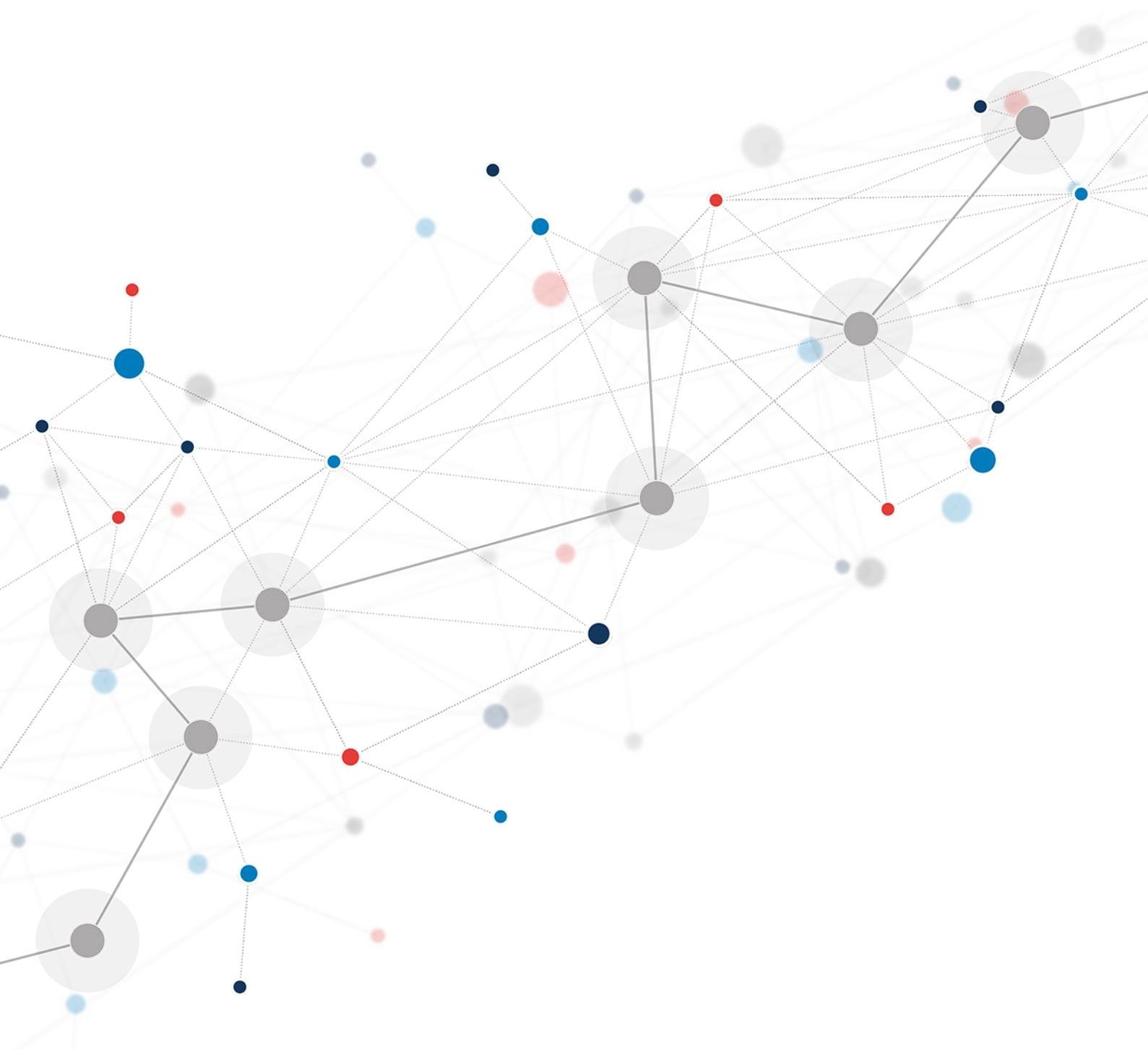


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# MOBILE MARKET STRUCTURE: POLICY AND INVESTMENT

## A REPORT COMMISSIONED BY VODAFONE

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# 1 SUMMARY

- 1.1 The ongoing development of mobile networks has delivered new and better quality services to consumers and essential connectivity for businesses. Data demand continues to grow exponentially. The European Commission and national governments are considering what approaches will best support industry in making the next leap forward in the widespread deployment of high quality 5G networks. The Commission has set targets for 5G to cover all urban areas and transport paths by 2025 and all populated areas by 2030.<sup>1</sup> The UK Government wants the majority of the UK population to have 5G coverage by 2027 and for the UK to be a global leader in 5G.<sup>2</sup>
- 1.2 This report, commissioned by Vodafone<sup>3</sup>, explores how governments and regulators can best facilitate the investment required to realise the benefits of widespread and timely 5G services. In particular, we consider how policies designed to achieve and maintain particular market structures can impact investment and whether changes in certain policies would improve investment conditions leading to better outcomes for consumers and industry.

## Mobile network investments have delivered large consumer benefits

- 1.3 Network investments have delivered better quality, higher volumes and lower prices:
- average smartphone speeds increased from 0.3mbps to 30mbps between 2010 and 2020;
  - data consumption per subscriber per month increased from 0.1 gigabyte (GB) to 9GB between 2010 and 2020; and
  - revenue per GB, a proxy of quality-adjusted prices, fell 96% in the UK between 2010 and 2017.<sup>4</sup> Vodafone's revenue per GB fell by between 98-100% in Germany, Italy and Spain between Q1 2011/12 and Q3 2020/21.
- 1.4 Evidence shows that gains in quality over time and the new applications enabled by better quality (such as the 'App Economy' facilitated by 4G) have delivered benefits to consumers which are an order of magnitude greater than the prices paid for mobile services. This highlights the importance to consumer welfare of quality-enhancing investment. And the earlier that investment happens the sooner the benefits will flow to consumers.

## 5G has the potential to deliver substantial additional gains

- 1.5 5G technology offers substantial gains in network capacity as well as providing for much higher data speeds, ultra-low latency and much higher user density. 5G is expected to be a key enabler of the 'Fourth Industrial Revolution' i.e. the integration of the Internet of Things (machine-to-machine communications) and computation, networking and physical processes to support greater factory and process automation. 5G is expected to transform manufacturing, transport, commerce and public services.

<sup>1</sup> European Commission, *5G Action Plan*, 2016, and *2030 Digital Compass: the European way for the Digital Decade*, 2021.

<sup>2</sup> UK Department for Digital, Culture, Media & Sport, *Future telecoms infrastructure review*, 2018 and *Next Generation Mobile Technologies: A 5G Strategy for the UK*, 2017.

<sup>3</sup> While the report has benefitted by many helpful comments and financial support from Vodafone, the views expressed are the sole responsibility of the authors and cannot be attributed to Compass Lexecon or its clients.

<sup>4</sup> In this paper, we refer to quality-adjusted prices to mean prices adjusted for customer valuation of changes in quality over time. A number of earlier merger decisions by authorities focused on Average Revenue Per User (ARPU) which does not capture the benefit to consumers of increased usage and better service quality.

- 1.6 The European Commission has recognised the importance of 5G: “5G is the critical next generation network technology that will enable innovation and support the digital transformation.”<sup>5</sup> Similarly, the UK Government states “Significant economic and social value can be gained from the widespread deployment of 5G networks. These networks will deliver faster, more reliable and flexible networks that have the potential to transform key sectors across the economy.”<sup>6</sup>

### Regulation and policymakers in Europe can do more to facilitate the investment required to realise the 5G opportunity

- 1.7 Realising the full benefits of 5G requires substantial investment in spectrum, new equipment on sites, additional sites, Multi-access Edge Computing and substantial upgrade to backhaul capacity and the core network. The EIB has estimated that there is a €254 billion gap between the investments required to meet the EC's coverage targets under the Digital Agenda for Europe and the European Gigabit Society and forecast private investment.<sup>7</sup> The use of high-band spectrum offers more innovative 5G applications but would require even greater investment to create a dense network of small cells, together with power and backhaul.
- 1.8 The regulatory environment in a number of markets across Europe is currently not conducive to substantial additional investment.
- a. Barriers to exit for underperforming firms tie up scarce spectrum and lead to fragmented and uncertain demand. This limits operators' ability to realise scale economies in deploying 5G outside urban areas, and in developing innovative 5G applications for industry. Past mobile merger decisions have focused on potential short-term price effects, while discounting the rivalry-enhancing efficiencies that drive future investment cases. In limiting potential exit options, strict merger policy can deter investment by increasing losses if investments turn out unsuccessfully and investors need to exit.
  - b. Authorities at European and national level have implemented policies to facilitate entry on favourable terms for new operators. Such interventions (pursued in spectrum auctions and as remedies in merger reviews) include access to spectrum below market rates and regulated access to the networks of incumbent operators. While the policies might support low pricing in the short-run, they undermine network investment incentives, and the new entrants may not be viable once the regulatory concessions are removed.
  - c. Spectrum licensing and spectrum pricing decisions can undermine investment. Approaches to licensing can create uncertainty over future access to spectrum and generate a risk of hold-up problems where operators with sunk networks are vulnerable to authorities increasing spectrum prices and/or imposing new conditions. High upfront licence fees, annual fees and costly licence obligations have significantly contributed to operators' declining free cash flows and high debt levels. This has forced operators to rely more on costly external sources of funding which limit how much new investment is viable.

### How can policy makers change the regulatory environment to help close the 5G investment gap?

- 1.9 There are a number of changes authorities and policy-makers can make to create a regulatory environment that supports investment in a way that would promote the long-term interests of end-users.

<sup>5</sup> European Commission, [Shaping Europe's digital future](#).

<sup>6</sup> UK Government, [5G supply chain diversification strategy](#), 7 December 2020.

<sup>7</sup> Gruber, H., [Very High Capacity and 5G Networks: From the EU Code to the EU Market](#), 24 June 2019.

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## Merger policy

- 1.10 Investment in capacity and technology upgrades have generated large consumer benefits which are an order of magnitude greater than prices paid for mobile services. This implies that the effects of mergers and merger policy on investment in mobile markets are likely to be of much greater importance to consumer welfare than the levels of static pricing effects that have been the focus of earlier merger assessments.
- 1.11 There is therefore a strong case for mobile merger assessment to place less weight on short-term pricing effects and more weight on dynamic competition, and particularly rivalry in investment.<sup>8</sup> In doing so, it needs to be recognised that rivalry is not the same as the number of operators - rivalry can actually increase following some mergers. Some mobile mergers enable the parties to offer better quality services and challenge the market leader. This can set off an investment race and lead to faster reductions in quality-adjusted prices. This was the case from the Orange UK/T-Mobile UK merger and appears to be happening following the recent Sprint/T-Mobile merger in the US and the VHA/TPG merger in Australia.
- 1.12 Understanding how a merger would impact dynamic competition requires detailed consideration of the counterfactual, i.e. what would be the nature of competition without the merger and how does this differ to the likely situation with the merger. Further, the assessment should consider competitive effects over a number of years so as to take into account effects of investment that may only appear in time. For example, keeping a weak operator in the market which has little incentive to invest may lead to low-price, low-quality offers which cater to price sensitive customers in the short term. However, this risks inefficient spectrum allocation and reduced market investment, leading to poorer quality products, and higher quality-adjusted prices for all consumers over time.
- 1.13 Merger policy which recognises the importance of dynamic competition would also integrate the consideration of rivalry-enhancing efficiencies into the assessment of whether a merger is likely to restrict competition.
- a. Network capacity is the product of sites, spectrum and technology efficiency. When operators' sites and spectrum are combined, there is a multiplicative effect on capacity. For example, we estimate that the merger of Orange and T-Mobile UK almost doubled the sum of the 3G capacity of the individual operators. A report for the EC found that the merger led to prices falling by between 2% and 18% relative to control countries. More capacity enables operators to offer larger data allowances which supports higher data usage and brings down the price per gigabyte.
  - b. In addition to eliminating inefficient duplicative investment (such as where operators have under-utilised sites in the same areas), mergers between operators can also support further quality-enhancing investments, that would otherwise not have been made. Combining customer bases can make wider 5G deployment economic. Combining spectrum reduces the incremental cost of capacity as with more spectrum each new site leads to more capacity. Rival operators can be forced to respond to the improved network of the merging parties by investing more in enhancing capacity and quality and/or reducing their prices.
- 1.14 While authorities have acknowledged some of the above benefits, the potential for these benefits is generally given insufficient weight in the assessment of whether a merger is likely to harm competition, particularly taking into account that investment is the key driver of consumer benefits in mobile telecoms markets.
- 1.15 Authorities have also acknowledged the benefits of network consolidation in relation to network sharing, which can generate some – but far from all – of the efficiencies highlighted above. There

<sup>8</sup> Merger policy in Europe can be compared with court assessments of recent mobile mergers in Australia and the US where 5G deployment was a key issue. In relation to the VHA/TPG merger and the Sprint/T-Mobile USA merger, the courts focused on the assessment of dynamic competition and accepted that the mergers would allow for a combination of assets which would make for a more effective competitor than the parties remaining independent. In both countries, the merging parties would continue to face two strong competitors. In the US, the transaction was subject to certain remedies including the divestment to Dish of Sprint's relatively small pre-paid subsidiary and of T-Mobile's 14 MHz of 800 MHz spectrum as well as an obligation to reach an MVNO agreement with Dish.

is now significant market evidence to guide authorities on when network sharing is a credible alternative (i.e. counterfactual) to a merger. Network sharing arrangements are difficult to agree on, and difficult to maintain over time. Sharing is unlikely where operators have different market positions, strategies, networks and financial positions, or where the operators are already in sharing arrangements with other operators. An operator will not enter a sharing agreement with a weaker operator if doing so supports the growth of the rival at its expense. Where network sharing is not a credible alternative, the efficiencies that can be generated from a full merger between network operators should be fully factored into the merger assessment.

- 1.16 Even where a particular form of sharing is possible, it may not be able to match the efficiencies of a merger. Mergers enable efficiencies from combining all the parties' spectrum, network and non-network assets and allow for full flexibility in network design. Mergers can generate greater efficiency than network sharing by providing for better investment incentives and coordination and avoiding double-marginalisation from usage-based charges.

### Merger policy can affect investment incentives

- 1.17 There is a current debate over whether merger policy should be made stricter. For example, the CMA has proposed that UK merger law be changed so that mergers by digital firms with strategic market status are assessed under a lower standard of proof of whether there is a 'realistic prospect' that a merger would give rise to a substantially lessening of competition. Some commentators have argued for a change in the burden of proof in EU merger regulation to require the merging parties to demonstrate that a merger would not be anti-competitive.
- 1.18 An issue that has received little attention in the current debate is how merger policies impact ex ante investment incentives. In particular, when deciding their investments, firms are likely to consider the range of potential outcomes including the scope for a merger or the sale of the business if returns prove insufficient. The impact of merger policy on ex ante investment incentives is important in the context of prospective 5G investments with uncertain returns.
- 1.19 Operators will not make additional investments if the probability-weighted expected return is less than their cost of capital. In this regard, merger policy will help shape industry players' expectations as to what future consolidation will be possible. If demand or market conditions turn out unfavourably so that an operator needs to exit, the value that the operator receives for its investments will depend on whether they are allowed to merge with other operators in the market (potentially realising significant synergies) or seek a sale to outside investors or, in the worst case, liquidate their assets.
- 1.20 An expectation that in-market mergers will not be allowed can reduce expected investment returns (by making downside losses greater) resulting in fewer investments being pursued.
- 1.21 Bisceglia, Padilla, Perkins and Piccolo find that, when taking into account the effect of merger policy on ex ante investment incentives, there is an inverted-U shaped relationship between authorities' expected receptiveness to mergers and investment.<sup>9</sup> The model shows that strict merger policy is more likely to harm ex ante investment incentives as uncertainty over investor returns increases. The model is relevant in the context of the rollout of 5G which has large potential overall benefits to society, but uncertain returns for operators particularly for investments beyond meeting the immediate need for additional capacity in congested areas.
- 1.22 The model suggests that making merger policy stricter (such as by changing the standard or burden of proof) could come at a significant cost to investment and consumer welfare if applied in markets with prospective risky investment.

<sup>9</sup> Bisceglia, M., J. Padilla, J. Perkins and S. Piccolo, "Optimal exit policy with uncertain demand", 2021 (available at SSRN: <https://ssrn.com/abstract=3889226> or <http://dx.doi.org/10.2139/ssrn.3889226>). The inverted U-shape arises in the model because more-receptive merger policy which increases the expected exit value stimulates investment if the exit value is not too large, but a very receptive merger policy makes exit likely which reduces the expected return to investments which depend on the firm remaining in the market.

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### Spectrum policies should also be reviewed to take into account effects on investment

- 1.23 Spectrum licensing approaches could also better support industry in making the large investment required for 5G particularly by:
- a. The adoption of perpetual, tradeable, spectrum licences (as in the UK) or licence extension to improve predictability and reduce the risk of regulatory opportunism;
  - b. A commitment to release all available spectrum and to avoid artificially raising future spectrum fees above the value of the spectrum for the alternative highest value user; and
  - c. Avoiding imposing new conditions on operators except at the time of releasing new spectrum when the cost of the obligation can be taken into account by operators in valuing the spectrum.
- 1.24 In assigning spectrum, some authorities have provided special assistance to entrants through spectrum reservation and regulated access to the established networks of rivals. Promoting entry below minimum efficient scale may be ineffective in promoting, and may even harm, dynamic competition. Spectrum reservation may deprive existing operators of the spectrum needed to meet the growing data demand of their customers, risking network congestion, declining quality and reduced incentives to compete for new customers. Entrants accessing reserved spectrum often have limited coverage implying that large parts of the country do not gain the benefit of the use of that spectrum. Regulated access to an operator's network may also reduce the incentive for that operator to seek a competitive advantage by deploying 5G more widely. While competition problems can arise from the excessive concentration of spectrum, this can be better addressed through a cap on the share of overall spectrum which individual operators are permitted to hold.

### Conclusion and report structure

- 1.25 5G offers large potential benefits for European consumers and businesses. However, operator returns from 5G are highly uncertain and current policy approaches risk delay and limited deployment. Authorities could significantly improve the environment for new investment by reviewing their approaches to merger assessment, spectrum licensing and other policies so as to reduce barriers to exit, avoid creating inefficient new entry and provide greater certainty over future spectrum licensing and licence conditions.
- 1.26 This paper is structured as follows:
- a. Section 2 examines the role that investment in capacity has played in delivering better quality services, new applications and rapid falls in quality-adjusted prices;
  - b. Section 3 considers the expected benefits and challenges of 5G including uncertain operator returns;
  - c. Section 4 identifies the 5G investment gap in Europe and how current policies deter operators in undertaking substantial new investment; and
  - d. Section 5 assesses what policy changes (including in relation to merger assessment and spectrum licensing) would promote investment and dynamic competition in the best interests of end-users.



## 2 INVESTMENT IN CAPACITY AND TECHNOLOGY UPGRADES ARE THE MAIN DRIVERS OF MOBILE CUSTOMER BENEFITS

2.1 In this section, we show that:

- a. Mobile markets have been characterised by operators investing in successive generations of technologies, spectrum and site densification;
- b. These investments have provided for substantial increases in capacity and service quality, new applications and large data bundles;
- c. Increased capacity, new applications and large data bundles have, in turn, supported exponential growth in data demand and rapid falls in quality-adjusted prices.

### Mobile capacity is determined by sites, spectrum and technology

2.2 Operators have substantially increased capacity over time by

- a. Deploying more sites to extend coverage and to use existing spectrum more intensely;
- b. Deploying more spectrum; and
- c. Deploying more efficient mobile technology in the radio access network - each successive generation of mobile technology has brought large gains in spectral efficiency and data transmission speeds and reduced latency (see Table 1).

**Table 1: Increased efficiency and quality from newer technology**

	Spectral efficiency (bps/Hz)	User experienced download speeds	Latency (roundtrip ms)
2G	0.25	32-175 Kbps	150-600
3G	0.5 – 1.0	226 Kbps – 1.4 Mbps	10 - 600
4G	1.4 – 2.25	20-42 Mbps*	10
5G	10.5	163-361 Mbps**	1

Notes: Range reflects different versions of each generation. Numbers are indicative of the order of magnitude of the gains from later technologies. \*4G speed is range for national average speed in Europe (excl. Russia and Belarus) in 2018. \*\* National average 5G speeds for global top ten in March 2021 (noting many countries are in an early stage of 5G rollout).

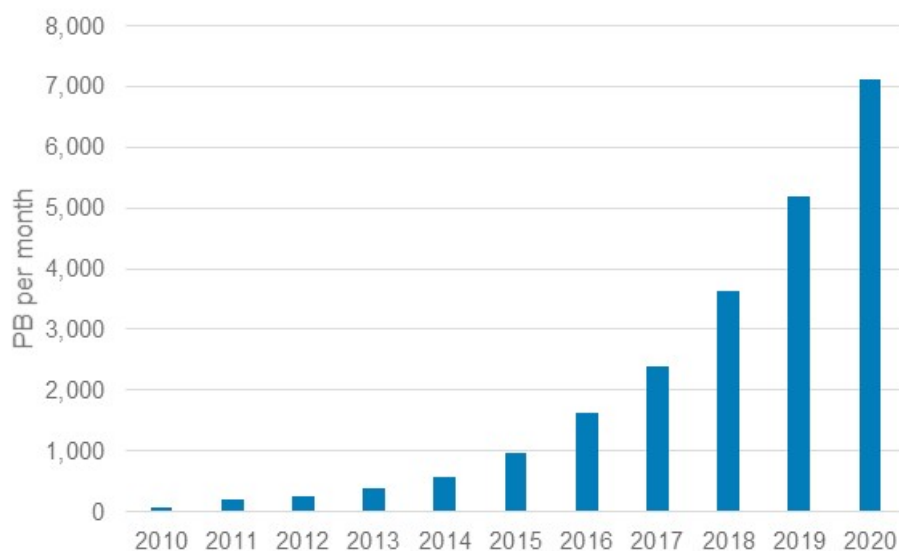
Source: Spectral efficiency from R. Clarke, "Expanding mobile wireless capacity: The challenges presented by technology and economics", 2013, p.13 and p.17 and Nokia, IEEE Summit presentation, November 2018; 2G and 3G speeds from ITU, "The economic impact of 5G"; 2G and 3G latency from T. Blaji et al., 2007, Latency Improvements in 3G Long Term Evolution; 4G speeds from Opensignal February 2018 and 5G speeds from Opensignal April 2021. Latency from ITU Recommendation ITU-R M.2083.0.

### Operator investments have led to large gains for customers

2.3 The direct impact of operator investments in sites, spectrum and the deployment of new technologies has been a large increase in network capacity and service quality.

2.4 Total mobile data traffic across Europe has grown exponentially over the last decade.

**Figure 1: Mobile data traffic (average PB per month) for the whole of Europe, 2010-2020.**



Source: Annual Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update. Values for each year are taken from the following year's update, except figures for 2017 onwards which are all taken from the most recent 2019 report and are forecasts for 2019 and 2020. 1 petabyte (PB) is equivalent to 1,000,000 gigabytes (GB).

2.5 Table 2 shows large gains in volumes and service quality experienced by mobile subscribers in Europe between 2010 and 2020. Higher speeds reflect both technology improvements and reduced risk of congestion at peak times.

**Table 2: Gains in outcomes for mobile subscribers in Europe, 2010 to 2020**

	2010	2020
<b>Mobile broadband subscribers per capita</b>	30%	107%
<b>Mobile data traffic (GB) per subscriber per month</b>	0.12	9.3
<b>Average smartphone speed (Mbps)</b>	0.27	30.2
<b>Population coverage</b>	90% 3G coverage	99.4% 4G coverage

Source: Mobile broadband subscribers per capita from OECD broadband statistics. Mobile data traffic 2010 from GSMA European Mobile Industry Observatory 2011 and for 2020 from Ericsson Mobility Report 2020 (average of western and central/eastern Europe). Average speed 2010 weighted average for Europe from Cisco Visual Networking Index: Global mobile data traffic forecast update 2010-2015; Average speed in 2020 from Cisco Annual Internet Report (2018–2023) White Paper (western, central and eastern Europe weighted by mobile users). Coverage 2010 from GSMA European Mobile Industry Observatory 2011. 2020 4G coverage from EC Digital Economy and Society Index (DESI) 2020 Connectivity, p.5.

- 2.6 Gains in capacity and quality (including faster speeds, better reliability and reduced latency) have supported a large growth in the range of apps and app features. The number of apps available had grown to 2.8 million on Google Play and 2.2 million on Apple's App Store by March 2017.<sup>10</sup> The majority of the most popular apps come from the United States.<sup>11</sup>
- 2.7 While many of the apps are available for a zero price, surveys find large valuations for such apps. Based on this evidence, we estimate that the value to consumers of using 10 popular apps over mobile networks equates to over £3,500 per individual per year.<sup>12</sup> This is multiples of the average spend on mobile services and implies large gains in consumer surplus.
- 2.8 The evidence on the large value of quality improvements in mobile services has significant implications:
- a. gains in quality over time and the new applications they enable have delivered substantial benefits to consumers which are an order of magnitude more than mobile service prices;
  - b. markets which deliver widespread access to high quality mobile services can be expected to deliver higher consumer benefits than markets in which the availability of higher quality services is more limited; and
  - c. delays in access to high quality mobile services mean that consumers lose the benefits they would otherwise have received from consuming the service.

### Investments in capacity have achieved sharp falls in mobile data prices

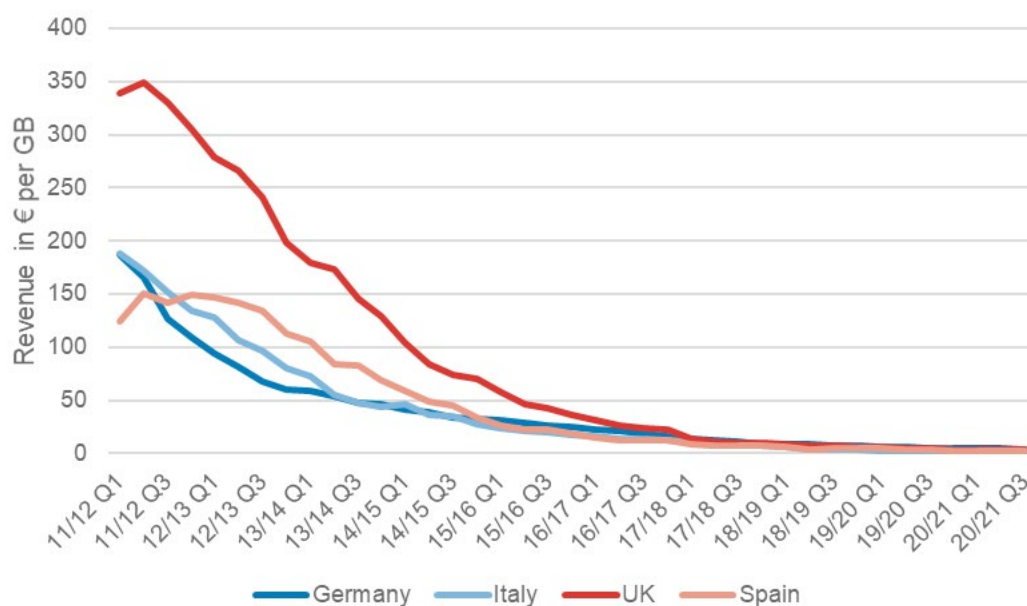
- 2.9 Investments in capacity and technology upgrades have enabled operators to offer large data bundles at lower prices. Many consumers are now on unlimited data, voice and SMS packages covered by a single monthly charge. Large and unlimited data bundles have supported ongoing exponential growth in data usage. The result has been sharp falls in mobile service revenue per gigabyte of data consumed (see Figure 2). Between Q1 2011/12 and Q3 2020/21, Vodafone's mobile service revenue per gigabyte fell 97.9% in Germany, 99.3% in Italy, 98.5% in Spain and 99.0% in the UK.<sup>13</sup>

<sup>10</sup> European Parliament Briefing: European app economy, May 2018, Table 1.

<sup>11</sup> European Parliament Briefing: European app economy, May 2018, p.5. Slower take-up of 4G (LTE) in Europe resulted from delays in making new spectrum available and restrictions on changing the use of spectrum. Yoo finds: "Finally, LTE coverage depended on early deployment of 2.6 GHz spectrum and a flexible approach to 1.8 GHz spectrum. Attempts to configure auctions to stimulate competitors led to considerable delays in deployment" (C. Yoo, "U.S. vs. European Broadband Deployment: What Do the Data Say?", 2014, *U of Penn, Inst for Law & Econ Research Paper No. 14-35*, p.51).

<sup>12</sup> This is based on Coyle and Nguyen finding of average 12 month valuations in the UK for personal email of £3,402, online search £3,095, online banking £2,790, Whatsapp £1,588, YouTube £1,399, Google maps £1,307, Facebook £1,278, online news £1,278, Messenger £1,088 and Instagram £657 among other apps (Coyle, D. and D. Nguyen, "Free goods and economic welfare", ESCoE Discussion Paper 2020-18, December 2020, Table 2) as well as Cisco's estimate that traffic over mobile networks will account for around 20% of global IP traffic in 2021, although mobile is likely to have a greater share of non-video content and personal data traffic (*Cisco Visual Networking Index (VNI) Global Mobile Data Traffic Forecast Update 2017 – 2021*).

<sup>13</sup> Data from Vodafone's Investor Relations.

**Figure 2: Vodafone's mobile service revenue (€) per gigabyte of data**

Notes: Calculated based on available mobile service revenue and mobile data usage as reported in Vodafone's quarterly financial information spreadsheets.

- 2.10 Officials of the UK Office of National Statistics and academics have recently examined how to assess price changes taking into account rapid growth in data supplied to users. Abdirahman *et al* consider two approaches: one based on unit value indices and revenue weights (which gives relatively little weight to data) and another a unit value index based on data usage.<sup>14</sup> They consider the two approaches to provide upper and lower bounds to an ideal constant utility index, although they note that they expect convergence over time (i.e. ultimately telecommunications networks transmit data and consumers have been substituting traditional voice and SMS services for over-the-top data-based alternatives such as Skype and WhatsApp). The authors find that taking into account the much larger volumes of data being supplied to customers, telecommunications services prices in the UK over 2010 to 2017 fell by 37% under the first approach and by 96% under the second approach. They note that an advantage of a data usage approach is that it implicitly captures some quality improvement such as increased data usage resulting from better coverage and speeds.
- 2.11 In Europe, the countries with lowest revenue per gigabyte consumed, e.g. Finland and Austria, have the highest data usage<sup>15</sup> and this has been enabled by relatively high capex per capita.<sup>16</sup> On the other hand, where network capacity is insufficient, operators are likely to seek to limit data usage (e.g. by ending unlimited data plans, throttling data usage or raising plan prices) with the result that the price per gigabyte increases.<sup>17</sup>
- 2.12 Operators' ability to offer more data at the same or lower prices is primarily the result of gains in capacity. For example, access to additional spectrum enables operators to supply greater volumes with their existing sites. Additional spectrum also reduces the cost of supplying additional output as fewer new sites need to be added to supply an additional increment of output: "MNOs with small

<sup>14</sup> Abdirahman, M., Coyle, D., Heys, R. & Stewart, W. (2020), "A Comparison of Deflators for Telecommunications Services Output", *Economie et Statistique*, 517 518 519.

<sup>15</sup> Tefficient, *Industry Analysis #3 2020: Mobile data first half 2020*, p.5 and p.20.

<sup>16</sup> Data on capex from GSMA Intelligence and on population from Eurostat shows that Finland had 2.3 times and Austria 1.4 times the capex per capita of the EU average over the period 2018 to 2020.

<sup>17</sup> For example, US mobile operators which had been offering unlimited data plans moved to introduce usage-based pricing and throttling to address congestion problems in the period 2010 to 2013 (US Government Accountability Office, *Broadband Internet: FCC should track the application of fixed internet usage-based pricing and help improve consumer education*, November 2014).

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*spectrum holdings will tend to have higher marginal costs of adding capacity than operators with a large spectrum holding.”<sup>18</sup>*

- 2.13 This is consistent with the European Commission’s finding in its *T-Mobile NL/Tele2 NL* decision that additional capacity from spectrum assignment led to lower prices:

*“Indeed, the additional capacity resulting from this spectrum increased the ability and incentive of market players to compete more aggressively for new subscribers by offering larger data bundles coupled with lower prices.”<sup>19</sup>*

- 2.14 The deployment of later generation mobile technologies has also had the effect of increasing the capacity available as well as reducing the incremental cost of supplying additional output.

- 2.15 The sharp fall in revenue per gigabyte in Europe has occurred across Europe and over a period when concentration in mobile markets has increased on average<sup>20</sup>, consistent with the fall in quality-adjusted prices being driven by gains in capacity including from more sites, access to more spectrum and from newer technologies being deployed.

## Conclusion

- 2.16 Past investments in capacity and technology upgrades have brought large benefits to customers, including higher quality services and dramatic reductions in price per gigabyte consumed. 4G provided the platform for the App Economy and the proliferation of services which are highly valued by consumers.

<sup>18</sup> Ofcom, *Award of the 2.3 and 3.4 GHz spectrum bands Competition issues and Auction Regulations*.

<sup>19</sup> *Case M.8792 - T-Mobile NL/Tele2 NL*, para. 453.

<sup>20</sup> GSMA, *Mobile Economy Europe 2018*, Figure 8.

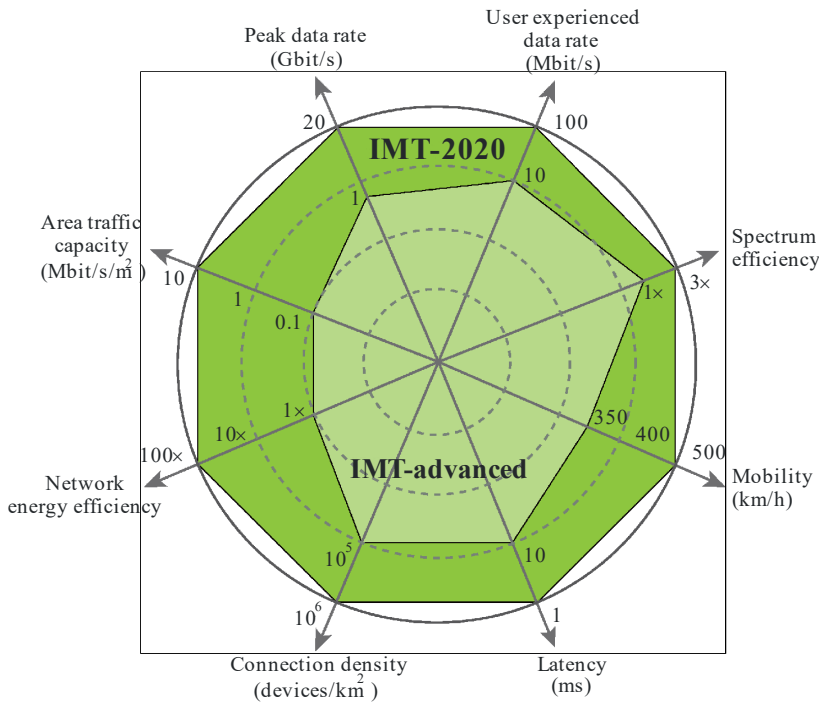
### 3 5G SERVICES ARE EXPECTED TO GENERATE LARGE BENEFITS TO CONSUMERS AND BUSINESS

- 3.1 In this section, we show that 5G offers both large increases in capacity as well as an order of magnitude improvement in quality, enabling both enhanced and new services and the prospect of a 'fourth industrial revolution'.
- 3.2 Globally, 5G is expected to play a large role in meeting growing data demand and is forecast by Ericsson to account for 54% of total mobile data by 2026.<sup>21</sup>
- 3.3 With spectral efficiency around 3 times larger than 4G, 5G technology together with the assignment of new spectrum to mobile services will provide a substantial increase in operators' overall capacity. As was the experience with 4G, greater capacity can be expected to lead to increased data usage and a significantly lower quality-adjusted prices.
- 3.4 5G is also expected to support higher data speeds, ultra-low latency, much higher user density (i.e. for both handsets and machine/devices), high quality services at high mobility and improved network energy efficiency (see Figure 3).
- 3.5 In the initial years, the major use of 5G is likely to be in the provision of enhanced mobile broadband. Ericsson expects 5G to lead to a cost per gigabyte 10 times lower than 4G networks (reliance on 4G alone to meet growing demand would instead lead to an increase in cost per gigabyte).<sup>22</sup> The faster speeds offered by 5G may also lead to a greater share of consumers choosing to rely solely on 5G for internet access and increase competitive pressure on fixed incumbent operators. 5G can also help bring ultra-fast broadband speeds to areas which are uneconomic to cover by fibre. Additional network capacity and greater ability to differentiate services is likely to give MVNOs greater bargaining power, particularly where they can bring additional end-customers to the host network.

<sup>21</sup> Ericsson mobility report, November 2020.

<sup>22</sup> Ericsson, [The 5G consumer business case](#), 2018, p.6-7.

**Figure 3: Performance gains of 5G (IMT-2020) over 4G (IMT-Advanced)**



M.2083-03

Source: ITU, Recommendation ITU-R M.2083-0, 2015.

3.6 Looking forward, 5G is also expected to bring new applications. In particular, one of the major benefits of 5G is that it is expected to be a key enabler of businesses of the future - what has been called the fourth industrial revolution. The term involves the integration of the Internet of Things (machine-to-machine communications) and computation, networking and physical processes to support greater factory and process automation including device automation, automatic guided vehicles, and augmented reality, among other technologies.<sup>23</sup> The UK Government notes:

*“The Fourth Industrial Revolution is characterised by the emergence of new technologies and their convergence in novel approaches. This process is creating new industries, changing existing ones and transforming the way things are produced and consumed. The increasing use of robotics and Artificial Intelligence in “smart” factories is driving productivity growth across the economy and new products and services – such as ‘Internet of Things’ devices, self-driving cars, drones and the hydrogen economy – offer real and significant opportunities to boost the UK’s prosperity and raise our quality of life.”<sup>24</sup>*

3.7 The future business applications expected to be supported by 5G require a large number of devices to be monitored and controlled in a way that ensures fast and precise coordination. Such applications require communications services which have ultra-low latency, very high reliability, very high bandwidth and high data rates. As with 4G, major applications may eventuate beyond those currently contemplated.

3.8 A number of studies have sought to estimate the economic potential of 5G. Fundamentally, the benefits arise from the ability of 5G to deliver much faster speeds, increased capacity, lower latency, reduced energy consumption and to offer specialised quality of service.

<sup>23</sup> See Rao and Prasad. 2018. “Requirements of 5G Technologies on Industry 4.0”, *Wireless Personal Communications*.

<sup>24</sup> UK Government, *Standards for the Fourth Industrial Revolution*, July 2021, p.2.

- a.** IHS Markit estimates that the 5G value chain will generate \$3.8 trillion of gross output by 2035 including \$128 billion in Germany, \$115 billion in France and \$90 billion in the UK, albeit with issues in deployment needing to be overcome including the high costs to operators.<sup>25</sup>
- b.** A study for the European Commission focused on the use of 5G in four sectors of the economy: automotive, healthcare, transport and utilities.<sup>26</sup> The study estimates that 5G would deliver benefits in these sectors of €62.5 billion per annum in 2025 and total economy-wide benefits from its use in these sectors of €113.1 billion. This suggests that the total economy-wide benefits of 5G may be 1.8 times the direct value of 5G.

3.9 The estimates of these studies are based on predicted 5G applications. Actual benefits from 5G may be much larger as a result of applications which are not yet envisaged.

<sup>25</sup> IHS Markit, *The 5G economy in a post-covid 19 era*, November 2020.

<sup>26</sup> See Tech4i2 et al. 2016. *Identification and quantification of key socio-economic data to support strategic planning for the introduction of 5G in Europe*.



## 4 EUROPE NEEDS A STEP-CHANGE IN INVESTMENT TO REALISE THE 5G OPPORTUNITY

4.1 In this section, we highlight the gap between the investment required to fully realise the benefit of 5G and planned investment in Europe. We then explore how regulatory environments act to deter higher investment. We examine barriers to exit for underperforming firms (from para. 4.22), interventions leading to inefficient entry (from para. 4.33), and the impact of spectrum allocation and spectrum pricing decisions (from para. 4.41).

### Europe's 5G investment gap

4.2 At the network level, 5G will require spectrum acquisition, new equipment on sites, additional sites, Multi-access Edge Computing (MEC)<sup>27</sup> and substantial upgrade to backhaul capacity and the core network. In Europe, most current 5G deployments are relying on mid-band spectrum (i.e. 3.3 to 4.2 GHz) which offers high capacity but may require additional sites and/or different site locations compared with sites used with the existing lower-frequency spectrum.

4.3 An analysis of 5G capital requirements found that if 5G investments are limited to that required for capacity extension to meet increasing traffic at today's service quality then capex can be kept at only about 10% above pre-5G levels. However, investment to further increase capacity and performance to run new 5G services requiring much higher capacity and reliability and reduced latency and to extend 5G coverage would require 2.4 times more capital expenditures over the period 2020 to 2027.<sup>28</sup>

4.4 Restrictions on the use of equipment of particular vendors is also increasing the cost of 5G deployment. The UK government's ban on Huawei equipment is estimated by the government to cost the UK telecoms sector up to £2 billion and cause a 2 to 3 year delay in 5G rollout.<sup>29</sup> The EU has also taken steps to coordinate restrictions on the use of particular vendors' equipment through the EU 5G toolbox measures.<sup>30</sup>

4.5 Harald Gruber of the EIB estimated that there is a €254 billion gap between the investments required to meet the European Commission's targets under the Digital Agenda for Europe and the European Gigabit Society and the expected private investments.<sup>31</sup>

4.6 There is a need to fundamentally improve the business case for extending high-speed, low-latency 5G, utilising mid-band spectrum, in order to fully cover cities and expand into rural areas.

4.7 The use of high-band spectrum (particularly the '5G millimeter wave pioneer band at 26GHz) offers even more innovative 5G applications, but to deploy this at scale would require even greater investment to create a dense network of small cells supplied with power and backhaul.

4.8 The consequences of a shortfall in investment include:

<sup>28</sup>

<sup>27</sup> MEC is a network solution to provide cloud computing and IT services closer to users to provide for dynamic and intelligent connections. GSMA, *Realising 5G's full potential: setting policies for success*, 2020, p.3.

<sup>29</sup> BBC news, "Huawei 5G kit must be removed from UK by 2027", 14 July 2020.

<sup>30</sup> European Commission, "Cybersecurity of 5G networks – EU Toolbox of risk mitigating measures", January 2020, <https://digital-strategy.ec.europa.eu/en/library/cybersecurity-5g-networks-eu-toolbox-risk-mitigating-measures>

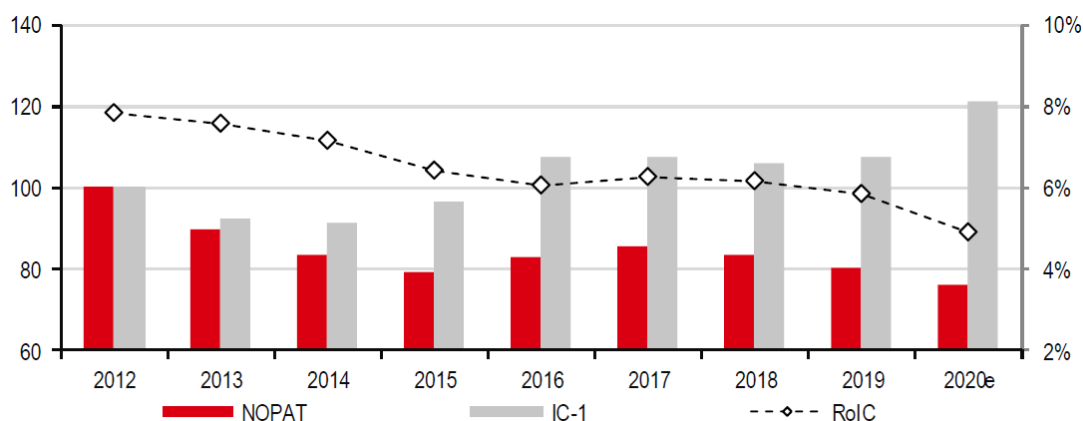
<sup>31</sup> Gruber, H., *Very High Capacity and 5G Networks: From the EU Code to the EU Market*, 24 June 2019.

- a. More limited geographic availability of services offering full 5G capability (including those reliant on the capacity of mid and/or high band spectrum), depriving people and businesses in less densely populated areas of the full benefits of 5G;
- b. Investment focused on relieving immediate congestion rather than in realising the full innovative potential of 5G such as through core network upgrades to support low latency and small cell deployment; and
- c. Slower deployment of 5G depriving consumers and businesses of the benefits they would have realised from access to better services sooner and risking innovative 5G applications being developed elsewhere in countries that take a lead in 5G deployment.<sup>32</sup>

**Conditions for a step change in 5G investment are unfavourable in many markets**

- 4.9 Europe’s telecoms operators have experienced falling returns and now many have returns below their cost of capital.
- 4.10 HSBC estimates that average Returns on Invested Capital (RoIC) for the major listed European telecoms operators fell from around 8% in 2012 to around 5% in 2020. By comparison, Ofcom calculated a pre-tax WACC for UK mobile operators for 2021 of 5.7%.<sup>33</sup>

**Figure 4: Declining RoIC for major European telecoms operator groups**

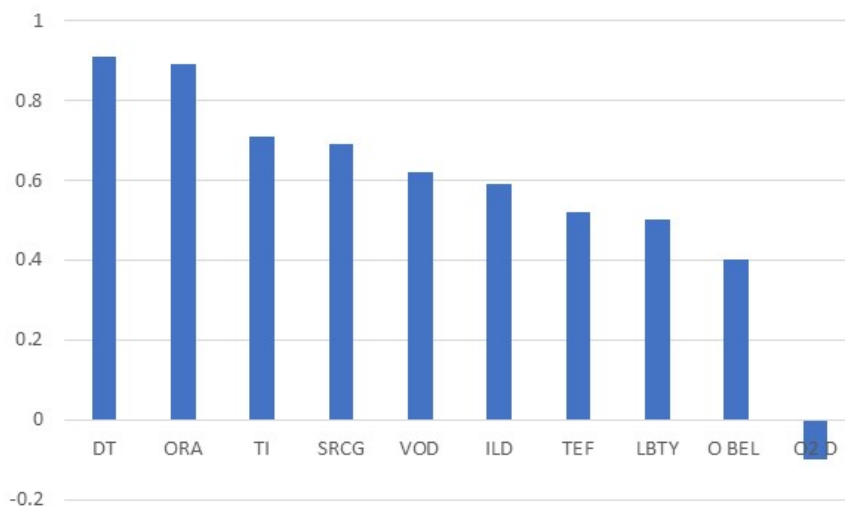


Notes: Average estimated RoIC for TNOR, ELI, PROX, BT, TKA, SCMN, ORA, TI, TLSN, DT, TEF and VOD.  
 Source: HSBC European Telecoms, Call to return (on capital), 5 February 2021, p.2.

- 4.11 HSBC calculates that a number of major listed European operators had RoIC below their WACC in 2019 (see Figure 5), implying that investors are losing money from investing in the sector relative to the returns available elsewhere for similar risk.

<sup>32</sup> McKinsey finds “The countries that stay in the forefront of connectivity could have a first mover’s advantage and position themselves to be the innovators” (McKinsey, *Connected world: an evolution in connectivity beyond the 5G revolution: Discussion paper*, 20 February 2020).  
<sup>33</sup> Ofcom, *Wholesale voice markets review 2021-2026 statement*, 2021, para.6.71.

Figure 5: Operators with ratio of RoIC to WACC less than 1, 2019



Source: HSBC European Telecoms, Call to return (on capital), 5 February 2021.

4.12 Many operators Return on Capital Employed (ROCE) are also low with, for example, Deutsche Telekom’s ROCE being 4.6% in 2020 and Vodafone’s being 3.9% in FY20.<sup>34</sup> HSBC comments:

*“In aggregate, returns in the sector – as we show below – have been falling and are poor...The problem essentially boils down to uncertainty of demand (defined rigidly as propensity to pay), which flows from competition at both the retail and (more importantly) the wholesale level. This means that business models have substantial margins for error at the outset, and those risks need to be compensated by the potential for higher rewards (ie, returns).”<sup>35</sup>*

4.13 While investors will invest based on expected returns, their expectations will be impacted by their experience of poor returns from earlier investments in the sector particularly if demand remains split across too many networks. Vodafone’s announcement of further spending on its network (particularly 5G) in May 2021 was identified as causing an 8.9 per cent drop in its share price, suggesting that investors see the new investment as destroying value, i.e. that expected returns are below the cost of capital.<sup>36</sup>

4.14 McKinsey considers that operator returns from 5G will be challenging:

*“The road for many connectivity providers has been rocky in recent years, and it does not look much smoother in the decade ahead. Build-outs and upgrades will demand major investment at a time when mature markets are saturated, and competition is leading to price wars. Many providers will struggle to find the required capital and make investments pay off with conventional revenue models.”<sup>37</sup>*

4.15 A risk is that returns to 5G network investment are captured by other players in the ecosystem such as the digital platforms rather than the operators making the investments. Teece notes that in ecosystems of complementary products, profits tend to go to the owners of the assets which have more bottleneck characteristics: *“For example, an increase in data rates with a new generation of technology may increase profits to providers of video content (and to advertising vendors) while imposing greater capital and depreciation costs on network providers.”<sup>38</sup>*

<sup>34</sup> Deutsche Telekom, The 2020 financial year, p.3 and Vodafone Annual Report 2021, p.31.

<sup>35</sup> HSBC European Telecoms, Call to return (on capital), 5 February 2021, p. 2-3.

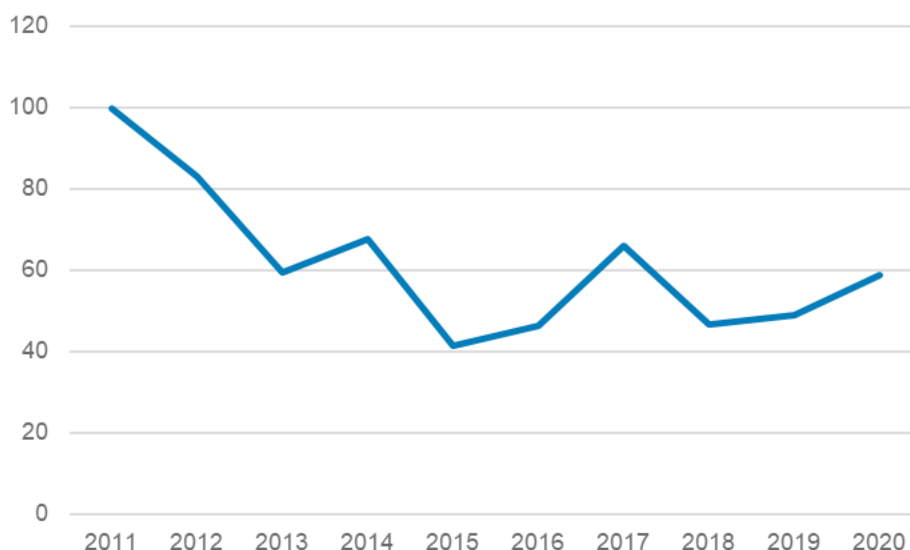
<sup>36</sup> The Times, [“Investment plans spook shareholders at Vodafone”](#), 19 May 2021 and This is money website, [“Vodafone sees £3bn wiped off its value after announcing it is to invest in upgrading its networks”](#), 18 May 2021.

<sup>37</sup> McKinsey, *Connected world: an evolution in connectivity beyond the 5G revolution: Discussion paper*, 20 February 2020.

<sup>38</sup> Teece, D., “Profiting from technological innovation”, *Research policy*, Volume 15, December 1986 and “Profiting from innovation in the digital economy: standards, complementary assets and business models in the wireless world”, *Tusher Centre for the Management of Intellectual Capital Working Paper Series No. 16*, August 2016, p.10.

4.16 With declining revenues (including as a result of regulated cuts in termination and roaming) and significant spectrum costs, operators’ cash flows have been falling (see Figure 6) which reduces the ability to finance higher investment from retained earnings. Moreover, investors will only agree to earnings being re-invested in the sector if they expect returns to match returns on investments of comparable risk, while many operators have faced declining returns which are now below their cost of capital.

**Figure 6: Free cash flows for major European telecom groups (normalised 2011 = 100)**



Notes: SFR was acquired from Vivendi group by Altice Europe N.V. in November 2014, so free cash flow data is taken from Vivendi group until 2014, then Altice after 2014. Free cash flow data for Altice not available for FY2020. Data converted into EUR using average annual exchange rates.

Source: Calculated from data from investor reports for ten major European telecom groups: BT, Deutsche Telekom, KPN, Orange, Telefonica, Telecom Italia, Telenor, Vodafone, Swisscom and SFR.

4.17 Less investment is likely to be economic if operators have to rely more on costly external sources of finance. Raising equity externally is costly because outside investors with less information on a firm’s prospects demand a discount on the price that they pay for shares, which harms current equity holders by reducing the value of their equity.<sup>39</sup> Similar mechanisms have been described for debt markets.<sup>40</sup> A number of empirical studies confirm that there is a statistically significant positive relationship between firms’ cash flows and their level of investment.<sup>41</sup>

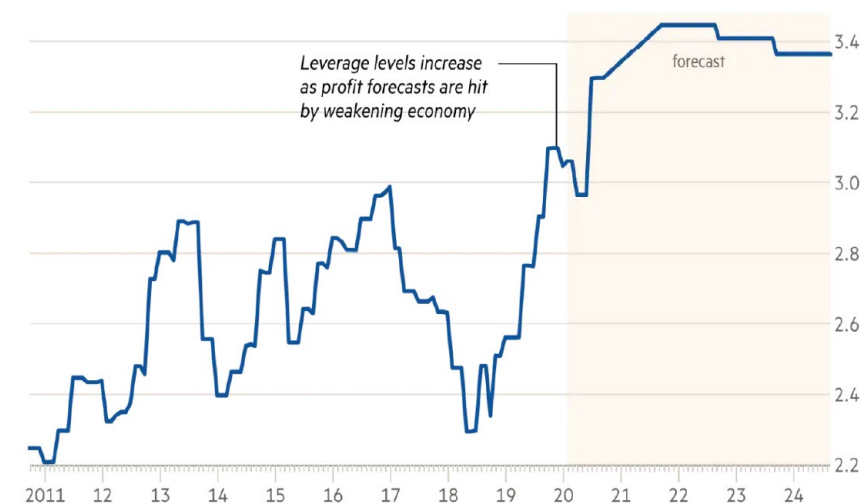
4.18 Operators’ debt levels have also risen substantially (see Figure 7) and their ability to raise new debt is now significantly constrained. BT, DT, Orange, Telefonica and Vodafone have credit ratings in the BBB- to BBB+ range, with the risk that significant new debt and adverse changes in business conditions could lead to the loss of investment grade credit rating. Raising new debt would be costly if it affects the credit rating for a company, resulting in higher interest rates and/or requiring greater collateral.

<sup>39</sup> The pecking-order theory of financing notes that firms prefer to rely on internal funds over raising debt and prefer raising debt to raising equity and states: “The pecking-order theory stresses the value of financial slack. Without sufficient slack, the firm may be caught at the bottom of the pecking order and be forced to choose between issuing undervalued shares, borrowing and risking financial distress, or passing up positive-NPV investment opportunities” (Brearly, Myers, Allen, Principles of corporate finance, 2011, p.466).

<sup>40</sup> See Stiglitz, J.E., and A. Weiss (1983), “Incentive effects of terminations: applications to the credit and labor markets”, American Economic Review, 73.

<sup>41</sup> For a detailed survey see Hubbard, R.G. (1998), “Capital-market imperfections and investment”, Journal of Economic Literature, 36. Lewellen and Lewellen find that a dollar of current and prior year cash flow is associated with \$0.32 of additional investment for firms that are least likely to be constrained in their access to external capital and \$0.63 of additional investment for firms that are the most likely to be constrained (J. Lewellen and K. Lewellen, “Investment and Cash Flow: New Evidence”, Journal of Financial and Quantitative Analysis, Vol. 51, No. 4, Aug. 2016, pp. 1135–1164).

Figure 7: Net debt to EBITDA ratio for Europe’s main listed telecoms



Based on constituents of the Stoxx 600 Telecommunications index  
 Source: Bloomberg  
 © FT

Source: Financial Times, “Why telecoms groups have fallen out of fashion with investors”, 31 January 2021.

4.19 Morgan Stanley diagnoses Europe merger and spectrum policies as leading to low returns and risks to network upgrades:

*“With a wave of new entrants and challengers, the European Telecoms sector has seen substantial fragmentation in recent years, triggering a significant disadvantage in scale vs. peers in China, the U.S. and Japan... The combined market capitalization of the European Telecoms sector now stands at just €300 billion, a 75% drop since 2000... Since 2000, European Telecoms have also spent enormous amounts on 3G, 4G and 5G spectrum leases, the rights to which they must repurchase every 15-20 years. Perhaps the largest setback, however, has been the European Commission’s decision to block various mergers and acquisitions, citing the need for competition... The largest European Telecoms’ returns on capital expenditures remain below their cost of capital — and regulators may have finally taken notice. Without a favorable return on their investment, these companies may hesitate to spend more to upgrade their networks.”<sup>42</sup>*

4.20 It should be noted that there are mobile markets in Europe where the market structure and wider policy environment are conducive to delivering good consumer outcomes as well as ongoing high investment per capita, such as the 3-operator markets of Austria and Finland (see Box 1).

**Box 1: Finland and Austria lead the world in data usage and low price per gigabyte**

The mobile markets of Finland and Austria (both 3-operator markets) are amongst the best performing markets in the world in terms of consumer outcomes. Finland and Austria have the highest data usage per SIM in the world and the lowest mobile service revenue per gigabyte.<sup>43</sup> Their operators were amongst the first to launch 5G services and they achieved significantly higher 5G coverage in 2020 than the EU average (with 5G population coverage of 48% in Austria and 58.4% in Finland).<sup>44</sup> These outcomes have been achieved with Elisa and Telekom Austria having relatively high Returns on Invested Capital compared with other European operators.<sup>45</sup> Investment has been high with mobile capex per capita 39% higher in Austria and

<sup>42</sup> Morgan Stanley, “Is the tide turning on M&A for European Telecoms?”, 16 November 2020.

<sup>43</sup> Tefficient, *Mobile data – first half of 2020*, Figure 16.

<sup>44</sup> GSMA Intelligence data.

<sup>45</sup> HSBC, *European Telecoms: Call to return (on capital)*, 2021, p.5.

228% higher in Finland than the EU average over 2018 to 2020.<sup>46</sup> Other evidence of effective competition includes changes in market shares, high levels of switching (e.g. churn rates in Finland over 15%<sup>47</sup>), significant price reductions and discounts and strongly growing demand.

4.21 Next, we consider the factors contributing to the poor returns of many European operators, particularly barriers to exit for underperforming firms, interventions leading to inefficient entry and the impact of spectrum allocation and spectrum pricing decisions.

### Barriers to exit for underperforming firms

4.22 Operators will only invest where they expect to earn a return sufficient to cover their cost of capital. While barriers to exit receive less attention from policymakers than barriers to entry, they can have important implications for expected returns and investment.

4.23 One way in which this comes about is where underperforming firms tie up scarce resources such as spectrum. The OECD states: “*reallocation of resources across firms, entry of new businesses and efficient exit mechanisms are key to boosting aggregate productivity growth.*”<sup>48</sup> As noted in Section 2, access to spectrum is important to expand mobile capacity. With more spectrum, the business case for additional network investment improves because a given level of investment in new sites will generate more capacity.

4.24 The presence of underperforming firms in a market can also affect the level of demand that is expected to be realised from new investment. The economics of extending 5G coverage and developing new 5G applications such as IoT services for business customers depends heavily on the customer base over which costs can be recovered. While underperforming firms may eventually exit, their presence and uncertainty over when they might exit can increase the risk to new investment. Co-investment or network sharing arrangements can help consolidate demand and realise scale economies<sup>49</sup>, although they may not always be possible (as we discuss further in Section 5).

4.25 Woroch finds for US cellular market areas that while excessive concentration can lead to inferior outcomes, there are also risks of spectrum being too fragmented:<sup>50</sup>

- a. there is an inverted U shaped relationship between spectrum concentration and subscription penetration; and
- b. more concentrated spectrum holdings are associated with better speeds and reliability.

4.26 The presence of an operator which limits its investment to instead focus on offering low price, low quality services may also constrain other operators in investing to offer higher quality services particularly if customers in choosing between networks have imperfect information on quality differences such as the level of congestion in local areas at peak times.

4.27 Mergers are a key means by which underperforming firms can exit the market. However, the current approach of competition authorities to mergers between mobile network operators appears overly restrictive.

<sup>46</sup> GSMA Intelligence capex data and population data from Eurostat.

<sup>47</sup> Elisa, Telia, DNA investor financial data.

<sup>48</sup> OECD, *Declining Business Dynamism: Cross-Country Evidence, Drivers and the Role of Policy*, 2021.

<sup>49</sup> For instance, the European Electronics Communications Code (recital 198) notes “*Due to current uncertainty regarding the rate of materialisation of demand for very high capacity broadband services as well as general economies of scale and density, co-investment agreements offer significant benefits in terms of pooling of costs and risks, enabling smaller-scale undertakings to invest on economically rational terms and thus promoting sustainable, long-term competition, including in areas where infrastructure-based competition might not be efficient.*”

<sup>50</sup> Woroch, G., “Spectrum Concentration and Performance of the U.S. Wireless Industry”, *Review of Industrial Organization*, 2019.

- a. In practice, the European Commission gives substantial weight to static Upward Pricing Pressure (UPP) tests in its final decisions assessing mobile mergers. This is despite the fact that consumer benefits from mobile services are much more driven by investments in capacity and technology upgrades. Further, the UPP measures used rely on simplifying assumptions which are inconsistent with the characteristics of mobile markets.
- i. UPP assumes that firms compete only on price (generally proxied by the Commission using ARPU with usage assumed to be exogenous) whereas quality is an important dimension of mobile competition.
  - ii. UPP is a measure of the incentive to raise prices in a static sense which ignores product repositioning after the merger by the parties and by competitors. As discussed in the next section, combining operators' spectrum and network assets can generally be expected to expand capacity, expand data allowances and improve quality. Further, mobile operators can use multi-brand strategies to enter into different segments should profitable opportunities arise.
  - iii. As noted by Dr Mike Walker, UPP measures "*omit important competitive constraints*" and "*there currently appears to be a danger of some authorities using these measures in an indiscriminating manner and that this is unlikely to lead to good merger control decisions*".<sup>51</sup>
  - iv. While UPP tests can be helpful as a screening device (particularly where there is a concern regarding the loss of competition between two close rivals), it is important that their results are not relied upon without considering whether their underlying assumptions hold in the particular market circumstances including the potential for product repositioning and non-price effects.
- b. Where the merger involves an underperforming firm making limited investment, the assessment of the likely 'counterfactual' outcome which would result without the merger may be critical. Such a firm may offer a diminishing competitive constraint while holding on to spectrum that could generate greater consumer benefits in other hands.
- c. European Commission merger decisions have tended to dismiss efficiencies from operator mergers as insufficiently substantiated or as achievable through network sharing. The Commission's approach reflects its view that the parties should bear the burden of proof in demonstrating efficiencies. However, certain efficiencies can increase rivalry and should be integrated into the assessment of whether a merger would restrict competition (as discussed further in Section 5).

4.28 A merger policy that is too restrictive may also harm investment incentives by reducing expected returns to investment. As noted in the previous section, the conditions for 5G investment are challenging and operator returns from investing in 5G are highly uncertain. The consequence of technology, demand and market uncertainty is that there is a large range of possible returns from investment in 5G, particularly for investment beyond that needed to meet short-term capacity needs. If conditions turn out favourably, operators may earn good returns. However, if conditions turn out unfavourably, operators may face significant losses.

4.29 Operators can be expected to consider the range of potential returns in deciding whether to make new investments such as in relation to the coverage and density of their 5G networks. The strictness of merger policy can significantly impact expected returns of risky investments by influencing the value that investors would receive if the investments turn out unsuccessfully and they need to exit the market.

4.30 Table 3 shows the different paths by which operators may exit a market together with an assessment of how the value that is likely to be received for its assets is likely to vary between the

<sup>51</sup> Walker, M., "Background note by the secretariat" in *OECD Economic Evidence in Merger Analysis*, 2011, p. 39-40.

paths and how current merger policy restricts mergers making it more likely that operators will be left with exit paths in which they will receive less for their assets.

- 4.31 Mergers with other operators in the market offer the highest potential sale value because of the potential for efficiencies to be realised (which we discuss in the next section). However, such mergers are less likely to be allowed by merger policy, particularly in markets with four or fewer current operators.<sup>52</sup> Merger policy may also discourage, or reduce the value of, other sales such as to private equity because buyers will also take into account the value they would realise through a future sale of the business.<sup>53</sup> In the worst case, where the business needs to be liquidated, investors may only receive back the scrap value of the assets. On the path to liquidation, an operator may remain in the market and gradually run down its network without making significant new investments.

**Table 3: Potential exit paths and the impact of merger policy**

Potential exit path	Likely value for assets	Impact of current merger policy
Merger between two major operators in market	Value likely to include efficiencies from full combination of assets	Unlikely to be allowed in markets with 4 or fewer operators
Merger between one major and one small operator in market	Value potentially lower than with merger between major operators if operators have fewer assets or less need for additional network capacity	May only be allowed for 4 or fewer operator markets if one or both operators are unlikely to remain viable absent the merger and/or with remedies to support entry
Cross-border merger	Potential for some efficiencies but more limited than in-market merger	Likely to be allowed
IPO or sale to private equity	Value lower than mergers because of no efficiencies. If limited competition to acquire the operator, the sale price may be close to the value of the assets under liquidation	Allowed (although restrictive merger policy may discourage acquisitions by private equity)
Liquidation	Low value potentially based on scrap value (if uneconomic for buyers to use the asset) or up to replacement cost	Allowed (albeit potential restrictions on sale of certain assets to rivals such as spectrum)

- 4.32 In the face of significant uncertainty over returns to 5G, investors can be expected to consider what value they would receive if they need to exit. A stricter merger control policy would be perceived as implying lower returns/higher losses if conditions turn out unfavourably because firms would then receive less for their assets. This may have a bigger impact on investment decisions of smaller

<sup>52</sup> Or if they are allowed, they may be subject to stringent conditions such as extensive divestment of assets or wholesale access obligations which reduce the sale price.

<sup>53</sup> InvestEurope finds that trade sales (i.e. to other firms in the industry) and sales to other private equity each accounted for 31% of the value of private equity divestments in H1 2020, while public offerings only accounted for 10% of divestments (InvestEurope, *Investing in Europe: Private equity activity H1 2020*, p. 35). Given the importance of trade sales, private equity can be expected to pay significant attention to merger policy. For example, an FT Article noted in relation to potential private equity acquisitions in the grocery sector: “*But Buxton was sceptical about more M&A, saying that private equity groups would worry about their exit route. The UK regulator’s decision to block the takeover of Asda by Sainsbury in 2019 means any merger involving two of the Big Four supermarkets is off the agenda*” (FT, *Pandemic makes UK grocers an easier sell to investors*, 1 May 2021).



operators whose long-term viability is less certain and hence, for whom, there is a significant probability of exit.

### Interventions leading to inefficient entry

- 4.33 A merger policy that is too restrictive undermines welfare-enhancing investments by prolonging underperforming firms in markets. Similar harm can also arise through policies which sponsor inefficient entry.
- 4.34 In a number of countries, authorities have implemented policies – through the merger review process and spectrum auctions - which have enabled new operators to enter without bearing the costs and risks faced by existing operators in rolling out their networks, particularly by providing entrants with reserved spectrum below market-rates (and relatively light rollout obligations, if any), regulated access to the networks of incumbent operators, and opportunities to acquire network assets as deep discounts. These interventions create artificial asymmetries which undermine the investment incentives of existing operators.
- 4.35 In Portugal, the regulator ANACOM's regulations for the auction of 5G spectrum included reserving spectrum for new entrants as well as requiring the existing operators to share their infrastructure and offer national roaming to entrants.<sup>54</sup> Regulated access to national roaming for entrants is provided for 10 years with the possibility of being extended longer and with entrants being subject to only relatively modest coverage obligations (e.g. 25% population coverage within 3 years and 50% within five years). Such obligations enable entrants to benefit from the network investments made by existing operators without incurring the risks they incurred in making their investments. In contrast, Spain decided not to regulate access to incumbent's network "*to incentivise the rollout of 5G data services*".<sup>55</sup>
- 4.36 In Italy, the Commission required remedies for the approval of the Hutchison/VimpelCom JV in 2016. These consisted of the divestment of spectrum and the transfer/colocation of base station sites to a new entrant, as well as the provision of access to national roaming services to the new operator on commercial terms assessed by the Commission. In 2018, the Italian regulator provided further concessions in auctioning spectrum for 5G services which:
- a. reserved further spectrum for the remedy-taker, Iliad, leaving less spectrum available for the 3 main operators;
  - b. provide regulated access to the networks of incumbent operators which acquire 700 MHz spectrum for 2.5 years nationally and for 5 years in areas not covered by the entrant; and
  - c. required wholesale access to service providers.<sup>56</sup>
- 4.37 While such policies can enable entrants to price aggressively in the short-term, such pricing may not be compatible with encouraging substantial new network investment by either the entrant or incumbent operators. Entrants which can gain regulated access to a rival's network may have little incentive to undertake extensive deployment of risky new technologies. Further, incumbents are likely to have less incentive to deploy 5G at scale if regulated access means that they do not gain a competitive advantage from doing so.
- 4.38 Entrants which make limited investments themselves and which are heavily dependent on continuing access to national roaming on favourable terms may not remain effective competitors over time. In *T-Mobile NL/Tele2 NL*, the Commission assessed the likely future of Tele2 which was reliant on a roaming agreement with T-Mobile and found that Tele2's competitive strength would likely deteriorate over time with service quality falling relative to the other Dutch operators.<sup>57</sup>

<sup>54</sup> ANACOM, *Regulation no. 987-A/2020*, 5 November 2020.

<sup>55</sup> <https://www.reuters.com/article/uk-spain-companies-5g-idUKKCN2DC1EU>

<sup>56</sup> De Luca, S., "The Italian approach to the licensing of the spectrum in 5G pioneer bands", August 2019.

<sup>57</sup> *Case M.8792 – T-Mobile NL/Tele2 NL*, Para. 565.

- 4.39 In Spain, the merger of Orange and Jazztel was cleared in 2015 with commitments including the provision of wholesale mobile access to the purchaser of the divested FTTH network.<sup>58</sup> Masmovil was the beneficiary of these commitments, obtaining very favourable wholesale mobile access terms, as well as an FTTH network at a discount. In 2016, Masmovil also acquired Xfera Moviles (Yoigo) - including its mobile sites and spectrum - at what is understood to have been a significant discount. Despite its acquisition of Yoigo, MasMovil's growth has been heavily dependent on continuing favourable wholesale access to Orange's network, as it has made limited investment in its own network (it has about one third the sites of a national network, and limited amounts of mid band spectrum<sup>59</sup>). Through very favourable wholesale terms, Masmovil now enjoys a strong competitive advantage in Spain, which undermines the investment incentives of the other operators. Masmovil did not participate in the recent Spanish 5G auction.
- 4.40 As such, in assessing the case for regulated access to national roaming and reserved spectrum, there is a need to balance potential benefits of lower prices for a period with the risk of undermining network investment. This is particularly the case for investments with uncertain returns and long pay-off periods such as 5G network deployment for which regulatory risks (including from policies sponsoring entry) may lead to operators adopting cautious deployment plans limited to meeting immediate capacity needs. The consequence can be poorer quality services and higher quality-adjusted prices than would otherwise be the case.

### The impact of spectrum allocation and spectrum pricing decisions

- 4.41 Spectrum is a key input in the supply of mobile services. However, authorities' licensing approaches can create substantial uncertainty over future conditions of access to spectrum. Licensing uncertainty, in turn, significantly affects expected returns to investment in the sector as well as operators' ability to finance new investments.
- 4.42 To meet the demand of their customers for growing data volumes and to be able to offer services using each successive generation of mobile technology, operators have needed additional spectrum. Operators now face the need to acquire spectrum for 5G services or risk becoming increasingly uncompetitive if they cannot match rivals' quality and service volumes.
- 4.43 For spectrum critical to a mobile operator's business, operators are vulnerable to regulatory opportunism. Where the future of their business is at risk, operators will be prepared to pay up to the forward-looking value of the business, i.e. ignoring costs that are already sunk.
- 4.44 Authorities can engineer high spectrum fees through setting high prices for administrative licence renewal, setting high reserve prices in auctions, holding back spectrum or by implementing auction designs and packaging spectrum so as to maximise revenue such as by forcing existing operators to bid for packages of critical spectrum which are fewer than the number of operators in the market. High prices in the Italian 5G auction have been attributed to the packaging of 3.7 GHz spectrum into two larger blocks and two smaller packets leading to strong competition between the three main operators for the two larger blocks.<sup>60</sup> We estimate that the reservation of 100 MHz of 3.5 GHz spectrum in the German 5G auction for local licences caused the price of the remaining spectrum available to national operators to more than double, i.e. from €2,021 million to €4,176m.<sup>61</sup>
- 4.45 In many countries, licences are limited to set terms creating uncertainty over whether operators will be able to retain even their existing spectrum as well as over the fees they will be charged. Operators may face large costs if they are unable to re-acquire critical spectrum such as the need to reconfigure their network and invest in new sites to try to recover some of the lost capacity needed to meet customer demand. Some authorities re-auction spectrum at the end of the licence term while others impose administratively set licence fees.

<sup>58</sup> *Orange/Jazztel* (case M.7421).

<sup>59</sup> Redburn, "Masmovil – I bit the hand that fed", 11 September 2019.

<sup>60</sup> Telegeography, "Italian 5G auction sees high price tags, raised eyebrows", 15 October 2018.

<sup>61</sup> Reynolds, P. and A. Lombardi, "When are departures from a market-based approach to spectrum licensing warranted", 2019, p.30.

- 4.46 Ofcom argues that annual licence fees are needed to ensure the efficient allocation of spectrum on the basis that spectrum trading is insufficient because “*there may be less importance placed on realising untapped revenue sources such as might arise from selling spectrum.*”<sup>62</sup> Ofcom’s position appears to be that commercial operators cannot be relied upon to efficiently manage their spectrum assets including to divest spectrum where the sale value is greater than the value from retaining the spectrum. However, there is no reason to consider that operators cannot efficiently manage their spectrum assets when they are capable of managing their other assets. In the UK, there have been significant trades of mobile spectrum not subject to annual licence fees including EE’s sale of 2.6 GHz spectrum to O2 in 2020, UK Broadband’s sale of 3.4 GHz spectrum to H3G in 2017. Qualcomm’s sale of 1.4 GHz spectrum to Vodafone and H3G in 2015. Uncertainty over the future level of annual licence fees itself has been identified as “*the crucial stumbling block in spectrum trading negotiations*” to overcome non-contiguous 5G spectrum allocation in the UK following the recent auction.<sup>63</sup> Thus annual licence fees in the UK which were introduced on the basis of theoretical concern that trading may not be optimal may be having the perverse impact of preventing trading necessary to improve the efficient use of spectrum.
- 4.47 Further uncertainty is created by authorities’ willingness to impose new obligations which may carry significant costs or counteract competitive advantages gained from earlier investments. As noted earlier, some governments have placed restrictions on the use of particular vendors at substantial cost to industry and existing operators have been required to allow new entrants to roam on their networks.
- 4.48 The long pay-back period for mobile investments together with operators’ vulnerability to changes in licensing approach significantly raises the risk to new mobile investment. While authorities may be able to capture or limit some of the returns on earlier (sunk) investments, such actions can make operators more cautious in undertaking new investments. In economics, this is an example of a hold-up problem. In particular, firms will invest less if they consider that there is a risk that, after the investment is sunk, they will be vulnerable to another party acting in a way that effectively captures some or all of the return on their investment.
- 4.49 High licence fees and costly licence obligations can also be expected to harm investment by depriving operators of cash flows which could otherwise be used to fund new investment at relatively low cost.

## Conclusion

- 4.50 Realising the full benefits of 5G will require operators to have the incentive and ability to undertake the substantial investment required for wide-scale deployment. However, conditions for substantial new investment in Europe’s mobile sector are currently unfavourable including many operators having returns below their cost of capital as well as high debt levels. The approaches of competition and regulatory authorities in a number of countries act to deter greater investment including:
- a. Barriers to exit and policies encouraging inefficient new entry which (i) tie up spectrum and other scarce resources; (ii) fragment demand and prevent the realisation of scale economies and (iii) reduce expected (i.e. probability weighted) returns to new investment by limiting exit options should investments turn out unsuccessfully; and
  - b. Spectrum licensing policies which create significant additional uncertainty and risks including the risk of high prices to obtain critical new spectrum in renewing existing licences as well as the risk of costly new obligations being imposed.

<sup>62</sup> Ofcom, Proposed annual licence fees for 2100 MHz spectrum, 14 July 2021, para. 5.11.

<sup>63</sup> Enders Analysis, “Spectrum trading thwarted – 5G stumbling blocks endure”, 3 September 2021.

## 5 WHAT POLICY CHANGES WOULD HELP CLOSE THE 5G INVESTMENT GAP?

5.1 In previous sections, we found that:

- a. investment in capacity and the deployment of new technologies have driven substantial improvements in quality, provided a host of new applications and resulted in rapid falls in quality adjusted prices;
- b. 5G holds the potential to be even more transformative although the extent and timing of 5G investment will depend on operators' having the incentive and ability to make the large investments required; and
- c. there is currently a significant gap between the investment required to fully realise the benefit of 5G and planned investment in Europe and the approach of regulators in some European markets is exacerbating this gap, in particular through the maintenance of barriers to exit for underperforming firms, interventions leading to inefficient entry and through spectrum allocation and spectrum pricing decisions.

5.2 In this section, we identify policy changes that would improve conditions for new investment and help realise the benefits of widespread and timely 5G deployment.

### **Merger assessments should focus on dynamic competition**

5.3 Competition authorities have been increasing their focus on dynamic competition. For example, the European Commission has developed its approach to the analysis of innovation over recent years including in the *Dow/DuPont* case. The CMA issued revised merger assessment guidelines this year with a key change to adopt a more dynamic approach to assessing mergers by considering the potential for more significant changes in how competition could develop in the future.

5.4 In investment-heavy markets, such as the mobile market, there is a strong case for a dynamic approach which focuses the assessment on likely future investment trends with and without the merger. In section 2, we showed that investment in capacity and technology upgrades have generated large consumer benefits which are an order of magnitude greater than prices paid for mobile services. This implies that the effect of mergers and merger policy on investment in mobile markets are likely to be of much greater importance to consumer welfare than the levels of static pricing effects that have been the focus of earlier merger assessments.

5.5 A focus on dynamic competition in investment and quality would also better reflect the nature of competition in mobile markets. With the growth in mobile data, operators increasingly compete by offering mobile plans which are distinguished by the technology and speed offered and by the data allowance. Unlimited calls and texts are generally offered as part of the monthly fee. A wide range of quality dimensions are now relevant including download and upload speeds, voice quality and latency as well as the extent to which quality levels are available geographically and available reliably including at peak times. As noted in Section 3, 5G is expected to enable an even greater range of innovative services raising the potential benefits of customers gaining access to high quality 5G networks.

- 5.6 A merger may promote or harm rivalry in investment depending on the specific circumstances. A merger that consolidates a market leader's position may reduce investment rivalry. Weaker operators may then be forced to focus on customers who attach less importance to quality, with the market leader facing less incentive to increase its investments.
- 5.7 On the other hand, where a merger of two smaller operators enables them to realise scale economies, improve spectrum utilisation and offer higher quality services which better challenge the market leader, this can spur the leader to increase its investments and/or improve its retail offers. As we note later in this section, there is evidence of this following mergers in Austria, Australia, the UK and the US. The alternative of requiring marginal operators to continue indefinitely in the industry risks firms relying on low-price, low-quality offers which may disproportionately impact the next weakest firms (i.e. whose financial position limits their investments relative to the market leader). While the uneconomic firm would be expected to eventually exit, the result could be that the weaker remaining firms are a less effective competitive constraint on the market leader.
- 5.8 Understanding how a merger would impact dynamic competition requires detailed consideration of the counterfactual. In dynamic markets, it should not be assumed that, without the merger, the current level of competition will necessarily continue. With demand growing rapidly and changing technologies, operators which do not continue to invest may face capacity constraints and/or suffer deteriorating quality.
- 5.9 In relation to the T-Mobile/Sprint, the US Federal Communications Commission recognised the importance of dynamic competition:

*"We agree with the Applicants that the proposed transaction will significantly increase New T-Mobile's coverage, speed, and capacity, which should increase competition in quality. Moreover, the network benefits are likely to engender competitive responses from AT&T and Verizon Wireless that are not fully accounted for in a static merger simulation."<sup>64</sup>*

### **Rivalry-enhancing efficiencies should be integrated with the assessment of whether a merger would restrict competition**

- 5.10 European Commission merger decisions have tended to dismiss efficiencies from operator mergers as insufficiently substantiated or as achievable through network sharing. The Commission's approach reflects its view that the parties should bear the burden of proof in demonstrating efficiencies. However, certain efficiencies can increase rivalry and should be integrated into the assessment of whether a merger would restrict competition.
- 5.11 In this section, we discuss three ways in which mergers can lead to increased rivalry:
- a. More efficient use of the merging parties' spectrum and network assets;
  - b. Incentives for the merging parties to make additional quality-enhancing investments; and
  - c. Competitive responses from rival operators.

#### **More efficient use of the merging parties' spectrum and network assets**

- 5.12 By combining the merging parties' sites, spectrum and other assets, operator mergers can be expected to increase capacity, coverage and speeds.
- 5.13 The capacity of a mobile network is the product of the number of cell sites, the spectrum deployed per site and the spectral efficiency of the technology in use. When two networks are combined, there is a multiplicative effect on overall network capacity.

<sup>64</sup> FCC, *T-Mobile US/Sprint: Memorandum opinion and order, declaratory ruling and order of proposed modification*, 2019, para. 164.

**Box 2: Efficiency gains from Orange UK/T-Mobile UK merger**

The merger of Orange UK and T-Mobile UK to form EE in 2010 resulted in a substantial increase in 3G capacity as set out in the following table. Even with the removal of some sites post-merger which were not needed for coverage or future capacity, the total 3G capacity of EE was almost twice the sum of the capacity of the individual operators (i.e. 2,160 compared with 1,110 GBps). EE was also able to offer its customers greater 3G coverage than they enjoyed previously.

**The multiplicative effect on capacity from combining operator sites and spectrum (Orange UK/T-Mobile UK)**

	3G Sites	3G spectrum per site (MHz)	Spectral efficiency	3G Capacity (GBps)	3G Coverage
Orange UK	7,400	20	1	444	93%
T-Mobile UK	11,100	20	1	666	96%
EE post-integration	18,000	40	1	2,160	>99%

*Notes: Capacity calculated as the product of sites (assuming 3 sectors per site), spectrum per site and spectral efficiency and converted from MBps to GBps by dividing by 1,000..*

*Source: Pre and post integration site numbers and coverage from Enders Analysis, "Everything Everywhere: UK Market leader (for a bit)", 1 October 2010. Spectrum from EC, T-Mobile/Orange (Case No COMP/M.5650), p.21.*

The creation of EE added to pressure on the two largest UK operators at the time, O2 and Vodafone to "significantly expand their 3G networks (at significant cost)"<sup>65</sup> and led to a focus on quality competition, large data bundles and with EE leading the market in introducing unlimited voice and text as standard in 2012<sup>66</sup>. Ofcom found that average household spend on mobile services declined 9% between 2009 and 2013 despite mobile data use growing rapidly including doubling between March 2011 and June 2012<sup>67</sup>. A study for the European Commission using a difference-in-difference approach found that prices fell because of the merger by between 2% and 18%, depending on the usage profile.<sup>68</sup> An upward pricing pressure test applied to the merger which ignored the large gain in capacity it created would have suggested price increases and entirely missed the dynamic competition it helped engender.

- 5.14 While the T-Mobile/Orange merger was a 5 to 4 merger, the efficiencies which led to lower prices will also apply to other mergers. The potential for lower prices from efficiencies should be integrated into the assessment of expected price effects. In Appendix A, we review post-merger studies and studies assessing the relationship between concentration and market outcomes more generally. We find that 5 to 4 mergers are often found to lead to lower prices, while with 4 to 3 mergers no general inference can be made in relation to effects on prices, investment and quality. This suggests that factors specific to each transaction and market matter.
- 5.15 As found with the creation of EE, by combining sites in different locations, mergers enable the parties to offer greater geographic coverage and better indoor coverage than the coverage available to them from their operator pre-merger.
- 5.16 Further, given that the operators would have already incurred the cost to access site locations, and to deploy equipment at those locations, the merged entity will retain sites in many locations for

<sup>65</sup> Enders Analysis, "Everything Everywhere: UK Market leader (for a bit), 1 October 2010, p.6

<sup>66</sup> Enders Analysis, "EE charges a premium for 4G", 23 October 2012.

<sup>67</sup> Ofcom 2013 Communications Market Report, Figure 1.12 and Ofcom, Mobile data strategy – consultation, 2013, para. 3.3

<sup>68</sup> Lear, DIW Berlin and Analysys Mason: Economic impact of competition policy enforcement on the functioning of telecoms markets in the EU, 2017.

incremental coverage and capacity benefits even where it would not be economic for an individual operator of equivalent size to the merged entity to establish a new site at that location.

5.17 Combining operators' spectrum can also deliver significant gains in capacity and quality in other ways.

a. Operators often hold differing mixes of spectrum in low, mid and high bands. Lower bands provide better coverage but more limited capacity. Equipment availability and cost can also differ depending on the band it is to be used for, particularly for new technologies such as 5G. Where mergers provide for spectrum holdings in different bands to be brought together, they can enable the operators' customers to benefit from the advantages of the mix of spectrum.

b. When spectrum within a single band is combined this can free up spectrum that would otherwise be used as a guard band between holdings to minimise interference and enable better quality 5G services. As Ofcom notes: "*There is a general consensus – including among MNOs and European regulatory bodies – that optimal deployment of 5G will be best achieved through large contiguous spectrum blocks*".<sup>69</sup>

5.18 The combination of the parties' network capacities significantly reduces the risk of congestion.

a. Telecommunications networks are designed to provide sufficient capacity to meet busy hour demand at a reasonable quality of service (e.g. in terms of data speeds, successful call rates and other quality metrics). With two independent networks, the capacity of each network is only available to meet the demand of customers on that network. As such, there can be times where one network is at capacity in an area while another has available capacity. A merger can make the combined capacity available to meet total demand.

b. The Erlang B formula describes the relationship between capacity, traffic and quality (i.e. the rate of unsuccessful call attempts).<sup>70</sup> An erlang is a unit of traffic density equivalent to one call in a specific channel for 3,600 seconds in an hour. The formula shows that when capacity is doubled, the traffic that can be carried at the same quality of service more than doubles. For example, with 10 traffic channels and 1% risk of congestion, traffic of 4.45 Erlangs can be supported.<sup>71</sup> With 20 traffic channels and maintaining the 1% risk of congestion, 12 Erlangs of traffic can be supported.

c. Significantly increased capacity implies much less risk of congestion and faster data speeds at peak times. Available capacity also enables operators to offer unlimited data and/or additional services at lower cost.

#### Incentives for the merging parties to make additional quality-enhancing investments

5.19 Operator mergers can also better position the parties to deploy 5G more widely and more quickly:

a. Mergers improve the economic return to deploying 5G into less densely populated areas and to deploying a denser network in urban areas because: (i) the merged entity will have a larger customer base; (ii) a single site visit can be used to deploy radio equipment able to utilise the combined spectrum; (iii) the same equipment can be used to deploy more spectrum and hence greater capacity (e.g. the equipment cost of deploying 2x5 MHz of 700 MHz is similar to the cost of deploying 2x20 MHz); and (iv) with lower backhaul costs than the sum of the costs for individual operators (i.e. a backhaul link offering twice the capacity is not twice the price);

<sup>69</sup> Ofcom, Award of the 700 MHz and 3.6-3.8 GHz spectrum bands, December 2018, para. 6.2.

<sup>70</sup> Angus, "An Introduction to Erlang B and Erlang C", *Telemanagement #187*, July-August 2001, <http://voip.poly.ro/docs/Erlang%20B%20&%20C.pdf>.

<sup>71</sup> Erlang B calculator, <https://www.erlang.com/calculator/erlb/>.

- b. 5G at mid-band spectrum, which has lower propagation than the lower band spectrum used for earlier technologies, is likely to require more sites – having access to operators’ combined sites can enable 5G to be deployed more quickly;
- c. Individual operators need to retain some of their existing spectrum for customers using older technology devices. A merger enables less spectrum to be reserved to support users on older technologies as the spectrum can be shared between the customers of both operators without needing each operator to individually retain the same amount of spectrum for older technologies. This enables customers using older technologies to continue to be supported while freeing up some spectrum to meet capacity required for newer technologies.
- d. Network consolidation can enable substantial savings on CAPEX and OPEX. BEREC reports savings from active sharing including spectrum of 33-45% for CAPEX and 30-33% for OPEX.<sup>72</sup> At a time when many operators are highly leveraged, savings allow operators to stretch their capital budgets further to support deploying 5G earlier and more widely. While sharing agreements are sometimes a realistic alternative to mergers, such agreements are not always possible (as discussed later in this section).

5.20 Operator mergers can also lead to significant falls in the cost of providing incremental capacity. First, the combination of the parties’ assets significantly increases available capacity, enabling the merged entity to provide much higher volumes with limited additional costs. Second, access to the parties’ combined spectrum means that each additional site leads to more capacity or equivalently fewer sites are needed to achieve a given increase in capacity. If the merger allows for new technology such as 5G to be deployed more widely and more quickly, the cost of incremental capacity would be further reduced because of the greater spectral efficiency.

5.21 The incremental cost reductions can be expected to flow through into lower prices per gigabyte consumed. As noted in Box 2, the Orange UK/T-Mobile UK merger was found to lead to significant price falls.

5.22 Significant improvements in the speed and reliability of services available at each price point imply a significant reduction in quality-adjusted prices. Higher quality network services can also support new applications, which further increases consumer surplus.

5.23 Savings in fixed costs can support higher investment by improving cash flows which provide a cheaper source of finance than raising funds externally. A number of empirical studies confirm that there is a statistically significant positive relationship between firms’ cash flows and their level of investment.<sup>73</sup>

5.24 The timing of investment is also an important determinant of the flow of benefits to consumers. In the presence of uncertainty, firms will consider not only the range of potential cash flows from an investment but also how those cash flows might change by investing later. For example, there may be value in waiting to see if demand or market uncertainty resolves before making an irreversible investment in order to avoid the risk of losses if conditions turn out unfavourably. Unsustainable market structures as well as unpredictable policies and regulation can heighten uncertainty and lead to investment being delayed.

5.25 In Appendix B, we discuss insights from the general literature on the potential effects of mergers on investment and innovation

<sup>72</sup> BEREC, Report on infrastructure sharing, 2018, p.16.

<sup>73</sup> For a detailed survey see Hubbard, R.G. (1998), “Capital-market imperfections and investment”, *Journal of Economic Literature*, 36. Lewellen and Lewellen find that a dollar of current and prior year cash flow is associated with \$0.32 of additional investment for firms that are least likely to be constrained in their access to external capital and \$0.63 of additional investment for firms that are the most likely to be constrained (J. Lewellen and K. Lewellen, “Investment and Cash Flow: New Evidence”, *Journal of Financial and Quantitative Analysis*, Vol. 51, No. 4, Aug. 2016, pp. 1135–1164).



### Competitive responses from rival operators

- 5.26 Where a merger gives an operator significantly greater capacity, faster speeds and better reliability, rival operators can be forced to respond to maintain their competitiveness by reducing price and/or investing in their network capacity and quality. This is particularly the case where a merger gives operators which previously had relatively low quality the ability to challenge the market leader. This can expose the market leader to neck-and-neck competition and create a larger incentive for it to innovate to try to escape the competition.
- 5.27 An analysis of the Hutchison 3G Austria/Orange Austria merger by Goad, Klein and Padilla found that following the merger, Hutchison was able to overtake the market leaders in terms of 4G coverage and download speeds while supporting rapid growth in data usage and continuing the same downward trend in price per gigabyte.<sup>74</sup> A report by the GSMA reached similar conclusions and found that the merger induced an improvement in the 4G network quality of the rival operators compared with the estimated quality without the merger.<sup>75</sup> As noted in Box 1, mobile capex per capita in Austria has been significantly higher than the EU average in recent years and Austria now has amongst the highest data usage per subscriber and lowest price per gigabyte in the world.
- 5.28 There is also similar evidence emerging for more recent mergers (see Box 3).
- 5.29 Lower marginal costs and lower quality-adjusted prices would imply an increase in competitive rivalry from mergers. As recognised by the General Court in its *CK Telecoms judgment*, certain efficiencies impact whether or not a merger gives rise to restrictive effects and should be distinguished from other efficiencies which could act as a possible counterbalance to any restrictive effects found.<sup>76</sup> While the Commission bears the burden of proof in relation to finding a restrictive effect, the notifying party is required to demonstrate the existence of efficiencies put forward as counteracting harm to consumers.

### Box 3: Evidence on increased competition following recent four to three mergers in the US and Australia

T-Mobile's Q4 2020 results show realised merger synergies to end 2020 exceeding guidance and forecast capital expenditures of \$11.7 to \$12 billion for 2021.<sup>77</sup> While the quality of Sprint and T-Mobile was previously held back by capex half that of AT&T and Verizon, Opensignal reports T-Mobile overtaking Verizon, for the first time, to offer the fastest 5G download speeds in the US.<sup>78</sup> T-Mobile also launched unlimited data plans in February 2021 which unlike rivals' plans do not slow or throttle speeds.<sup>79</sup> The record amount paid in the 5G auction of \$81 billion in February 2021 was seen as reflecting the need for Verizon and AT&T to catch up to T-Mobile following its merger.<sup>80</sup>

While Wang and Scott Morton have argued that the T-Mobile/Sprint merger has been "disastrous",<sup>81</sup> they offer little evidence to support their claim. The phase-out of Sprint's and Verizon's old CDMA networks was already underway before the merger. The relatively few remaining CDMA customers will need new handsets but gain access to T-Mobile's better quality 4G/5G network. Prepaid customers have the choice of multiple competitive operator and MVNO offers<sup>82</sup> and Dish is rolling out its network. T-Mobile is offering better unlimited postpaid data plans than its rivals.

<sup>74</sup> Goad, A., T. Klein and J. Padilla, *Case Study: Effects of the H3G/Orange Austria Transaction*, 2015.

<sup>75</sup> GSMA, *Assessing the impact of mobile consolidation on innovation and quality: an evaluation of the Hutchison/Orange merger in Austria*, 2017.

<sup>76</sup> *CK Telecoms UK Investment Ltd v European Commission* (Case T-399/16), para. 279.

<sup>77</sup> *T-Mobile US Q4 2020 earnings release*.

<sup>78</sup> Opensignal, *5G user experience report: January 2021*.

<sup>79</sup> Bloomberg, "T-Mobile casts aside low-budget reputation with new \$90 Plan", 22 February 2021.

<sup>80</sup> The Economist, "America's drowsy telecoms giants face a 5G wake-up call: T-Mobile is leaving them standing", 20 March 2021 and MarketWatch, "Why Verizon, AT&T and T-Mobile just spent \$80 billion in an auction, and what it will mean for 5G", 26 February 2021.

<sup>81</sup> Wang, M. and F. Scott Morton, "The Real Dish on the T-Mobile/Sprint Merger: A Disastrous Deal From the Start", *Promarket*, 23 April 2021.

<sup>82</sup> <https://www.techradar.com/uk/deals/best-cell-phone-plans>

In Australia, following the merger between VHA and TPG completed in July 2020, VHA launched unlimited mobile data plans in September 2020 which the market leading operators responded to by providing more data at lower speeds.<sup>83</sup> The ACCC has subsequently claimed mobile operators' have increased prices. However, the operators' financial results show ARPU has having declined or been stable at the same time as data usage has increased significantly.

**Network sharing can bring significant benefits but is difficult to implement and maintain, and will not match merger efficiencies**

- 5.30 In several cases, the European Commission has claimed that merger efficiencies can be achieved through network sharing arrangements which better protect competition.<sup>84</sup> However, market evidence shows that, in some cases, parties are unlikely to be able to reach a network sharing agreement; and in nearly all cases, the type of network sharing agreement which is feasible would not match the efficiencies of mergers.
- 5.31 To assess whether network sharing is a realistic alternative to a merger requires examining whether the parties have the incentive to agree on a particular form of network sharing given their specific circumstances. That requires consideration of the costs as well as benefits of network sharing to each party.
  - a. Sharing is less likely where one party has a superior network to the other and sharing the existing network would cede that competitive advantage with the potential loss of subscribers to its partner.
  - b. In contrast, sharing is more likely to be mutually beneficial where it relates to both operators deploying technology to a new area.
  - c. Sharing can also be difficult where the parties have very different strategies and financial positions or where one or both operators are already in a sharing agreement with another operator.
- 5.32 In Vodafone's experience operators choose active sharing partners based on whether they provide a good match in network size, balanced spectrum assets, balanced appetite for investment, similar technology strategy aspirations, similar commercial approach and being prepared for a long-term contract.
- 5.33 Even where a network sharing agreement is able to be reached, it may not match the competitive benefits of a merger (see Table 4).

**Table 4: Active network sharing versus mergers**

Parameter	Comparison
Competition between the parties	Sharing allows for some service differentiation and competition in retail
Competition with other MNOs	Mergers can deliver greater efficiencies and increase competition with other MNOs
More efficient utilisation of assets	Mergers enable efficiencies from combining all of the parties' spectrum and network and non-network assets (e.g. retail network) and full flexibility in network design

<sup>83</sup> See "[TPG Telecom CEO Iñaki Berroeta calls 'unlimited' data like Vodafone Infinite 'the future'](#)", 27 October 2020 and "[Best unlimited mobile data plans: Telstra vs. Optus vs. Vodafone](#)", 8 February 2021.

<sup>84</sup> For example, H3G Austria/Orange Austria; H3G UK/Telefónica Ireland; Telefónica Deutschland/E-Plus; H3G Italy/WIND /JV.

**Table 4: Active network sharing versus mergers**

Investment by the parties	Sharing can result in less investment where investments need to be mutually agreed and through risks to incentives
Pricing efficiencies	Mergers can lead to lower prices by avoiding double-marginalisation from usage-based charges for network capacity

- 5.34 A merger enables all of the parties’ spectrum, network and other assets to be shared and gives the parties full flexibility to optimally design their network to meet customer demand. For example, the network grid can be re-planned combining the best selection of existing and new sites and densifying the network to give superior coverage and capacity. A feasible sharing agreement may only relate to a subset of assets (i.e. typically extending to spectrum sharing for which the compensation process for use of spectrum is difficult to implement). Operators who share may also be constrained in their network design. These factors would reduce the potential cost savings and capacity and quality improvements of sharing relative to a merger. The current approach of the European Commission to active radio access network sharing also tends to limit their scope to rural and suburban areas.
- 5.35 Operators with differing strategies and limited funds may only be able to agree on a lowest common denominator set of investments. In the UK, Vodafone took the decision to unwind its active network sharing with Telefonica across c.2500 sites in the major towns and cities (having previously already unwound the network sharing in London).<sup>85</sup>
- 5.36 Network sharing can also blunt incentives to invest relative to a merger. For example, a reason for operators to invest in 5G deployment is to seek to steal a march on their competitors. However, this incentive is reduced where the investment enables one of your competitors to also offer 5G. The European Commission has also noted that “*asymmetries in incentives may arise in network sharing agreements and that such agreements are incomplete contracts which may give rise to hold-up problems*”.<sup>86</sup> For example, both parties may limit investments because of a concern the other party might be able to subsequently engage in conduct that boosts their return at the expense of the other party.
- 5.37 Even where parties initially have similar traffic, traffic imbalances often arise over time. In such cases, there will be pressure for network costs to be split based on usage. This can lead to some costs such as the cost of coverage which would have been treated as a fixed cost by an individual operator now being a variable cost. This can lead to double-marginalisation and higher prices for end-customers.
- 5.38 The European Commission’s *Non-horizontal Merger Guidelines* recognise that vertical integration provides substantial scope for efficiencies such as in relation to downward price pressure (by eliminating double marginalisation), better investment incentives and decreased transaction costs.<sup>87</sup> These types of efficiencies can also lead to mergers generating greater benefits than network sharing.
- 5.39 Depending on the market conditions, the parties for which sharing is feasible may differ to the parties for which a merger is feasible. Given this, a merger may result in a more competitive market structure than what would be achieved by a sharing agreement.

<sup>85</sup> Vodafone Group Plc Trading Update for the quarter ended 31 December 2018, slide 8.

<sup>86</sup> Case M.7612 Hutchison 3G UK/Telefonica UK, European Commission decision of 11 May 2016, paragraph 2484.

<sup>87</sup> EC Non-horizontal merger guidelines, para. 13-14.

**Merger policy should take into account ex ante investment effects**

- 5.40 In section 4, we noted how a strict merger policy can impact expected returns of risky investments by limiting potential exit options and the value that investors would receive if the investments turn out unsuccessfully and they need to exit the market. The risk of low returns on exit can discourage investors from making investments in the first place.
- 5.41 The risk to ex ante investment incentives, and thus to consumer welfare, can be taken into account in a model to identify optimal merger policy. In this section, we summarise the results of a new theoretical model by Bisceglia, Padilla, Perkins and Piccolo.<sup>88</sup> We first describe the model, then discuss the key findings, before outlining its policy implications.

**Description**

- 5.42 The model is intended to investigate the relationship between merger policy and investment in mobile technology, particularly to understand how merger policy affects firms’ incentives to invest in new technologies ex ante and how consumer welfare is affected.
- 5.43 The structure of the basic model is that there are two firms competing in the supply of mobile services to customers. One firm is a strong incumbent, which is committed to invest and stay in the market. The other firm is a weaker competitor, which decides whether or not to invest and whether to exit the market; this replicates the asymmetry found in many mobile markets in practice. As happens in many real-world situations, the firm makes its investment decision in a situation of uncertainty – it does not know how much demand there will be for the new technology. Investment is costly to the firm, but increases the value of mobile services to consumers, meaning that both the firm and consumers can benefit.
- 5.44 The focus is on how merger policy will affect investment and consumer welfare. If firms are unable to merge or are only allowed to merge in exceptional circumstances, they may receive significantly less for their assets if they wish to leave the market, potentially deterring investment. Alternatively, a firm might stay in the market as a ‘zombie’ firm, with low investment and low quality. Because consumers benefit from greater investment in higher-quality goods or more capacity, consumer surplus can be lower as a result.

**Findings**

- 5.45 The core result from the model is that there is an inverted-U shaped relationship between expected strictness of merger policy and investment. That is, as merger policy becomes less strict (and so the firm’s exit value increases), investment initially rises, before falling again. This is because less strict merger policy supports investment by enabling the firm to leave the market on good terms if it invests and then finds out that demand will be low. But a very high exit value (very lenient merger policy) means that the firm will almost always decide to leave the market, reducing competition.
- 5.46 The model therefore suggests that investment can be increased by an ex ante commitment to be more receptive to mergers in markets where future demand and investment returns are uncertain. Consumers receive higher quality services as a result of the investment, which can be interpreted as lower quality-adjusted prices. Greater uncertainty increases the benefits of a high exit value, as it makes the support to investment provided by less strict merger policy more important (see Table 5).

**Table 5: Schematic relationship between uncertainty and exit value**

	Low exit value	Medium exit value	High exit value
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<sup>88</sup> Bisceglia, M., J. Padilla, J. Perkins and S. Piccolo, “Optimal exit policy with uncertain demand”, 2021. The implications of the model are assessed in J. Padilla, J. Perkins, S. Piccolo and P. Reynolds “Merger Control Z”, 2021 (available at [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3889230](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3889230)).

**Table 5: Schematic relationship between uncertainty and exit value**

Low uncertainty (static markets)	Firm invests and stays in market	Firm invests and stays in market	Firm does not invest, sometimes exits
Medium uncertainty (4G technology)	Firm doesn't invest, stays in market	Firm invests and stays in market	Firm invests, and sometimes exits
High uncertainty (5G technology)	Firm doesn't invest, stays in market	Firm doesn't invest, and often exits	Firm invests, and sometimes exits

Notes: The aqua colouring indicates the best option for consumers for each level of uncertainty.

Source: See Bisceglia, Padilla, Perkins and Piccolo, "Optimal exit policy with uncertain demand", 2021.

### Merger policy should not be changed without considering risks to ex ante investment

- 5.47 Merger assessments involve weighing up evidence as to the likelihood of particular future outcomes. In particular, authorities compare the likely level of competition with the merger with the likely level of competition without the merger (the latter referred to as 'the counterfactual').
- 5.48 These assessments relate to uncertain future developments and therefore carry some risk of error. Generally, authorities undertake such assessments focused on the ex post effects of the specific transaction or decision. For example, they may try to balance the cost of type I errors (e.g. prohibiting pro-competitive mergers) versus the cost of type II errors (i.e. incorrectly allowing anti-competitive mergers to proceed).
- 5.49 There is a current debate over whether merger policy should be made stricter, at least in relation to acquisitions by digital platforms. For example, the CMA has proposed that UK merger law be changed so that mergers by digital firms with strategic market status are assessed under a lower standard of proof of whether there is a 'realistic prospect' that a merger would give rise to a substantially lessening of competition.<sup>89</sup> Motta and Peitz have argued more generally for a change in the burden of proof in EU merger regulation to require the merging parties to show that a merger would not be anti-competitive.<sup>90</sup>
- 5.50 In markets with significant prospective investment with uncertain returns, a stricter merger policy could however carry a large cost to consumers in deterring investment. The implication of the model described above is that optimal merger policy should take into account the risk of discouraging investment. Such an approach would be consistent with the conclusion of a paper by Mason and Weeds.<sup>91</sup> They find that a more lenient merger policy increases incentives for entry and that this can result in more effective competition in the long run. Optimal merger policy should balance the risk of losses from increased post-merger concentration with the gains from greater ex ante entry and competition.
- 5.51 At a minimum, the model described above suggests that changes should not be made to tighten merger policy (such as in terms of changing the standard or burden of proof) without considering the risk of harm to investment and noting that this harm can go beyond transaction-specific type 1 and type 2 errors.

### Spectrum licensing should be reviewed to promote investment and sustainable competition

- 5.52 In section 4, we identified how the spectrum licensing approaches of a number of authorities significantly exacerbates uncertainty in ways which tend to reduce the expected returns of new

<sup>89</sup> CMA, A New Pro-Competition Regime for Digital Markets, 2020.

<sup>90</sup> Motta, M. and M. Peitz, "Challenges for EU merger control", *Concurrences*, 2, 2019.

<sup>91</sup> Mason, R. and H. Weeds, "Merger policy, entry, and entrepreneurship", *European Economic Review*, vol. 57(C), 2013, pages 23-38.

investment. Using the industry as a source of government revenues also risks harm to investment because of the poor financial position of many European operators.

5.53 There are a number of ways in which authorities could improve spectrum licensing so as to better support the industry in making the large investments required for 5G deployment.

a. A change to perpetual spectrum licences (as in the UK) or to longer licence terms (such as the Spanish 700 MHz licences which have an initial term of 20 years with the potential to be extended for another 20 years) would improve predictability and reduce the risk of regulatory opportunism. Provided that the spectrum is tradeable, it can be expected to remain efficiently allocated over time.

b. A commitment to release all available spectrum and to avoid artificially raising future spectrum fees above the value of the spectrum in the next best use would also improve the investment environment.

c. Authorities should also avoid imposing new conditions on operators except at the time of releasing new spectrum where the cost of the obligation can be taken into account by operators in valuing the spectrum.

5.54 Expected returns to investment can also be impacted by authorities providing special assistance to entrants such as through spectrum reservation and regulated access to the incumbents' networks. While such policies are undertaken to promote competition, they can have negative effects. Where established operators are unable to obtain sufficient spectrum to meet the growing demand for data of their customers, they face either declining quality through congestion or the need to limit demand by raising prices. Either case is likely to make them a less effective competitor. Further, overall competition in the market may decline if the new entrant is a poor substitute for the existing operator in terms of the quality-adjusted prices it can offer. Providing access to the existing networks of rivals at prices which do not recognise the risks borne in the investment of those networks may reduce new investment by both established operators and new entrants.

5.55 While excessive concentration of spectrum can be harmful, this is better targeted with a cap on the overall share of spectrum able to be acquired by a single operator rather than to reserve spectrum for entrants or smaller players where it may be poorly utilised. The level of such a cap should be set weighing any short-term competitive benefit with the costs of spectrum being potentially assigned less efficiently which may harm longer term dynamic competition.

### Conclusion

5.56 We have identified key ways in which regulatory policies that affect market structures could become more conducive to investment, in particular how merger assessments could focus more on potential effects on investment and efficiencies. We have also identified how investment can be promoted through changes to spectrum licensing. These measures would help stimulate the investment required for 5G deployment and support the achievement of the 5G targets of national governments as well as the European Commission's 5G ambition:

*"Excellent and secure connectivity for everybody and everywhere in Europe is a prerequisite for a society in which every business and citizen can fully participate. Achieving gigabit connectivity by 2030 is key...It is our proposed level of ambition that by 2030, all European households will be covered by a Gigabit network, with all populated areas covered by 5G."<sup>92</sup>*

<sup>92</sup> The European Commission's 2030 Digital Compass: the European way for the Digital Decade.

# APPENDIX A: EMPIRICAL CONCENTRATION AND POST-MERGER STUDIES

- 1 In this appendix, we review empirical studies which examine whether there is a relationship between mobile market concentration and prices, investment and quality.
- 2 Table 6 summarises the results of studies considering findings of statistically significant price effects of mobile operator mergers. While 5 to 4 mergers are found to reduce prices or have no statistically significant effect on prices, for 4 to 3 mergers there are findings of price increases and decreases, even from studies assessing the same mergers. The differences in results reflect a range of reasons including different price data for the same baskets, whether baskets are representative of the overall market and of usage over time, different time periods and different methodologies to estimate what would have been the level of prices absent the mergers.<sup>93</sup> Some studies do not properly account for increased data usage. None of the studies adjust prices for increased speeds and reliability and hence may fail to capture differences in quality and quality-adjusted prices between countries.
- The results of studies with clear data and methodological issues should be treated sceptically.
  - The detailed results of other studies could collectively be used to help understand how mergers between particular types of operators in specific market conditions may be likely to impact prices for different types of customers over the various shorter and medium term periods considered by the studies. Thus, the detailed results could help inform the assessment of particular proposed mergers.
  - The mixed results suggest that it would be misleading to suggest either that 4 to 3 mergers necessarily lead to price increases or that such mergers never risk price increases at least to some types of customers and/or for some period of time.

**Table 6: Estimated merger price effects from post-merger studies**

Authors	Merger examined	Price effect	Comments
CERRE	Exits between 2002 and 2014	4.3%	General result for exits and not specific to 4 to 3 mergers, significant at 10% but not 5% level
Aguzzoni et al	NL 2008 (4 to 3)	0% to 10%	No statistically significant price effect found under synthetic control method
	Austria 2006 (5 to 4)	-20% to -2%	Notable changes in pricing of remaining operators
Csorba and Pàpai	NL 2008 (4 to 3)	29% in third year only	Risk that price increase is caused by unobserved factors

<sup>93</sup> An issue with estimating post-merger effects by comparing the path of prices in the country with the merger with the price path in other countries is that other factors may lead to differences in prices and price evolution between countries. For example, BEREC notes that the low pre-merger prices in Austria meant that Austria could not be expected to match price falls in other countries.

**Table 6: Estimated merger price effects from post-merger studies**

	Austria 2006, Denmark 2005, NL 2006 (5 to 4)	-	No statistically significant price effect found
RTR	Austria 2013 (4 to 3)	50% to 90% for smartphone users	Price comparisons across countries are for different baskets and hence may be distorted by change in relative prices for different services
BWB	Austria 2013 (4 to 3)	14% to 20%	Results likely to be distorted by increasing data usage
Frontier	Austria 2013 (4 to 3)	Prices below pre-merger trend	Limited information provided on estimation
Houngbonon	Austria 2013 (4 to 3)	A price fall of \$6 per GB	Price fall by comparison with the comparator Italy, identified as best comparator by principal components analysis
Lear/ DIW/ Analysys Mason	UK 2010 (5 to 4)	-18% to -2%	Lack of common trend between UK and comparator countries may bias results. Accounting for it increases size of decrease (potentially to -42%).
BEREC	Austria 2013 (4 to 3)	No statistically significant effect to 94% increase in one period	No statistically significant effect found for BEREC's high use basket (which is most representative of average usage of Austrian customers over the period) when using the most reliable SCG approach
	Ireland, Germany 2014 (4 to 3)	Increases mainly found under one approach and only for some half years	No statistically significant effect using SCG approach except for 3 <sup>rd</sup> half year after merger in Germany which is more likely to reflect a temporary unrelated factor. Price series inconsistent with those of national regulators.

Source: CERRE (Genakos, C., Valletti, T., en Verboven, F.), Evaluating Market Consolidation in Mobile Communications, 15 September 2015. Aguzzoni, L., Buehler, B., Di Martile, L., Kemp, R., and Schwarz, A.: Ex-post analysis of mobile telecom mergers: the case of Austria and the Netherlands, De Economist, published online 24 November 2017. Csorba, G. and Pápai, Z.: Does one more or one less mobile affect prices? RTR, Ex-post analysis of the merger between H3G Austria and Orange Austria, 2016. A comprehensive ex-post evaluation of entries and mergers in European mobile telecommunication markets, August 2015. BWB, An Ex-post Evaluation of the Mergers H3G/Orange and TA/Yesss!, 2016. Frontier Economics, Assessing the case for in-country mobile consolidation, 2015. Houngbonon, G.V., The impact of entry and merger on the price for mobile telecommunications services, 2015. Lear, DIW Berlin and Analysys Mason: Economic impact of competition policy enforcement on the functioning of telecoms markets in the EU, 2017.

- 3 There are a number of existing studies which have examined the relationship between concentration of various national markets and price levels. Such price concentration studies provide limited evidence on the effect of any actual merger.
- a. Factors driving higher costs or other less favourable economic conditions in a market may lead to both fewer operators being viable and relatively high prices. As such, a relationship between concentration and prices across markets does not imply that a merger in any specific market would increase prices.
  - b. While a merger may reduce the number of operators in a market, it does not imply that the network capacity in the market suddenly disappears. For example, merging operators may decide to keep many of their existing sites to meet future demand, particularly given sunk costs.



Thus, a market in which a merger has taken place may have more capacity which will tend to drive down prices than a market which always had that number of operators.

- 4 Several studies have examined the effect of mergers on investment and have generally found capital expenditure increased post-merger. Fruits *et al* reviewed 18 studies of the effect of changes in market concentration and found that of the five studies which found a statistically significant effect of 4-to-3 mergers on investment, all found investment increased post-merger.<sup>94</sup> Two studies which examined the relationship between concentration and investment for the periods 2000-2014 and 2003-2013 found total investment is highest in 3 operator markets.<sup>95</sup>
- 5 What ultimately matters for consumers will be quality and price. The actual level of market investment may be only an imperfect proxy for beneficial quality effects (for example, avoiding duplication of sites in areas with excess capacity may lead to lower investment but not impact quality). The GSMA found a significant increase in quality from the 2012 Hutchison/Orange merger in Austria<sup>96</sup> and that three-operator markets have higher download speeds and increased capex per operator.<sup>97</sup>
- 6 Ofcom produced a report assessing their views about the existing empirical evidence on the relationship between market structure, investment and quality in mobile markets, and present their own analysis on the topic.<sup>98</sup> Ofcom claims the econometric panel data analyses set out in its first economics discussion paper shows that both investment and download speeds are lower when there are fewer MNOs or a higher level of market concentration in a country, and that this is confirmed by Ofcom's counterfactual analyses of the effects of mergers in Austria, Ireland and Germany.
- 7 However, there are problems with Ofcom's panel data analyses of both investment and download speeds and the results of Ofcom's counterfactual analyses are mixed, which raises questions about the robustness and reliability of the evidence and Ofcom's conclusions.
- 8 The panel data investment model estimated by Ofcom suffers from various problems.
  - a. The capex data used by Ofcom is not reliable for Ofcom's analyses as it is mostly not actual capex data but a constructed series based on expected long-term relationships. Ofcom has also considered nominal capex rather than real capex despite the latter being the expected driver of end-user benefits.
  - b. The panel data model which Ofcom has used to estimate the impact of market concentration on industry capex suffers from a fundamental methodological problem. The underlying assumption of this panel data model is that the same process determines capex per capita in each of the 30 countries in Ofcom's dataset. However, when we tested this assumption using the dataset we have created, it is clearly rejected. This is not surprising given the major differences in how capex per capita has evolved in the 30 countries. As such, Ofcom's capex panel data model is misspecified, and hence the results are not reliable or informative about the effect of market structure on industry investment.
  - c. Ofcom's Synthetic Control Method (SCM) approach to estimate the impact of mergers in Ireland, Austria and Germany on investment suffers from similar flaws. Focusing on Ireland (the only one of the three countries where Ofcom was able to use the SCM to estimate the effect of the merger on industry capex), we find there are material differences in how industry capex has evolved in Ireland and the countries used to construct the synthetic control for Ireland, which (consistent

<sup>94</sup> Fruits, E. *et al* "A review of the empirical evidence on the effects of market concentration and mergers in the wireless industry", ICLE Antitrust and Consumer Protection Research Program White Paper, 2019, p.12 (available at [https://one.oecd.org/document/DAF/COMP/GF\(2019\)13/en/pdf](https://one.oecd.org/document/DAF/COMP/GF(2019)13/en/pdf)).

<sup>95</sup> Hounghonon, Georges Vivien and Francois Jeanjean, "Is There a Level of Competition Intensity That Maximizes Investment in the Mobile Telecommunications Industry?", 2014 and HSBC "Supersonic: European Telecoms Mergers Will Boost Capex, Driving Prices Lower and Speeds Higher.", 2015.

<sup>96</sup> GSMA, *Assessing the impact of mobile consolidation on innovation and quality: An evaluation of the Hutchison/Orange merger in Austria*, 2017.

<sup>97</sup> GSMA, *Mobile market structure and performance in Europe: lessons from the 4G era*, 2020.

<sup>98</sup> Ofcom, *Market structure, investment and quality in the mobile industry*, 2020.

with the results of our assessment of Ofcom's capex panel data model), suggests the process determining industry capex differs across these countries. In particular, differences in the timing and speed of the rollout of 4G in different countries, are likely to result in industry capex evolving differently in these countries, and at most Ofcom has controlled for differences in timing of the 4G rollouts, but not the large differences in the time taken for 4G rollout between countries. These issues raise serious doubts about the reliability of the synthetic controls in Ofcom's SCM analysis as counterfactuals.

- d. In its panel data analysis of download speeds, Ofcom found no evidence of a statistically significant direct effect of market concentration on download speeds. Ofcom inferred there was an indirect effect based on their finding that market concentration had a negative effect on industry capex, and industry capex had a direct effect on download speeds. However, as discussed above, Ofcom's finding that market concentration has a negative effect on industry capex is not reliable or robust as it is based on a mis-specified model, so the indirect effect of market concentration on download speeds is also not reliable or robust. The robustness of Ofcom's SCM analysis of download speeds is questionable, as (i) the control variables used in the analysis are not important or relevant to download speeds; (ii) industry capex (which is an important determinant of download speeds) is not used as a control variable; and (iii) differences in the timing and speed of the rollout of 4G mean it is questionable whether download speeds are being determined by the same process in these countries in the analysis.

# APPENDIX B: THE EFFECTS OF MERGERS ON INVESTMENT AND INNOVATION

- 1 There is a significant economic literature on the effects of mergers on investment and innovation which identifies the potential for positive and negative effects.<sup>99</sup> In this section, we consider to what extent insights from this literature are relevant to the assessment of mobile mergers and the effects of different market structures. We find that some potential effects are likely to be relevant including as operators develop innovative 5G applications. Nevertheless, it should also be recognised that mobile operator investments and incremental process and product innovations will differ to certain types of R&D investments relevant in other sectors such as those with a winner-takes-all aspect in which the first successful innovator dominates the market. The literature also focuses on how specific mergers can impact innovation, whereas in this report we also highlight how investment can be harmed by the effect of restrictive merger policy in reducing expected returns to new investment by limiting expected exit options if investments turn out unsuccessfully.
- 2 Size can be beneficial to investment and innovation. There can be economies of scale and scope including learning benefits in R&D. Bell Labs (previously a subsidiary of the US incumbent operator, AT&T) invented many foundational technologies which underpin modern information and communications networks and devices with research resulting in nine Nobel prizes.<sup>100</sup> The Japanese incumbent, NTT, and its divested mobile business NTT DoCoMo also have a history of significant inventions including the i-mode mobile internet phone launched in 1999. While some economies of scale might also be achieved by large international groups and/or research joint ventures, others might arise out of teams working closely with enterprise and other customers.
- 3 Larger firms can also have greater incentives to develop better, lower cost, processes because they can realise savings and improvements over their larger share of the market. Process innovation will often need to be undertaken internally by firms where it relies on access to detailed business information and an understanding of practical constraints.
- 4 Where the development of new products and processes has spillover benefits through revealing information that helps other firms in the market to improve their products and processes, a merger can increase incentives for such innovation because it enables the firm to capture more of the return to the innovation.
- 5 Similarly, where innovation in relation to a complementary product increases the value of a firm's core product, the incentive for such innovation can be greater the larger the firm's share of the core product market. For example, the development of a 5G application may increase the value of 5G connectivity with benefits to operators in proportion to their share of such connectivity.<sup>101</sup> As noted earlier, Teece found that in ecosystems of complementary products, profits tend to go to the owners of the assets which have more bottleneck characteristics. This might suggest that the digital

<sup>99</sup> See, for example, Jullien, B. and Y. Lefouili, "Horizontal mergers and innovation", *TSE Working Papers*, No. 18-892, May 2018, W. Kerber, "Competition, innovation and competition law: Dissecting the interplay", *MAGKS Joint Discussion Paper Series in Economics* and G. Federico, F. Scott Morton and C. Shapiro, "Antitrust and innovation: welcoming and protecting disruption" in *Innovation Policy and the Economy*, Volume 20, 2020.

<sup>100</sup> Nokia media release, "2018 Nobel Prize in Physics laureate Arthur Ashkin delivers his Nobel Lecture at Nokia Bell Labs", 17 December 2018.

<sup>101</sup> On the other hand, some innovations may erode the value of the firm's other products. For example, incumbent operators with large fixed revenues may be reluctant to pursue 5G innovations which would make 5G a better substitute for fixed services.

gatekeepers will be able to capture a significant share of the overall social return to 5G network investments.

- 6 Mergers can lead to less investment where part of the expected return is from taking customers from rivals (the ‘business stealing effect’). In particular, a merger between rivals could dampen the incentive to invest because the firm no longer benefits from gaining the customers of the merging party (but only from gaining customers of the remaining rivals).
- 7 The risk of losing customers to a rival that develops a better product can also spur a firm to invest more. A merger that reduces this risk could reduce the firm’s incentives to invest.
- 8 In relation to mobile mergers, it is important to recognise that while mergers eliminate rivalry between the merging parties, they may increase the potential for rivalry with the remaining operators. As noted in the section 5, mobile operator mergers can be expected to improve the capacity and quality of the merged network and better position the merging parties to make additional quality-enhancing investments. A merger that enables smaller operators to better challenge the market leader could increase investment if post-merger such investment is less costly to make and/or enables the parties to take more customers from the leader. Such a merger could then also spur the market leader to invest more because it would be at greater risk of losing customers if it does not improve its network.
- 9 Federico *et al* state:
- “We stress in this article that innovation is best promoted when market leaders are allowed to exploit their competitive advantages while also facing pressure to perform coming from both conventional rivals and from disruptive entrants. These labels depend on context: the same firm can be a market leader in one area and a disruptive upstart in another. Market leaders may face competitive pressures to innovate coming from (a) other large firms in the same market, (b) other large firms in adjacent spaces, or (c) smaller, pesky disruptive firms. Casual empiricism indicates that all of these sources of competition are important in different settings. All have historically been protected using competition policy. The central theme animating our analysis is that a market leader is best motivated to innovate if it fears losing its leadership position to a disruptive rival.”<sup>102</sup>*
- 10 Kerber notes that while the models of Federico/Langus/Valletti and Motta/Tarantino find that mergers lead to less innovation, the result depends on a number on assumptions made in relation to homogeneous or differentiated products, price or quantity competition, the specific appropriability conditions, entry barriers and whether product or process innovation is being analysed.<sup>103</sup>
- 11 The literature also identifies a number of other potential effects of mergers which may be relevant to specific transactions.
- 12 The development of a new product may lead to greater horizontal differentiation (e.g. 5G service-layer differentiation and enterprise applications which appeal to different types of customers). Such investment may benefit rivals because some customers may switch to the rivals’ product which is closer to their preferences. In this case, a merger could lead to higher investment if the firm benefits from customers switching to its merging party’s brand and products.
- 13 A merger of firms offering similar products may lead to them repositioning the products post-merger and increase product variety to the benefit of customers.
- 14 A merger which leads the parties to reduce their output so as to increase their margins could reduce the incentive to undertake cost-saving innovations because the savings would apply to smaller volumes (a ‘margin expansion effect’). In particular, the incentive to undertake risky, cost-saving innovation depends on the expected benefits and these may be lower if the merging parties’

<sup>102</sup> Federico, G., F. Scott Morton and C. Shapiro, “Antitrust and innovation: welcoming and protecting disruption” in *Innovation Policy and the Economy*, Volume 20, 2020, p.127.

<sup>103</sup> Kerber, W., “Competition, innovation and competition law: Dissecting the interplay”, *MAGKS Joint Discussion Paper Series in Economics*, p.7.

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volumes are lower post-merger. However, if there is a fixed cost of R&D to develop a cost-saving innovation (such as to develop a new 5G application), then the larger merged entity may be more likely to undertake it than the individual parties pre-merger. As noted above, the example of Bell Labs suggests large telecoms operators may undertake R&D which is not pursued by smaller operators.

15 A merger which leads to higher post-merger gross margins per unit may encourage innovation which increases demand because the firm will be able to earn the higher margins on higher volumes (*‘the demand expansion effect’*). Bourreau and Jullien consider a model where two operators compete in relation to prices and coverage.<sup>104</sup> Their model finds that a merger to monopoly can lead to higher prices and, because of the resulting higher margins, investment in greater coverage (which would now be more profitable given the higher margins on the services supplied in the extended coverage area and higher margins on any additional subscribers who are attracted to join the network). The impact on total welfare and consumer surplus would depend on the relative size of the effects. The general implication is that mergers which lead to higher margins may support higher levels of certain types of investments and potentially a need to weigh up the effects of higher prices and higher investment to determine the overall effect on consumer welfare.

16 Jullien and Lefouilli conclude their survey of the literature stating that:

*“Our analysis strongly suggests that competition authorities should take a neutral perspective when assessing the impact of a merger on innovation, and should balance the various effects at work. Competition authorities should take account of both theories of harm and benefits. All the effects of a merger on the incentives to innovate identified in this paper, including spillover effects, should be part of the main competitive assessment carried out by competition authorities. Insofar as the demand expansion and margin expansion effects are part of the appropriability dimension of a merger, appropriability must be a key element in merger analysis, at par with other dimensions.”<sup>105</sup>*

<sup>104</sup> Bourreau, M. and B. Julian, [“Mergers, investments and demand expansion”](#), Economics Letters, vol. 167(C), pages 136-141.

<sup>105</sup> Jullien, B. and Y. Lefouilli, [“Horizontal mergers and innovation”](#), TSE Working Papers, No. 18-892, May 2018, p.26-27.

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