intelligence

Figure 4

Share of connections by mobile technology generation in Europe



Source: GSMA Intelligence

The transition to 5G is when these shifts materialise most clearly. Early 5G deployment focused primarily on coverage and capacity through non-standalone (NSA) networks, which anchor the 5G radio to an existing 4G core. The full performance benefits of 5G (including lower latency, greater reliability facilitated by dedicated network slicing, stronger uplink and more consistent speeds) depend on 5G standalone (SA), which requires a dedicated 5G core, alongside denser networks and deeper spectrum deployment. This necessitates a significant degree of investment. At the same time, incremental monetisation of 5G over 4G has so far been limited in most markets, with recurring revenues broadly flat since the launch of 5G.

This combination – significant investment requirements and constrained revenue growth – makes the return on 5G investment highly sensitive to the size of the subscriber base over which fixed deployment costs can be amortised, making scale a critical consideration.

The transition to 5G SA remains limited in Europe. As of the last quarter of 2025, no European market included in the 5G Connectivity Index had reached 5G SA adoption of over 10%.[9] In contrast, several markets outside Europe have made considerable progress: China leads globally at 81% 5G SA adoption, followed by India (52%), Singapore (41%), the US (32%), Australia (17%) and the UAE (11%).[10]

Declining revenue per user, market saturation and continuedly high investment needs are together squeezing operators' margins. Data collected from 15 operator groups, representing more than two thirds of European mobile market revenues, shows that around half of European operator groups struggled to maintain return on capital employed (ROCE) above their weighted average cost of capital (WACC).[11] Sub-scale operators are particularly exposed to this challenge. Figure 5 illustrates this association: operators with lower market shares also tend to exhibit lower ROCE.

9 Proportion of 5G samples on 5G SA, sourced from Ookla

10 Four of these six markets (China, the US, Australia and the UAE) operate with three principal mobile operators. India offers a particularly instructive example: market concentration, measured by HHI, increased substantially from around 1,400 in 2010 to approximately 3,450 in 2025.

11 Data was collected for European operator groups representing 66% of European mobile market revenues.

Figure 5
Europe: ROCE versus mobile market share, 2015–2024

Note: Data was collected for European operator groups representing 66% of European mobile market revenues. The analysis covers 15 operator groups. Figures represent averages over the period 2015–2024, where operator groups have a presence.

Source: GSMA Intelligence

The recent experience of European mobile operator groups underscores how local scale is fundamental in mobile markets. Vodafone and Telefónica have exited or scaled back operations in geographic markets where they lacked sufficient scale.[12] This highlights that meaningful synergies in mobile networks arise at a localised (national or sub-national) level. Network deployment, spectrum use and cost efficiencies depend on scale being achieved within national markets. As a result, operators have concentrated investments in their core European geographies, where they have critical mass, rather than maintaining smaller cross-border footprints. The European investment and divestment experiences demonstrate that sustainable investment and efficiency gains in mobile sector rely on in-market scale.[13]

Evidence from the GSMA Intelligence 5G Connectivity Index[14] highlights the consequences of these market structure constraints as markets have moved into the 5G era. Europe lags behind North America, the Middle East and North Africa, China and leading Asia Pacific markets not only in headline 5G indicators, but more importantly in the depth and capability of deployed networks (see Figure 6a).

Consistent with the global progress in 5G SA deployment and adoption discussed earlier, eight of the top 10 performing markets in the 5G Connectivity Index have three or fewer operators (though this is also affected by geographic and market-specific differences). In addition, within Europe and globally, comparisons among peer-group countries suggest that markets with fewer operators tend to exhibit stronger performance, as illustrated in Figure 6b.

To further assess this relationship, the next subsection documents the relevant mobile outcome trends observed in Europe until 2025, while Section 2 examines whether these scale patterns are also empirically reflected in consumer welfare and investment outcomes.

12 Examples of these strategic exits include Vodafone's exits from Spain and Italy and Telefónica's divestments outside Europe, including Argentina, Chile, Colombia, Ecuador, Uruguay and Peru.

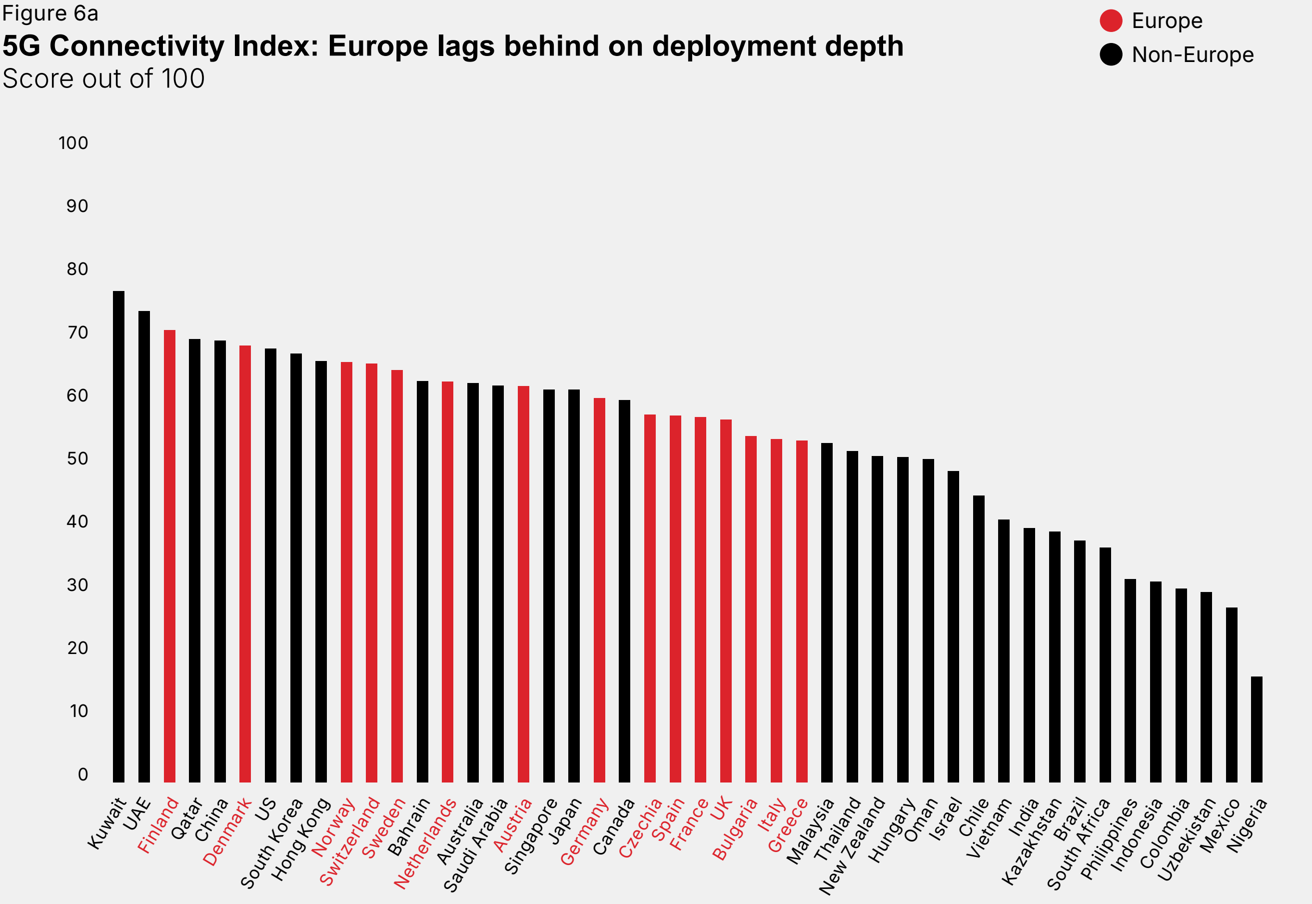
13 The strategic decisions of Vodafone, Orange and Telefónica – divesting non-core international operations while reinforcing scale in core European markets – highlight that mobile synergies are primarily local. This has direct relevance for policy debates on market structure, pointing to domestic scale as the key driver of investment and efficiency.

14 See the 5G Connectivity Index

Figure 6a

5G Connectivity Index: Europe lags behind on deployment depth

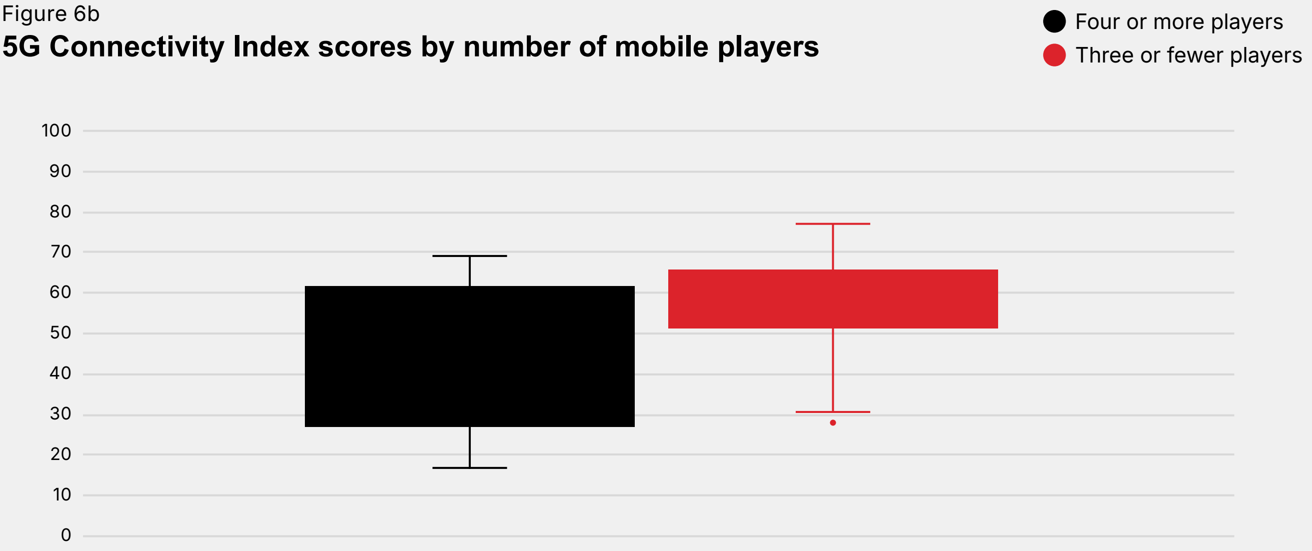
Score out of 100



Source: GSMA Intelligence

Figure 6b

5G Connectivity Index scores by number of mobile players



Source: GSMA Intelligence

1.3
Market structure trends: operator scale and performance in Europe

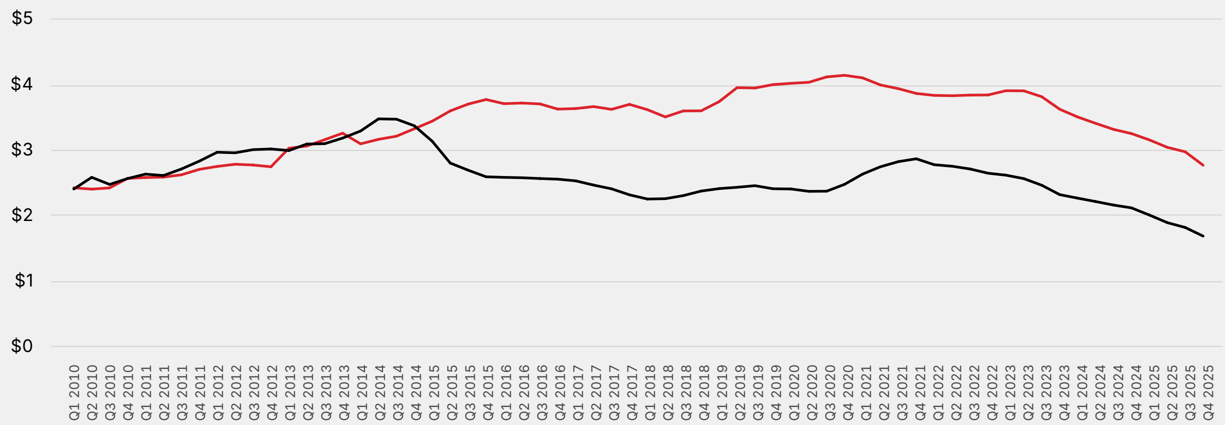
Against this backdrop, the trends between market structure and performance across European countries is clear. The data shows a consistent pattern: in markets where operators have greater scale, operators invest more efficiently, build better networks and do not charge higher prices to consumers.

Since 2016, operators in three-player markets in Europe have invested approximately 48% more per connection than operators in four-player markets (see Figure 7a). Figure 7b shows that total aggregate investment at the country level is not lower in three-player markets; on the contrary, it is broadly comparable to, and in recent years higher than, aggregate investment at the country level in four-player markets. These metrics show that consolidation leads to a reduction in inefficient and duplicative allocation of resources. From an investment and consumer-welfare perspective, what matters is how efficiently each subscriber base supports investment. In a three-player market, each operator has lower marginal costs, serves more subscribers, spreads its fixed costs more efficiently and generates stronger returns on each network upgrade. This creates both the financial capacity and the competitive incentive to invest more compared to in a four-player market.[15]

Figure 7a

Capex per connection (moving average) in Europe by number of players (operator level)

● Four or more players
● Three or fewer players

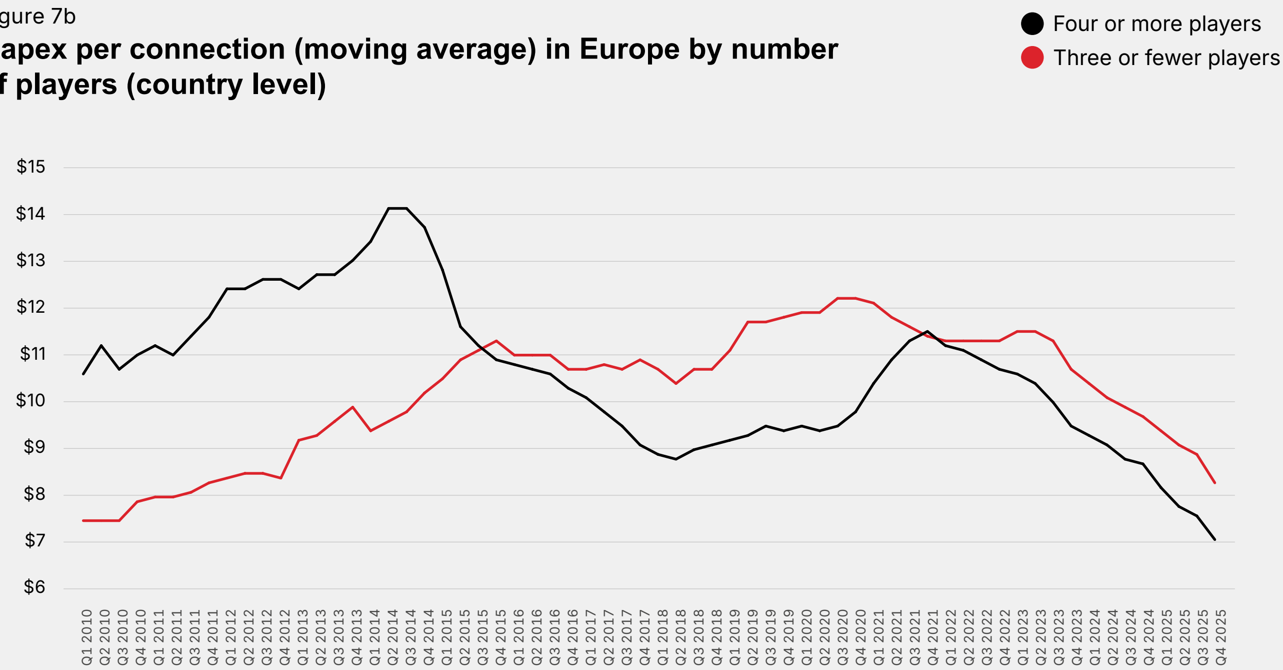


Source: GSMA Intelligence

15 The competitive incentive refers to the pressure to differentiate on network quality in markets with fewer, larger rivals, where failure to invest risks losing subscribers to operators with comparable scale and coverage ambitions.

Figure 7b

Capex per connection (moving average) in Europe by number of players (country level)



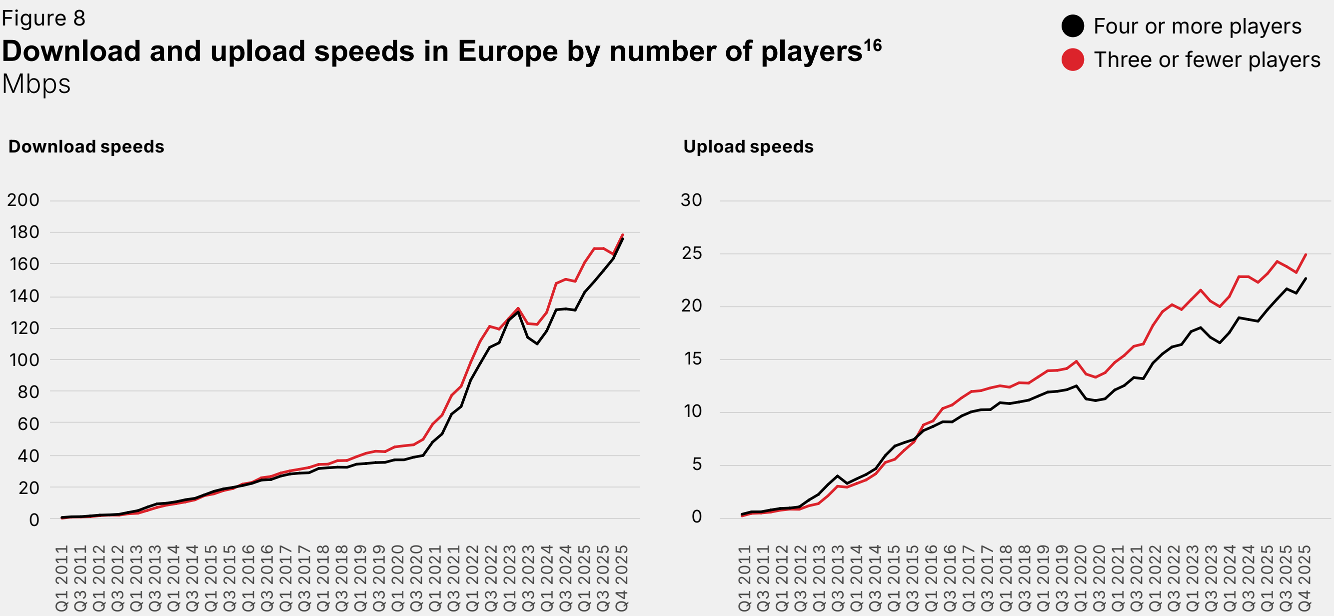
Source: GSMA Intelligence

Higher investment per connection translates directly into better networks. Three-player markets in Europe have achieved download and upload speeds approximately 15% faster on average than four-player markets since 2016 (see Figure 8). The same pattern is true for coverage expansion and 5G adoption. Markets with operators that have achieved scale reach higher 4G and 5G population coverage faster (see Figure 9), reflecting the greater capital that each operator deploys per network upgrade cycle.

Figure 8

Download and upload speeds in Europe by number of players[16]

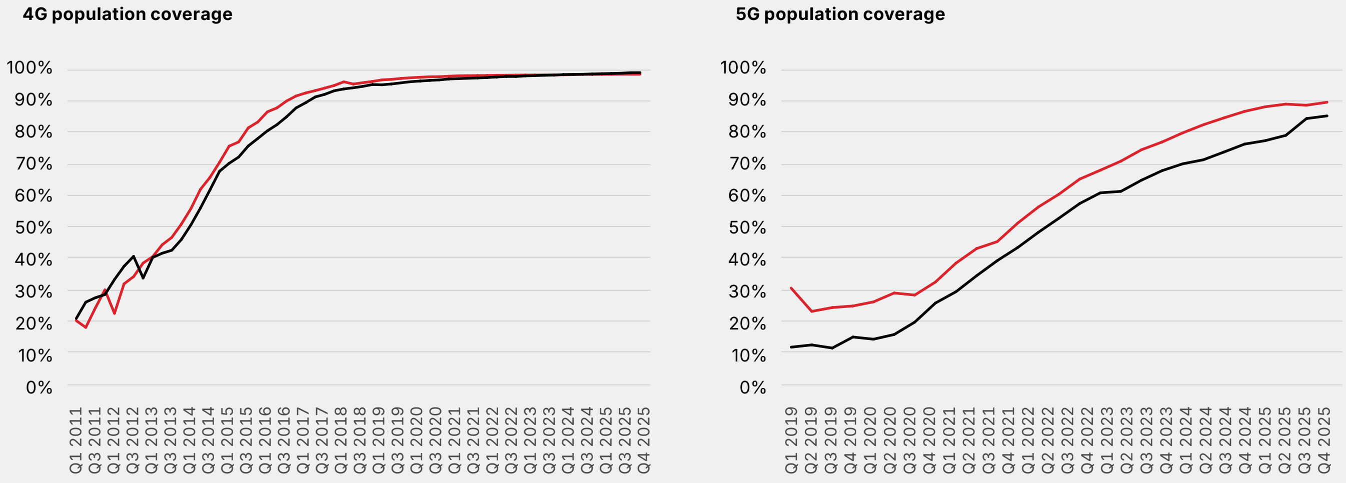
Mbps



16 Recent mergers in the UK and Romania in 2025 have reduced the positive difference in speeds previously observed in three-player markets.

Figure 9
4G and 5G population coverage (%) in Europe by number of players

Four or more players
Three or fewer players

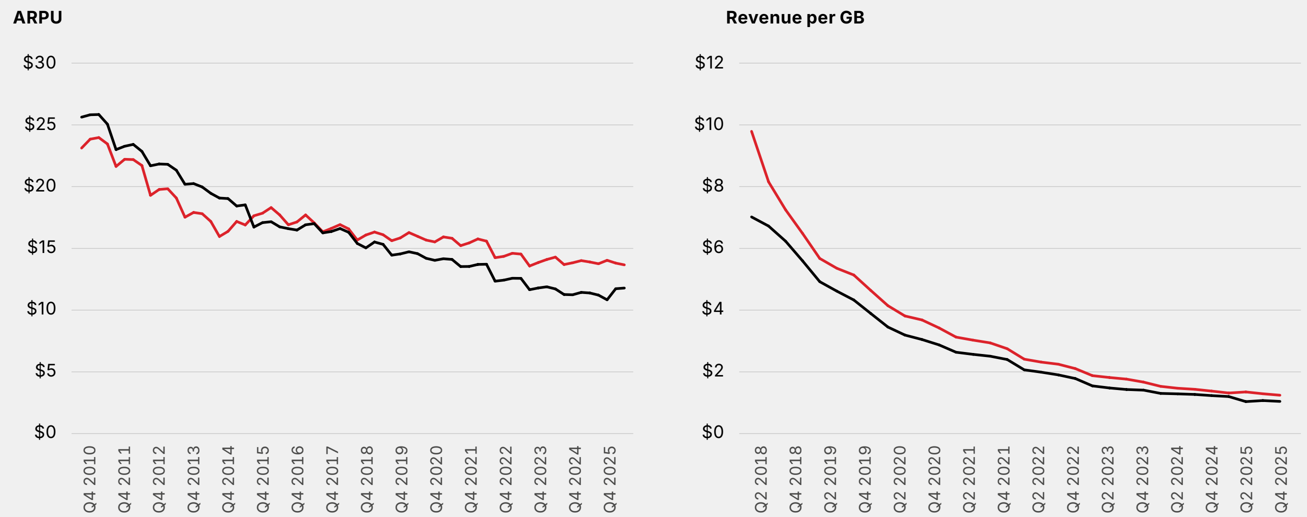


Source: GSMA Intelligence

A valid concern is whether these investment and quality advantages come at a price cost to consumers. Differences in ARPU between three- and four-player markets primarily reflect higher data consumption in better-quality networks (consumers in markets with faster networks use more data), not higher prices per unit. Revenue per gigabyte trends confirm this, as this price metric has declined consistently across both market structures. Similarly, tariff basket analysis, covering both entry-level and high-usage baskets, does not consistently show clear price differences across market structures. Moreover, regardless of market structure, Europe shows significantly lower baskets prices than comparable high-income countries (see Figures 10 and 11).

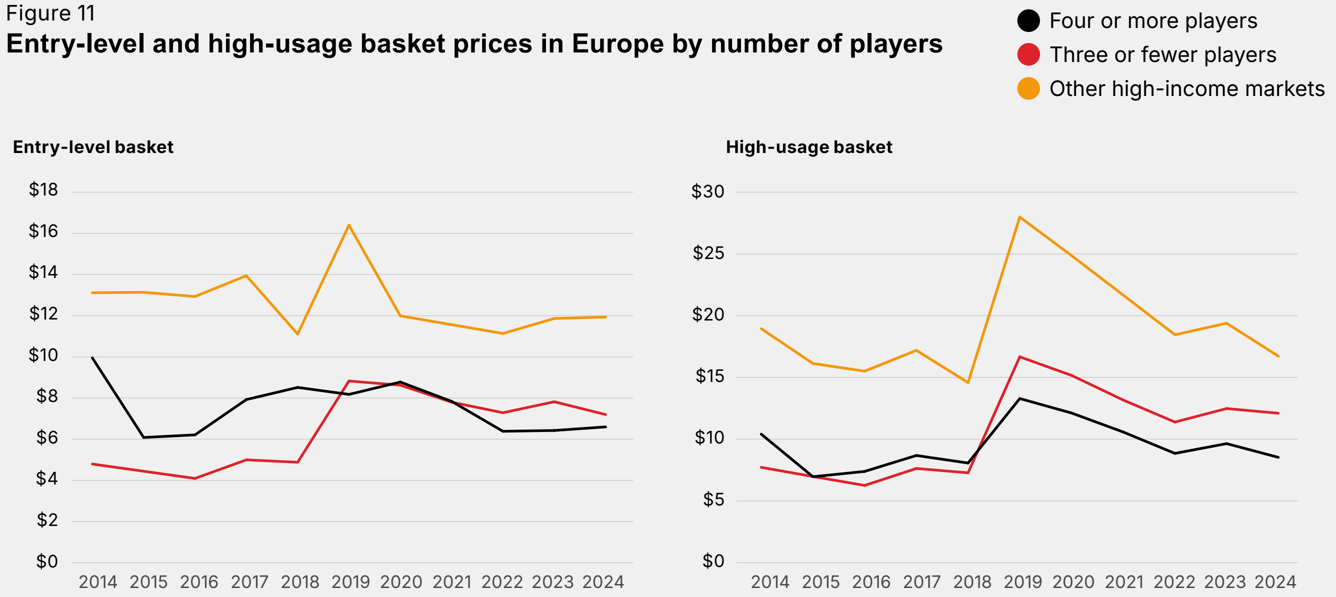
Figure 10
ARPU (real) and revenue per GB in Europe by number of players

Four or more players
Three or fewer players



Source: GSMA Intelligence

Figure 11
Entry-level and high-usage basket prices in Europe by number of players



Source: GSMA Intelligence

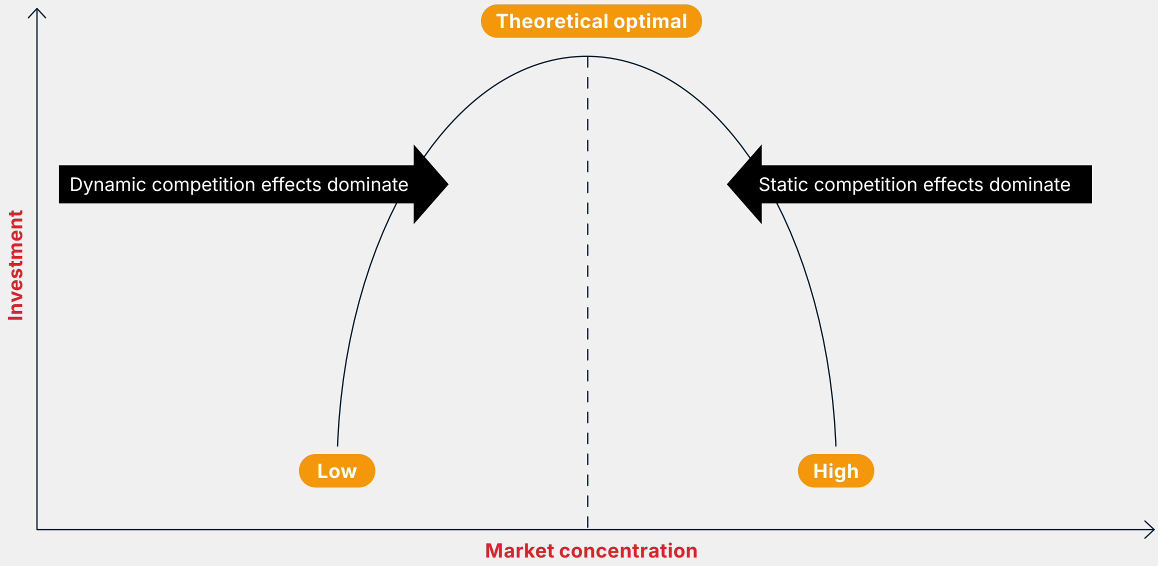
Taken together, these descriptive trends point in a clear direction: greater operator scale in European markets is associated with higher investment, better networks and comparable prices. The remainder of this study tests whether these associations are causal, examines the specific role of consolidation and entry events and draws out the policy implications.

02
Market structure effects on investment and consumer welfare in Europe

Previous empirical and theoretical literature broadly supports an inverted-U relationship between market concentration and investment: returns to scale increase investment up to an optimal level, beyond which excess concentration may reduce competitive pressure.[17] Figure 12 illustrates this conceptually.

Importantly, no published study has found that consolidation reduces total country-level investment; the consistent finding is that per-operator investment rises following consolidation because the remaining operators can spread fixed costs more efficiently.

Figure 12
The inverted-U relationship between market concentration and investment



Source: GSMA Intelligence

This study provides a comprehensive and up-to-date empirical assessment of this relationship in Europe. It addresses three core questions:

1. Is greater scale causally associated with higher levels of investment in the European data era?
2. Do these gains come at the expense of consumer outcomes, such as price, quality or coverage?
3. What do the experiences of consolidation and market entry in Europe since 2010 reveal about how changes in market structure affect consumer welfare in practice?

To move beyond descriptive trends and assess causality in how market structure affects investment, network quality and consumer outcomes, this study draws on multiple complementary empirical approaches. It examines patterns across countries and operators over time, compares markets that experienced consolidation or entry events with those that did not, and analyses how outcomes evolved following structural changes in European mobile markets since 2010. Taken together, these approaches allow the study to move beyond simple correlations and identify underlying effects by controlling for relevant confounding factors. The combination of evidence provides a robust and consistent assessment.[18]

17 See for example: Competition and Innovation: An Inverted-U Relationship, Aghion, P., Bloom, N., Blundell, R., Griffith, R. and Howitt, P., 2005; Is There a Level of Competition Intensity that Maximizes Investment in the Mobile Telecommunications Industry?, Jeanjean, F. and Houngbonon, G. V., 2014; Market Structure and Investment in the Mobile Industry, Jeanjean, F. and Houngbonon, G. V., 2017; The dynamic effects of competition on investment: the case of the European mobile, Bahia, K. and Castells, P., 2023; Evaluating market consolidation in mobile communications, Genakos, C., Valletti, T. and Verboven, F., 2018; Market structure and investments: A progress report, Lefouili, Y. and Madio, L., 2023; Is Draghi report really wrong about telecoms? (An overview of academic papers on telecom market structure and mergers), Jeanjean, F. and Ciriani, S., 2025; Competition Dynamics in Mobile Markets in Europe: Effects on Investment and Quality, GSMA, 2022; Bahia, K. and Castells, P., 2023; Impact of mobile operator consolidation on unit prices, Aimene, L., Jeanjean, F. and Liang, J., 2021; Competition, technological change and productivity gains: a sectoral analysis, Ciriani, S. and Jeanjean, F., 2020; Competition, technological change and productivity gains: a European sectoral analysis, Ciriani, S. and Jeanjean, F., 2022.

18 The dataset covers 29 European countries over 2010–2025, drawing mainly on GSMA Intelligence's operator-level database, Ookla Speedtest data, Tarifica tariff data and standard macroeconomic sources. Methodological details are in the annex.

2.1
Operator scale, investment and network performance: evidence of an inverted-U relationship

As discussed earlier, the intuition behind the inverted-U relationship is that as operators gain scale they are able to generate stronger returns on each network upgrade, supporting higher investment. However, investment may eventually decline if market concentration becomes so high that the competitive pressure on network quality largely disappears and network synergies taper off. The relevant policy question is whether European markets lie on the peak interval of this relationship, where greater concentration is associated with higher investment.

This question can be examined at two levels. At the country level, higher concentration is not associated with lower aggregate investment across European markets, despite these markets having fewer networks (see Table A1.1 in the Annex). In fact, in a number of cases the relationship is positive, with more concentrated markets investing more in total.

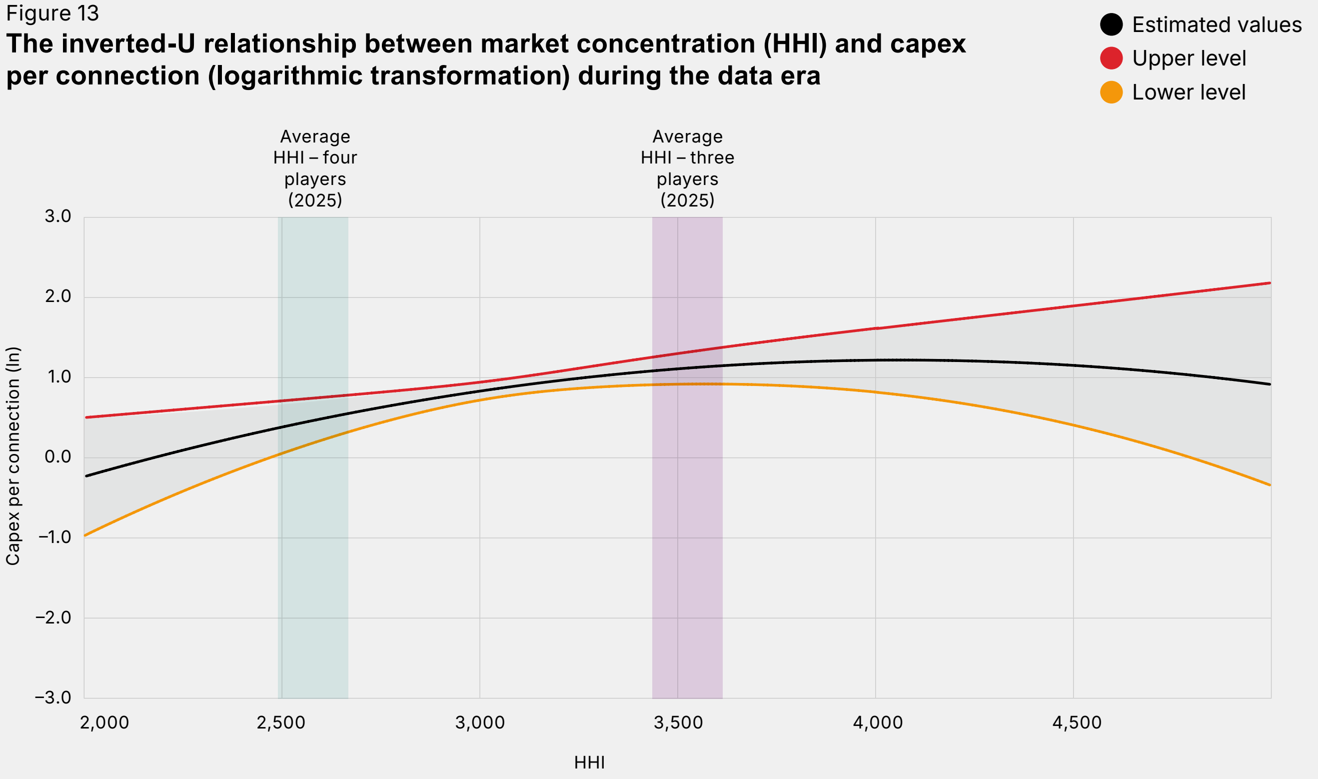
Even where no country-level effect is found, this does not rule out a positive effect at the operator level: consolidation may leave total country investment broadly unchanged while allowing each individual operator to deploy capital per connection more efficiently, as a larger subscriber base improves the returns on each network upgrade. The following analysis examines this operator-level relationship directly.

Figure 13 presents the estimated relationship between market concentration (measured by HHI) and capex per connection from the operator-level panel analysis for the data era.[19] The results confirm an inverted-U relationship, with investment increasing as concentration rises across the relevant range of European market structures and peaking at an HHI of between 3,100 and 4,000. Most European mobile markets today remain below this level, implying that further consolidation would be expected to increase, rather than reduce, investment incentives and efficiency.

A key empirical concern is reverse causality, meaning that operators may simply invest more in markets where they have already achieved a significant position. Instrumental variable (IV) analysis addresses this issue and yields the same conclusion: both investment and market concentration follow an inverted-U relationship.[20]

Figure 13

The inverted-U relationship between market concentration (HHI) and capex per connection (logarithmic transformation) during the data era



Source: GSMA Intelligence

19 An inverted-U relationship during the data era holds for total capex in real USD prices (log-transformed), as shown in Annex 1.

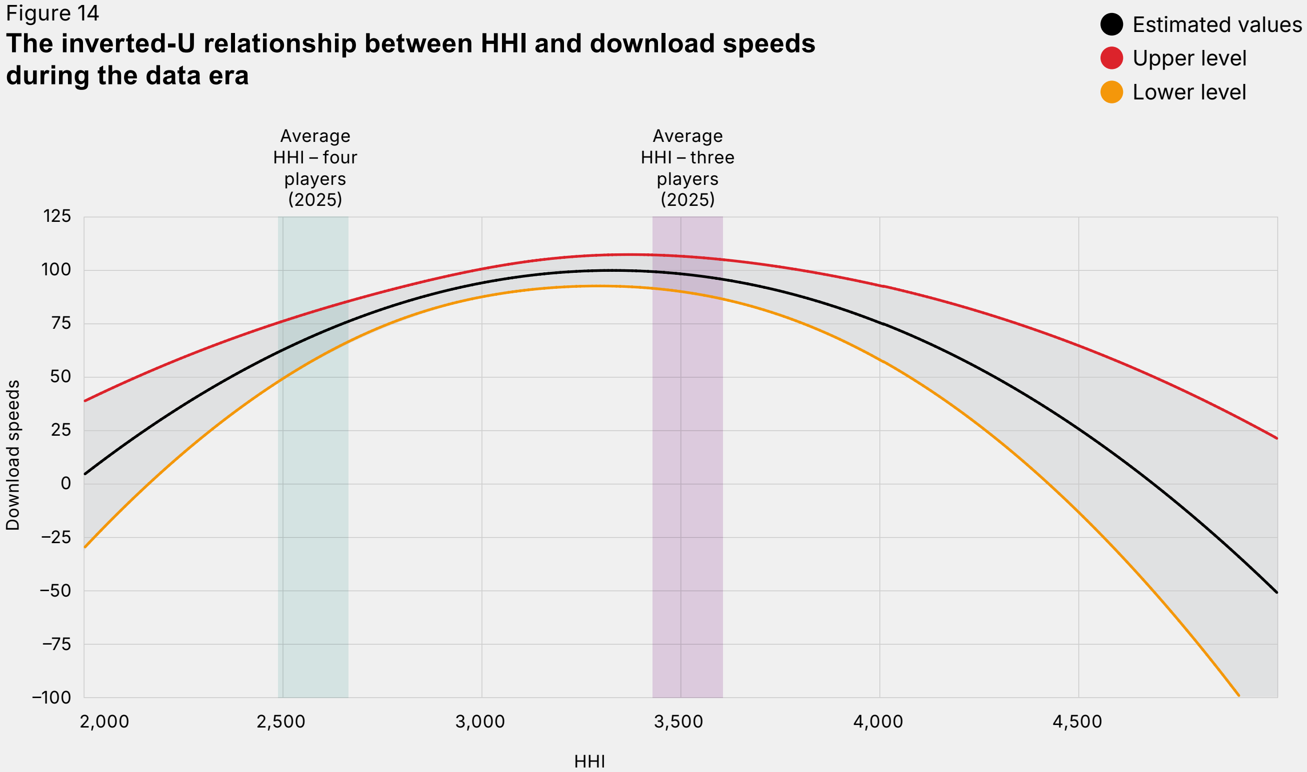
20 Full OLS and IV results are reported in Annex 1 and 2.

To understand what this means in practice, the average European four-player market has an HHI of 2,500. A transition to a three-player structure (depending on the distribution of market shares) would typically increase HHI to approximately 3,000–3,500. According to the estimated relationship, this is precisely the range where investment incentives are strongest. The evidence therefore suggests that consolidation in most European markets would increase investment rather than reduce it.

Higher investment, when efficiently deployed, translates into better network performance and superior quality outcomes. The evidence confirms that this is the case.

The relationship between market concentration and network speeds follows a similar inverted-U pattern observed for investment, with peak download speed outcomes at an HHI of approximately 3,300. This reflects the fact that the quality benefits of scale materialise progressively as cumulative investment is translated into network upgrades over time. Figure 14 illustrates this relationship for download speeds. The ordinary least squares (OLS) analysis shows a positive and statistically significant association between concentration and speeds during the data era, with the inverted-U shape clearly visible in operator-level specifications.[21]

Figure 14
The inverted-U relationship between HHI and download speeds during the data era



Source: GSMA Intelligence

The two relationships tell a consistent story. As markets across Europe consolidate towards this optimal range, operators gain the scale needed to justify higher and more efficient network capex, and that investment, deployed over time, translates into measurably better network quality. Both effects follow the same inverted-U pattern, with peak outcomes at concentration levels that most European markets have not yet reached.

21 Tables A1.2 and A2.3 report the econometric outputs, with Table A2.3 reflecting the robustness of the findings shown using IV.

2.2
Concentration did not increase prices in the 4G/5G data era

One of the main regulatory concerns about higher concentration and mobile consolidation events relates to prices. The conventional argument is that fewer competitors weaken competitive pressure, leading to higher prices after mergers, particularly in markets that reach higher concentration levels. The evidence suggests that higher market concentration has not led to higher prices. In the data era, price effects are neutral or, in some cases, negative. This holds true across multiple price metrics: entry-level tariff baskets, high-usage tariff baskets, ARPU and revenue per megabyte. Across these measures, there is no evidence that increased concentration has resulted in higher consumer prices since the transition to the data era.

Figure 15
Summary of empirical effects of concentration and mobile prices

	Full period (2010–2025)	Before 2018	After 2018
ARPU	Positive link	Positive link	No significant link
Revenue per MB	No significant link	N/A	No significant link
Tariffs	No significant link	Positive link	No significant link

Source: GSMA Intelligence

The economic logic underpinning these findings is intuitive. Mobile markets are highly capital intensive and, since the introduction of 4G, competition has been driven primarily by network quality rather than price alone. In this context, the key channel linking scale to consumer outcomes operates through cost efficiency rather than the exercise of market power. When consolidation allows operators to spread large fixed network costs over a broader subscriber base, unit costs fall. And, providing that markets remain contestable in the optimal HHI range depicted above, consumer welfare increases. The econometric results strongly support this interpretation. In OLS regressions covering tariff baskets, the HHI coefficient on entry-level basket prices is negative and statistically significant in post-2017 specifications, indicating that more concentrated markets are associated with lower – not higher – entry-level prices.[22]

22 Full regression results for tariff baskets are reported in Annex 1 (Table A1.4).

2.3
How consolidation and entries shape investment efficiency and consumer welfare

After establishing that scale is causally linked to higher investment and better quality with no evidence of price increases, this section assesses how these effects have evolved during consolidation and entry events in Europe since 2010.[23] Using difference in differences (DiD), the analysis examines structural changes by comparing markets affected by entries or consolidation with similar markets that did not experience these changes, offering additional, robust evidence on how shifts in operator scale influence investment, quality and prices.

The purpose of using DiD

Rather than focusing only on incremental variations, DiD methods allow us to examine the impact of significant shifts in operator scale and competitive dynamics (changes driven by entries, mergers or market exits) to assess the consistency of scale effects on mobile outcomes in Europe.

While OLS and IV models provide valuable insights into average effects, DiD offers an additional perspective by focusing on major, event-driven changes in the markets.[24] DiD enables the estimation of causal effects by comparing treated and control markets before and after specific events, such as mergers, exits or entries, providing a robust framework to assess the impact of structural shifts on mobile outcomes.

A useful analogy is a clinical drug trial: just as researchers compare the outcomes of patients who receive a new treatment with those of similar patients who do not, these DiD models compare the evolution of market results in countries that experience consolidation or entries with those that do not while controlling for other differences between these markets. This approach ensures that any differences observed are attributable to the specific event evaluated, rather than to broader market trends or external shocks.

The DiD framework is particularly well suited to the European context, where consolidation and entries have occurred at different times and under varying conditions. By exploiting this staggered adoption, the analysis can separate the effects of market shifts or structural changes from broader market trends or external shocks. The methodology controls for unobserved, time-invariant differences between markets and for common shocks, providing a robust basis for policy evaluation. For this analysis, we apply three modern DiD estimators that address treatment heterogeneity and staggered adoption: Sun and Abraham (2021); Borusyak, Jaravel and Spiess (2024); and de Chaisemartin and D'Haultfoeuille (2020).[25]

Consolidation leads to more efficient investment and improved consumer outcomes

Looking at the consolidation events that have taken place since 2010 (in Austria, Ireland, Norway, the Netherlands and, more recently, Spain, Romania and the UK), the results consistently show that investment rose following merger events.[26] In preferred model specifications, which include the full set of controls (see Table A3.1, models 3 and 7), average treatment effects on capex per connection range from approximately 33% to 45%.[27] The dynamic pattern in Figure 16 shows that these effects strengthen progressively over time as operators implement their post-merger network investment plans.[28]

23 The description of the events considered in this section is also detailed in Annex 4.

24 OLS and IV are regression-based methods used to estimate relationships between variables of interest while controlling for other relevant factors; IV additionally addresses potential endogeneity concerns, helping to isolate the relationship of interest. These methods were employed across Sections 2.1 and 2.2 to examine associations between market structure and a range of outcomes.

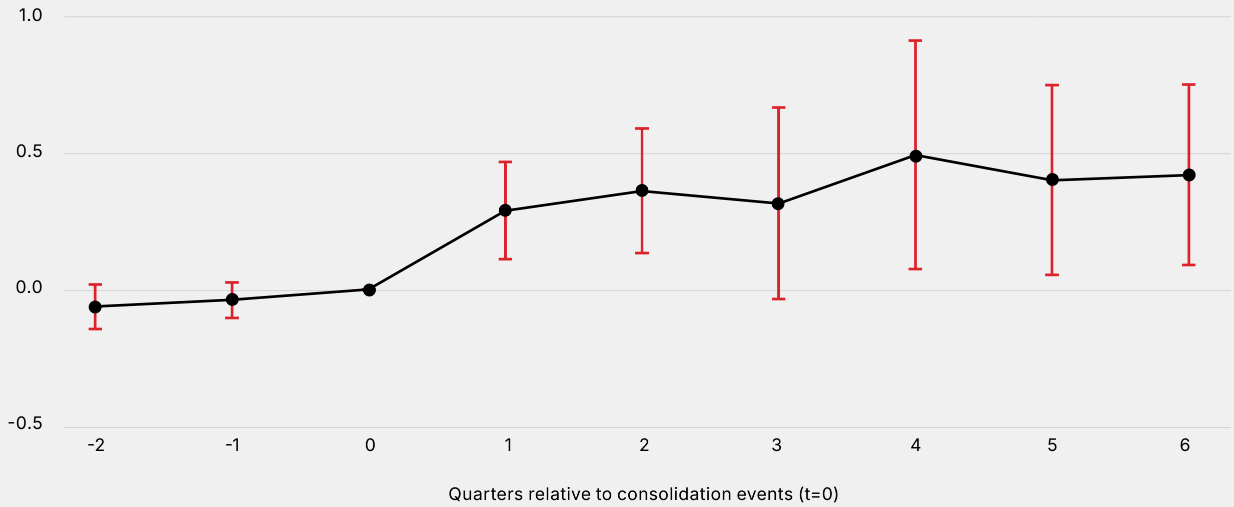
25 This estimator calculates group-time average treatment effects using only comparisons between treated and untreated units at each time point. It ensures that all weights are positive and is valid under heterogeneous treatment effects. The method is well suited for policy evaluations where treatment effects may differ by cohort or evolve over time. For the purposes of this study, periods are evaluated quarterly. The analysis assesses six periods following the implementation of the policy experiment.

26 Details on entry and consolidation events across the countries considered are summarised in Annex 4.

27 Percentage effects are calculated as exp(β) – 1, where β is the ATT estimated on log (capex per connection).

28 Results are robust when using a logarithmic transformation of total operator-level capex, measured in real USD terms.

Figure 16
Dynamic DiD effects on operator capex per connection following consolidation



Source: GSMA Intelligence

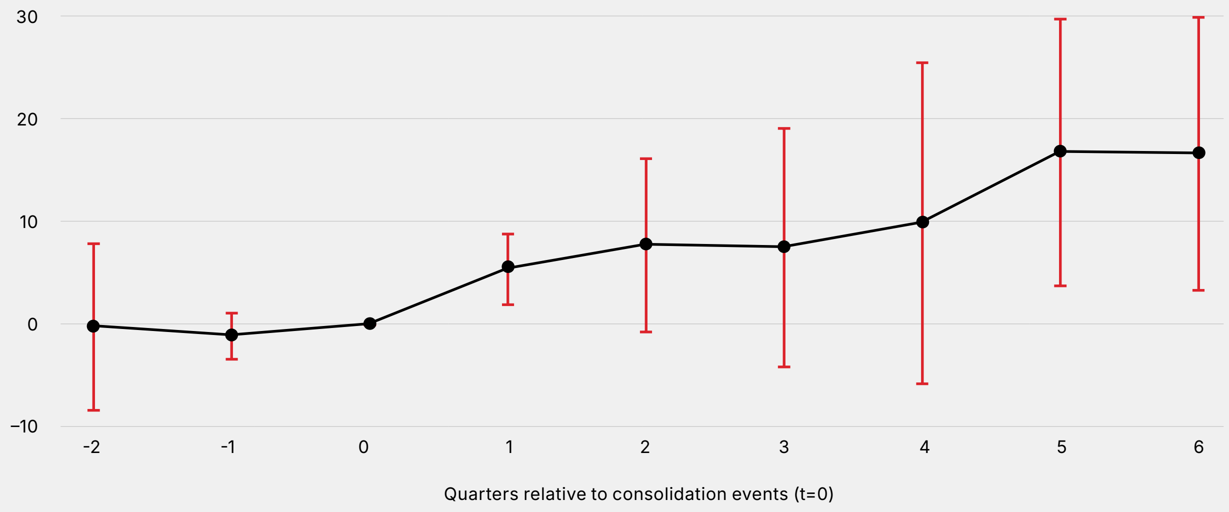
The economic explanation for this pattern centres on investment efficiency. When two operators merge, the resulting entity does not simply eliminate one network – it also combines subscriber bases, creating a larger and more stable revenue base that can support higher and more efficient network investment per connection. Not only do fixed network costs get spread across a larger number of subscribers, but operational synergies that result from the combination of cell site and spectrum assets improve unit economics. At the same time, mergers strengthen investment incentives, as a greater number of users benefiting from each network upgrade increases the expected return on additional capex. As a result, both the efficiency of investment and the capacity and willingness to invest are enhanced.

Higher investment translates into measurable improvements in what consumers experience. For 5G coverage, estimators show average treatment effects of 4–17 percentage points associated with consolidation across aggregated specifications.[30] For download speeds, restricting to mature consolidation events (excluding the 2024–2025 mergers in Spain, Romania and the UK, which are too recent for full network effects to materialise), all three estimators produce consistent average effects of approximately 9–11 Mbps (see Figure 17).[31]

These effects are statistically significant and parallel trends are satisfied. The economic magnitudes are also meaningful: a 10 Mbps improvement in download speeds represents a substantial enhancement in the mobile experience for the average user, equivalent to a 15% increase in weighted download speeds over the data era (after 2017) and 25% over the full period. Overall, the results show that consolidation is associated with higher and more efficient investment, which translates into measurable improvements in network quality. These gains enhance user experience and contribute positively to consumer welfare.

29 CH (de Chaisemartin-D'Haultfoeuille) dynamic estimator. Pre-trend tests satisfied. For full static and dynamic results across all three estimators, see Annex 3 (Tables A3.1 and A3.2).
30 See Table A3.2 for results based on the SA and B methodologies.
31 See Table A3.5 for results based on the SA and B methodologies.

Figure 17
Dynamic DiD effects on weighted download speeds following mature consolidation events

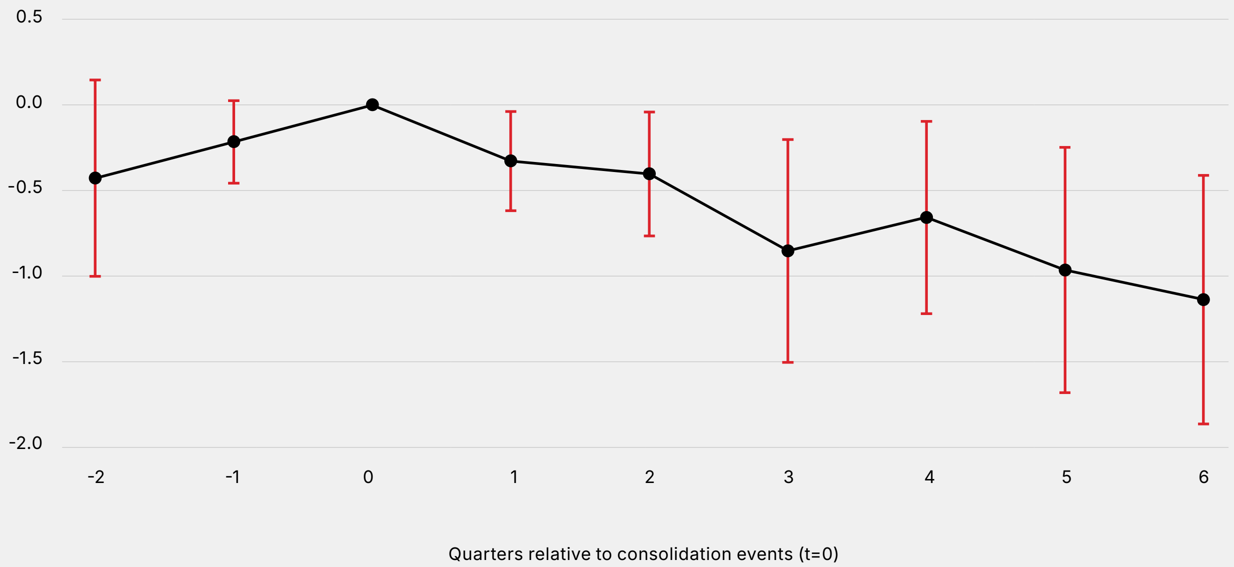


Source: GSMA Intelligence

Likewise, a common concern in merger reviews is that fewer competitors mean higher prices. The DiD results suggest that consolidation is not associated with increases in ARPU. In preferred model specifications, that is controlling for additional factors (see Table A3.3, models 3–5 and 7–9), average treatment effects on real ARPU following consolidation are on average reductions of approximately $1.5 to $1.6 per month.[32]

Figure 18 shows the dynamic pattern: price reductions appear consistently across post-merger periods. This outcome reflects and confirms the gains in cost efficiency rather than reduced competitive pressure: operators serving larger subscriber bases can spread fixed network costs more efficiently, lowering unit costs and passing these efficiency gains through to consumers.

Figure 18
Dynamic DiD effects on ARPU (real USD) following consolidation events



Source: GSMA Intelligence

32 Results are reported in Annex 3 (Table A3.3).

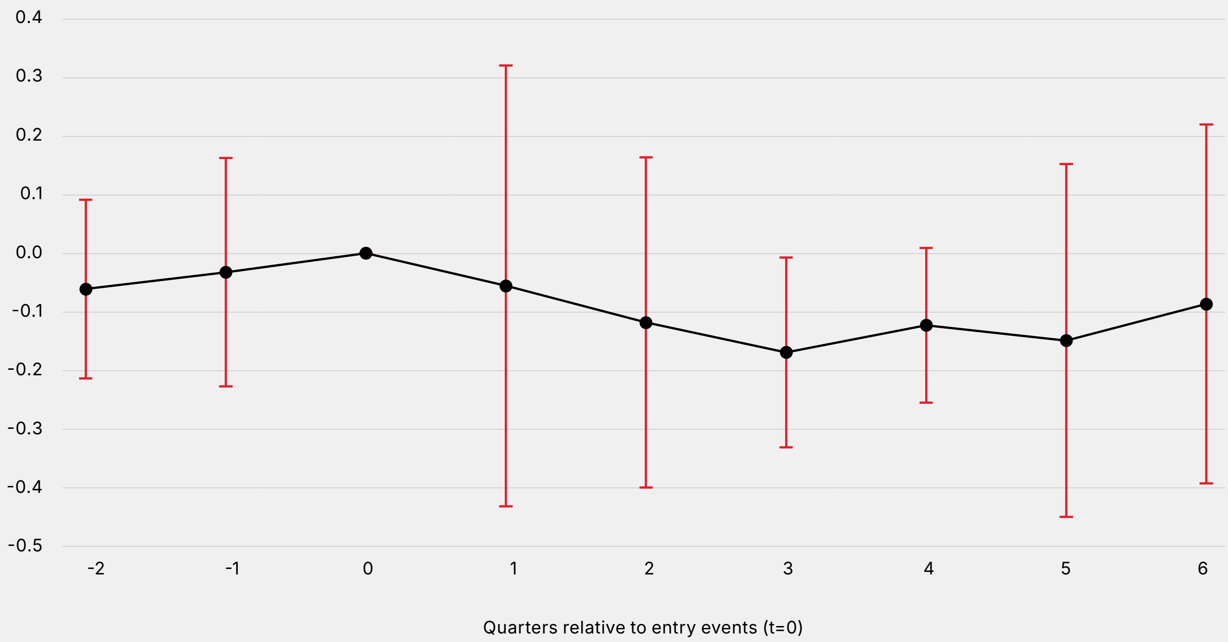
Entry events: no clear investment gains and limited consumer benefits

The evidence on entry events provides the clearest contrast to the consolidation narrative and is equally relevant for policy assessment. If better outcomes were primarily driven by greater competitive intensity (i.e. if adding competitors automatically led to higher investment and lower prices), then market entries should produce similar improvements. The evidence in Europe shows that this was not the case. Entry episodes are associated with null or negative effects on investment, weaker network-quality outcomes and price reductions that are smaller and less consistent than those observed following consolidation.

Entries add an additional network but do not create additional subscribers; instead, it redistributes an existing subscriber base across a larger number of operators. This weakens the economic and financial position for incumbents (fewer subscribers must support the same fixed-cost infrastructure), reducing both the capacity and the incentives to sustain high investment intensity. New entrants, in turn, typically compete with lower-cost offers supported by a less extensive network footprint. This may attract price-sensitive customers, but it does not systematically raise the quality of the market's overall infrastructure. In a market where competition is increasingly defined by network performance, entries can increase the number of players while reducing what each player can economically deliver on quality.

This is what the DiD results show (see Figure 19).[33] Following entry events, operator-level capex per connection displays no uplift or a null effect.[34] The same pattern holds for network outcomes: entry events are associated with negative effects on download speeds and significantly lower 5G adoption (see Figure 20).[35] These findings are consistent across estimators, control sets and outcome measures.[36]

Figure 19
Dynamic DiD effects on capex per connection following entry events



Source: GSMA Intelligence

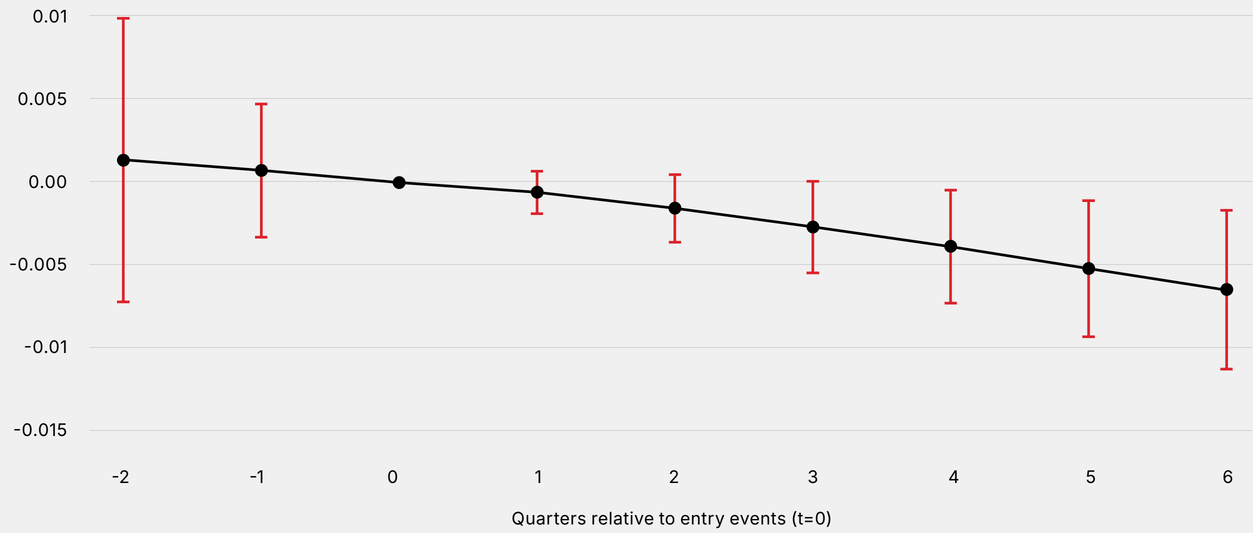
33 The entry events analysed include France (2012), Italy (2018), Slovakia (2015) and Germany (2023). Recent entry events in Belgium and Portugal are excluded, as by the end of 2025 none of the entrant operators had reached a 5% market share of mobile connections.

34 Results are reported in Annex 3.

35 For download speeds, as reported in the Annex 3 (Table A3.7), when the parallel-trends condition is satisfied, entry effects are associated with negative impacts of between 5 and 29 Mbps.

36 Results for entry events and their effects on download speeds and 5G adoption are reported in Annex 3 (Table A3.7 and Table A3.8).

Figure 20
Dynamic DiD effects on 5G adoption following entry events



Source: GSMA Intelligence

On prices, entry events show some evidence of ARPU reductions in control specifications, but these effects are smaller, less significant and less consistent than those following consolidation.[37] This contrast is economically informative: entries produce modest and temporary price pressure through competitive matching, without the structural cost reduction that generates the durable price benefits observed after consolidation. The short-term effects of entries on prices may look superficially similar to those of consolidation, but the underlying mechanisms (and the long-term implications) are entirely different.

The asymmetry is clear and consistent. Consolidation has positive effects on investment (significant), positive effects on network quality (significant for mature events) and negative effects on prices (significant). For entries, there is a null or negative effects on investment, negative effects on quality and smaller and less consistent price reductions that are not accompanied by any investment or quality improvement.

Figure 21
Summary of empirical effects of concentration and mobile prices

Metric analysed	Consolidation	Entry
Capex per connection	Positive link	No significant link
Download speeds	Positive link	Negative link
ARPU	Negative link	Negative link (weaker effect)

Source: GSMA Intelligence

37 Annex 3 (Table A3.9) reports lower coefficients and less robust results

03
Policy implications and conclusions

3.1
What the evidence implies for Europe

The evidence presented in this study points to a clear and coherent conclusion. Europe entered the mobile data era with the most fragmented market structure globally, largely reflecting regulatory choices that prioritised the number of operators over investment capacity. These market-shaping regulatory choices made sense in a subscriber-growth era dominated by voice. As mobile economics have evolved – characterised by declining ARPU, saturated subscriber penetration, rising network costs and the significant increased capital requirements of 5G – the limitations of this structure have become increasingly apparent. These include insufficient investment per connection; weaker 5G performance relative to markets that allowed consolidation; limited operator returns; and an investor response marked by declining valuations of European telecoms assets and a reallocation of capital towards markets where scale supports sustainable returns.

The empirical analysis demonstrates that these patterns are causal, not coincidental. Greater scale leads to higher and more efficient investment; higher investment leads to better network performance; and improved networks do not result in higher prices. In fact, efficiency gains associated with scale reduce costs in ways that are passed through to consumers. Market consolidation results in structural adjustments that directly address market fragmentation, consistently delivering the investment, quality and consumer outcomes that regulatory policy aims to achieve. By contrast, the analysis of entry events in European markets finds no significant investment or consumer-welfare effect associated with entries, suggesting that facilitated entries and related conditions – such as structural remedies and MVNO obligations – may weaken, rather than replicate, the investment and consumer-welfare dynamics observed in consolidated markets.

The transition to 5G makes these findings particularly pressing. Europe's underperformance is not primarily about basic 5G indicators, but about the depth and capability of its deployed networks. 5G SA – the architecture required to unlock advanced capabilities such as network slicing, ultra-low latency and enterprise applications central to Europe's digital competitiveness agenda – remains limited in Europe compared with North America, the Middle East and North Africa, China and leading Asia Pacific markets. These markets are already moving ahead with 5G-Advanced. Structural underinvestment compounds over time, as each technology generation builds on the infrastructure of the previous one.

3.2
Consolidation as a policy tool

Consolidation in European mobile markets should be assessed using a framework that reflects overall consumer welfare, which is shaped by dynamic factors such as investment and innovation, and not only by short-term price effects. The evidence in this study shows clearly that consolidation in the mobile data era did not raise prices. Instead, it is associated with stable or lower prices alongside higher investment and better network quality. The long-standing presumption that having fewer operators harms consumers through higher prices is not supported by evidence in current European market conditions.

These results reflect the economics of mobile networks. Mobile is a capital-intensive sector with long payback periods and competition that is driven primarily by network quality. Although successive technologies have reduced the unit cost of data delivery, traffic volumes have increased rapidly while revenues per gigabyte have fallen. At the same time, investment requirements remain high due to network densification, spectrum deployment, 5G-Advanced and enterprise use cases. The notion that the capital investment cycle is largely complete is inconsistent with these structural pressures.

Policy should therefore focus less on operator count and more on whether operators can achieve efficient scale. Markets with fewer, well-capitalised operators consistently deliver higher investment per connection and better network outcomes than markets with a larger number of sub-scale operators. Maximising the number of competitors as an objective without considering dynamic factors that drive longer-term consumer welfare risks undermining long-term quality, coverage and affordability goals.

This has direct implications for horizontal merger assessments. Competition policy in mobile markets must explicitly recognise dynamic competition effects – that is, how mergers affect investment incentives, financial sustainability and competition on network quality over time. Static, price-centred analysis is inadequately suited to capital-intensive sectors. The evidence in Europe shows that when dynamic effects are properly considered, consolidation can strengthen effective competition and improve consumer welfare in the mobile data and 5G era.

Annexes

Annex 1: OLS regression tables

This annex presents the full OLS regression results supporting the analysis in Sections 2.1 (investment), 2.2 (quality) and 2.3 (prices). All models include country or operator fixed effects and year fixed effects. Standard errors are clustered at the country level. Controls include log GDP per capita, rural population share and spectrum holdings. Traffic per connection is added in columns 5–6 and 11–12 where indicated.

Table A1.1

OLS: capex per connection (log) and real capex (log), country level

	Capex per connection (log)						Capex USD real (log)					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variables	All	All	Pre	Pre	Post	Post	All	All	Pre	Pre	Post	Post
HHI	0.0003***	0.0006	0.0003***	-0.0001	0.0004***	0.0010	0.0001	0.0001	-0.0000	-0.0000	0.0001	0.0002
	(0.0001)	(0.0008)	(0.0001)	(0.0008)	(0.0001)	(0.0009)	(0.0001)	(0.0008)	(0.0001)	(0.0006)	(0.0001)	(0.0008)
Square HHI		-0.0000		0.0000		-0.0000		-0.0000		-0.0000		-0.0000
		(0.0000)		(0.0000)		(0.0000)		(0.0000)		(0.0000)		(0.0000)
Rural	-0.0133	-0.0151	-0.1823*	-0.1787	-0.0531	-0.0630	-0.0119	-0.0119	-0.1177	-0.1180	-0.0483	-0.0495
	(0.0530)	(0.0534)	(0.1029)	(0.1065)	(0.0660)	(0.0673)	(0.0546)	(0.0549)	(0.1219)	(0.1228)	(0.0569)	(0.0555)
GDP per capita	-0.3158	-0.3231	-0.2609	-0.2025	0.1160	0.1400	-0.2573	-0.2574	-0.5360	-0.5408	0.2796	0.2825
	(0.3105)	(0.3068)	(0.4491)	(0.4760)	(0.4098)	(0.4068)	(0.2916)	(0.2888)	(0.4586)	(0.4642)	(0.3783)	(0.3729)
Spectrum	0.0003**	0.0003**	0.0001	0.0001	0.0003**	0.0003**	0.0003**	0.0003**	0.0002	0.0002	0.0003***	0.0003***
	(0.0001)	(0.0001)	(0.0005)	(0.0005)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0005)	(0.0005)	(0.0001)	(0.0001)
Traffic per connection					0.0000	0.0000					0.0000	0.0000
					(0.0000)	(0.0000)					(0.0000)	(0.0000)
Constant	3.4275	3.1431	7.5063	7.4151	-0.4854	-1.4490	20.9823***	20.9790***	27.3392***	27.3467***	15.7796***	15.6611***
	(3.7879)	(4.0558)	(5.2805)	(5.4169)	(4.9671)	(4.9066)	(3.5677)	(3.7918)	(5.9773)	(5.9858)	(4.4866)	(4.5183)
Observations	1,392	1,392	319	319	1,044	1,044	1,392	1,392	319	319	1,044	1,044
R-squared	0.8604	0.8605	0.8811	0.8812	0.8841	0.8846	0.9762	0.9762	0.9799	0.9799	0.9801	0.9801

* p<0.10, ** p<0.05, *** p<0.01
Note: Standard errors in parentheses, clustered at country level.

Source: GSMA Intelligence

Table A1.2

OLS: capex per connection (log) and real capex (log), operator level

	Capex per connection (log)						Capex USD real (log)					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variables	All	All	Pre	Pre	Post	Post	All	All	Pre	Pre	Post	Post
HHI	0.0006***	0.0017	0.0005**	-0.0002	0.0006**	0.0028**	0.0005***	0.0022	0.0004**	-0.0002	0.0007**	0.0032**
	(0.0002)	(0.0012)	(0.0002)	(0.0012)	(0.0003)	(0.0013)	(0.0002)	(0.0013)	(0.0002)	(0.0011)	(0.0003)	(0.0013)
Squared HHI		-0.0000		0.0000		-0.0000*		-0.0000		0.0000		-0.0000**
		(0.0000)		(0.0000)		(0.0000)		(0.0000)		(0.0000)		(0.0000)
Rural	0.0019	-0.0064	-0.1885	-0.1722	-0.0860	-0.1146	-0.0109	-0.0228	-0.1925	-0.1775	-0.0841	-0.1175
	(0.0727)	(0.0743)	(0.1488)	(0.1471)	(0.0820)	(0.0868)	(0.0787)	(0.0795)	(0.1594)	(0.1591)	(0.0812)	(0.0867)
GDP per capita	-0.4075	-0.4566	-0.4102	-0.3148	0.2060	0.3855	-0.3502	-0.4204	-0.5062	-0.4184	0.3176	0.5271
	(0.3653)	(0.3507)	(0.4701)	(0.4456)	(0.5598)	(0.5627)	(0.3927)	(0.3691)	(0.4773)	(0.4479)	(0.5011)	(0.5053)
Spectrum	0.0004**	0.0004**	0.0010*	0.0010*	0.0004*	0.0003*	0.0005**	0.0004**	0.0010*	0.0010*	0.0004**	0.0003*
	(0.0002)	(0.0002)	(0.0006)	(0.0006)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0006)	(0.0006)	(0.0002)	(0.0002)
Traffic per connection					0.0000	0.0000					0.0000	0.0000
					(0.0000)	(0.0000)					(0.0000)	(0.0000)
Constant	3.0639	2.0417	8.1821	7.8321	-1.6281	-6.2073	19.1891***	17.7270***	25.7275***	25.4056***	13.2801**	7.9331
	(4.8216)	(5.1310)	(5.6833)	(5.3334)	(5.5527)	(6.0338)	(5.1968)	(5.5788)	(5.9195)	(5.6136)	(5.1541)	(5.8597)
Observations	4,282	4,282	1,081	1,081	2,721	2,721	4,282	4,282	1,081	1,081	2,721	2,721
R-squared	0.4177	0.4187	0.4249	0.4251	0.4428	0.4443	0.7987	0.7993	0.8091	0.8091	0.8007	0.8015

* p<0.10, ** p<0.05, *** p<0.01
Note: Standard errors clustered at country level.

Source: GSMA Intelligence

Table A1.3

OLS: download speeds (unweighted and weighted, Mbps), operator level

	Download all						Download weighted					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variables	**All**	**All**	**Pre**	**Pre**	**Post**	**Post**	**All**	**All**	**Pre**	**Pre**	**Post**	**Post**
HHI	0.0181*	0.1813***	0.0016	0.0023	0.0192	0.3609***	0.0144**	0.0757**	0.0010	-0.0216*	0.0106	0.2280***
	(0.0095)	(0.0362)	(0.0014)	(0.0125)	(0.0150)	(0.0742)	(0.0062)	(0.0362)	(0.0017)	(0.0112)	(0.0104)	(0.0650)
Square HHI		-0.0000***		-0.0000		-0.0001***		-0.0000		0.0000*		-0.0000***
		(0.0000)		(0.0000)		(0.0000)		(0.0000)		(0.0000)		(0.0000)
Rural	-11.3248**	-12.2827**	-1.8651	-1.8795	-16.7296	-20.8512**	-3.9974	-4.3700	-5.0680	-4.6189	-3.9710	-6.6480
	(5.1618)	(4.9457)	(3.0533)	(3.1545)	(11.0893)	(8.6987)	(3.8951)	(3.9329)	(3.1312)	(3.3212)	(8.0509)	(7.1741)
GDP per capita	-72.6497*	-79.3736*	-7.5777	-7.6823	-83.1147	-55.8489	-57.3715*	-59.9163**	-14.6095*	-11.3462	-32.6530	-14.8506
	(41.6851)	(40.4813)	(13.9350)	(14.1202)	(52.8546)	(49.2383)	(28.0147)	(28.7653)	(8.0224)	(6.7319)	(44.1414)	(38.1878)
Spectrum	0.0433**	0.0397*	0.0041	0.0041	0.0441**	0.0311	0.0194	0.0179	0.0122***	0.0122***	0.0151	0.0066
	(0.0209)	(0.0206)	(0.0065)	(0.0066)	(0.0209)	(0.0187)	(0.0157)	(0.0157)	(0.0035)	(0.0034)	(0.0151)	(0.0139)
Traffic per connection					0.0018	0.0027**					0.0017**	0.0024**
					(0.0011)	(0.0011)					(0.0008)	(0.0009)
Constant	1,047.1551**	894.0186**	141.7416	142.1036	1,296.0794**	587.1651	703.7837**	646.9607**	293.5728**	282.2904**	449.4238	-4.4276
	(407.9714)	(391.1717)	(162.6699)	(163.9347)	(544.1068)	(522.5441)	(286.1380)	(275.4847)	(118.3418)	(110.0078)	(475.5165)	(411.5847)
Observations	4,237	4,237	1,070	1,070	2,684	2,684	4,249	4,249	1,070	1,070	2,696	2,696
R-squared	0.7305	0.7355	0.4799	0.4799	0.6733	0.6827	0.7857	0.7873	0.6000	0.6033	0.7497	0.7586

* p<0.10, ** p<0.05, *** p<0.01

Note: Standard errors clustered at country level. GDP per capita, rural share, spectrum and traffic per connection (columns 5–6 and 11–12) as controls.

Source: GSMA Intelligence

Table A1.4

OLS: entry-level and high-usage tariff baskets (USD), country level

	Entry-level baskets						High-usage baskets					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variable	**All**	**All**	**Pre**	**Pre**	**Post**	**Post**	**All**	**All**	**Pre**	**Pre**	**Post**	**Post**
HHI	-0.0025	-0.0038	0.0036*	0.0468	-0.0048**	-0.0069	0.0000	-0.0169	0.0045**	-0.0339	-0.0027	-0.0185
	(0.0015)	(0.0102)	(0.0021)	(0.1093)	(0.0018)	(0.0149)	(0.0025)	(0.0180)	(0.0020)	(0.0846)	(0.0032)	(0.0253)
Square HHI		0.0000		-0.0000		0.0000		0.0000		0.0000		0.0000
		(0.0000)		(0.0000)		(0.0000)		(0.0000)		(0.0000)		(0.0000)
Rural	-0.1549	-0.1669	1.2615	1.2944	-0.1646	-0.1899	0.6183	0.4541	1.3199	1.3020	1.5228	1.3315
	(0.3220)	(0.3469)	(1.1753)	(1.1957)	(0.5198)	(0.5294)	(0.5801)	(0.4999)	(0.9855)	(0.9376)	(1.1332)	(0.9987)
GDP per capita	-3.5314	-3.4859	10.3936	9.8034	-5.0938	-5.1991	-7.0942	-6.1598	11.7521	12.5683*	-5.2164	-5.9732
	(6.0243)	(6.0947)	(8.9529)	(7.6267)	(8.9711)	(8.9270)	(6.1424)	(6.1192)	(7.3172)	(6.3963)	(8.7735)	(9.1595)
Spectrum	-0.0023	-0.0022	0.0103	0.0113	-0.0022	-0.0022	0.0035	0.0040	0.0080	0.0070	0.0034	0.0040
	(0.0036)	(0.0036)	(0.0097)	(0.0115)	(0.0034)	(0.0034)	(0.0037)	(0.0038)	(0.0072)	(0.0087)	(0.0036)	(0.0039)
Traffic per connection					-0.0000	-0.0000					0.0002	0.0002
					(0.0002)	(0.0002)					(0.0002)	(0.0002)
Constant	59.5528	61.2529	-158.4812*	-230.0017	84.6788	89.7132	68.5395	88.5681	-173.6292**	-113.2666	31.6003	69.1373
	(59.3436)	(58.3748)	(85.8667)	(255.6503)	(92.5823)	(93.7815)	(61.7240)	(65.9702)	(75.4326)	(193.5418)	(95.7650)	(110.3149)
Observations	794	794	56	56	682	682	801	801	58	58	685	685
R-squared	0.5980	0.5981	0.8544	0.8562	0.6349	0.6350	0.6642	0.6680	0.8877	0.8894	0.6890	0.6908

Source: GSMA Intelligence

Annex 2: IV regression tables

Tables A2.1 and A2.2 present the full IV results for capex (referenced in Section 2.1), while Table A2.3 covers download speeds (Section 2.2). The instrument used is operators' own lagged spectrum share, lagged by 16 periods.

Table A2.1

IV estimation: capex per connection (log)

	All sample | FE					All sample | No FE				
Controls →	**(1) GDP**	**(2) GDP+Rural**	**(3) GDP+Rural $+HHI^2$ [pre-traffic]**	**(4) GDP+Rural +Traffic**	**(5) GDP+Rural +Traffic $+HHI^2$**	**(1) GDP**	**(2) GDP+Rural**	**(3) GDP+Rural $+HHI^2$ [pre-traffic]**	**(4) GDP+Rural +Traffic**	**(5) GDP+Rural +Traffic $+HHI^2$**
A. HHI coefficient (β_1 — endogenous regressor)										
β (HHI)	**0.0167*** **	**0.0169*** **	**0.1638*** **	**0.0171*** **	**0.1698*** **	**0.0013*** **	**0.0012*** **	**0.0319*** **	**0.0012*** **	**0.0328*** **
	(0.0037)	*(0.0037)*	*(0.0476)*	*(0.0038)*	*(0.0495)*	*(0.0001)*	*(0.0001)*	*(0.0079)*	*(0.0001)*	*(0.0082)*
B. HHI^2 coefficient (β_2)										
β (HHI^2)	n/a	n/a	**-0.0000*** **	n/a	**-0.0000*** **	n/a	n/a	**-0.0000*** **	n/a	**-0.0000*** **
			(0.0000)		*(0.0000)*			*(0.0000)*		*(0.0000)*
Turning point $-\beta_1/(2\cdot\beta_2)$	—	—	**3212.069**	—	**3204.400**	—	—	**3126.314**	—	**3125.029**
C. Model information										
Observations (N)	1,929	1,929	1,929	1,929	1,929	1,929	1,929	1,929	1,929	1,929
Country & Year FE	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
Instrument			*RAW: own lagged spectrum share*					*RAW: own lagged spectrum share*		
D. Instrument validity tests										
Kleibergen-Paap F (weak ID)	23.805	23.816	12.802	23.361	12.654	281.772	270.38	20.707	298.38	19.684
Cragg-Donald F (weak ID)	17.269	16.99	13.897	16.618	13.117	281.425	276.031	32.066	285.945	30.673
Stock-Yogo 10% CV [= 16.38]	*16.38*	*16.38*	*16.38*	*16.38*	*16.38*	*16.38*	*16.38*	*16.38*	*16.38*	*16.38*
Underidentification p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
E. Endogeneity test										
Endogeneity χ^2 statistic	87.034	87.119	87.416	87.229	87.46	67.435	71.566	70.866	73.716	72.905
Endogeneity p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

* p<0.10, ** p<0.05, *** p<0.01

Note: Instrument used is own lagged spectrum share.

Source: GSMA Intelligence

Table A2.2

IV estimation download speeds (Mbps)

Controls →	(1) GDP	(2) GDP+Rural	(3) GDP+Rural +HHI² [pre-traffic]	(4) GDP+Rural +Traffic	(5) GDP+Rural +Traffic +HHI²
	Download speeds				
β (HHI)	**0.6651***** (0.1531)	**0.6707***** (0.1542)	**7.9375***** (2.7590)	**0.6835***** (0.1579)	**8.3312***** (2.8871)
β (HHI²)	n/a	n/a	**-0.0012***** (0.0004)	n/a	**-0.0013***** (0.0005)
Implied curve shape	—	—	**∩ Inv-∪**	—	**∩ Inv-∪**
Turning point $-\beta_1/(2\cdot\beta_2)$	—	—	**3202.412**	—	**3203.811**
Observations (N)	1,903	1,903	1,903	1,903	1,903
Country & Year FE	Yes	Yes	Yes	Yes	Yes
Instrument			*RAW: own lagged spectrum share*		
Kleibergen-Paap F (weak ID)	21.143	21.267	8.561	20.907	8.46
Cragg-Donald F (weak ID)	15.441	15.299	8.683	15.016	8.149
Stock-Yogo 10% CV [= 16.38]	16.38	16.38	16.38	16.38	16.38
Underidentification p-value	<0.001	<0.001	0.003	<0.001	0.003
Endogeneity χ^2 statistic	119.976	119.847	119.746	121.871	121.294
Endogeneity p-value	<0.001	<0.001	<0.001	<0.001	<0.001

* p<0.10, ** p<0.05, *** p<0.01

Source: GSMA Intelligence

Annex 3: DiD tables

Below are the full DiD results for all outcome variables for both consolidation and entry events. Three estimators were applied: Sun and Abraham (SA 2021), Borusyak, Jaravel and Spiess (B 2024) and de Chaisemartin-D'Haultfoeuille dynamic (CH 2020). All models include operator and year fixed effects. Parallel trends tests assess the validity of the identifying assumption; specifications where the assumption is not satisfied are flagged.

Table A3.1

DiD: capex per connection (log), consolidation events

	Sun & Abraham (SA)	Borusyak et al – imputation (B)				de Chaisemartin & D'Haultfoeuille – dynamic (CH)			
	No controls	No controls	All controls	GDP+Traffic	GDP+Rur +Traf	No controls	All controls	GDP+Traffic	GDP+Rur +Traf
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A. Treatment effect estimates									
ATT / average total effect	0.1774	0.1907	0.2844*	0.2506	0.2506	0.3914	0.3709**	0.3344**	0.3682**
	(0.1529)	(0.1498)	(0.1631)	(0.1640)	(0.1640)	(0.2448)	(0.1454)	(0.1390)	(0.1452)
B. Parallel trends / pre-trend tests									
Pre-trend t−1	n/a	-0.2508	-0.0134	-0.0467	-0.0468	0.1327	-0.0387	-0.0371	-0.0388
Pre-trend t−2	n/a	-0.1209	-0.0496	-0.0830	-0.0831	0.0109	-0.0629	-0.0610	-0.0629
Parallel trends met?	**n/a**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**
Pre-trend / placebo p-val	—	t−1: 0.283 | t−2: 0.414	t−1: 0.884 | t−2: 0.583	t−1: 0.631 | t−2: 0.382	t−1: 0.633 | t−2: 0.386	0.139	0.188	0.217	0.186
C. Model information									
Observations (N)	6,274	6,275	2,696	2,696	2,696	2,949	1,057	1,057	1,057
Operator FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf

* p<0.10, ** p<0.05, *** p<0.01

Note: All models include operator and year fixed effects.

Source: GSMA Intelligence

Table A3.2

DiD: real capex USD (log), consolidation events

	Sun & Abraham (SA)	Borusyak et al – imputation (B)				de Chaisemartin & D'Haultfoeuille – dynamic (CH)			
	No controls	No controls	All controls	GDP+Traffic	GDP+Rur+Traf	No controls	All controls	GDP+Traffic	GDP+Rur+Traf
A. Treatment effect estimates									
ATT / average total effect	**0.1505**	**0.1638**	**0.3628****	**0.3342****	**0.3258****	**0.3552**	**0.3352****	**0.2995****	**0.3323****
	(0.1530)	(0.1497)	(0.1632)	(0.1636)	(0.1636)	(0.2448)	(0.1455)	(0.1390)	(0.1452)
B. Parallel trends / pre-trend tests									
Pre-trend t–1	n/a	-0.2599	-0.0391	-0.0771	-0.0757	0.1326	-0.0371	-0.0356	-0.0373
Pre-trend t–2	n/a	-0.1301	-0.0757	-0.1140	-0.1124	0.0118	-0.0573	-0.0554	-0.0573
Parallel trends met?	n/a	**Yes** ✓	**Yes** ✓	**Yes** ✓	**Yes** ✓	**Yes** ✓	**Yes** ✓	**Yes** ✓	**Yes** ✓
Pre-trend / placebo p-val	—	t–1: 0.261 | t–2: 0.367	t–1: 0.639 | t–2: 0.351	t–1: 0.381 | t–2: 0.181	t–1: 0.397 | t–2: 0.195	0.142	0.237	0.269	0.235
C. Model information									
Observations (N)	6,274	6,275	2,696	2,696	2,696	2,949	1,057	1,057	1,057
Operator FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Source: GSMA Intelligence

Table A3.3

DiD: real ARPU (USD), consolidation events

	Sun & Abraham (SA)	Borusyak et al – imputation (B)				de Chaisemartin & D'Haultfoeuille – Dynamic (CH)			
	No controls	No controls	All controls	GDP+Traffic	GDP+Rur+Traf	No controls	All controls	GDP+Traffic	GDP+Rur+Traf
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A. Treatment effect estimates									
ATT / average total effect	**-2.5389***	**-2.7062****	**-1.5899*****	**-1.5358*****	**-1.6083*****	**0.5592**	**-0.6714*****	**-0.7831*****	**-0.6692*****
	(1.3417)	(1.3592)	(0.2196)	(0.2085)	(0.2110)	(0.7778)	(0.2576)	(0.2306)	(0.2571)
B. Parallel trends / pre-trend tests									
Pre-trend t–1	n/a	-0.7104	0.0050	-0.0253	-0.0124	0.0685	-0.2148*	-0.2088*	-0.2147*
Pre-trend t–2	n/a	-0.6451	-0.1934	-0.2256	-0.2107	-0.3971**	-0.4267	-0.4203	-0.4267
Parallel trends met?	n/a	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**
Pre-trend / placebo p-val	—	t–1: 0.386 | t–2: 0.473	t–1: 0.989 | t–2: 0.661	t–1: 0.946 | t–2: 0.611	t–1: 0.974 | t–2: 0.637	0.122	0.143	0.159	0.143
C. Model information									
Observations (N)	6,303	6,304	2,713	2,713	2,713	2,961	1,069	1,069	1,069
Operator FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf

Source: GSMA Intelligence

Table A3.4

DiD: 5G coverage (%), consolidation events

	Sun & Abraham (SA)	Borusyak et al – imputation (B)				de Chaisemartin & D'Haultfoeuille – dynamic (CH)			
	No controls	No controls	All controls	GDP+Traffic	GDP+Rur+Traf	No controls	All controls	GDP+Traffic	GDP+Rur+Traf
A. Treatment effect estimates									
ATT / average total effect	**4.4826***** (1.3652)	**4.5358***** (1.4077)	**11.6043***** (1.8929)	**16.6473***** (1.8984)	**11.6291***** (1.8127)	**-0.5677** (0.3923)	**-1.4495** (1.0993)	**-1.1782** (1.1020)	**-1.3957** (1.0966)
B. Parallel trends / pre-trend tests									
Pre-trend t–1	n/a	-3.8552	-7.4228	-8.2783	-7.3792	0.2065	0.1656	0.1577	0.1690
Pre-trend t–2	n/a	-3.6488	-7.1395	-8.1278	-7.0958	0.5345*	0.4741	0.4618	0.4740
Parallel trends met?	**n/a**	**Yes** ✓	**Yes** ✓	**Yes** ✓	**Yes** ✓	**Yes** ✓	**Yes** ✓	**Yes** ✓	**Yes** ✓
Pre-trend / placebo p-val	—	t–1: 0.105 | t–2: 0.132	t–1: 0.011 | t–2: 0.020	t–1: 0.013 | t–2: 0.018	t–1: 0.013 | t–2: 0.022	0.225	0.731	0.742	0.733
C. Model information									
Observations (N)	6,303	6,304	2,713	2,713	2,713	2,961	1,069	1,069	1,069
Operator FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf

Source: GSMA Intelligence

Table A3.5

DiD: weighted download speeds (Mbps), mature consolidation events (excluding Spain, Romania, UK)

	Sun & Abraham (SA)	Borusyak et al – imputation (B)				de Chaisemartin & D'Haultfoeuille – dynamic (CH)			
	No controls	No controls	All controls	GDP+Traffic	GDP+Rur +Traf	No controls	All controls	GDP+Traffic	GDP+Rur +Traf
A. Treatment effect estimates									
ATT / average total effect	8.7920**	8.6429**	12.7842**	12.2653**	9.1451*	3.7316**	10.7468**	11.2275**	10.9789**
	(3.9560)	(3.9381)	(5.1170)	(5.1015)	(5.0976)	(1.7503)	(5.2697)	(5.2568)	(5.2691)
B. Parallel trends / pre-trend tests									
Pre-trend t–1	n/a	3.8954	-0.6870	-0.6971	-0.7127	-0.2726	-1.1102	-1.1125	-1.1117
Pre-trend t–2	n/a	3.6258	-1.8210	-1.8400	-1.8541	-0.0705	-0.2129	-0.2170	-0.2155
Parallel trends met?	**n/a**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**
Pre-trend / placebo p-val	—	t–1: 0.193 | t–2: 0.197	t–1: 0.856 | t–2: 0.587	t–1: 0.854 | t–2: 0.583	t–1: 0.850 | t–2: 0.580	0.584	0.555	0.554	0.554
C. Model information									
Observations (N)	5,737	5,737	2,787	2,795	2,787	1,839	528	528	528
Operator FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf

Source: GSMA Intelligence

Table A3.6

DiD: capex per connection (log), entry events

	Sun & Abraham (SA)	Borusyak et al – imputation (B)				de Chaisemartin & D'Haultfoeuille – dynamic (CH)			
	No controls	No controls	All controls	GDP+Traffic	GDP+Rur +Traf	No controls	All controls	GDP+Traffic	GDP+Rur +Traf
A. Treatment effect estimates									
ATT / average total effect	**-0.0511**	**-0.0543**	**-0.2381****	**-0.3104*****	**-0.3192*****	**-0.1178**	**-0.1161**	**-0.1196**	**-0.1186**
	(0.1222)	(0.1294)	(0.1148)	(0.0918)	(0.0919)	(0.1090)	(0.0885)	(0.0878)	(0.0882)
B. Parallel trends / pre-trend tests									
Pre-trend t–1	n/a	0.2465	0.0707	0.0375	0.0341	-0.0326	-0.1296*	-0.1297*	-0.1297*
Pre-trend t–2	n/a	0.2095	-0.0585	-0.0919	-0.0953	-0.0616	-0.0523	-0.0524	-0.0524
Parallel trends met?	**n/a**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**
Pre-trend / placebo p-val	—	t–1: 0.017 | t–2: 0.164	t–1: 0.206 | t–2: 0.195	t–1: 0.563 | t–2: 0.099	t–1: 0.603 | t–2: 0.093	0.726	0.000	0.000	0.000
C. Model information									
Observations (N)	6,274	6,137	2,803	2,803	2,803	2,191	1,036	1,036	1,036
Operator FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf

* p<0.10, ** p<0.05, *** p<0.01

Note: Entry events include France (Iliad 2012), Germany (1&1 2022) and Italy (Iliad 2018).

Source: GSMA Intelligence

Table A3.7

DiD: download speeds (Mbps), entry events

	Sun & Abraham (SA)	Borusyak et al – imputation (B)				de Chaisemartin & D'Haultfoeuille – dynamic (CH)			
	No controls	No controls	All controls	GDP+Traffic	GDP+Rur +Traf	No controls	All controls	GDP+Traffic	GDP+Rur +Traf
A. Treatment effect estimates									
ATT / average total effect	**-8.2818***	**-8.4005***	**-11.6854****	**-29.4760*****	**-26.1668*****	**-4.8261*****	**-9.7054*****	**-9.4273*****	**-9.4895*****
	(4.5115)	(4.6283)	(4.5195)	(4.4564)	(4.4721)	(1.1851)	(2.0339)	(2.0378)	(2.0314)
B. Parallel trends / pre-trend tests									
Pre-trend t–1	n/a	0.3241	13.3937	5.3551	6.6479	-0.9861	-5.1244**	-5.1213**	-5.1213**
Pre-trend t–2	n/a	-0.6592	8.3034	0.2338	1.5248	0.3267	1.2686	1.2797	1.2795
Parallel trends met?	**n/a**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**No ×**	**No ×**	**No ×**
Pre-trend / placebo p-val	—	t-1: 0.949 | t-2: 0.902	t-1: 0.213 | t-2: 0.481	t-1: 0.624 | t-2: 0.984	t-1: 0.547 | t-2: 0.899	0.181	0.000	0.000	0.000
C. Model information									
Observations (N)	5,727	5,584	2,772	2,772	2,772	2,128	1,009	1,009	1,009
Operator FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf

* p<0.10, ** p<0.05, *** p<0.01

Note: CH dynamic specifications with controls fail parallel trends; SA and B results are primary.

Source: GSMA Intelligence

Table A3.8

DiD: 5G adoption (%), entry events

	Sun & Abraham (SA)	Borusyak et al – imputation (B)				de Chaisemartin & D'Haultfoeuille – dynamic (CH)			
	No controls	No controls	All controls	GDP+Traffic	GDP+Rur +Traf	No controls	All controls	GDP+Traffic	GDP+Rur +Traf
A. Treatment effect estimates									
ATT / average total effect	**-0.0136***** (0.0029)	**-0.0152***** (0.0031)	**-0.0080** (0.0074)	**-0.0146**** (0.0064)	**-0.0040** (0.0065)	**-0.0017**** (0.0008)	**-0.0034**** (0.0015)	**-0.0035**** (0.0015)	**-0.0033**** (0.0015)
B. Parallel trends / pre-trend tests									
Pre-trend t–1	n/a	0.0014	-0.0011	-0.0033	0.0007	0.0002	0.0007	0.0007	0.0007
Pre-trend t–2	n/a	0.0016	-0.0003	-0.0026	0.0015	0.0003	0.0014	0.0014	0.0014
Parallel trends met?	**n/a**	**Yes** ✓	**Yes** ✓	**Yes** ✓	**Yes** ✓	**Yes** ✓	**Yes** ✓	**Yes** ✓	**Yes** ✓
Pre-trend / placebo p-val	—	t–1: 0.738 | t–2: 0.677	t–1: 0.940 | t–2: 0.979	t–1: 0.822 | t–2: 0.846	t–1: 0.960 | t–2: 0.906	0.418	0.454	0.455	0.458
C. Model information									
Observations (N)	6,303	6,138	2,804	2,804	2,804	2,192	1,037	1,037	1,037
Operator FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf

* p<0.10, ** p<0.05, *** p<0.01

Source: GSMA Intelligence

Table A3.9

DiD: real ARPU (USD), entry events

	Sun & Abraham (SA)	Borusyak et al – imputation (B)				de Chaisemartin & D'Haultfoeuille – dynamic (CH)			
	No controls	No controls	All controls	GDP+Traffic	GDP+Rur +Traf	No controls	All controls	GDP+Traffic	GDP+Rur +Traf
A. Treatment effect estimates									
ATT / average total effect	**-3.4370***** (0.9153)	**-3.6488***** (0.9414)	**-0.8645** (0.5341)	**-0.8321** (0.5128)	**-0.9234*** (0.5129)	**-0.7178***** (0.2738)	**-0.3177*** (0.1806)	**-0.2960*** (0.1796)	**-0.3211*** (0.1809)
B. Parallel trends / pre-trend tests									
Pre-trend t−1	n/a	-0.3973	0.0592	0.0667	0.0322	0.0199	0.2368	0.2368	0.2368
Pre-trend t−2	n/a	-0.3672	0.2946	0.3020	0.2675	0.1621	0.2981	0.2980	0.2980
Parallel trends met?	**n/a**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**	**Yes ✓**
Pre-trend / placebo p-val	—	t−1: 0.506 | t−2: 0.478	t−1: 0.942 | t−2: 0.599	t−1: 0.934 | t−2: 0.586	t−1: 0.968 | t−2: 0.633	0.623	0.838	0.838	0.838
C. Model information									
Observations (N)	6,303	6,138	2,804	2,804	2,804	2,192	1,037	1,037	1,037
Operator FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf	No	All+Traffic	GDP+Traffic	GDP+Rur+Traf

* p<0.10, ** p<0.05, *** p<0.01

Note: Price reductions from entry are smaller and less consistent than from consolidation. In controlled B specifications the effect is not significant.

Source: GSMA Intelligence

Annex 4: structural events and country classifications

Table A4.1 lists all structural events included in the DiD analysis. Operators are classified as players if they hold at least 5% market share at any point in time.

Table A4.1

Consolidation and entry events in Europe, 2010–2025

Country	Event	Year	Players: before to after
Austria	Merger (H3/Orange)	2013	4 to 3
France	Entry (Iliad)	2012	3 to 4
Germany	Entry (1&1/Drillisch)	2023	3 to 4
Ireland	Merger (O2/Three)	2014	4 to 3
Italy	Entry (Iliad)	2018	3 to 4
Netherlands	Merger (ODIDO/Tele2)	2019	Net 3 (entry then consolidation)
Norway	Merger (Tele2/Telia)	2015	4 to 3
Romania	Exit (Telekom Romania)	2025	4 to 3
Slovakia	Entry (SWAN Mobile)	2015	3 to 4
Spain	Merger (Orange/MasMovil)	2024	4 to 3
UK	Merger (Orange/EE)	2010	5 to 4

Note: Germany and Italy classified as entry events. Netherlands classified as consolidation event reflecting the 2019 merger following an earlier entry. The UK also experienced an additional recent consolidation event through a 2025 merger between Three and Vodafone.

Source: GSMA Intelligence

Table A4.2

Countries included in the study and number of mobile operators, 2010–2025

Country	2010	2015	2020	2023	2025
Austria	4	3	3	3	3
Belgium	3	3	3	3	3
Bulgaria	3	3	3	3	3
Croatia	3	3	3	3	3
Czechia	3	3	3	3	3
Denmark	4	4	4	4	4
Estonia	3	3	3	3	3
Finland	3	3	3	3	3
France	3	4	4	4	4
Germany	4	3	3	4	4
Greece	3	3	3	3	3
Hungary	3	3	3	3	3
Ireland	4	3	3	3	3
Italy	4	4	4	4	4
Latvia	3	3	3	3	3
Lithuania	3	3	3	3	3
Luxembourg	3	3	3	3	3
Malta	3	3	3	3	3
Netherlands	3	4	3	3	3
Norway	4	3	3	3	3
Poland	4	4	4	4	4
Portugal	3	3	3	3	3
Romania	4	4	4	4	3
Slovakia	3	4	4	4	4
Slovenia	4	4	4	4	4
Spain	4	4	4	4	3
Sweden	4	4	4	4	4
Switzerland	3	3	3	3	3

Source: GSMA Intelligence

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